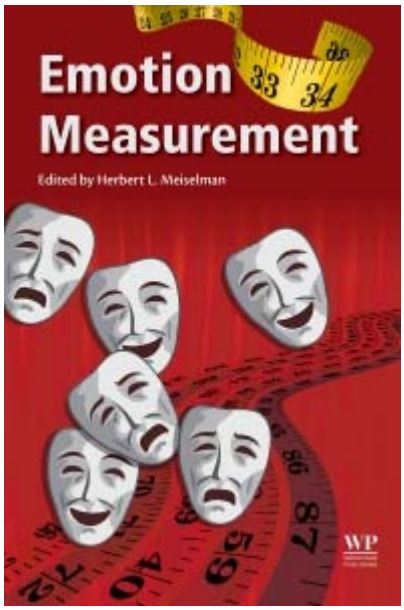

Emotion
Measurement
Edited by Herbert L. Meiselman
WP

Emotion Measurement

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Preface

The study of emotions has exploded in many disciplines and many areas of study. This has been demonstrated in the Society for Affective Science, which was recently formed with conferences beginning in 2014, and maintains an academic (and clinical) orientation. This growth has been demonstrated in the more product-oriented emotion papers at both the Pangborn Sensory Science Symposium and the Eurosense Conference, both of which have recently included 50 or more papers on product emotions at their semiannual meetings in the field of sensory and consumer science. The study of emotions has been a large and complex field for a long time, and the field keeps getting larger and more complex. Should we study and measure emotions behaviorally, physiologically, or with self-report questionnaires? Should we study and measure mainly positive emotions or mainly negative emotions? And at the most basic level, how do we define emotions, and restrict emotion research to that definition.

The goal of this book is to combine material from academic research and study, applied commercial research and study, and clinical research and study. These fields of emotion research have existed in somewhat isolated states, especially the newer, and growing applied commercial research. But each area of research on emotions has something to offer the other areas, and progress in understanding and measuring emotions would be enhanced by combining our methods and our insights. That is why this book is titled *Emotion Measurement*, not just Emotion or Emotions. The focus throughout the book is on methods for measuring emotions. If we agree on proper methods to use, if we understand the trade-offs that all methods have, and if we try different methods the field will advance.

When I started this book project I was warned that this was too big a topic, too unwieldy a topic. But part of the solution to the problem of different disciplines and different orientations towards emotion research is to bring these different perspectives together in one book. That was my goal, and this book shows that we have succeeded in doing that.

A special feature of this book is that each chapter has been peer-reviewed. This is unusual in most books. In this book each chapter has received one, two, or occasionally three reviews. But the chapters maintain the individual tone of each author, and the individual point of view of each author, and the reader will see the enormous diversity of opinion and approach which exists in the field of emotion measurement. That is the strength of the field of emotion research and that is the strength of *Emotion Measurement*. We must learn from each other to advance our field, and one of the ways to learn from each other is to share our thinking, our methods, and our results.

Along the way from the first idea of a book to the production of the book, I have been helped by many individuals and organizations. Woodhead Publishing (an imprint

of Elsevier) have shown enthusiasm for this project from the very beginning, and have backed up their enthusiasm with steady assistance from Rob Sykes (Acquisitions Editor) and Josh Bennett (Editorial Project Manager). Major thanks go to the authors who not only provided excellent chapters, but served as reviewers. On a more personal note, I thank my wife, Deborah Prescott Meiselman, for her boundless support for a husband who is often reading, writing, and editing.

I hope you enjoy this book. If you do, let me know.

Herbert L. Meiselman
Rockport, MA, United States

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List of Contributors

Lisa Feldman Barrett Department of Psychology, Northeastern University, Boston, MA, United States; Department of Psychiatry, The Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital/Harvard Medical, Charlestown, MA, United States

Lina Cárdenas Bayona Department of Design, Universidad de Chile, Santiago, Chile

Moustafa Bensafi Lyon Neuroscience Research Center, CNRS UMR 5292, INSERM U1028, Claude Bernard University Lyon 1, Lyon, France

Gary G. Berntson Department of Psychology, The Ohio State University, Columbus, OH, United States

Armand V. Cardello U.S. Army Natick RD&E Center, Natick, MA, United States

I. Cayeux Firmenich SA, Geneva, Switzerland

Yulia E. Chentsova-Dutton Georgetown University, Washington, DC, United States

Géraldine Coppin Max Planck Institute for Metabolism Research, Cologne, Germany; Swiss Center for Affective Sciences, Campus Biotech, Geneva, Switzerland; Laboratory for the Study of Emotion Elicitation and Expression, Department of Psychology, University of Geneva, Geneva, Switzerland

S. Delplanque Swiss Center for Affective Sciences, University of Geneva, Geneva, Switzerland

Louise den Uijl Wageningen UR Food & Biobased Research, Consumer Science & Health, Wageningen, The Netherlands

Pieter M.A. Desmet Department of Industrial Design, Delft University of Technology, Delft, The Netherlands

John S.A. Edwards Food Service and Applied Nutrition Research Group, Bournemouth University, Poole, United Kingdom

Charis Eisen Faculty of Letters, Kobe University, Kobe, Japan

Panteleimon Ekkekakis Department of Kinesiology, Iowa State University, Ames, IA, United States

C. Ferdenzi Lyon Neuroscience Research Center, CNRS UMR5292, University of Lyon, Lyon, France

Steven F. Fokkinga Department of Industrial Design, Delft University of Technology, Delft, The Netherlands

Arnaud Fournel Lyon Neuroscience Research Center, CNRS UMR 5292, INSERM U1028, Claude Bernard University Lyon 1, Lyon, France

N. Gaudreau Firmenich SA, Geneva, Switzerland

Agnes Giboreau The Center for Food and Hospitality Research, Institut Paul Bocuse, Ecully, France

Daniel Grühn Department of Psychology, North Carolina State University, Raleigh, NC, United States

Heather J. Hartwell Food Service and Applied Nutrition Research Group, Bournemouth University, Poole, United Kingdom

Hyisung C. Hwang San Francisco State University, San Francisco, CA, United States; Humintell, El Cerrito, CA, United States

Keiko Ishii Faculty of Letters, Kobe University, Kobe, Japan

Rubén Jacob-Dazarola School of Design, Universidad de Chile, Santiago, Chile

Sara R. Jaeger The New Zealand Institute for Plant & Food Research Limited, Auckland, New Zealand

Gerry Jager Division of Human Nutrition, Wageningen University, Wageningen, The Netherlands

Silvia C. King McCormick & Co., Inc., Hunt Valley, MD, United States; Silvia C. King Consulting LLC, Cincinnati, OH, United States

Ueli Kramer University of Lausanne, Lausanne, Switzerland; University of Windsor, Windsor, ON, Canada

Stefanie Kremer Wageningen UR Food & Biobased Research, Consumer Science & Health, Wageningen, The Netherlands

Jaime L. Kurtz James Madison University, Harrisonburg, VA, United States

Samuel H. Lyons Northeastern University, Boston, MA, United States

David Matsumoto San Francisco State University, San Francisco, CA, United States; Humintell, El Cerrito, CA, United States

Herbert L. Meiselman Herb Meiselman Training and Consulting, Rockport, MA, United States

Saif M. Mohammad National Research Council Canada, Ottawa, ON, Canada

Elizabeth Necka Department of Psychology, The University of Chicago, Chicago, IL, United States

Juan Carlos Ortíz Nicolás Institute of Architecture, Design and Art, Autonomous University of Ciudad Juarez, Ciudad Juarez, CH, México

Greg J. Norman Department of Psychology, The University of Chicago, Chicago, IL, United States

Anna Ogarkova Swiss Centre for Affective Sciences, University of Geneva, Geneva, Switzerland

Bunmi O. Olatunji Department of Psychology, Vanderbilt University, Nashville, TN, United States

Deger Ozkaramanli Department of Industrial Design, Delft University of Technology, Delft, The Netherlands

C. Porcherot Firmenich SA, Geneva, Switzerland

Catherine Rouby Lyon Neuroscience Research Center, CNRS UMR 5292, INSERM U1028, Claude Bernard University Lyon 1, Lyon, France

David Sander Swiss Center for Affective Sciences, Campus Biotech, Geneva, Switzerland; Laboratory for the Study of Emotion Elicitation and Expression, Department of Psychology, University of Geneva, Geneva, Switzerland

Neika Sharifian Department of Psychology, North Carolina State University, Raleigh, NC, United States

David M.H. Thomson MMR Research Worldwide, Wallingford, Oxfordshire, United Kingdom

Hannelize van Zyl Heineken, Zoeterwoude, The Netherlands

Megan Viar-Paxton Department of Psychology, Vanderbilt University, Nashville, TN, United States

Cheryl A. Welch James Madison University, Harrisonburg, VA, United States

JungKyoon Yoon Department of Industrial Design, Delft University of Technology, Delft, The Netherlands

Zachary Zenko Department of Kinesiology, Iowa State University, Ames, IA, United States

Theoretical Approaches to Emotion and Its Measurement

1

Géraldine Coppin[1,2,3] and David Sander[2,3]
[1]Max Planck Institute for Metabolism Research, Cologne, Germany [2]Swiss Center for Affective Sciences, Campus Biotech, Geneva, Switzerland [3]Laboratory for the Study of Emotion Elicitation and Expression, Department of Psychology, University of Geneva, Geneva, Switzerland

1 Introduction

The topic of emotion rarely leaves individuals unemotional. Philosophers in the West have discussed it as early as Socrates' times (470–399 BC), and many contemporary research traditions find their roots in philosophical approaches developed over the centuries (see Deonna & Teroni, 2012). During the 20th century, advances in experimental psychology and neuroscience allowed for the empirical testing of critical ideas, and the development of new models of emotion. Since the 1980s, there has been an explosion of the scientific study of emotion, and the topic has set off several vibrant debates. Experimental data are accumulating showing that emotion can impact most domains of animal and human cognition and behavior: emotion guides attention, memory, decision-making, and action. Research has led to models describing how emotion is elicited and how the emotional response is organized. Researchers have proposed conceptual clarifications regarding emotion and its regulation, and various methodological developments have allowed advances in the measurement of emotion. "Affective sciences" emerged as a new integrative and interdisciplinary domain investigating emotion and other affective phenomena (Sander & Scherer, 2009) as a result of many disciplines taking an "affective turn" during the last few decades. This domain includes disciplines such as psychology, neuroscience, philosophy, economics, literature, history, sociology, and computer sciences, which taken together aim at understanding, measuring, modeling, and predicting affective reactions.

In this chapter, we will start by discussing some of the different definitions of emotion and present what can be considered as a consensual view, namely that emotion is best defined as a multicomponent concept. We will then describe each of these components, the different indicators used to measure them, and their relation to the major current theoretical approaches of emotion. Finally, we will summarize the key points we have discussed and raise questions for future work. A discussion of affective neuroscience, and how knowledge about the emotional brain has impacted models of emotion is beyond the scope of this chapter, and has been presented and discussed elsewhere in detail (see Armony & Vuilleumier, 2013; Sander, 2013).

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For the purpose of this chapter, let us mention that research on the emotional brain went hand-in-hand with the development of the conceptual approaches of emotion. Thus, the three theories of emotion discussed in the current chapter have all been linked to the emotional brain (Hamann, 2012; Sander, 2013; Sander, Grafman, & Zalla, 2003; Skerry & Saxe, 2015), with particular focus on the amygdala, the insula, the orbitofrontal cortex, somatosensory cortices, basal ganglia, but also the dorsolateral prefrontal cortex, and the superior temporal sulcus. Although some attempts to link discrete emotions with dedicated brain structures (eg, fear with the amygdala, and disgust with the insula) have been made, current approaches tend to focus on how brain networks may underlie dimensions or components (Brosch & Sander, 2013; Namburi et al., 2015; Pessoa & Adolphs, 2010; Sander, 2009).

We hope this chapter will provide an overview on current theoretical approaches to emotion and its measurement, without neglecting their historical roots. Simultaneously, our goal is to bring the major conceptual foundations for the work described in the following chapters. We have grouped theories of emotion in three families, a taxonomy grounded in historical and conceptual reasons that is helpful to grasp theoretical developments in affective sciences, and to systematically present key concepts and theories in the field. Far from creating a barrier or being an "ineffective organizational approach" (see chapter: Navigating the Science of Emotion, p. 31), such a classification provides the readers with an organized description of theoretical roots and major conceptual distinctions in affective sciences. Boundaries between categories are always fuzzy, but it does not mean that categories do not exist (see Fig. 1.1; see chapter: Navigating the Science of Emotion).

2 What is an emotion?

2.1 Definitions

2.1.1 The complexity of defining emotion

Fehr and Russell (1984) appropriately stated that "everyone knows what an emotion is, until asked to give a definition. Then, it seems, no one knows" (p. 464). In one of the most famous articles on emotion, James (1884) raised the question of what an emotion is, highlighting that many definitions had been suggested before he proposed his theory. But the variety of approaches of emotion did not stop with James' seminal paper: emotion has been defined in various ways in the 20th century as well. The numerous characterizations of emotion vary as a function of many factors, such as the historical and cultural contexts, as well as the different theoretical approaches they are embedded in.

To explicitly address the definitional question, Kleinginna and Kleinginna (1981) reviewed almost 100 definitions of emotion. They found that definitions have emphasized different aspects of it, aspects that can be classified into 11 categories. For instance, while some definitions of emotion have focused on the physiological aspects of emotion, others have insisted on expressive behaviors. Some have focused

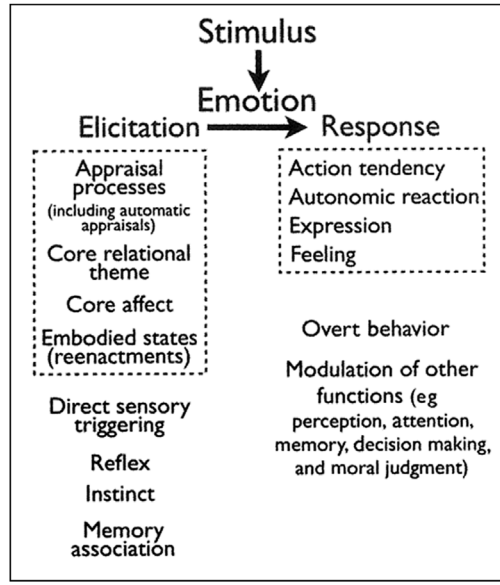


Figure 1.1 Mechanisms involved in emotion elicitation and their effects on emotional response. *Dashed lines* around some of the mechanisms represent the assumption made in some theories of emotion that these mechanisms are part of the emotion process. Appraisal processes refer to the subjective evaluation of the event's significance. Core relational themes are categories of emotion-eliciting appraisals. Core affect is "a neurophysiological state consciously accessible as a simple primitive nonreflective feeling" (Russell & Feldman-Barrett, 2009). Embodied states (reenactments) refer to the reactivation of various bodily-related systems, in which high-level cognition is grounded. Appraisal processes, core relational themes, core affect, and embodied states are described in detail in Sander (2013, pp. 18–19).

on emotion as a disturbing factor (eg, related to psychopathology) while others have rather focused on the functions of emotion (eg, related to evolutionary advantages). The difficulty of defining emotion, and delineating its boundaries to other affective phenomena (eg, mood, preference, attitude, passion, affect) is not the only challenge. It is also not straightforward to classify different emotions (as negative vs positive, as basic vs self-reflective, etc.; for a discussion on this aspect, see Sander, 2013). These conceptual problems are also evident in applied fields (eg, Meiselman, 2015). The issue of defining emotion is still a contemporary one (Russell, 2012), and strongly impacts current models of emotion (Sander, 2013).

A consensual definition that emerges from an analysis of the literature is the following: an emotion is an "event-focused, two-step, fast process consisting of (1) relevance-based emotion elicitation mechanisms that (2) shape a multiple emotional response (ie, action tendency, automatic reaction, expression, and feeling)" (Sander, 2013, p. 23). The mechanisms involved in emotion elicitation and their effects on emotional response are represented in Fig. 1.1. We will consequently

restrict the term emotion to brief periods of time during which several subsystems of the organism (ie, emotions are multicomponent phenomena) are synchronized to an event considered relevant to an individual's needs, goals, and/or values. Note that this definition emphasizes the fact that in addition to an emotional response, there are eliciting mechanisms, which are considered as being part of emotion and not just antecedent to it. Thus, although emotion can be perceived as "mysterious and deeply perplexing" (see chapter: Navigating the Science of Emotion, p. 31), there are ways to provide working definitions of this very complex phenomenon.

2.1.2 The multicomponent character of emotion

The three major theories of emotion—basic emotion, dimensional, and appraisal theories—all describe emotion as a phenomenon with multiple components (this is not a new idea; see, eg, Irons, 1897). This perspective typically characterizes emotion in terms of five components: (1) expression, (2) action tendency, (3) bodily reaction, (4) feeling, and (5) appraisal. This multiple components approach has proven useful not only to conceptualize (Sander, Grandjean, & Scherer, 2005) but also to measure (Mauss & Robinson, 2009) emotions. We will define and detail each of these components in the following sections of the chapter.

Before doing so, we would like to mention that besides this multicomponent character, there is now a consensus to define emotions with three additional criteria. First, emotions are two-step processes where emotion elicitation mechanisms generate emotional responses. Emotion elicitation mechanisms, such as appraisal processes, are more and more conceived as being part of emotion. Second, "relevant" or "significant" objects, which refer to both evolutionary and idiosyncratic concerns or situations, are required for emotions to occur. Third, emotion duration is brief and emotion has a quick onset (see chapter: Short-term Time Structure of Food-Related Emotions: Measuring Dynamics of Responses). More specifically, and although rarely studied (see Verduyn, Van Mechelen, & Tuerlinckx, 2011), emotion duration is thought to be shorter than other affective phenomena (eg, moods or preferences, which are typically conceptualized as more stable; see, eg, Beedie, Terry, Lane, & Davenport, 2011).

We will now describe each of the five emotional components and address their measurement. As different approaches of emotion have focused on different components, we will present these theories in the sections dealing with the components that they particularly emphasize.

2.2 Emotion components

2.2.1 Is emotion an expression?

Darwin's early work

Emotions go hand-in-hand with emotional expressions, such as facial expressions (eg, frowns, clenched teeth), vocal expressions (eg, prosody), body actions and postures (eg, forward whole body movement in hot anger). Body cues play an important role

in expressing and perceiving emotions and are increasingly studied (eg, Aviezer et al., 2008; Dael, Mortillaro, & Scherer, 2012). However, so far, facial expressions have been by far the most studied subtype of these expressions.

In this respect, Darwin's interests were no exception. He was inspired by Duchenne de Boulogne, who stimulated each individual facial muscle to determine its expressive value and created a facial muscle cartography, which was published in 1862. However, Darwin's approach to emotional facial expressions was innovative—Darwin (1872/1998) described them as innate and universal and conceptualized them in the context of evolution and natural selection. He proposed that they have evolved through interaction with our physical environment. More specifically, he believed that emotional facial expressions have derived from purposeful animal actions (eg, showing the teeth before attacking). Thus, Darwin's perspective assumes that emotions are survival tools and focuses on their functions. For instance, he surmised that the emotional expression of disgust was originally associated with the action of spitting spoiled food items (see chapter: Measurement of Disgust Proneness).

Since then, it has been experimentally shown that some emotional expressions do indeed have a functional role—for instance, the expression of fear enhances sensory acquisition, whereas the expression of disgust dampens it (Susskind et al., 2008). According to Darwin, emotional facial expressions consequently did not directly derive from the purpose of communicating emotions, and this communication function is rather an epiphenomenon. This perspective had considerable impact on the emotion literature, in particular on the basic emotion approach, one of the three major current approaches of emotion (but for other influences, see also Plutchik's evolutionary perspective theory of emotions; Plutchik, 1980).

Basic emotion theories

As mentioned in the previous section, the basic emotion theories have been extensively (though not exclusively) inspired by work on facial expressions of emotion. This approach is more generally rooted in evolutionary psychology. Thus, emotions are defined here as "transient, bio-psychological reactions designated to aid individuals in adapting to and coping with events that have implications for survival and well-being" (Matsumoto & Ekman, 2009, p. 69). There is a limited number of "basic," "primary," "fundamental," or "discrete" emotions, which have an evolutionary status. Note that this idea of basic emotion is not new. For instance, in the 17th century, Descartes (1649/1996) already identified six "primitive passions" ("passion" formerly being used as a term for "emotion"): wonder (admiration), desire, love, joy, hatred, and sadness.

According to Ekman (1994), eight criteria need to be fulfilled for an emotion to be considered basic: presence in other primates; distinctive universal signals (which can be universally recognized; see Fig. 1.2); distinctive physiology; distinctive universals in antecedent events; rapid onset; brief duration; automatic appraisal; and unbidden occurrence. A few years later, Ekman (1999) added three additional criteria: distinctive appearance developmentally; distinctive thoughts, memories, images; and distinctive subjective experience.

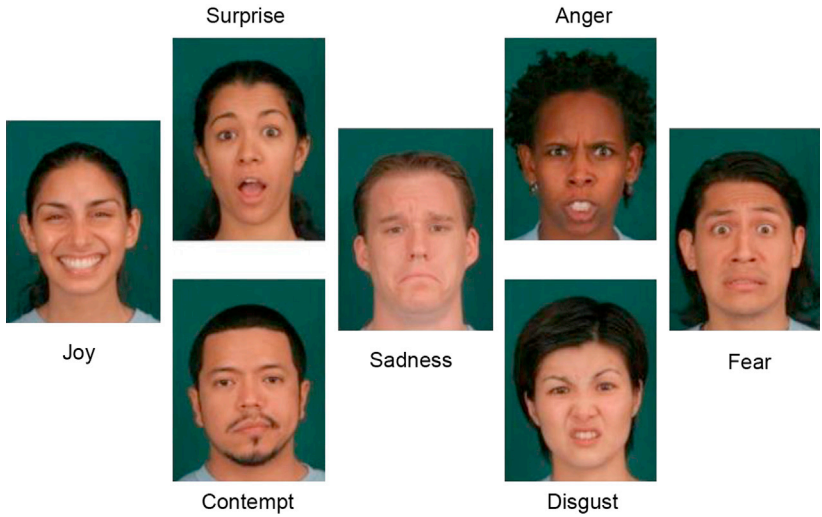


Figure 1.2 The universal facial expressions of emotion according to Matsumoto and Ekman (2009).
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Fear, disgust, anger, sadness, surprise, and enjoyment ("the Big Six," Prinz, 2004, which are typically agreed upon, see Ortony & Tuner, 1990) can be labeled as basic emotions (see also Matsumoto & Ekman, 2009). However, the establishment of which emotions qualify as basic emotions is a topic of disagreement between authors who advocate this approach. For instance, while Solomon (1980) suggested that there are only two primary emotions, Izard (1977) enumerated 10: fear, disgust, anger, distress-anguish, surprise, interest-excitement, joy, contempt, shame, and guilt. By contrast, complex emotions (eg, shame, pride) are thought to be the result of a mixture between basic emotions (eg, Tomkins, 1963).

In the context of evolutionary adaptiveness, Öhman and Mineka (2001) have even proposed that a module for fear elicitation and fear learning has evolved. This module is purportedly (1) selective, that is, only activated by fear-relevant stimuli; (2) automatic; (3) relatively independent from cognitive processes; and (4) originates in a dedicated neural circuitry centered around the amygdala.

Although very fruitful, this approach has been criticized, notably because facial expressions of emotion are not immutable and their recognition may not be as universal (eg, Russell, 1994) as previously thought (eg, Ekman, 1972; Ekman & Friesen, 1971). For instance, culture plays an important role in emotion recognition (eg, Elfenbein & Ambady, 2002; Gendron, Roberson, van der Vyver, & Feldman-Barrett, 2014), and so does, more generally, social information (eg, Manstead & Fischer, 2001; Mumenthaler & Sander, 2012, 2015). According to some researchers adopting a constructivist approach (eg, Russell, Bachorowski, & Fernandez-Dols, 2003), facial expressions of emotion are actually not caused by specific emotions, but reflect a mixture of valence and arousal, or social messages. Their interpretation should

consequently be undertaken cautiously. Similarly, according to appraisal theorists, emotional expressions should be understood in the context of the situation's evaluation (de Melo, Carnevale, Read, & Gratch, 2014).

Measuring emotional expressions

To measure facial expressions of emotion, several tools exist. First, it is possible to use the Facial Action Coding System (FACS) developed by Ekman and Friesen (1978). This tool is a standardized facial movement coding system that aims to specify the muscle movements involved in human facial expressions of emotion. Forty-four muscle movements, such as tightening of the lips, are covered. For a given emotional expression, a value is assigned to each action unit according to contraction strength. Unfortunately, one of its main disadvantages is that it is time-consuming to both learn and use (ie, a trained FACS coder can take up to 100 minutes to code 1 minute of video; Cohn, Ambadar, & Ekman, 2007). One of its advantages is that it is not dependent upon a particular theory of emotion. Although Ekman and his colleagues have developed this tool, it can be used to describe facial expressions in the framework of all emotion theories.

Second, electromyography (EMG) allows the activity measurement of muscles involved (besides other functions) in facial emotional expressions (eg, Bradley, 2000). It is very discriminating, as it can measure muscular activity even when no facial contraction is visible. The corrugator supercilli (responsible for furrowing one's brow) and the zygomatic (responsible for raising the corners of the lips) muscles are the most commonly measured. However, it requires the placement of sensors on the face, which may partially inhibit expression.

Third, it is possible to use automated facial image analysis measurement, the development of which is encouraging despite a number of technical challenges (for a discussion of these two techniques, see Coan & Allen, 2007; see chapters: Conceptual Profiling, Short-term Time Structure of Food-Related Emotions: Measuring Dynamics of Responses).

Fourth, thermal analysis of facial muscle contractions (eg, Jarlier et al., 2011; Nguyen, Chen, Kotani, & Le, 2014) is also under development. Both of these last two techniques have the advantage of not requiring sensors on the face, thus not restricting facial expression.

Independently of the tool used to measure facial expressions, it is important to keep in mind that large correlations exist between these expressions and the emotional state's valence of the person expressing them (eg, Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005). For instance, the zygomatic muscle activity correlates positively with the pleasantness of stimuli (eg, Larsen, Norris, & Cacioppo, 2003).

Besides measuring facial expressions of emotion, tools also exist to measure recognition of emotion in facial expressions. For instance, facial emotional expressions can be systematically manipulated using tools such as FACSGen (Roesch et al., 2011), offering perfect control over the displayed expressions, and the emotional recognition then measured (as used in eg, Mumenthaler & Sander, 2012, 2015). Finally, different tools have been developed to measure multimodal (eg, facial, vocal, and postural) emotion recognition (see, eg, Bänziger, Grandjean, & Scherer, 2009; Schlegel, Grandjean, & Scherer, 2014).

Besides facial expressions, emotion is expressed in other forms—for instance, through voice source parameters (eg, Bachorowski, 1999; Scherer, Johnstone, & Klasmeyer, 2003). These parameters belong to either general voice quality variables (ie, tension state of specific muscles in the larynx) or prosodic parameters (ie, voluntary changes in the tension of specific muscles in the larynx during speech production) (see Scherer et al., 2003 and Section 2.2.5). The most common measures are the voice amplitude (ie, how loud the voice is) and the fundamental frequency (ie, the lowest frequency of a periodic waveform). Higher fundamental frequencies are associated with higher levels of arousal (eg, Kappas, Hess, & Scherer, 1991).

Emotional expressions could also go through chemosensory cues contained in sweat. Such signals have been shown to influence emotional recognition (eg, Pause, 2012) and influence behavioral and cerebral responses to emotional stimuli (eg, Mujica-Parodi et al., 2009).

For more information, we recommend reading chapter: "Measuring Emotions in the Face".

2.2.2 Is emotion an action tendency?

States of action readiness

Dewey (1895) submitted the idea that emotions imply "a readiness to act in certain ways" (p. 17) and suggested that anger for instance "means a tendency to explode in a sudden attack, not a mere state of feeling." Almost a century later, Frijda (1986) suggested that emotions have evolved to prepare and guide actions in the different environments humans face. More specifically, Frijda proposed that emotions involve different processing stages induced by evaluating events as important to the individual's major concerns, leading to a preparation for action. In his own words, "different action tendencies are what characterize different emotions" (Frijda, Kuipers, & ter Schure, 1989, p. 213). Arnold (1960) was actually the first researcher to explicitly use this concept as a central part of emotion. In her words, an action tendency refers to "the felt tendency toward anything intuitively appraised as good (beneficial), or away from anything intuitively appraised as bad (harmful). This attraction or aversion is accompanied by a pattern of physiological changes organized toward approach or withdrawal. The patterns differ for different emotions" (p. 82). Thus, emotions are for doing.

These action tendencies (eg, approach, avoidance, domination, submission) prepare the individual to act with specific relational aims (eg, proximity, protection, regaining control). They are also thought to underlie overt behavior such as running away (Frijda, 2009). Similarly to facial expressions, some authors argue that there are universal adaptive action tendencies (eg, Shaver, Wu, & Schwartz, 1992). In recent conceptual developments, action tendencies have also been linked to other behaviors, such as impulsive actions, that is, a nondeliberate action aimed at changing one's relation to an object as more or less pleasant (Frijda, Riddenrinkhof, & Rietveld, 2014).

Two opposing action tendencies have been mostly studied: approach and avoidance. "Approach motivation refers to an urge or action tendency to go toward an object, whereas withdrawal motivation refers to an urge or action tendency to move away from an object" (Gable & Harmon-Jones, 2008, p. 476). According to Davidson

and Irwin (1999), two distinct systems underlie these action tendencies: an approach and an avoidance system. Crucially, the approach–avoidance and the positive–negative dimensions are not identical, because both approach and avoidance tendencies can lead to both positive and negative emotions (eg, Carver, 2004). For instance, anger is a negative emotion that can lead to approach tendencies, and admiration is a positive emotion that can nevertheless trigger avoidance tendencies.

Measuring action tendencies

Action tendencies have been often measured using push and pull reactions. Solarz (1960) showed that participants were faster to pull cards with pleasant words towards themselves (which is assumed to reflect approach), and to push cards with unpleasant words away from themselves (which is assumed to reflect avoidance). Since Solarz, other more recent studies have employed related designs (see, eg, Cacioppo, Priester, & Berntson, 1993; Phaf, Mohr, Rotteveel, & Wicherts, 2014; Seidel, Habel, Kirschner, Gur, & Derntl, 2010).

Other authors (eg, Kriegimeyer & Deutsch, 2010) have used different apparatus, such as a joystick that participants had to pull towards themselves (approach movement) or to push away from themselves (avoidance movement). Note however that in some situations, the association of pull–approach and push–avoidance may be reversed (see, eg, Phaf et al., 2014 for a discussion on this aspect).

These differences may reflect differences in subordinate goals (Bossuyt, Moors, & De Houwer, 2014). For instance, to reach the superordinate goals related to anger (ie, dominance/aggression), approach (a subordinate goal) is often functional. But according to this hypothesis, the association between anger and approach is only found when approach reflects the goals to aggress or hurt someone. By eliminating the functionality of approach for the superordinate goals of dominance/aggression (eg, by making avoidance serves dominance/aggression experimentally), the relation between anger and approach is no longer present (see Bossuyt et al., 2014), suggesting that considering subordinate goals is important when examining action tendencies.

It may seem surprising that the actual action of a participant is not measured as an indicator of his/her action tendencies. However, although action tendencies are precursors to an actual behavior, they do not imply that a specific action will occur (eg, Elliot, Eder, & Harmon-Jones, 2013). Accordingly, measuring actual behavior is not necessarily the most informative measure. Instead, self-reports of action tendencies have been used (eg, Frijda et al., 1989). For instance, to measure the approach and avoidance action tendencies, items like "I wanted to approach, to make contact" and "I wanted to have nothing to do with something or someone, to be bothered by it as little as possible, to stay away" were used, respectively.

Finally, indirect measures of action tendencies have been studied, in particular the "frontal asymmetry," which refers to the contrast in alpha power (8–13 Hz band) found using electroencephalography (EEG) in the left versus the right frontal region (eg, Davidson, Ekman, Saron, Senulis, & Friesen, 1999). This asymmetry has been used as a reflecting approach (left hemisphere activation) and avoidance motivation (right hemisphere activation). For instance, anger, an approach-related emotion, has been linked to great left-hemispheric activation (Harmon-Jones & Allen, 1998).

As mentioned earlier, EMG can measure activity in muscles whose contractions are not visible, before actions are initiated. The sensitivity of this measure allows the detection of slight contractions over time, and possibly of simultaneous, although contradictory, action tendencies.

The way an action is carried out can also be used as an indirect measure of action tendencies. For instance, participants afraid of spiders moved more directly away from a spider picture and less directly towards a spider picture than control participants (Buetti, Juan, Rinck, & Kerzel, 2012). This change in action trajectories can be seen as a measure of the action tendency of withdrawing from a threatening stimulus in spider-fearful participants.

2.2.3 Is emotion a bodily reaction?

The James–Lange versus Cannon–Bard debate

James and Lange's peripheralist approach James (1884) and Lange (1885)'s position goes against the classic idea according to which we first imagine or perceive an emotion-elicitation event, experience an emotion, and then experience bodily reactions. They claim that bodily reactions elicit emotions in consciousness and are consequently *primary* to other emotional components. In James' words, "if we fancy some strong emotion, and then try to abstract from our consciousness of it all the feelings of its characteristic bodily symptoms, we find that we have nothing left behind" (James, 1884, p. 193). According to this view, we *first* experience the bodily reactions directly elicited by the imagination or perception of an emotion-elicitation event. James stated "My theory… is that the bodily changes follow directly the perception of the exciting fact, and that our feeling of the same changes as they occur IS the emotion" (James, 1884, pp. 189–190). Note that James assumes that this applies to what he thought of as *standard* emotions (eg, surprise, fear, anger) but it is not clear that this would apply to other emotions (eg, shame), as they may not have a distinct set of bodily reactions.

This "peripheralist" approach to emotion was influential because of its originality and because it was empirically testable. This controversy regarding the "sequence problem" (Candland, 1977) has been nicely summarized by Lange (1885): "If I begin to tremble because I am threatened by a loaded pistol, does first a physical process occur within me, does terror arise, is that what causes my trembling, palpitation of the heart, and confusion of thought; or are these bodily phenomena produced directly by the terrifying cause, so that the emotion consists exclusively of the functional disturbances in my body?"

Cannon and Bard's centralist approach In contrast, Cannon (1927) and Bard (1928) assume that emotions are elicited by the processing of a stimulus in the central nervous system, in particular the thalamus. Consequently, bodily reactions are not considered to be causal in emotion elicitation, notably because of their lack of specificity—the bodily reactions elicited by very different emotions can be similar to one another, as well as the ones present in nonemotional states.

Cannon (1927) conducted several empirical tests in animals to disprove the peripheralist approach. For instance, he reported that abolishing visceral afferents did not

prevent emotions and that the artificial induction of the bodily reactions associated with a given emotion did not elicit this emotion. But Cannon's tests have also been criticized (eg, Fehr & Stern, 1970).

A review of 134 publications on the existence of patterns of bodily reactions specific to a particular emotion has concluded that there is evidence for "considerable autonomic nervous system response specificity in emotion when considering subtypes of distinct emotions" (see Kreibig, 2010, p. 394). Response patterns can generally be discriminated between basic emotions. However, this neither demonstrates autonomic specificity, nor does it explain the factors that could underlie these differences. For instance, if anger and fear are associated with a different pattern of bodily reactions, this may be because anger elicits an approach tendency while fear evokes a withdrawal tendency.

The consequences of this debate for models of emotion The historical James–Lange/Cannon–Bard debate has been and is still important in emotion research. As pointed out by Ellsworth (1994), it is however important to keep in mind that James's theory has been simplified and that bodily reactions were not the only important aspect of it—the interpretation of the stimulus was, too.

This debate has initiated empirical research regarding the temporal sequence of emotion. Let us mention briefly three lines of work derived from this.

First, Allport (1924) and later Tomkins (1962) suggested that feedback from the facial expressions plays an important role in the differentiation of emotions—known as the facial feedback hypothesis (Laird, 1974; Tourangeau & Ellsworth, 1979), which may extend to postural feedback also (eg, Stepper & Strack, 1993). Thus, emotions are thought to be "sets of muscle and glandular responses located in the face" (Tomkins, 1962).

Second, embodied theories of emotion (Niedenthal, 2007) have suggested that embodiment (reenactments of emotional expressions but also of a particular physiological state) is a key element to take into account when considering emotion elicitation. In line with the facial feedback hypothesis, contracting facial muscles recruited in a given emotional expression could intensify or elicit the congruent emotion, even when participants are not aware of this contraction's goal (eg, Soussignan, 2002; Strack, Martin, & Stepper, 1988).

Third, this debate has influenced several major authors in emotion research, notably Schachter and Damasio.

In line with James–Lange's idea, Schachter and Singer (1962) have presented a new theory of emotion as well as an experiment designed to support it. The two-factor theory they conceived emphasizes the role of physiological arousal (ie, what James called bodily reactions) but also of cognition. Schachter believed that physiological arousal was not enough to produce an emotion. Similarly, he believed that cognition without physiological arousal would not produce an emotion.

Schachter and Singer's experiment is famous, despite its critics (eg, Maslach, 1979; Plutchik & Ax, 1967) and the nonsystematic replication of its main results (eg, Marshall, & Zimbardo, 1979; Reisenzein, 1983). More generally, while the theory has generated a lot of interesting work, data tend not to support it (eg, Cotton, 1981). It is however still known for its emphasis on the role of cognitive factors.

Damasio's perspective is a neo-Jamesian theory of emotion. He has suggested the existence of "somatic markers," that is, physiological reactions associated with past emotional events (Damasio, 1994). When a new event is encountered, these markers are activated and influence decision-making. For instance, when an individual is exposed to an object previously associated with pleasant experiences (eg, a chocolate cake associated with the ingestion of nutrients), these somatic markers or bodily sensations bias the evaluations and decisions of this individual (making him/her more likely to approach and possibly consume this cake). The concept of somatic markers has notably been tested in the Iowa gambling task (see Bechara, Damasio, Damasio, & Anderson, 1994).

Measuring bodily reactions and bodily feeling

To the best of our knowledge, all current major theories of emotion consider bodily reactions as an aspect of emotion. For instance, according to appraisal theories, physiological reactions support adapted responses for the expression of emotion and production of action tendencies. Consequently, measuring them is important. When studying emotions, many psychophysiological indicators can be measured and combined (see, eg, Kreibig, 2010; chapter: The Psychophysiology of Emotions). They all have the advantage to eliminate self-report biases (eg, Orne, 1962). We believe that their choice should be motivated by the question of interest. The most commonly used indicators are electrodermal and cardiovascular responses.

Most of these measures are cardiovascular (ie, blood circulatory system; eg, heart rate, heart rate variability, systolic and diastolic blood pressure, preejection period, total peripheral resistance), electrodermal (ie, sweat gland; eg, skin conductance level, skin conductance responses), respiratory activity (eg, Stevenson & Ripley, 1952), in addition to the startle reflex measurement (eg, Lang, Bradley, & Cuthbert, 1990). While heart rate (eg, Delplanque et al., 2009) and startle reflex amplitude (eg, Bublatzky, Guerra, Pastor, Schupp, & Vila, 2013) are relatively good indicators of valence, skin conductance (eg, Boucsein, 2012) and pupil diameter (eg, Bradley, Miccoli, Escrig, & Lang, 2008) are more arousal-related. Some of these measures primarily reflect sympathetic activity (eg, skin conductance level), a combination of sympathetic and parasympathetic activity (eg, heart rate), or primarily parasympathetic activity (eg, heart rate variability).

As stated by Kreibig (2010, p. 29), the physiological adjustments that are elicited by emotion consist of an integrated pattern of responses. It is consequently important to judiciously choose the psychophysiological indicator(s) relevant for a particular study and analyze them properly. Note that several guidelines are available on the Society for Psychophysiological Research website (eg, for the startle reflex: Blumenthal et al., 2005; for heart rate: Jennings et al., 1981).

Besides measuring bodily reactions per se, one may want to measure the subjective perception of bodily sensations. Nummenmaa, Glerean, Hari, and Hietanen (2014) and Hietanen, Glerean, Hari, and Nummenmaa (in press) have recently developed an indirect tool of bodily reactions, called the "emBODY tool." It measures the feeling of increased and decreased activities in different body regions during an emotional episode. The participant is asked to color regions whose activity becomes stronger

or faster, and regions whose activity becomes weaker or slower. Nummenmaa et al. (2014) have measured these maps of bodily sensations for basic emotions in different cultures and found that they were concordant across cultures. Hietanen et al. (in press) showed that this tool can be used in adults as well as in children. Interestingly, these bodily maps can be correlated with psychophysiological measures to assess whether the subjective perception of bodily sensations and the actual sensations match.

Finally, in a more social perspective, it is worth mentioning that chemosignals (for instance, signals present in sweat, eg, Prehn, Ohrt, Sojka, Ferstl, & Pause, 2006; tears, Gelstein et al., 2011; or exchanged during handshaking, Frumin et al., 2015) may be involved in modulating physiological reactions in others (in the first two examples quoted, effects were shown on the startle reflex and different psychophysiological indicators of sexual arousal as well as testosterone levels in men, respectively) (see also chapter: The Role of the Senses in Emotion).

2.2.4 *Is emotion a feeling?*

Dimensional theories of emotion

Feeling refers to the subjective emotional experience, typically conscious. "Emotion" and "feeling" are often used interchangeably in everyday language. This was also often the case in early scientific study of emotion, to the point that most early theories of emotion were actually theories of feeling.

Several models have described feeling with different dimensions. For instance, more than a century ago, the Wundt's model suggested three basic dimensions (pleasure/displeasure, excitement/inhibition, and tension/relaxation) (Wundt, 1905). Bidimensional theories of emotion typically consider feeling in not three but two elementary dimensions. Russell is the major contemporary contributor of this approach.

Russell (1980) notably suggested a circumplex model of emotion (see Fig. 1.3 for a chart). This model represents emotions using a circle with two axes: the valence dimension indicating pleasure/displeasure (that almost all current models consider necessary, see Colombetti, 2005) and another dimension indicating arousal. More recently (eg, Barrett, Mesquita, Ochsner, & Gross, 2007; Russell, 2005), this circumplex model has been linked to what is called "core affect," that is, the neurophysiological state, always accessible, of feeling good or bad, energized or relaxed. According to the conceptual act model of emotion (Feldman-Barrett, 2006), emotions emerge from core affect and categorization. Thus, psychological construction theories also surmise that valence and arousal are the major characteristics of emotions (see chapter: Navigating the Science of Emotion).

Currently, this approach is probably the most commonly used for measuring subjective emotional experience, although it has been criticized. First, considering valence and arousal as the two main dimensions of feeling is controversial. Second, thinking of these dimensions as a unidimensional continuum is also controversial (see, eg, Cacioppo & Berntson, 1994; Robbins, 1997; see also chapter: The Psychophysiology of Emotions). Third, disentangling physiological arousal from other dimensions such as the intensity of the emotional experience or the intensity of the emotion-eliciting stimulus is important. Fourth, in an article entitled

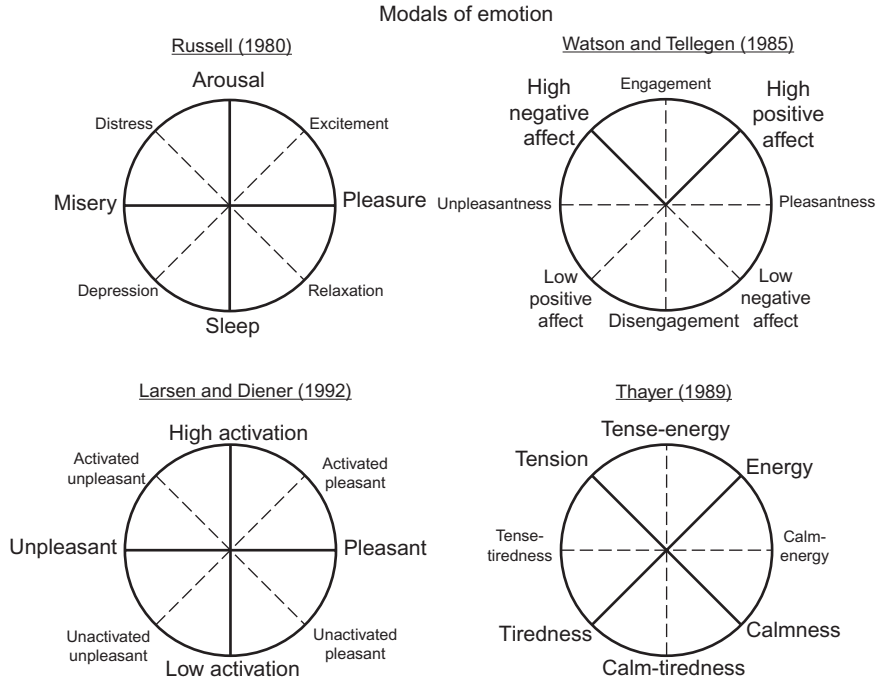


Figure 1.3 Representation of four types of affective circumplex models of emotion. This figure is reproduced by permission of Oxford University Press.

"The world of emotions is not two-dimensional," Fontaine and colleagues show that four dimensions—evaluation-pleasantness, potency-control, activation-arousal, and unpredictability—capture appropriately the emotional experience (Fontaine, Scherer, Roesch, & Ellsworth, 2007). Two dimensions would consequently not offer a satisfactorily representation.

Some appraisal theories of emotion offer an alternative approach, considering feelings as a reflection and a modulation of the change in the other components of emotion (eg, Scherer, 2004). Conscious emotional experience purportedly emerges as a function of appraisal-driven response synchronization (see Grandjean, Sander, & Scherer, 2008). Damasio, who is not an appraisal theorist, has similar ideas regarding the reflective character of feeling. In his own words, "the term feeling should be used to describe the complex mental state that results from the emotional state" (Damasio, 1998, p. 84). Some authors have emphasized other components more than others in the feeling experience, notably action tendency (eg, Lowe & Ziemke, 2011).

Measuring feeling

Many self-reports inspired by dimensional theories have been developed (see, eg, Ekkekakis, 2013). If feeling is a categorized blend of valence and arousal, one may think that measuring these two dimensions independently before combining them

may be the best approach. However, this is also not a simple task. For instance, regarding arousal measurement, Duffy (1957, p. 265) warned that "the terms 'activation' and 'arousal' … refer to variations in the arousal or excitation of the individual as a whole, as indicated roughly by any one of a number of physiological measures (eg, skin resistance, muscle tension, EEG, cardiovascular measures and others). The degree of arousal appears to be best indicated by a combination of measures."

Feeling has only been assessed using self-reported measures, and, to the best of our knowledge, no physiological or brain responses have been specifically associated with specific feelings. Of course, in physiological and brain-imaging experiments, participants do have feelings that are measured, but, again to the best of our knowledge, no specific *signature* of feeling, as a specific component of emotion, has been analyzed. Note that self-reports can be used in experiments where participants are placed in an emotion-elicitation situation, but also where participants are asked to imagine emotional events, or recall past emotional events, offering some flexibility. Note however that they tend to be more valid when they measure currently experienced emotions (Mauss & Robinson, 2009). Although self-reports have several important problems (eg, not everyone accurately reports his/her current emotional states), they can also be a valuable approach (eg, Keefer, 2014), in particular when combined with other measures.

For instance, the Geneva Emotion Wheel (Sacharin, Schlegel, & Scherer, 2012) has been developed to report feeling, inspired by an appraisal perspective. This wheel refers to discrete emotion terms (arranged in emotion families; for instance, disgust and repulsion) that are organized in a circular graphical structure. The valence and control dimensions underlie this grouping. Moreover, different levels of intensity for each emotion family are offered.

Scales measuring emotions in specific sensory modalities also exist. For instance, scales measuring emotions elicited by olfactory stimuli have been developed (Chrea et al., 2009) in different cultures (Ferdenzi et al., 2011) (see chapter: Emotions of Odors and Personal and Home Care Products). These studies suggest that feelings induced by odors are structured around few dimensions, some common across cultures (eg, disgust-irritation), some culture-specific (eg, spirituality in Singapore).

2.2.5 Is emotion a cognition?

The Zajonc/Lazarus debate

Another major debate in the psychology of emotion is known as the Zajonc/Lazarus debate. These two authors presented opposing perspectives regarding the conceptualization and relationship of cognition and emotion (eg, Lazarus, 1982; Zajonc, 1980, 1984). More specifically, Zajonc proposed that emotion and cognition are separate and that emotion is primary over cognition. In his own words, "an affective reaction always directly follows the sensory input" (Zajonc, 1980, p. 171). Thus, exteroceptive sensory processing can directly trigger an emotion. To support his "affective primacy hypothesis," Zajonc conducted empirical work showing that preferences can be generated for stimuli that are not consciously perceived (eg, Murphy & Zajonc, 1993).

In contrast, Lazarus stated that cognition (ie, cognitive appraisal) is a feature of emotion and that cognition is primary over emotion (for a more extensive discussion on this debate, see Sander, 2013). According to him, Zajonc's definition of cognition, equated with conscious thoughts, is faulty. Lazarus considers that cognition can be automatic and fast, and therefore that consciousness is not necessary. Thus, while Lazarus calls the minimal information required for emotion to be elicited cognition, Zajonc does not. Moreover, while Zajonc focuses on simple affective judgments (preferences in terms of negative vs positive valence), Lazarus is interested in emotions, with the intrinsic complexity it entails.

This debate has led to important discussions regarding the definitions of cognition, and also of emotion. These have once again showcased the importance of semantics. A few years later, this debate is echoed in the affective neuroscience field (see, eg, Ledoux, 1989; Parrott & Schulkin, 1993; for a discussion, see Sander, 2013).

Appraisal theories of emotion

According to appraisal theories of emotion, the evaluation of a stimulus or a situation according to different criteria is the cause of the elicitation and differentiation of emotions (see Scherer & Ellsworth, 2009). Theoreticians assume that these different dimensions can be processed automatically (eg, Moors, 2009). Appraisal (also called "transaction" by Lazarus, eg, Lazarus & Folkman, 1984) refers to the cognitive process eliciting emotion. According to these models, organisms constantly explore their environment and react to relevant stimuli. Contrary to basic emotion theories, appraisal theories assume that an almost limitless number of emotions exist, without necessarily considering some as more "basic" than others, but accommodating that some are more frequent and typical than others. Several appraisal theories of emotion exist. However, because of their set of common assumptions, they belong to one family of theories of emotion.

The appraisal process is made based on specific criteria, which differ across authors, but most agree on novelty, intrinsic pleasantness (or unpleasantness), predictability, goal-relevance (ie, their significance for the individual's goals), coping potential (ie, the individual's ability to cope with the consequences of the event), and normative significance (ie, the compatibility with personal or social norms and values).

As described by Arnold (1960, p. 171), who is the pioneer of the contemporary appraisal theories of emotion: "To arouse an emotion, [an] object must be appraised as affecting me in some way, affecting me personally as an individual with my particular experience and my particular aims. If I see an apple, I know that it is an apple of a particular kind and taste. This knowledge need not touch me personally in any way. But if the apple is of my favorite kind and I am in a part of the world where it does not grow and cannot be bought, I may want it with a real emotional craving." The construct of "relevance" captures evolutionary concerns, but also more idiosyncratic ones. A "concern" is defined as the disposition to desire the occurrence or nonoccurrence of specific stimuli or events (eg, Frijda, 2007).

A few years after Arnold, Lazarus (1966) defined the concepts of primary appraisal, secondary appraisal, and reappraisal. The primary appraisal refers to the evaluation of a stimulus as significant for the individual. The secondary appraisal is related to the

coping potential, that is, the evaluation of the resources this individual has at his/her disposal to face the situation. Finally, a reappraisal can lead to changes of the primary and/or secondary appraisal. Thus, emotion regulation, defined by Ochsner and Gross (2005, pp. 242–243) as involving "the initiation of new, or the alteration of ongoing, emotional responses through the action or regulatory processes" can be considered as an important part of the emotion process.

Appraisal theories have contributed to the understanding of mechanisms leading to the creation and the differentiation of emotions. They have been shown to predict emotions not just in laboratory (eg, Smith & Ellsworth, 1985), but also in real-life situations (eg, Smith & Ellsworth, 1987). Moreover, they have inspired other theories of emotion, such as social constructivism theories, which posit that the way a situation is appraised depends on the interpersonal and cultural context. What a given culture considers appropriate circumstances of an emotion influences the emotional process. For instance, according to Averill (1980), "emotional syndromes are among the role societies create, and individuals enact… Often, an emotional role is built upon, or incorporates elements from, one or more biological systems of behavior. But the meaning of the emotion—its functional significance—is to be found primarily within the sociocultural system." Consequently, this perspective emphasizes the interesting role of the environment and context.

Appraisal also shares uni- (in the case of attention) and bidirectional links with memory, motivation, reasoning, and self (see Fig. 1.4; see, eg, Montagrin, Brosch, & Sander, 2013; Pool, Brosch, Delplanque, & Sander, 2014, 2016). Accordingly, appraisal theories can explain developmental and clinical changes in emotion. In this framework, affective disturbances can be explained by several malfunctions of the emotional elicitation, differentiation, and/or regulation process, such as an inadequate evaluation of situations, desynchronization between the different components, inappropriate feelings, etc.

Another interesting aspect of appraisal theories is that they can apply to emotions elicited by all sensory modalities, including less studied ones such as olfaction and gustation (see, eg, Chrea et al., 2009; Coppin & Sander, 2011; Pichon et al., in preparation). Thus, and although not dominant in the field of olfaction, we believe that the appraisal approach provides an ecologically and theoretically plausible model of the emotion process (see Delplanque, Coppin, & Sander, in press), even in different cultures (Ferdenzi et al., 2011).

Measuring appraisal

The continuous nature of the appraisal process makes its measurement challenging, but not impossible. To measure appraisal, several methods have been used: an appraisal questionnaire containing fundamental appraisal dimensions (eg, Ellsworth & Smith, 1988; Scherer & Meuleman, 2013; van de Ven, Zeelenberg, & Pieters, 2012), indirect experimental methods (eg, Moors & De Houwer, 2001), facial expressions (eg, Kaiser & Wehrle, 2001; Lanctôt & Hess, 2007), voice (eg, Johnstone, van Reekum, Hird, Kirsner, & Scherer, 2005 have shown that mean energy, fundamental-frequency level, utterance duration, and the proportion of an utterance depend on goal conduciveness; see also Laukka & Elfenbein, 2011), and psychophysiological

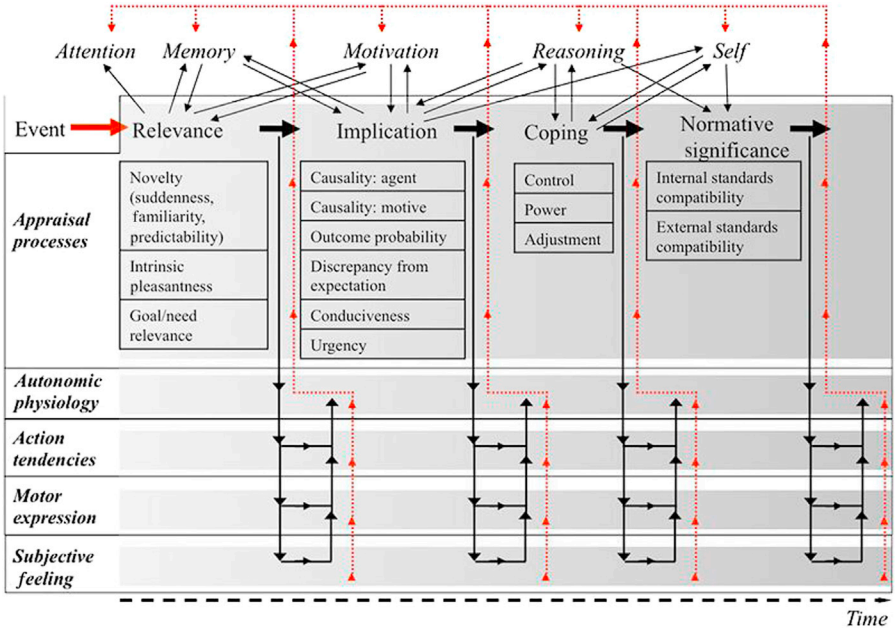


Figure 1.4 Representation of the component process model. According to this model, an event's significance is evaluated on several criteria in a fixed temporal sequence. These appraisal criteria are organized into four categories: (1) Relevance, that is, how relevant is this event for me or my social reference group? (2) Implication, that is, what are the consequences of this event and how does it affect my well-being and goals? (3) Coping, that is, how well can I adjust to these consequences? (4) Normative significance, that is, what does this event mean with respect to my self-concept and to social norms and values? Several subcriteria exist for each of these four categories (eg, novelty, intrinsic pleasantness, and goal/need relevance in the relevance category). *Black arrows* on top of the figure represent the effects of appraisal criteria on other cognitive processes (eg, attention, memory). *Gray arrows* represent the effects of different components (eg, autonomic physiology, action tendencies) on other cognitive processes. The different components are synchronized during an emotional episode, as shown by the *black arrows* on the bottom of the figure.

responses (eg, interbeat interval, pulse transit time, skin conductance, finger temperature have been shown to be associated with goal conduciveness; see Pecchinenda & Smith, 1996; Smith, 1989; van Reekum et al., 2004).

There is also an increased tendency to use brain-imaging methods to investigate the nature of appraisal processes (see Brosch & Sander, 2013). Brain-imaging methods allow the measurement of brain responses to variables manipulated independently of the attentional focus. Additionally, Brosch and Sander (2013) have proposed a neurocognitive process model of the appraisal model. For instance, the hippocampal activity has been associated with the detection of novelty, the amygdala responses to relevance, the anterior cingulate cortex activity to goal-incongruence, the temporoparietal junction activity to agency, and the dorsolateral prefrontal cortex activity

to norm compatibility assessment. This is particularly useful in the framework of appraisal theories because it allows testing the assumption that the appraisal process is automatic. Brain-imaging methods are also used to investigate the dynamics of appraisal processes. For instance, Grandjean and Scherer (2008) used EEG and event-related potential methods to test the sequence hypothesis assumed by the component process model. They showed that early appraisal checks (ie, novelty and intrinsic pleasantness) do occur before late appraisal checks (ie, goal conduciveness). The interested reader should refer to chapter "Short-term Time Structure of Food-Related Emotions: Measuring Dynamics of Responses," which presents the measurement of the temporal dynamics of emotion responses.

3 Conclusion

Depending on how one defines affect and cognition on one hand, and their relationship on the other hand, affective sciences can be seen as either integrated or complementary to cognitive sciences. In any case, emotion is not just an everyday life concept—it can be defined and studied scientifically. Accordingly, several theories have conceptualized emotion. Great progress has been made in the study of emotion and its effects in the past century in terms of concepts, methods, and measures. Thus, we do not feel that "the science of emotion is struggling today with the very same dilemmas as it was a century ago" (see chapter: Navigating the Science of Emotion, p. 31).

Each contemporary approach of emotion has its own definition and set of core tenets regarding emotion. Notably, they differ on the emotional component they focus on: expression, actions tendency, bodily reaction, feeling, or appraisal. However, they partially overlap, and there is an increasing conceptual clarity regarding emotion, considered, as mentioned in the Introduction, as a fast process focused on a relevant event. During an emotional episode, elicitation mechanisms shape an emotional response composed of changes in several components (for discussion, see Sander, 2013). Thus, emotion is a complex and highly interactive phenomenon.

Consequently, there is also increasing agreement regarding emotion measurement. As stated by Mauss and Robinson (2009), all measures (eg, self-reported or physiological) are relevant to the understanding of emotion. Their choice depends to a large extent on the aspect(s) of emotion one would like to study. A great deal is at stake when using a measure to properly capture what one intends to measure. Consequently, the issue of emotion measurement needs to be considered carefully. Moreover, it is important to keep in mind that measuring emotions can impact the emotional response itself (eg, Kassam & Mendes, 2013). Timing is also an important factor to consider when trying to measure emotions, for instance in more applied settings (see, eg, Köster & Mojet, 2015). For all the techniques discussed, it is worth mentioning that the development of virtual reality enables the immersion of participants in realistic situations, which can lead to emotions closer to real-life situations (eg, Ischer et al., 2014). This offers the possibility to study both natural emotional expressions and emotional recognition in a controlled, yet credible, context.

Studies attempting to measure all components of emotion at the same time are expected to bring important insights into the understanding of this complex phenomenon. Besides measuring the nature of emotion, one may be interested in measuring other aspects, such as duration. Unfortunately, this task is not easier, as it is difficult to tease apart what exactly is measured: the duration of a new emotional episode (induced by the remembrance of the event) or that of its first appearance.

As alluded to before, we believe that affective sciences would benefit from the integration of stimuli from all sensory modalities (eg, Oud & Coppin, 2012) and we invite the reader to refer to the following chapters of this book to further explore the possibilities offered by such an integrative approach.

Acknowledgments

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Navigating the Science of Emotion

2

Lisa Feldman Barrett[1,2]
[1]Department of Psychology, Northeastern University, Boston, MA, United States
[2]Department of Psychiatry, The Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital/Harvard Medical, Charlestown, MA, United States

1 Preliminary observations

Those who are new to the science of emotion have a common experience: when they crack open a textbook or review chapter, they are confronted with a perplexing *multitude* of emotion theories that vary a great deal from one another in almost every way imaginable; theories disagree on the details of how an emotion should be defined, on where to draw the boundaries for what counts as an emotion and what does not, on which emotions matter, on how emotions are different from related concepts like mood, reward, and motivation, and on how various phenomena such as facial movements, physiological changes, and feelings should be treated. In an attempt to bring some order to this dizzying cornucopia of theories, writers have created a particular narrative framework where theories are assembled into a few broader groupings, or categories, much like what appears in this volume. In chapter "Theoretical Approaches to Emotion and Its Measurement," for example, we are told that there are three families (ie, categories) of emotion theories (basic emotion, dimensional, and appraisal), and that they agree on very little other than that emotions, as brief reactions with synchronized components (expressions, action tendencies, bodily reactions, feelings, and appraisals), are triggered by "relevant" and "significant" objects in the world. By grouping variable theories together into a category, while separating others into different categories, a writer digests the variation, inviting you (the reader) to ignore certain distinctions between the theories (within the same category) and to focus your attention on others (in different categories). Any category is a grouping of items, events, objects, and even theories that are treated as similar *for some purpose* (Murphy, 2002). So, a category of theories is a grouping of theories that are deemed similar for some purpose. In any science, the organizing principle for grouping theories—the purpose—is determined by the writer's goal.

For the past century or so, the goal of many writers has been to argue over whether certain emotions are "basic" (forged in evolution, present in other animals, and having their own, unique biological mechanism, as well as their own pattern of facial expressions, autonomic reactivity, vocalization, behavior, and so forth). Some writers argue for the existence of "basic" emotions by either selectively reviewing evidence, or attempting to explain why it is reasonable to claim that emotions are "basic" in the

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face of growing empirical evidence that does not support the hypotheses of basicness. Other writers argue in favor of abandoning the idea of "basic" emotions, without offering much in the way of alternative theory to replace it. Some writers merely survey the literature, describing disagreements in as neutral a way as possible. All yield a similar sort of framework. Sometimes there are three categories (as in chapter: Theoretical Approaches to Emotion and Its Measurement); sometimes more (check out the Wikipedia page for "emotion" https://en.wikipedia.org/wiki/Emotion).

In my view, the standard narrative framework in the science of emotion constitutes one of the largest barriers to scientific progress, leaving both newcomers and scientists ill-equipped to make informed decisions about how to measure emotions. The framework is muddled, first, by errors. For example, some scientists advocate the utility of measuring "affect," ie, general feelings of valence (pleasure and displeasure) and arousal (calm and still to highly activated). Based on this, other scientists mistakenly describe these theories as reducing all emotions to two dimensions (eg, chapter: Theoretical Approaches to Emotion and Its Measurement). Then, they criticize the theories for their inability to distinguish different emotions from one another. In the standard narrative, for example, anger is defined as a high-arousal, negative state. But so are fear, disgust, guilt, and a variety of other emotions. The problem here does not lie in the theories themselves—it lies in the narrative framework. So-called "dimensional" theories of emotion do not actually exist. Most of these theories hypothesize valence and arousal as necessary, but not sufficient, features of emotion. Categorizing theories as "dimensional" betrays a fundamental misunderstanding of how these theories work. A careful read of the literature reveals that no theory has ever hypothesized that emotions can sufficiently be reduced to or *explained by* valence and arousal. Instead, these theories hypothesize that valence and arousal are important (and perhaps necessary) *descriptive features* of all emotions. Mischaracterizing theories as "dimensional" and then criticizing them for the limitations of a "dimensional approach" is not helpful to scientific clarity. The grouping of "dimensional" theories is actually better understood as "psychological construction" theories, which are described in some detail below (also see Barrett & Russell, 2015a, 2015b).[1]

[1] Psychological construction theories hypothesize that emotions are created as the interpretation of affective changes. They integrate dimensional and categorical perspectives, in the following way: It is hypothesized that all emotional events, at their core, can be *described* as having psychologically primitive affective properties (they feel pleasant/unpleasant, a property called valence, and agitating/quiescent, a property called arousal); this is the "dimensional" aspect of the theories. Psychological construction theories also propose, however, that people automatically and effortlessly use some type of mechanism to these affective changes meaningful in relation to objects and events in the world; this is the "categorical" aspect of the theories. Psychological construction theories are mislabeled as merely "dimensional" because people view them through a reductionistic lens, causing a profound misunderstanding: they attempt to redefine an emotion (or ontologically reduce an emotion) to it's most basic elements, which they mistakenly believe to be valence and arousal. As far as I know, no modern psychological constructionist theories have suggested that emotions are nothing more than valence and arousal (ie, no modern theories posit that affect alone provides a sufficient characterization for emotion). Instead, most theories characterize emotions as phenomena that *emerge* from the interaction of more basic mechanisms. Emergence implies that the product (the emotional instance as a whole) is more than the sum of its parts, and has properties that the core systems (the individual contributing parts) do not, making reductionism impossible. Furthermore, valence and arousal, as descriptive features of affect, are not even basic mechanisms. The affective circumplex (Barrett, 2004; Russell, 1980; Russell & Barrett, 1999; see chapter: Theoretical Approaches to Emotion

A further error in the standard narrative is that it characterizes valence and arousal as causal processes or mechanisms when the theories themselves do not. Valence and arousal are descriptive properties, not mechanisms that cause anything. They are also not unique to emotion (valence and arousal are fundamental features of all thoughts, beliefs, memories, perceptions, and so on; simply put, they are descriptive features of consciousness; for a discussion, see Barrett & Bliss-Moreau, 2009; Wundt, 1897/1998).

The standard framework also obscures some important variations within each theoretical "family." For our purposes, the most important distinction that is muddled involves the "appraisal" theory category. One variety of appraisal theories, which I have called *causal* or *classical appraisal theories* (Barrett, Mesquita, Ochsner & Gross, 2007; Gross & Barrett, 2011), assumes that "appraisals" are literal cognitive mechanisms that cause the subjective evaluations that, in turn, either cause or constitute emotions (Arnold, 1960a, 1960b; Frijda, 1986; Lazarus, 1966; Roseman, 2011; Sander, Grandjean, & Scherer, 2005; Scherer, 2005; see chapter: Theoretical Approaches to Emotion and Its Measurement). But another variety of appraisal theory characterizes "appraisals" as descriptive features, much like valence and arousal; for example, if an emotion is associated with the appraisal of "novelty," then during the experience of that emotion, something is experienced as novel. This descriptive variant of the appraisal category (Clore & Ortony, 2000, 2008; Ortony & Clore, 2015) is agnostic on the mechanisms that produce the appraisals. So, whereas causal appraisal theories would assume that an experience of novelty is caused by a literal novelty-detector in your brain (just as they mistakenly assume that the experience of pleasure and displeasure is caused by a literal valence detector in your brain), descriptive appraisal theories don't assume that there is a single mechanism that causes novelty (or valence). These *constitutive* or *constructive appraisal theories*, like psychological construction theories, do not assume that there is any parallelism between a mechanism and the resulting experience (ie, there is no anger mechanism causing anger, no "goal relevance" mechanism evaluating goal relevance, and so on).

The standard narrative framework not only conceals meaningful variation within a category of emotion theories, but it also obfuscates similarities across categories. The most important similarities are related to *essentialism*. Essentialism is the belief that a category of instances named by the same word (such as anger, pride, awe, etc.) or a phrase (eg, "basic emotion theories," "appraisal theories," etc.) share a deep, underlying causal mechanism (this is essentialism as described by John Locke). Basic emotion and causal appraisal theories indulge in Lockean essentialism. For example, both groupings of theories assume that a psychological phenomenon is caused by a dedicated mechanism of the same name (eg, in basic emotion theories, the experience of fear is caused

and Its Measurement, Fig. 2.2, which can also be found in Barrett & Russell, 1999, Fig. 2.1) is not an explanatory theory of emotion. It is a low dimensional, descriptive map that represents two properties or features of emotional experiences. These are properties or features of experience, valence and arousal, themselves cannot be mechanistically reduced, and are emergent properties of more basic processes. One well-known psychological construction theory by Russell (2003) is agnostic on how affect (described as feelings of valence and arousal) is caused. Another psychological construction theory, my own Conceptual Act Theory (Barrett & Bliss-Moreau, 2009; Barrett, Wilson-Mendenhall & Barsalou, 2015), makes very specific hypotheses about how affect arises from more fundamental mechanisms in the brain and body.

by a "fear" mechanism; in causal appraisal theories, the experience of novelty is caused by a "novelty" mechanism). Furthermore, both groupings of theories hypothesize a specific, dedicated underlying causal mechanism for each emotion category, either a population of dedicated neurons (for a review, see Tracy & Randles, 2011) or a particular configuration of appraisals (Scherer, 2009; see chapter: Theoretical Approaches to Emotion and Its Measurement).

Basic emotion and causal appraisal theories also share another version of essentialism: the belief that a group of instances either share a "fingerprint" (ie, a pattern of features that are similar across instances of the category) or that there is one best "instance" of the category (like a prototype; this is the sort of essentialism advocated by Plato). Both groupings assume that emotion categories have a "fingerprint," or a Platonic essence that issues from the Lockean essence (ie, each emotion category supposedly has a specific, synchronized pattern of measurable changes in the face, in the body, in behavior, etc.), that can be used to diagnose instances of that category, and the pattern is supposedly caused by the dedicated emotion circuit (in basic emotion theories) or by the pattern of appraisals (in causal appraisal theories). In principle, both theory groupings allow for variation within an emotion category. A fingerprint can vary from one instance to another because of the oils and substances on your fingertips, the temperature of your skin, and the surfaces you touch, even though the underlying ridges on your skin are constant; so too do basic emotion theories allow for variation in movements of the face, in electrical signals of the autonomic nervous system, in acoustical changes of the voice, in voluntary movements of the body, and so on. Some randomness is expected, and other processes, independent of an emotion itself, are thought to account for this variation, such as "display rules" or other regulatory strategies, such as suppression (Ekman & Cordaro, 2011; Gross, 2015; Matsumoto, Keltner, Shiota, Frank, & O'Sullivan, 2008; Roseman, 2011; Tracy & Randles, 2011). Nonetheless, it is assumed that an emotion's fingerprint exists and can be used to uniquely "recognize" the emotion in the same way that a fingerprint uniquely identifies an individual person.[2] Appraisal theories, to some extent, were motivated to account for variation in emotional phenomena, and while in principle they acknowledge the likelihood of such variation, their theorizing and research tends to focus on the presumed "basic" categories (cf. Barrett, Ochsner, & Gross, 2007).

Essentialist assumptions persist, despite accumulating evidence that they are false, for many reasons, most notably because of a phenomenon called "psychological essentialism" (Medin & Ortony, 1989), which allows people to posit a hypothetical or unseen essence in the absence of any evidence of what the essence might be (eg, the "affect program" concept) (Ekman & Cordaro, 2011; Tomkins & McCarter, 1964).

[2] Consider the idea of a "fingerprint." The pad of your finger has ridges which do not change from instance to instance. The sweat, dirt, ink, or other substances on the ridges of your finger are transferred to the surface of a brass door handle, a wooden table, a piece of paper, or whatever you touch, leaving a print. Your fingerprint won't look exactly the same each time you touch a surface. Sometimes you might grip the handle with more pressure or less. Some surfaces are rough with strong traction, while others are smoother and allow your fingers to slip a bit. Sometimes your skin might be warmer and more pliable. Even though your fingerprint does not look identical each time, it looks similar enough and is unique to you, and only you, so that it can be used to identify you but not other people.

This inoculates believers against disconfirming evidence, allowing them to continue to theorize about and believe in the existence of emotion essences, and to focus on the small proportion of published studies that support their existence, despite the even larger number of studies that disconfirm them (Barrett, 2006a, 2012, 2013; Barrett et al., 2007; Guillory & Bujarski, 2014; LeDoux, 2015; Lindquist, Wager, Kober, Bliss-Moreau, & Barrett, 2012; Touroutoglou, Lindquist, Dickerson, & Barrett, 2015).

The errors, the important differences between theories of the same category, and the implicit similarities in assumptions across categories, leave the science of emotion with an ineffective organizational framework making clear measurement recommendations almost impossible. Without meaningful theoretical integration, newcomers find it difficult to identify what is known about emotion with any degree of certainty. Scientists are paralyzed in a "disconfirmation dilemma" (Greenwald & Ronis, 1981) that makes accumulating knowledge about emotion almost impossible (except within theory-based silos). Lakoff recently called emotion an *essentially contested concept*: everyone agrees that emotions exist, but a variety of meanings are simultaneously employed for emotion, and scientific inquiry seems unable to settle the matter. Indeed, the science of emotion is struggling today with the very same dilemmas as it was a century ago (Gendron & Barrett, 2009). And the status of the empirical literature today is not that different: there are some experiments that support the hypothesis of emotion essences, but these are the tip of a much larger iceberg of scientific evidence that does not. Despite tremendous investments of research time and money, emotions remain mysterious and deeply perplexing.

Scientists realize that this confusion has a high price tag: measures don't work as well as expected, or sometimes at all. Studies don't replicate. There is a persistent confusion about how to measure emotions. And emotions don't predict behavior as well as they could (or by some accounts, at all). And the costs are rising. In the new "emotion economy," many businesses are investing millions of dollars and tremendous person-hours developing "emotion-aware" technology that they have been led to believe will be able to "read" emotions from perceiver-independent measurements of the face, body, and behavior (ie, they are developing technology and algorithms to measure emotions solely by tracking how facial muscles move, how autonomic signals in the body, how electrical signals across the scalp change, and so on). These companies have unwittingly ignored years of disconfirming evidence and embraced essentialism. But if the scientific literature is to be trusted, and one includes all well-designed and well-executed studies (not just those that support's one deeply held beliefs), then our best conclusion is that emotion essences don't exist. The unfortunate consequence is that so much effort and investment will be wasted. Even worse, people might end up concluding that emotions are not an important part of the equation in predicting behavior, all because they unwittingly used a set of unwarranted guiding assumptions to begin with. The empirical literature indicates the immediate need for a different scientific approach to explain what emotions are and how to measure them.

In this chapter, I offer a different approach—a narrative framework to reorganize the field according to whether or not theories assume the existence of emotion essences. Denying the existence of emotion essences does not mean denying the existence of emotions (Barrett, 2012). Instead, it means acknowledging the importance of

true variation in emotional life, and attempting to capture that variation when measuring an emotion category. It also means explaining the existence of emotion categories in all their glorious variability, without the need for emotion essences. Emotion theories vary in the extent to which they indulge in essentialism and in the type of essentialism they incorporate, if at all, and understanding these distinctions provides a more useful roadmap for the science of emotion, including ways to measure emotion.

For the remainder of the chapter, I introduce and discuss a new narrative framework, one that will allow you to make sense of the rest of this volume's chapters in terms of the underlying assumptions that are so rarely revealed and openly evaluated. Hopefully, this will give you a firmer footing on which to make informed measurement decisions. My goal is not to convince you that essentialism is detrimental. As you might have surmised, I believe it is. Essentialism has been show to interfere with scientific thinking, particularly when it comes to evolution and natural selection (Gelman & Rhodes, 2012) and emotion (Barrett, in press). Over a century ago, William James (1890/1998) pleaded for psychology to abandon essentialism: "The trouble with the emotions in psychology is that they are regarded too much as… psychic entities, like the old immutable species in natural history" (p. 449). Essentialism is so powerful, in fact, that is has, ironically, led the field to completely misinterpret James's ideas as essentialist in nature (cf. Gendron & Barrett, 2009). But my goal in this chapter is not to convince you that William James's original intent was correct. Instead, I have opted for the more modest goal of providing you with a framework for identifying whether a theory is assuming essentialism or not. Hopefully, this will equip you to properly evaluate the remaining chapters in this volume, as well as understand the consequences of the assumptions (whether they are explicitly stated or not). By the end of this chapter, you will also hopefully be more aware of your own assumptions, as well as their consequences of your measurement choices. Within the next section, I not only offer a framework for navigating the science of emotion, but I also consider the general measurement model for each approach. The chapter ends with a discussion of a new analytic technique—pattern classification—which is touted as the way to identify emotion "fingerprints," "signatures," or "biomarkers," and how such claims are mathematically mistaken because the technique is being viewed through the lens of essentialism.

2 To essentialize or not to essentialize? That is the question

Throughout the ages, philosophers, scientists, and other scholars who concern themselves with the nature of the human mind have disagreed on the nature of emotion in similar ways. In general, scholars have aligned themselves with one of two positions. One position incorporates some sort of essentialism, which I refer to as *the classical view of emotion*; the second assumes variability is the norm, which I refer to as *the construction approach to emotion*. A revised framework for modern emotion theories, organized by essentialist assumptions, is presented in Fig. 2.1 (for a brief historical review, see Appendix A).

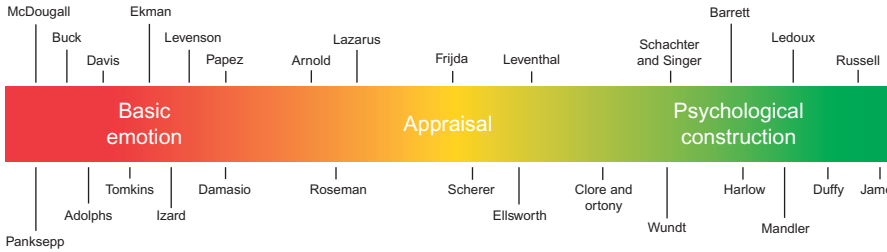


Figure 2.1 Modified from Gross and Barrett (2011). Emotion theories are loosely arranged along a continuum, populated with representative theories drawn from the field of psychology. Three "zones" are distinguished: (1) basic emotion, in red, for example, Anderson and Adolphs (2014), Buck (1999), Damasio (1999), Davis (1992), Ekman (1972), Izard (1993), Levenson (1994), McDougall (1908/1921), Panksepp (1998), and Tomkins (1962, 1963); (2) appraisal, in yellow, for example, Arnold (1960a, 1960b), Clore and Ortony (2008), Frijda (1986), Lazarus (1991), Leventhal (1984), Roseman (1991), Scherer (1984), and Smith and Ellsworth (1985); and (3) psychological construction, in green, for example, Barrett (2009), Duffy (1941), Harlow and Stagner (1933), James (1884), LeDoux (2015), Mandler (1975), Russell (2003), Schachter and Singer (1962), and Wundt (1897/1998). Theories in the red zone and the left-most portion of the yellow zone are much more essentialist than those in the right-most part of the yellow zone and the green zone (which are all non-essentialist theories). Indeed, the greatest heterogeneity in essentialist assumptions can be found in the appraisal zone, where classical appraisal theories (eg, Arnold, Roseman, and Lazarus) share many similar assumptions with basic emotion theories, whereas constituative appraisal theories (eg, Clore and Ortony) have more in common with psychological construction theories.

3 The classical view of emotion

In the first theoretical approach, which I call the *classical view*, an emotion is understood as a separate and independent ability, or *faculty*, caused by its own separate *processes*. In this approach, emotions are categorically different phenomena from perceptions and cognitions, and each emotion (eg, anger, sadness, fear, and so on) is categorically different from every other emotion, each being caused by a different mechanism. Some phenomena, like feelings of fatigue or love, are not considered to be emotions at all. Emotions, in this approach, are basic elements of the mind and body. In basic emotion theories, you "have" emotions and "recognize" emotions, such as happiness, and certain emotions are assumed to be psychologically and biologically primitive (meaning that the emotion cannot be further reduced at these levels of measurement). In causal appraisal theories, emotions can be caused and described in terms of their components (ie, the appraisal mechanisms).

In the classical view, each emotion faculty is assumed to have its own innate *physical essence* that distinguishes it from all other emotions. This might be a Lockean essence (an underlying causal mechanism that all instances of an emotion, such as happiness, share, making them that kind of emotion and not some other kind of emotion (eg, interest)). Lockean essences might be biological, such as a set of dedicated neurons (exemplified in basic emotion theories, ie, Tracy & Randles, 2011). They

might also be psychological, such as a set of evaluative mechanisms called "appraisals" (exemplified in causal appraisal theories). An emotion is also assumed to have a Platonic essence (a physical fingerprint that instances of that emotion share, but that other emotions do not, such a set of facial movements (an "expression") and a pattern of autonomic nervous system activity). Of course, no one is expecting an emotion's fingerprint to be identical each and every time the emotion is triggered, but it is assumed that instances of a category are similar enough to be easily diagnosed as the same emotion using objective (perceiver-independent) measures alone. Simply put, a handful of emotions (anger, sadness, fear, disgust, surprise, happiness, and perhaps a few others) are said to be natural kinds with firm boundaries in nature (Barrett, 2006a, 2006b). Scientists seem unable to agree on which emotions are "basic" or are natural kinds, however (for a discussion, see Ortony & Turner, 1990).

3.1 Measurement implications

There is a particular measurement theory implied in the classical view of emotions. If emotions are natural kinds, then the best way to measure them is using perceiver-independent tools, such as facial electromyography, measures of autonomic nervous system activation, or brain imaging. All measures (except perhaps, self-reports of subjective experience) should be correlated and therefore interchangeable with one another, because all signals have a common cause (the emotion essence) (for a discussion, see Barrett, 2000, 2006a, 2006b, 2011a, 2011b; Coan, 2010; Russell, 2003). This idea is embedded in classical measurement theory and depicted using the notation of probabilistic graphical models in Fig. 2.2. From an information theory standpoint, individual measures do not carry unique information about the emotion. Self-reports, on their own, are considered a fallible way of measuring emotions, because according to this view, people may not be conscious of their emotional state. So it is necessary to

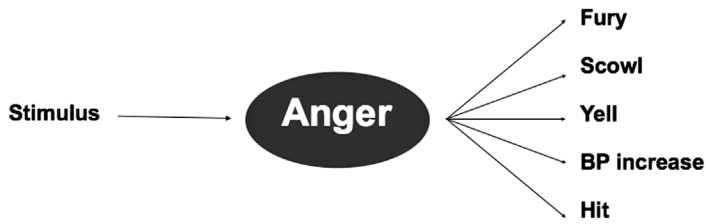


Figure 2.2 The measurement model for the classical view of emotion. *BP*, blood pressure. This is a causal model and a measurement model. The causal mechanism (the emotion essence) is depicted in the black oval. The resulting emotion fingerprint is on the right. In structural equation modeling, which is a type of probabilistic graphical model, the oval is latent (ie, not measurable) but its existence is established by correlations between the output measurements that make up the fingerprint (scowling, yelling, etc.). Various emotion essences have been proposed, including an affect program (eg, Ekman), appraisals (eg, Roseman, Scherer), brain circuits (Tracy & Randles, 2011), a dynamical brain system (Lewis, 2005), and even a pattern of brain activity (Kragel & LaBar, 2015).

scientifically test the accuracy of self-reports by comparing them with the perceiver-independent measurements before they can be used (and they should be correlated when accurate). When self-reports do not correlate with more objective measures (as is often the case), then self-reports are assumed to be inaccurate.

In the classical view, emotions are universal in humans (meaning that measurement tools should reveal the same underlying causes and fingerprints for each emotion across cultures), and are homologous in other animals (meaning that studying emotion in nonhuman animals will sufficiently reveal the secrets of emotions in humans). Therefore, classical conditioning with an aversive cue (like an electric shock) becomes "fear learning" (for a discussion see Barrett, 2012; LeDoux, 2014). Reward processing in rodents and monkeys should be the same as in humans because both are located in the so-called "limbic system," which is supposed to be evolutionarily primitive in the brain and identical in all mammals (or at least in primates) (MacLean, 1949, 1990; Panksepp, 1998); only humans are supposed to have the well-developed neocortex necessary for cognition and therefore for sophisticated emotion regulation. One implication of this formulation is that emotion words and concepts (which are part of cognition) are separate from the emotion themselves (Izard, 1993, 2011); self-reports of emotional experience are assumed to involve consciously accessing an emotional state (with more or less accuracy) compared to and described with adjectives on a questionnaire (such that the experience of emotion is presumed to be independent of the emotional state itself).

3.2 Drawbacks to using the classical view's measurement model

The major stumbling block in using the classical view to guide emotion measurement is that it does not fit the majority of data that have been collected to study it (cf. Barrett, 2006a, 2006b; Barrett et al., 2007). Some studies do support the classical view (many of which are reviewed in chapter: Theoretical Approaches to Emotion and Its Measurement), but these exist in a context of many more studies that disconfirm it. Disconfirming studies are rarely discussed in scientific reviews that are written in support of the classical view, which ultimately confuses newcomers to the field who, because they are reading broadly in an effort to familiarize themselves, quickly realize that there is substantially more to digest and integrate than those selectively written reviews provide.

Broader summaries of the literature do exist, however, and they paint a very different picture of the empirical landscape. Narrative summaries clearly show that perceiver-independent measures from the face, the body, and the brain do not correlate with one another to reveal an emotion's essence (ie, no Lockean essences have been identified for any emotion; Barrett, 2006a, 2006b; Barrett et al., 2007; Mauss & Robinson, 2009; Russell, 2003). Nor does neuroscience reveal evidence of emotion essences. For example, meta-analyses of neuroimaging studies have been unable to locate a specific region of the brain dedicated to a specific emotion (Lindquist et al., 2012). The brain does not contain an intrinsic network that is specifically dedicated to any emotion (Touroutoglou et al., 2015). Even individual neurons are not dedicated to specific emotions (Clark-Polner, Wager, Satpute, & Barrett, in press-b; Guillory &

Bujarski, 2014; Quiroga, Reddy, Kreiman, Koch, & Fried, 2005; Viskontas, Quiroga, & Fried, 2009).[3] For a discussion of some reasons why experiments on nonhuman animals do not reveal emotion essences, see Barrett (2012) and LeDoux (2014, 2015).

Nor do research findings give evidence of a consistent, specific physical fingerprint for each emotion (ie, no Platonic essences have been identified for any emotion; Barrett, 2006a, 2006b; Barrett et al., 2007). The facial expressions that are assumed to be specific to each emotion were not discovered but were actually stipulated, first by Darwin (1872/1965), and then later by Tomkins and McCarter (1964) (for a brief history, see Widen & Russell, 2013); scientists routinely repeat the mantra that these particular facial movements are universal displays of emotion, but studies that measure facial movements using facial electromyography do not support this claim (for reviews, see Barrett, 2006a, 2006b, 2011a, 2011b; Russell, Bachorowski, & Fernández-Dols, 2003). Even experiments using perceiver-based coding methods (called the Facial Action Coding System; FACS; Ekman & Friesen, 1978) do not find consistent evidence of these expressions during emotion (eg, see Table 13.2 in Matsuomoto et al., 2008).[4] Furthermore, engineers have shown that different combinations of action units can produce similar-looking expressions, violating a basic assumption of the classical view (Tian, Kanade, & Cohn, 2001). The point is not that people never scowl during anger or pout during sadness, but that they do not routinely do so. No one is claiming that facial movements are random or meaningless. The evidence clearly shows that people move their faces in various ways during happiness, during anger, or during any emotion. But variation is the norm within each emotion category. Because there is no set of facial movements that is consistent and specific to each emotion category (ie, no essential "expression"), emotion "recognition" studies are really "perception" studies where "agreement" (among perceivers, or between

[3] For example, amygdala neurons respond too slowly to be the brain essence of fear (usually responding about 250 ms after the image is shown). If you consider that it takes about another 500+ ms to mobilize a physical movement, then this is too slow to sound a fear "alarm" when a fearful object or event occurs. Cells in the medial temporal lobe (including the amygdala) appear to act as a memory cache for important things (eg, photos of friends, family, famous people, the patients themselves, landscapes, directions; some cells don't respond to anything for a few days, and then begin to respond when the experimenters walk into the room); at some other point, the cells might adopt and code for something entirely different that becomes important (Cerf, personal communication, 7/30/15).

[4] FACS coders isolate specific facial movements and indicate whether they are present or absent. Another version of FACS, called "Emotion FACS" or EMFACS, has coders decide whether an expression is present or absence by indicating whether an entire group of muscle movements (the expression) occurs en-mass, rather than detecting each movement one at a time; EMFACS produces better results supporting the Classical View, but it is less reliable (www.erikarosenberg.com), less precise and less objective. For example, of the hundreds of published studies using FACS and EMFACS to code facial muscle movements during emotion, a recent scholarly review listed only 25 that reported test subjects making spontaneous facial movements matching the configurations in the posed photos (Matsumoto et al., 2008; Table 13.2). Of the 15 studies using FACS coding, only 7 actually found evidence that spontaneous facial movements matched the expected configurations; 5 studies found that facial movements distinguished pleasant and unpleasant feelings, and 3 studies were not designed to test the question in the first place because the test subjects were only presented with pleasant stimuli like jokes and cartoons. Of the nine studies using EMFACS coding, all found evidence supporting the claim that people make spontaneous facial movements during emotion matching the expected facial expressions.

perceivers and the experimenter's expectations) serves as an estimate "accuracy" (instead of comparing a person's perceptions to some objective index of whether or not the emotion is present in the target).

Variation is also the norm for autonomic measurements taking during emotion. Although some writers have made a very persistent case for the existence of autonomic signatures (Friedman, 2010; Kreibig, 2010), actual meta-analytic summaries do not support such claims (Cacioppo, Berntson, Larsen, Poehlmann, & Ito, 2000; Lindquist, Siegel, Quigley, & Barrett, 2013; Siegel et al., under review; for a discussion, see Quigley & Barrett, 2014). A recent meta-analysis from our lab, for example, summarized findings from over 200 experiments measuring autonomic reactivity during instances of emotion categories and failed to find distinct autonomic fingerprints for any emotion category. Instead, we documented tremendous variation both within and across categories; experimental context explained some of the variation, but even studies using the same methods, stimuli, and sampling from the same population of participants display such variation (eg, compare findings from Kragel & LaBar, 2013, with Stephens, Christie, & Friedman, 2010).

"Variation is the norm" is a fair summary of the experimental literature on emotion, to date. While some experiments do give evidence of emotion fingerprints, many more do not. Studies are either unable to distinguish one emotion from another over and above their basic affective differences, or the patterns that distinguish one emotion from another do not replicate across studies (for a recent review, see Barrett, 2013).

Probably the most robust and replicable finding in the science of emotion comes from classic emotion perception studies, but only when a particular experimental set up is used: perceivers are shown a posed, caricatured face or body, or listen to a posed, caricatured vocalization, and then are provided with a small set of emotion words from which they choose the correct label. This is called force-choice responding (with samples from remote cultures, sometimes perceivers hear a brief story about an emotion, and then are presented with two or three stimuli from which they must choose the correct match). Hundreds of experiments using this method have been performed on perceivers sampled from a range of cultures and they generally find that perceivers choose the correct response more often than chance, leading to claims that emotions are universally "recognized" (for a meta-analytic review of emotion perception in faces, see Elfenbein & Ambady, 2002). But remove the conceptual context (ie, the words and stories) and ask participants to freely label the emotion cue, or interfere with a perceiver's ability to access emotion concept knowledge during the task, and agreement rates drop precipitously (for a review, see Barrett, 2011a, 2011b). In fact, upon close inspection, it becomes obvious that emotion perception is highly influenced by context (Barrett, Mesquita, & Gendron, 2011; Gendron, Mesquita, & Barrett, 2013). Most importantly, of those participants who have little familiarity with Western cultural practices and norms, only those who are inadvertently taught US emotion concepts during the course of the perception task and who are provided with a small selection of emotion words to choose from appear to perceive emotions in a universal (ie, American) way; without conceptual support within the task, there is little, if any, evidence that emotion perceptions are universal (see Gendron, Roberson, & Barrett, 2015; Gendron et al., 2014a, 2014b).

Here is the takeaway point: if you adopt the classical view to guide study design and emotion measurement, you are accepting a set of assumptions that are thus far unvalidated. Much of the confusion in the science of emotion could be avoided if scientists properly evaluated their assumptions (eg, discover, rather than stipulate, how people move their faces and bodies, how vocal acoustics change, and how autonomic reactivity fluctuates during naturalistic instances of an emotion concept in a range of contexts). In the meantime, it is crucial to be cautious about studying and measuring emotions as if they have essences when it remains unclear if they do. I find it ironic that most studies in the science of emotion are designed to induce and observe only the most stereotypical examples of emotion, yet those studies routinely produce evidence of substantial variation in facial movements, autonomic patterns, and brain activity, well beyond what would be expected by error. So imagine what the science of emotion would be like if our starting assumption was that variation is the norm, and we attempted to measure and capture that variation, both within a person across contexts as well as across individuals both within and across cultures. And, in fact, an increasing number of reports are, in fact, doing just that (Ceulemans, Kuppens, & Van Mechelen, 2012; Hortensius, Schutter, & Harmon-Jones, 2011; Kuppens, Van Mechelen, & Rijmen, 2008; Kuppens, Van Mechelen, Smits, De Boeck, & Ceulemans, 2007; Nezlek, Vansteelandt, Van Mechelen, & Kuppens, 2008; Stemmler, Aue, & Wacker, 2007), but more are desperately needed.

Those who adhere to the classical view have a standard approach to solving the ever-widening chasm between their assumptions and the scientific evidence. The response to variation is usually to create more fine-grained typologies, in an attempt to bring nature under control and make it easier to identify emotion essences. Maybe there are "primary" and "secondary" emotions? Maybe there are "basic" and "non-basic" emotions? Maybe there are "non-social" and "social" emotions? Scientists sometimes try other typological divisions, like distinguishing emotion "elicitation" from "emotion regulation," and when that does not do the trick, they distinguish "steps" and "sequences" in their emotion elicitation phase of things. They distinguish "affect" from "value," and then cleave "value" into different types of "valuation." And so on. But there is another approach to emotion, one that accounts for all the empirical evidence (both the evidence that supports the classical view and that which does not). This is an essence-free view that considers typological thinking as a lot of misplaced creativity and effort.

4 The construction approach to emotion

Throughout the ages, a second approach to understanding the nature of emotion has been called by many different names, but can be united and collectively referred to as the *construction approach* to emotion (cf. Gendron & Barrett, 2009; Lindquist & Barrett, 2012). Constructionist approaches come in three flavors: social construction (how emotions are influenced by social roles and values), psychological construction (how emotions emerge from more basic psychological processes related to making meaning of affective feelings; see Fig. 2.1), and neuroconstruction (experience wires a brain for emotion during brain development). Only recently have these three varieties

of construction been integrated into one *theory of constructed emotion* (Barrett, 2013, in press; Barrett et al., 2015); in prior research, this approach was called the "conceptual act theory" (Barrett, 2006a, 2006b).

In the construction approach, an emotion is not a distinct "faculty" with its own distinct mechanism. Instead, one key hypothesis that unites all constructionist theories is that an emotion word, such as happiness, refers to a *population* of highly variable instances, each of which is tailored to a specific situation or context (Barrett et al., 2015). So an emotion is not an entity with firm boundaries in nature—it is a category of instances. Instances within a category vary because each one is tailored to the environment, that is, there are no Platonic emotion essences or fingerprints. For example, an instance of happiness can be pleasant and arousing (eg, you are finishing a challenging task with no errors and hear applause), pleasant and quiescent (eg, you feel comfortable and rested after a good night's sleep), and even unpleasant (eg, you want to call your friend to share your recent success but he is unreachable) (Wilson-Mendenhall, Barrett, & Barsalou, 2013). The actions you make in happiness will depend on the situation (eg, you might laugh, smile, cry, jump, sigh, shout, slam your fist against a table, and so on)—whatever has been most functional for you in past, similar situations. And your cardiovascular response will be similarly variable across instances of happiness, because those responses support action (Obrist 1981; Obrist, Webb, Sutterer, & Howard, 1970); therefore, there is no one-to-one correspondence between a behavior, a physiological pattern, and an emotion word (eg, Lindquist et al., 2013). Thus, in the construction approach, an emotion does not have an essence. Emotion categories are not natural kinds (Barrett, 2006a, 2006b). Without essences, it is not meaningful to ask what is, and what is not, an emotion. Nor do you "have" emotions or "recognize" them. You construct emotions as experiences or perceptions—they emerge from complex dynamics within your nervous system, which is constantly in dynamic interaction with the surrounding context, often including other creatures who each have a nervous system. In a sense, you can think about emotions as tools, born of the social reality we create, to influence and regulate one another's nervous systems (Barrett, 2012).

A second key hypothesis uniting different constructionist theories is that instances within the same emotion category (eg, happiness), instances across emotion categories (eg, happiness vs fear), and even instances of nonemotion categories such as thoughts, beliefs, perceptions, and so on, all emerge from the dynamic interactions of more fundamental *common or domain general processes* within the nervous system (Barrett & Satpute, 2013; Lindquist & Barrett, 2012). No emotion category (or, in fact, any mental category) is assumed to have a Lockean essence. No emotion category is presumed to be any more biologically basic than any other. The validity of constructionist approaches depends on specifying the shared causal mechanisms, not on finding a single mechanism for each emotion, or a stable pattern of observable consequences stemming from those mechanisms (in the classical view, there is more emphasis on finding fingerprints than on identifying a single causal mechanism, because fingerprints should always be measurable, whereas essences can be hidden). Because constructionist theories rely on population thinking and domain-general mechanisms rather than essentialism, variability is *assumed* to be the norm, rather than a nuisance to be explained after the fact.

Because constructionist theories are much less intuitive, and because they are highly heterogeneous, it usually helps to focus in more closely on one theory to more fully understand its implications for the measurement of emotion. Here, I will focus my own theory of constructed emotion.

4.1 The theory of constructed emotion

According to the theory of constructed emotion, an instance of an emotion category (and any other mental category) emerges as the brain makes meaning of incoming sensory inputs from the body and the world. Every waking moment of your life, your brain is taking in constantly changing, noisy sensory information from the world and transforming it into sights, sounds, smells, and so on. From your brain's perspective, your body is another domain that is sending constantly changing, noisy, incomplete sensory inputs from your blood rushing, your muscles stretching, your lungs expanding, and so on; the autonomic nervous system, endocrine system, and immune system all create sensory changes within what scientists call the internal milieu of your body, and you brain makes sense of these as affective feelings that belong to physical symptoms, emotions, thoughts, perceptions, and so on. How does your brain make sensations meaningful? By categorizing them. This means using past experience, organized as concepts, to explain what caused the sensations and what to do about them (ie, how to act). Here is a succinct summary of the theory:

> *In every waking moment, your brain uses past experience that function as concepts to guide action and give sensations meaning. In this manner, your brain models your body in the world. When the concepts involved are emotion concepts, your brain constructs instances of emotion.*

To demonstrate categorization using concepts from past experience, have a look at Fig. 2.3.

If you are like most people who have never seen the image in Fig. 2.3 before, then you are in a state of "experiential blindness." Your brain cannot categorize the visual input—it cannot make sense of it—so all you see are black and white blobs. To cure your experiential blindness, please turn to the appendix (Fig. A.1), and then return to this page.

After viewing the appendix (Fig. A.1), most people now see an object in Fig. 2.3. So what does this exercise demonstrate? Your brain added information, stored from your (very recent) past, to make sense of the incoming sensory input (visual) to *construct* your experience of the object in Fig. 2.3. This example is instructive in several ways. First, the construction process is ongoing, obligatory, and automatic; notice that you had no sense of agency or effort in the construction process. No matter how hard you try, you cannot introspect about how your brain accomplished this feat of making incoming sensations from Fig. 2.3 into a meaningful visual experience. Also, it is virtually impossible to "unsee" the object—to deconstruct the experience by the sheer force of will.

To the best of our current knowledge, here is what went on in your brain. Neurons in certain parts of your brain changed the firing of neurons in your visual cortex to construct your experience of lines that actually aren't present on the page, linking



Figure 2.3 An example of categorizing to construct an experience.

the blobs into the shape of a cow whose image isn't physically there on the page. Scientists call this "simulation" (Barsalou, 2008). Simulation is when the neurons in some parts of your brain changed the firing of sensory neurons in other parts of the brain so that you can, for example, see lines and other visual features, without sensory input. Simulation can be visual, as in this example, but it also involves your other senses. If you've ever had a song stuck in your head, or put food into your mouth, expecting to taste one thing but then experienced the shock of tasting something entirely different, then you have experienced simulation in other sensory modalities. Memories, daydreams, mind wandering—these are also examples of simulation. In the science of emotion, we measure this kind of simulation all the time without realizing it. We hook people up to blood pressure monitors, electrocardiograms, and so on, show them evocative images, and then measure changes in autonomic nervous system activity, even though people are sitting perfectly still this works, not because the images "trigger" reactions, but because people are simulating the action that they would make in that situation, as well as the interoceptive sensations (from the core of the body) that they would receive. Whenever you ask respondents to report on an experience that has happened in the past, this is also tapping simulation. Simulation during brain scanning produces activity in somatosensory and motor cortices when subjects are completely still, in primary visual cortex when eyes are closed, and even in primary interoceptive cortex (for sensing changes in the core of the body) when there is no threat or reward immediately present (Wilson-Mendenhall et al., 2013). Understanding the brain dynamics of simulation—how people apply knowledge wired into the brain to create experiences and perceptions in a particular context will reveal how the brain constructs experiences and perceptions of emotion.

A full explanation of simulation is beyond the scope of this chapter, so a brief summary will have to suffice. The first thing you must realize is that your brain is not merely responding to stimuli in the world. Your simulations function like predictions that continuously *anticipate*, rather than react to, sensory inputs from the world. Your

brain is wired to be a generative model of your world, by using past experience to actively create simulations that best fit the situation you are in. The second insight is that predictions, as simulations, are then corrected by sensory input from the world; so, information from the world is feedback on how good the simulations are. This includes not only the neurons for vision, audition, touch, taste, and smell, but also for interoception, because from the brain's perspective, the body is part of the brain's world (since the body holds the brain); it's also likely true for affect, which is the low dimensional experience of interoceptive sensations. Your brain is constantly generating predictions of upcoming sensations and then adjusting these predictions (more or less) by computing error signals that track the difference between the predicted sensations and those that are incoming from the sensory world. And the brain is not only making sensory predictions—it is also making motor predictions; it is anticipating the motor changes that will be required in a moment from now by changing the firing of motor neurons before they are needed. In fact, your brain generates visceromotor predictions (to control your autonomic nervous system, your neuroendocrine system, and your immune system) and voluntary motor predictions first, and then anticipates the sensory consequences of those visceromotor/motor predictions (ie, predicted motor changes produce sensory predictions) so that, in a sense, sensation follows (and is dependent on) action (Barrett, in press; Barrett & Simmons, 2015; Chanes & Barrett, 2016; Clark, 2013; Hohwy, 2013; Friston, 2010).

When your brain creates a prediction from past experience, it does not issue one neural pattern, but an entire population of potential predictions, each one having some probability (computed with Bayesian priors) of being the best fit to the current circumstances (Barrett, in press). This population of neural patterns is, for all intents and purposes, being treated by your brain as similar for some purpose—to make meaning of and dealing with the impending sensory array. Another insight of the theory of constructed emotion, then, is that this population of predictions is a *concept*, constructed as you need it, on the fly (what Barsalou and colleagues call an "ad hoc" concept; Barsalou, 1983, 2003; Barsalou, Simmons, Barbey, & Wilson, 2003). Certain predictions will provide a better fit to the incoming sensory input, and these become your perception and guide your action (ie, they categorize your sensory inputs). So, constructing meaning by correctly anticipating (predicting and adjusting to) incoming sensations is what I mean when I say that the brain is using emotion concepts to categorizing sensations to construct an instance of emotion. Sensations are conceptualized (ie, categorized) so that they are (1) actionable in a situated way and therefore (2) meaningful, based on past experience. The sensory array in need of prediction and action contains both interoceptive inputs from the body representing the allostatic changes in the body's various systems (the internal world) and exteroceptive inputs representing sensory changes in the outside world. When past experiences of emotion (eg, happiness) are used to categorize the predicted sensory array and guide action, then an experience of that emotion (happiness) is experienced or perceived. An emotional instance is constructed the way that all other perceptions are constructed, using the same neural systems (and correspondingly, the same domain-general psychological processes). This is why the neuroscientist Edelman (1998) referred to experience as "the remembered present."

To see how this works, lets do a thought experiment. For example, in the past, you might have experienced the comfort of dozing on a hammock on a sunny day, the comfort of hugging a long-lost friend, the comfort of eating a piece of chocolate cake, the comfort of a warm bath, the comfort of flying on an airplane, and the comfort of reclining on a sofa in front of a fire. Each instance of comfort is not identical to every other, and when the brain creates an ad hoc concept for comfort to predict incoming sensory inputs, it constructs simulations (as potential actions and perceptions) of those instances that are most similar to the current situation (each prediction having some probability of being correct, given past experience). So the brain simulates an on-line concept of comfort, not in absolute terms, but with reference to your particular goal in the moment (eg, to relax and minimize stress, to feel close to others through shared comfort, and so on). This means that an emotion word like "comfort" or "happiness" has a specific meaning, but its specific meaning can change from one instance to the next (Barrett, in press).

The theory of constructed emotion is an evolutionary theory, but it does not hypothesize that emotions are universal. Unlike the classical view, which takes its inspiration from the more essentialist *The expression of the emotions in man and animals* (Darwin, 1872/1965), the theory of constructed emotion uses conceptual innovations found in Darwin's *On the origin of species* (cf. Barrett, 2013). In fact, Darwin is credited with vanquishing essentialism in biology in *Origin* (Mayr, 2004), so it is ironic that he went on to write a highly essentialized treatment of emotion slightly more than a decade later (for a hypothesis of why Darwin did this, see Barrett, in press; also see Fridlund, 1992). The theory of constructed emotion's use of population thinking comes from Darwin's *Origin* (eg, a species is not a natural kind category with one, fixed Platonic form serving as its essence, where variation around this form is error; instead, a species is a conceptual category populated with unique individuals who have differing degrees of fit to the environment). The theory of constructed emotion also incorporates Darwin's focus on holism, or the need to study a part in the context of the whole that influences it. Intrinsic to holism is the importance of studying a phenomenon in context, rather than attempting to find general, context-free laws (as is typical in certain forms of reductionism; Mayr, 2004).

The theory also incorporates several other concepts from biology, the most important being that there is more than one cause to produce the same phenomenon, called degeneracy (Edelman & Gally, 2001; Marder & Taylor, 2011; Tononi, Sporns, & Edelman, 1999). Degeneracy is a property of virtually every level of analysis in biological systems, from the systems inside cells to the entire organism. For example, different proteins can catalyze the same reaction of enzymes (Edelman & Gally, 2001; Tononi et al. 1999), different antibodies can bind to the same antigen (Edelman & Gally, 2001), different genotypes can produce the same phenotype (Edelman & Gally, 2001; Tononi et al. 1999), different neurons can give rise to the same intrinsic network (Marder & Taylor, 2011; Tononi, Edelman, & Sporns, 1998; Tononi et al., 1999), and different patterns of network interaction can give rise to the same behavior (Price & Friston, 2002). Degeneracy refers to the capacity for structurally dissimilar systems or processes to give rise to identical outcomes (Edelman & Gally, 2001), such as many different facial configurations, autonomic configurations, or brain states mapping to the same emotion category.



Figure 2.4 The measurement model for theory of constructed emotion. This is a measurement model, but not a causal model, of emotion (ie, this figure does not depict the mechanisms that cause emotion, but only how measures might configure to assess an instance of emotion) (for a fuller explanation, see Barrett, 2011a, 2011b).

4.2 Measurement implications

The measurement model implied by the theory of constructed emotion is difficult to draw, because it involves tracking a high-dimensional brain and body state dynamically over time in an iterative way. A poor approximation is depicted in Fig. 2.4, although strictly speaking, this figure has limitations for modeling the theory of constructed emotion (for a discussion, see Barrett, 2011b).

In this measurement model, assessments of facial movements, autonomic reactivity, and vocal acoustics will not necessarily be correlated, and therefore carry unique information about an emotional episode (ie, they are not necessarily interchangeable from an information theory standpoint). (This measurement model is useful, because in reality, measures from different modalities are rarely correlated with one another.) One measure cannot stand in for another, so that *optimal* measurement of emotion requires a multimodal approach. The experience of an emotion can change from one instance to the next, and therefore cannot be stipulated in advance; instead, the relationships between measures must be inductively discovered within a person across contexts. From this standpoint, it will never be possible to properly measure emotion by merely measuring the face, or skin conductance, or any single or set of physical measures alone.

In the theory of constructed emotion, without a multimodal measurement approach, it is perhaps best to measure emotion via self-report, because there is no "objective" way of determining when someone is, or is not, in a particular emotional state (Barrett, 2006b). Furthermore, to date, we have no ability to model emergence mathematically when it comes to emotion (where the product of dynamically interacting systems has properties that the systems themselves do not). Self-reports, on their own, have limitations, of course, because they only capture some instances of emotion (those of which the respondent is aware); in this view, as is the classical view, people may not be conscious of the emotion they have constructed (although for an entirely different set of theoretical hypotheses). But when self-reports do not correlate with more objective measures, the self-reports are *not* necessarily assumed to be inaccurate (more on this below). Moreover, because emotion concepts are integral to the construction of emotional experiences and perceptions, words and other symbols that prime emotion concepts (ie, that launch predictions and simulations) will influence what is experienced and felt. As a consequence, self-reports of emotional experience

are influenced by the words that we give respondents to communicate their experiences or perceptions. It is possible to change a person's feeling merely by the type of measurement instrument you give them. And respondents will use the measure you give them to report what they want to tell you, which may not necessarily match what you are asking (eg, if a respondent feels excited, but you ask if he/she is happy, the respondent will use the item to tell you how excited he/she is).

In the theory of constructed emotion, emotions are not universal (meaning studying all aspects of emotion, including emotion concepts, is crucial across cultures). Nor are emotions assumed to be homologous in other animals (meaning that studying emotion in nonhuman animals will *not* reveal all the secrets of emotions in humans, although such study is undoubtably crucial to learn about some ingredients of emotion.). Humans and other animals are hypothesized to share some species-general core systems, and some species-specific core systems. Therefore, classical conditioning with an aversive cue (like an electric shock) is not "fear learning" but "threat learning" (for a discussion see Barrett, 2012; LeDoux, 2014). Reward processing in rodents and monkeys might be the same as in humans in some ways, but it might also be different because the brain did not evolve according to a phylogenetic scale like sedimentary rock; the cortex did not evolve on top of preserved subcortical regions like icing an already-baked cake; as brains grow, they expand and reorganize (Barrett et al., 2007; Striedter, 2005).

Another implication is that questions about "recognition accuracy" are not scientific, because emotions have no perceiver-dependent essences with which to compare to a perceiver-based judgment (whether a perception of someone else's emotion or a self-report of experience). Instead, what we actually measure is consensus (Do you and I agree on the emotion you are feeling? Do you and I agree on the emotion that some other person is feeling? Do our perceptions agree with the cultural norms for emotion in this specific situation?). The reliance on consensus (or agreement) is not a bug—it is a feature that reflects the status of emotions as social (not biological) kinds (Barrett, 2012).

Emotions are not assumed to be perceiver-independent phenomena, waiting to be discovered in nature by a human mind. They are instances that are created within a human mind, in concert with other human minds. Emotions depend on the human mind for existence—they are perceiver-dependent phenomena. Thus, emotions are made, not found. They are perceived, not detected. And measuring emotion *requires measuring human experience and perception*, as well as "objective" measures, such as facial muscle movements, cardiovascular reactivity, and so on. Measuring emotion means capturing when and how mere physical changes are categorized so as to serve the psychological functions of an emotion (as opposed to other times when the same physical changes are not understood as an emotion and therefore serve some other psychological function; Barrett, 2012).

4.3 Drawbacks to using the construction approach's measurement model

Complexity and cost, both in terms of time and money, are the primary drawbacks to using the measurement model of the theory of constructed emotion. The more

observable aspects of emotion (facial movements, autonomic responses, etc.) cannot be used to stand in for or validate a person's own experience, at least with the methods that we have currently available. Validation requires measuring the underlying mechanisms that create an instance of emotion, and optimally this requires developing a more suitable epistemological approach (ie, following individuals in context over time) rather than anchoring and adjusting way from an approach that was developed to evaluate the classical view.

In the meantime, lack of correspondence between verbal reports and behavior does not necessarily indicate that the verbal reports are invalid. In fact, because instances of emotion are thought to emerge from more basic processes, the instances will have features that are not reflected in measurements of the individual processes themselves. Thus, for now, verbal report, even with all of its failings, may be the best means of assessing the experience of emotion in a quick and efficient way. If you want to know whether people are experiencing an emotion, you have to ask them (cf. Barrett, 2006a). This may sound easy, but there are a few landmines here as well. You can't assume that a feeling of happiness in one context is similar to the feeling of happiness in another (Wilson-Mendenhall, Barrett, Simmons & Barsalou, 2011; Wilson-Mendenhall et al., 2013). You also can't necessarily assume that two people mean the same thing by happiness, as people differ in emotional granularity; for some people, the word "happiness" refers to a specific feeling state, whereas for others, it refers to a general, pleasant feeling (eg, Barrett, 2004; Barrett & Bliss-Moreau, 2009). It is also not possible to assume that an emotion word means the same thing in different cultures (eg, Barrett, in press; Pavlenko, 2014). In fact, a construction mindset helps explain why certain emotion categories exist in some cultures, but not in others, and that what counts as an emotion in some cultures is not an emotion in others (for a discussion, see Barrett, in press; Pavlenko, 2014; Russell, 1991). The implication is that it is always a good idea to include a measure of emotion concepts whenever measuring the experience of emotion.

5 A cautionary note: Beware of lurking essentialism

Whether you rely on the assumption of emotion essences or not, it is important to be vigilant for the use of an essentialist mindset where it does not belong, lest you misinterpret your own (or someone else's) findings. A good example of such misinterpretation can be found in the increasingly frequent use of pattern classification approaches to distinguish the instances of one emotion category from another. Pattern classification techniques refer to a family of statistical methods designed to categorize data by learning from existing categories or grouping variables to make predictions about and assign membership to new instances. These techniques are being used with measures of autonomic physiology, facial movements, and changes in neural response measured as blood oxygenation level-dependent (BOLD) signal within

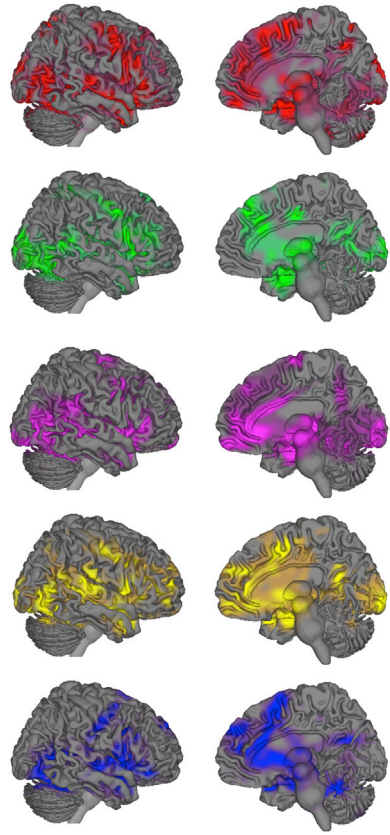


Figure 2.5 Intensity maps for each of the five emotion categories examined by Wager et al. (2015). Classification rates were Anger (red) = 43%, Disgust (green) = 76%, Fear (pink) = 86%, Happiness (yellow) = 58%, and Sadness (blue) = 65%.

the brain (that is divided up into three-dimensional cubes called voxels) (Kassam, Markey, Cherkassky, Loewenstein, & Just, 2013; Kragel & Labar, 2013, 2015; Park, Jang, Chung, & Kim, 2013; Rainville, Bechara, Naqvi, & Damasio, 2006; Saarimäki et al., 2015; Yuen et al., 2012). Researchers train a classifier using some set of measurements for known instances of emotion categories, and then use the classifier to diagnose new instances of those categories using similar measurements. For example, Fig. 2.5 presents the multivoxel patterns that successfully classified five categories of emotion above chance in our recent meta-analytic paper (Wager et al., 2015). We trained classifiers on brain maps from existing studies of anger, sadness, fear, disgust, and happiness, and then used the classifiers to diagnose the emotion being represented in brain maps from new studies.

The lure of essentialism leads scientists to claim that the patterns are something like neural essence for each emotion category. For example, Saarimäki et al. (2015) claimed to find "fingerprints" and "signatures" for certain emotion categories, while Kragel and LaBar (2015) claimed to find their "biomarkers," where a biomarker is a measurable indicator of some category, such that its presence in an instance indicates that the instance belongs to a particular category (Strimbu & Tavel, 2010).[5] In medicine, a biomarker is a measurable substance that is present in all members of a category. Biomarkers must be sensitive and unique to a specific category to work properly. Both Saarimäki et al. (2015) and Kragel and LaBar (2015) interpreted their findings as support for the classical view of emotion, when, in fact, they actually found evidence in support of the theory of constructed emotion (Clark-Polner et al., in press-b).

Patterns that successfully distinguish one emotion category from another are not emotion essences. They are not biomarkers, fingerprints, or signatures of an emotion category. The implication in using terms like "biomarker," "fingerprint," and "signature" is that the pattern for an emotion category is it's brain state—the elements of the pattern (eg, the pattern of voxels) are assumed to be both unique to a single emotion category and unchanging across its instances. Yet, a pattern derived from pattern classification techniques does not appear in *every instance* (or in fact, in *any instance*) of a category, even when the pattern can classify a category's instances with 100% accuracy. We have demonstrated this with simulations (Clark-Polner, Johnson, & Barrett, in press-a). Patterns should be understood from the standpoint of population thinking—the pattern is an abstract, statistical summary of a category's instances; the pattern does not (and need not) exist in nature to work well. Although as a group, the instances of any emotion category can be diagnosed with a pattern, the pattern itself is an abstraction. Similarly, the average middle-class US family has 3.13 children, but this is an abstract representation, because no family actually has 3.13 children. To assume that a pattern is the fingerprint or biomarker for an emotion category is to mistake a statistical summary for the norm. The take-away point is that successful pattern classification using *any* type of measures provides evidence that emotion categories, similar to biological categories, are conceptual categories populated by unique and highly variable instances that do not share any necessary features.

Furthermore, a quick review of some recent neuroimaging findings (eg, Kassam et al., 2013; Kragel & Labar, 2015; Saarimäki et al., 2015; Wager et al., 2015) indicates that patterns distinguishing one emotion category from another in one study do not replicate in another study; the same is true for studies that successfully created patterns of autonomic physiology, even when two studies use the same stimuli, the same experimental method, and sample participants from the same population (Kragel & LaBar, 2013; Stephens et al., 2010). Once again, this is evidence that variation is the norm.

[5] Kragel and LaBar (2015) are careful to point out "it is unlikely that the patterns we identified perfectly capture the essence of an emotion, but are better characterized as an amalgamation of the components which make emotions unique" (p. 1446).

6 Conclusions

Essentialism is not necessarily a bad thing. Utilizing it unknowingly is, however. The goal of this chapter is to allow you to view the current science of emotion as a continuation of the long-standing debate over whether mental categories are carved into nature by essences, or whether they are more flexible groupings of highly variable and situated instances, created from more basic mechanisms (for a discussion, see Lindquist et al., 2012). Some scientists consider essentialism a useful strategy for scientific inquiry because they believe that it mirrors the structure of the real world (ie, they believe the world is full of natural kind categories) (eg, Bloom, 2000; Kornblith, 1993; Pinker, 1997). Others, however, believe that essentialism is a particularly poor strategy for scientific inquiry (Lewontin, 2000). You can make your decision. Just do it explicitly, and with an appreciation of the consequences.

If you are going to use the classical view to guide your measurement of emotion, you should do so with caution, realizing that the bulk of the scientific evidence does not yet support it. This leaves you vulnerable to investing a lot of time and money in an enterprise that might seem deeply intuitive, but that might deliver very little in return. Alternatively, for those of us who relinquish essentialism as a guiding assumption for the nature and measurement of emotion, we should refrain from feeling smug or superior. Beware the lesson of Charles Darwin, who became famous in one field (biology) by vanquishing essentialism, while becoming famous (psychology) in another by relying on it.

It is worth pointing out that the history of science can be read as a long, slow march away from essentialist thinking, discovering that universal laws are actually contextual (eg, in physics, with the discover of relativity theory and then quantum mechanics) and discovering that variation is meaningful and is not error (eg, in biology, with Darwin's *On the origin of species*, and then again a century later with the study of epigenetics and genomics). Construction approaches have also emerged in psychology, precisely when it is discovered that instances grouped together as the same phenomenon do not share sufficient organizational coherence to be explained by a common mechanism (eg, recognizing variation is not always error and is, in fact, meaningful, such that instances of the same category are caused by different mechanisms). More recently, it has been discovered that instances which have been designated as different phenomena (eg, "stress," "emotion," and "memory") in fact arise from the same mechanisms, revealing shared regularities across these instances that had been thus far ignored (ie, recognizing similarities across categories).

Essentialism is a habit of the human mind that is difficult to vanquish, particularly when it comes to thinking about emotion. The very enterprise of measuring emotion tempts us with essentialism. As William James put it, "Whenever we have made a word… to denote a certain group of phenomena, we are prone to suppose a substantive entity existing beyond the phenomena, of which the word shall be the name" (James, 1890, p. 195). Essentialism is also difficult to vanquish because when people group instances together and treat them as similar, they are often unaware of their own goals in the process. As a consequence, they come to mistakenly believe that the similarity they perceive is real in nature, and the variation is error in a more universal

sense, rather than merely not useful for meeting a particular goal in some particular context (but may very well be useful for some other goal in some other context).

Categorization is necessary: we can't live or do science in a world where everything is different from everything else, where learning in one situation does not allow us to predict in the next. But it's possible to use categories, and measure them, without reifying them with essences.

Appendix A

The last several thousand years of scholarly writing on the nature of emotion can be understood as an ongoing debate between essentialism and construction (of one sort or another). Although a comprehensive history of this literature is beyond the scope of this chapter, a few touch points are instructive for the uninitiated. In the Western scholarly tradition, essentialist approaches to emotion include Plato and Aristotle in Ancient Greece; Descartes (1649/1989) during the Enlightenment, with a theory that foreshadowed Carl Lange (1885/1922) and Damasio (Damasio & Carvalho, 2013); Gall, of phrenology fame (Zola-Morgan, 1995); Irons (1897a, 1897b) and Dewey (1895) who were the first modern classical appraisal theorists; Darwin (who vanquished essentialism in biology with *On the origin of species* but then went on to write a highly essentialized book on emotions a decade later); Carl Lange (1885/1922), who crafted a modern basic emotion theory which Dewey (1895) then tattooed on to William James's (1890) constructionist theory (mangling James's theory to create the James–Lange theory and creating a misunderstanding that has survived to this day;[6] McDougall (1923) with a theory very similar to Panksepp's basic emotion theory; Panksepp, 1998); Allport (1922, 1924) who invented the facial feedback hypothesis; Cannon (1927) who localized emotion to a specific brain region; Papez (1937) who expanded the region into a circuit; and MacLean (1949, 1990) who created an elixir of Plato's tripartite mind (rational thoughts, passions (which

[6] Notice that William James was a constructionist. He wrote, for example, that "Surely there is no definite affection of 'anger' in an 'entitative' sense" (1894/1994, p. 206), believing instead that each instance of emotion had its own associated physical state. James believed that believing in emotion essences was the psychologist's fallacy. The "trouble with emotions in psychology" he wrote, is that they are regarded too much as absolutely individual things. … But if we regard them as products of more general causes (as "species" are now regarded as products of heredity and variation), the mere distinguishing and cataloguing becomes of subsidiary importance (James, 1890/1998, p. 449). Instead, James prescribed an entirely constructionist approach for the study of psychology, including emotion. "A science of the relations of mind and brain" James wrote, "must show how the elementary ingredients of the former correspond to the elementary functions of the latter" (1890/1998, p. 28). Although it is beyond the scope of this chapter, it is fascinating how James's constructionist theory of emotion was transformed (by ignoring the constructionist features) to integrate it with Lange's highly essentialized vasomotor theory of emotion was strongly essentialistic (each emotion had its own bodily essence), creating the James-Lange theory (first named by Dewey, 1895). So the James–Lange theory is based on a profound misunderstanding of William James.

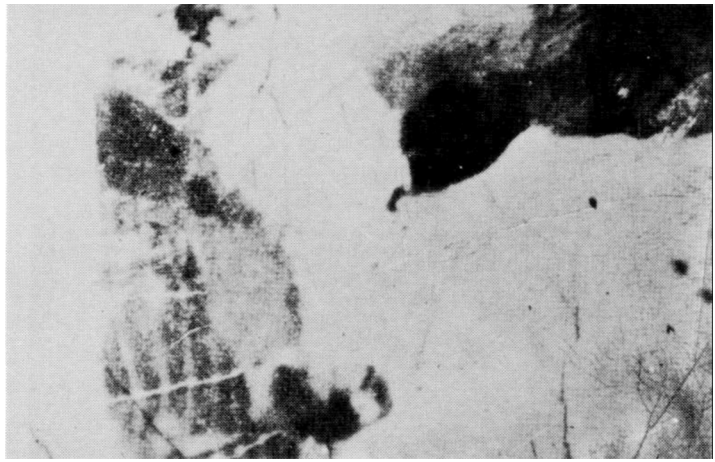


Figure A.1 An example of categorizing to construct and experience.

today we would call emotions), and appetites like hunger and sex drive), Aristotle's phylogenetic scale (scala naturae) idea, and Darwin's ideas from *The descent of man* (1871), wrapped them in neuroanatomy to create the triune brain concept which is still popular today (Panksepp, 1998) (for a review, see Gendron & Barrett, 2009). In the traditional Buddhist view (the Abhidharma school) dating back to the 2nd century BCE, a mind is created from a set of universal, discrete 82 psychophysical elements called *dharmas*, 52 of which are mental; several of the mental dharmas bear a striking resemblance to certain emotions that are considered to be biologically basic (anger, pride, joy, shame, regret, jealousy).

Historically, construction is more varied and difficult to summarize, but key ideas can be found in the writings of Heraclitus in Ancient Greece, Ibn al Haythan (in the middle ages), Locke and Kant during the Enlightenment, Spencer (1855), James (1890, 1894), and Wundt (1897/1998) during the 19th century (all of whom offered arguments against faculty psychology), as well as Duffy (1934a, 1934b, 1941), Dunlap (1932), Hunt (1941), and Harlow and Stanger (1932) in the first half of the 20th century (all of whom observed that emotions had no essences, and therefore must be constructed as a person makes sense of autonomic changes, although no specific mechanisms or processes were offered). In the past, constructionist ideas on the nature of emotion were often nascent, embedded in broader critiques of classical view. More recently, a new generation of psychological construction theories have emerged, articulating a more detailed and nuanced scientific agenda for the study of emotion (Barrett & Russell, 2015a, 2015b; also see Lane & Schwartz, 1987; LeDoux, 2012, 2015; Olsson & Ochsner, 2008; Roy, Shohamy & Wager, 2012; Seth, 2013). Buddhist philosophy also has a more constructionist version of the mind. A range of influential thinkers associated with the *Sautrāntika, Madhyamika*, and *Yogācāra*

schools (cf. 3rd century CE through the 7th century CE), the most well-known of which was named Dharmakirti in the 7th century CE who suggested that the dharmas are not basic elements of the human mind, but are themselves creations of that mind, emerging as a function of human concepts (Dreyfus & Thompson, 2007).

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The Role of the Senses in Emotion

3

Catherine Rouby, Arnaud Fournel and Moustafa Bensafi
Lyon Neuroscience Research Center, CNRS UMR 5292, INSERM U1028,
Claude Bernard University Lyon 1, Lyon, France

The pioneering work of Darwin (1890) demonstrated, as a logical extension of his work on species evolution, how human emotions descend from animal emotions, and showed that a limited number of basic emotions (anger, fear, surprise, etc.) are maintained across species. As a heritage of this work, many theories subsequently considered emotion as a phylogenetic adaptation, with an important innate component that becomes more complex and socially adapted during individual adult life. James (1884) and Cannon (1927) set out to investigate whether the source of emotion is central (from senses and central processing to psychophysiological and peripheral reactions) or peripheral (from peripheral reactivity to central processing) and established the bases of the neural mechanisms of emotions. In the mid-20th century, however, Papez (1937) and MacLean (1949) enlarged the description of these neural networks and put forward the idea of top-down cortical control of emotional response, allowing context and experience to modulate behavioral and autonomic responses with at least partial awareness. These ideas are still currently debated between researchers in this field, with a particular stress on the way the senses influence emotion.

Our senses can be considered as parallel channels that connect us to the environment, be it physical or social. Subjectively, however, these channels do not appear as separated: in our experience, the flow of diverse stimuli reaching our senses is integrated. From these "inputs" of stimuli, we constantly build representations of the external world, and our actual behavior is the motor "output" of this process. Recent advances in neuroscience shed light on the emotional and cognitive processes that interact with the senses in the construction and adaptation of the self. The weight of the senses in emotional well-being is illustrated by pathology. Olfactory deficits, for example, impact on the quality of life: subjects with an impaired sense of smell show a significantly higher rate of depression; they are handicapped in terms of safety (detection of smoke, gas, or spoiled food), personal hygiene (insecurity about personal body odor), and sexual life (Croy, Nordin, & Hummel, 2014). Aging also takes a toll on our senses, but its impact on odor hedonics has only recently received attention (Joussain, Thevenet, Rouby, & Bensafi, 2013). This decreased quality of life and increased risk of depression is also true for people with double auditory and visual sensory loss (Heine & Browning, 2014). Thus, sensory function is important for emotional equilibrium.

In this chapter, we first present the five classical sensory channels (touch, smell, taste, hearing, and sight), both in their neurobiological aspects and in the functions each channel may fulfill in emotional life. Some sensory channels will not be described here: the specificities of pain and thermal sensitivity, balance, interoceptive sensitivity to viscera, heart, gut, muscles, etc. challenge the classic categorization into

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five senses (see Damasio (1999) and Holley (2015)), but this is beyond the scope of this chapter. The second section presents some relevant aspects of the early development of these relationships between senses and emotions in humans. Thirdly, the way these sensory channels merge their inputs in integrated multisensory processing, and the way they influence emotions will be presented. Finally, we discuss this concept of five senses that stimulate and feed the brain with input from the external world, and present some challenging new evidence that the brain itself is able to stimulate our senses in a top-down process. The take-home message is that the complex interactions between the sensorimotor aspects of emotion on the one hand and memory, knowledge, and imagination on the other may have important consequences for the measurement of emotion.

1 From senses to emotions

1.1 Touch

Four types of mechanoreceptor in the skin convey pressure-vibration sensations via low-threshold myelinated Aβ fibers that quickly transmit tactile input to the ganglia in the spinal cord. Other nerve endings in the skin (Aδ fibers) convey other sensations (pain and temperature) more slowly. Finally, C fibers, with a far slower velocity, have free-endings all over the skin that are also specialized in conveying pain, temperature, itchiness, and pleasant tactile sensations. The last of these, C tactile fibers (CT), are found only in the hairy skin, where they respond to gentle stroking, with force lower than in the nociceptor range (McGlone, Wessberg, & Olausson, 2014). These fibers are additionally tuned to respond to tactile stimuli with the specific thermal characteristics of a gentle caress delivered at normal skin temperature (Ackerley et al., 2014). This reinforces their role as a peripheral mechanism for signaling pleasant skin-to-skin contact in humans, with a reward function that promotes interpersonal touch and affiliative contact (Gallace & Spence, 2010; McGlone et al., 2014).

From the spinal cord, two somatosensory pathways convey sensations: the dorsal column, transmitting touch, pressure, vibration, and proprioception (from muscles and joints), and the spinothalamic tract, transmitting pain and temperature. They contact the thalamus, which receives both affective and discriminative inputs and projects to the primary somatosensory cortex in a somatotopic (body-mapped) manner; they also reach the insular and secondary somatosensory cortices and the posterior parietal cortex, a higher-order cortex integrating the various somatic modalities necessary for perception. Primary somatosensory maps also project to limbic and frontal areas involved in emotion: by stroking the body with either a wooden dowel or a piece of velvet, Francis et al. (1999) showed that the discriminative and affective aspects of touch are processed in different brain areas; activation of the primary somatosensory cortex was stronger to the wood stimulus, whereas the orbitofrontal cortex was activated more by the velvet stimulus. This area has also been shown to represent painful as well as pleasant touch, demonstrating its importance for representing the emotional dimensions of skin sensitivity, both positive and negative (Rolls et al., 2003).

Touch has both discriminative and affective functions. It is now clear that there are labeled lines from the skin to regions such as the insular and orbitofrontal cortex that transmit the affective properties of social touch (McGlone et al., 2014). Touch is of prime importance in parent/infant bonding and sexual and social life; moreover, interpersonal touch is a way to transport and exchange body odors, communication being mostly a multichannel process. Finally, due to the number of cells innervating them, the representation of the tongue, lips, and face on cortical maps is far larger than for other body parts except the hands, which may explain their importance in the perception of food texture. Texture is a very important component of *flavor*, which some authors consider to be a multisensory process integrating signals from smell and taste and also other sensory inputs such as vision and touch (Auvray & Spence, 2008; Giboreau, 2012). Touch is only one of the sensory channels involved in texture perception, but plays a prominent role in the dynamic process that leads to flavor release (Foster et al., 2011).

1.2 Smell

Any environmental volatile molecules that fulfill certain properties (ie, appropriate polarity, water solubility, vapor pressure, etc.) have a chance of being detected and discriminated by olfactory receptors within the nasal cavity. The cilia of sensory neurons are in contact with inhaled molecules and contain olfactory receptors which bind to odorant molecules and initiate the neural message from the olfactory nerve to the olfactory bulb. Each olfactory cell expresses 1 of 350 receptor proteins that recognize certain molecular features of the odorant; the axons of cells bearing the same receptor type converge to the same glomerulus, a functional unit in the olfactory bulb, thus representing the odorant's chemical properties in a spatial map of excitations and inhibitions of a combination of receptors. The primary olfactory cortex, including the amygdala and piriform cortex in the temporal lobes, processes both the chemical and the affective properties of the stimuli. The secondary cortex includes the insular and orbitofrontal cortices, where several representations of odors are constructed according to their pleasantness/unpleasantness and meaning for the perceiver and his/her actual situation, including internal states such as hunger and satiety (Salesse & Gervais, 2012).

With these tight anatomical connections with brain areas also involved in emotional processing, the olfactory system is in a good position to influence approach avoidance behaviors (Rolls, Kringelbach, & de Araujo, 2003). Smell has three main functions. Firstly, a particular odor can provide an early warning system for toxic substances in the environment. For example, spoiled or toxic food, industrial pollutants, or additives to natural gas are detected in part by the olfactory system and enable us to avoid these dangerous substances. Secondly, olfaction plays a major role in hedonic pleasure. Appreciating the positive hedonic value of a particular odor is one of the most important levels of processing of olfactory information. Even respiration and sniffing are modulated by the subjective pleasantness of an odor: sniff duration and volume increase for pleasant compared to unpleasant odors (Bensafi et al., 2003). Thirdly, odors, and body odors in particular, influence social behavior, sometimes covertly.

Aversive and appetitive reactions to odors appear at both verbal and motor levels but also in the peripheral nervous system, and very often at all levels together. For example, Bensafi et al. (2002a, 2002b) showed that arousing odors increased skin conductance, and unpleasant odors increased heart rate and facial corrugator muscle activity, both correlating with negative emotional feelings. Skin temperature was also modulated by odor type: Bensafi, Tsutsui, Khan, Levenson, and Sobel (2004) showed that high concentrations of a component of body odor (androstadienone) increased skin conductance and decreased skin temperature in women (vs men) and that this was associated with an increase in positive mood and decrease in negative mood in women (vs men). These effects of body odors on physiology and behavior illustrate how another primary function of smell in many mammals is to transmit social information on the identity, sex, reproductive status, emotional state, and health of conspecifics. In humans also, research has demonstrated that body, breath, and hand odors allow discrimination of the sex, identity, and parental status of others (Roberts et al., 2005). Handshaking is sufficient to release several substances (squalene, hexadecanoic acid, and geranyl acetone) that are putative chemosignals in animals (Frumin et al., 2015). These authors showed that humans frequently sniff their own hands when alone, and that this hand investigation increases after hand shaking when subjects are left alone after greeting the experimenter. Moreover, this behavior is different after shaking hands within gender versus across genders, suggesting that a simple handshake may help detect chemical signals from other people. Other chemosignals, however, are devoid of odor but nevertheless influence physiology and feelings: sniffing the odorless tears of women watching sad films reduced the sex appeal attributed by men to pictures of women's faces. Moreover, after sniffing such tears, men showed reductions in self-rated sexual arousal, physiological measures of arousal, and levels of testosterone. The mechanisms by which such odorless signals impact behavior are not clearly understood, but functional magnetic resonance imaging revealed that sniffing women's tears selectively reduces activity in the brain substrates of sexual arousal in men (Gelstein et al., 2011). Regarding axillary secretion, many studies showed that our emotional states are transmitted to others by smell. Fear, for example, is transmitted by the sweat of subjects experiencing their first skydive (Mujica-Parodi et al., 2009). Whereas subjects sniffing sweat samples did not discriminate between sweat resulting from exercise or from emotional stress, brain images showed that their amygdala did, being selectively activated by "fear" sweat; this emotional processing did not depend on conscious odor perception (Lundström & Olsson, 2010).

1.3 Taste

Taste sensory cells are clustered in 8000–10,000 taste buds on the tongue, soft palate, and part of the esophagus, but also exist in the stomach and gut (Rozengurt, 2006); in each taste bud, 50–100 taste cells present villosities that make contact with the chemical tastants via membrane receptors or channels. Through this interaction, taste cells are able to react to a vast number of substances; physiologists describe five basic tastes: salty, sweet, sour, bitter, and umami (the taste of L-glutamate, considered as

typical of protein taste). Nevertheless, humans are able to discriminate between different sweet substances, different bitter ones, etc. (Faurion & Montmayeur, 2012).

Taste-bud cells form direct neural connections with three cranial nerves: facial (nerve VII), glossopharyngeal (nerve IX), and vagus (nerve X). These converge in the nucleus of the solitary tract in the brainstem, then in a region of the thalamus that also receives somesthetic information from the tongue and integrates this dual sensory input. The primary gustatory cortex was identified in humans only in the late 20th century, and is composed of the insula in the temporal lobe and the operculum in the frontal lobe. Notably, these primary areas respond not only to taste stimuli but also to multiple sensory inputs (somatosensory, olfactory, visceral); they then project to the secondary gustatory cortex (dorsolateral orbitofrontal cortex), where certain neurons selectively respond to a given taste, while others respond to several tastes plus other sensory stimuli such as odor, texture, and the visual aspects of food. This is the pathway of conscious sensitivity, while other projections connecting the brainstem to the amygdala and hypothalamus may non-consciously influence visceral and somatic responses (reflex tongue movement, salivation, insulin secretion) and emotional responses of acceptance/rejection/disgust (Doty, 2003; Rolls, 1999).

Along with smell, taste is one of the most emotional senses for humans, governing two main functions: approach of appetitive food (pleasure) and avoidance of dangerous substances (disgust). Physiological responses to four tastes show a large difference in emotional reactivity to sweet taste, the primary positive reinforcer, and bitter taste: the electrodermal responses induced by the unpleasant bitter taste indicate strong sympathetic activation, as confirmed by strong cardiac and thermovascular responses (increased instantaneous heart rate and skin temperature). Responses to sucrose show very weak sympathetic activation, and responses to sour and salty tastes show moderate activation, correlating with the subjective unpleasantness of the stimuli and concentrations used in the study (Rousmans, Robin, Dittmar, & Vernet-Maury, 2000). The function of taste in eliciting approach/avoidance of oral stimuli is present from birth in the behavioral responses of human and other primate newborns: lip smacking, tongue protrusion, and smiling for sweet tastes, and gaping, nose wrinkling, and negative facial movements for bitter tastes (Steiner, Glaser, Hawilo, & Berridge, 2001). This continuity of emotional responses to taste in mammals and humans may be explained by the importance of taste in food intake, digestion, and satiation. Avoidance of toxins is also efficient from birth, with rejection of bitterness. Which emotional feelings are associated with these behavioral responses is difficult to assess, but many physiologists consider that all mammals have feelings, although they may not have the same elaborate contents of consciousness as humans (Tsuchiya & Adolphs, 2007).

1.4 Hearing

Air vibrations of frequencies between 20 and 20,000 Hz can be detected by the human ear. They are amplified by the external ear, and mechanically transmitted by the middle ear to the cochlea, where ciliated cells transform the frequency of the mechanical

displacement of the cilia into a neural message. The base of the cochlea is sensitive to high frequencies and cells sensitive to lower frequencies are found near the apex; thus, sensitivity to sounds is organized tonotopically. The auditory nerve relays to the brainstem and then to the thalamus, while another pathway connects to the midbrain, which processes maps of the auditory space (*Where*). The thalamic pathway integrates the temporal and pitch characteristics of sounds, still with a tonotopic organization, and projects to the primary cortex in the temporal lobe, where the tonotopy is conserved. Near the primary cortex are the secondary cortex and the language area in the left hemisphere, enabling sound identification (*What*), language comprehension, and the perception of pitch and rhythm in complex music (Vuilleumier & Trost, 2015; Zatorre & Salimpoor, 2013).

The human auditory system is especially sensitive to the human voice, a complex stimulus that carries a strong emotional component. Specific voice-selective areas have been reported in the auditory cortex (Belin, Zatorre, Lafaille, Ahad, & Pike, 2000); these respond more strongly to emotional than neutral voices (Frühholz & Grandjean, 2013), suggesting that information about vocal emotion is already available at the perceptual level of processing. Moreover, recent research shows that emotional features of the human voice may be extracted and processed prior to the auditory cortex; this early feature-based decoding occurs at the subcortical level along the auditory pathway, and provides a preliminary coarse-but-fast characterization of the affective quality of the auditory signal before more refined (but slower) cortical processing is completed (Pannese, Grandjean, & Frühholz, 2015).

Another auditory emotional stimulus is music: playing and listening to music goes back to prehistoric times. Recent research shows that interactions between the sensory, cognitive and emotional systems on the one hand and reward circuits on the other may give rise to musical pleasure. The reward circuit of the brain relies on dopamine cells, which are thought to encode the degree to which a stimulus meets expectations; this is true for fundamental rewards such as sex and food, and also for secondary rewards such as music; listening to music leads to continuous generation of expectations and predictions, anticipating *what* sound sequence to expect and *when*. Composers play on expectations, and studies show that musical pleasure is related to violation, when the sequence heard is "better" than expected. Dopamine is released when desirable sounds are heard; familiar music also leads to dopamine release, in anticipation of pleasure peaks we have previously experienced. New music that has never been heard before can also produce the same result, without explicit expectation, because we have implicitly learned the musical rules of the culture we are exposed to, and prefer music that surpasses our expectations (Salimpoor, Zald, Zatorre, Dagher, & McIntosh, 2015).

That hearing music evokes emotional experience is attested by electrodermal responses (Blood & Zatorre, 2001) and by chills observed in many perceivers; both physiological responses are involuntary, but correlate with subjective feelings of pleasure (Grewe, Kopiez, & Altenmüller, 2009). The emotional effects of music may be conveyed to the brain by two distinct routes: the amygdala may be specifically involved in rough decoding of the emotional value of voices and music, while the hippocampus may process more complex vocal and musical emotions, and might play an

important role, especially in decoding musical emotions by providing memory-based and contextual associations (Frühholz, Trost, & Grandjean, 2014).

1.5 Sight

Our retina contains two types of visual transducer that transform light into neural messages: cones and rods. Rods (about 125 million in each retina) cover the entire surface of the retina except the central part. They are very sensitive to low illumination and thus specialize in night vision and movement detection, with low spatial resolution. Cones (5 million) are mainly located in the central retina and are more specialized in daytime vision; three types of cone sensitive to different wavelengths enable color vision. Both types of receptor connect to ganglion cells (1.5 million), which constitute the optic nerve. Different types of ganglion cell detect differences in luminance, and other cells in the retina contribute to detecting contrast. Notably, other visual pathways from the retina connect to structures that control pupil reflexes and coordinate head and eye movements (Purves et al., 2001).

As output from the retina, two types of ganglion cells form the optic nerve: one type conveys information on the color, shape, and details of the image (*What it is*), and the other conveys information on coarse image features and movement in the periphery of the visual field (*Where it is*). This information is relayed to the thalamus, then to the primary visual cortex in the occipital lobe in a topographic (retina-like) map. The primary visual area responds to the elementary constituents of the stimulus, such as orientation and movement. Other perceptual features are processed in a number of other visual areas: color, movement direction, stimulus identity. Thus, any visual object is represented by a population of neurons distributed around the brain. Physiologists distinguish the *What* pathway, from occipital primary visual cortex to inferior temporal cortex, and the *Where* pathway, from the same primary cortex to the parietal and cingulate cortices. Both pathways have connections with the amygdala and hippocampus, and thus entries into the emotional and memory circuits.

Of all visual objects, faces are those which evoke the most reproducible emotional responses. Face processing serves a social function: recognizing gender, age, and identity; from the outset, before any sophisticated appraisal, emotional processing tells much about the feelings and intention of others. Tools like the FACS (facial action coding system) code facial movements (muscle contractions) before relating them to the sender's subjective feelings and perceiver's interpretation in terms of basic emotions (Ekman & Friesen, 1978).

Extensive research supports the existence of a specialized face-processing network that is distinct from the visual processing areas used for general object recognition. This visual sub-system relies on the response properties of the fusiform face area and occipital face area, which together are thought to constitute the core network of areas involved in facial identification. Before a face can be identified, which requires several steps in the visual system, emotional facial expression is differentiated very early. In classical event-related-potentials research, the negative potential occurring on the electroencephalogram 100 ms after presentation of a face represents detection of a face, and the following negativity at 170 ms represents recognition of the face.

However, differences in response between fearful and happy faces in the occipital cortex (primary visual area) were reported to occur as early as 80 ms (Pizzagalli, Regard, & Lehmann, 1999), and between happy and sad faces in the time window of 90–110 ms (Eimer & Holmes, 2002; Halgren, Raij, Marinkovic, Jousmäki, & Hari, 2000; Holmes, Vuilleumier, & Eimer, 2003; Pourtois, Grandjean, Sander, & Vuilleumier, 2004). Eimer and Holmes (2002) and Holmes, Vuilleumier, and Eimer (2003) showed that frontal regions differentiate fearful faces from neutral faces at 100 ms. Thus, faces are processed by the emotional brain even in the absence of consciousness (Axelrod, Bar, & Rees, 2015).

Visual emotional processing is, of course, not limited to faces and gestures: visual aspects of food, including color, may evoke salivation or disgust and are of prime importance in food neophobia, for example. In this context, selected complex visual scenes also elicit reproducible subjective feelings and measurable responses in the autonomic nervous system. For example, to evoke affective states in a laboratory setting, researchers assembled sets of pictures (Lang, Bradley, & Cuthbert, 1999) chosen to elicit a range of positive, neutral or negative affective states; participants had to rate the pictures for hedonic valence and emotional arousal, two prominent dimensions of affective response to the environment (Russell & Mehrabian, 1977). As observed in olfaction, arousing visual images increased skin conductance, and unpleasant visual images increased facial corrugator muscle activity (Lang et al., 1998). These associations between verbal report and physiological response enable objective measurement of human affects, bypassing age- and culture-dependent language issues.

2 Modulation during human development

From the sensory and emotional points of view, newborns are not devoid of experience: sensory systems develop before birth and the responses of fetuses also evolve throughout pregnancy from partial reflexes to more complex behaviors. Much stimulation is available in the fetal milieu as sensory systems develop in the following sequence: somesthetic and proprioceptive system, chemosensory systems (smell and taste), vestibular and auditory systems, then visual system (see Lecanuet & Schaal (1996) for a review). The whole body surface responds to *touch* around the third month of gestation; vestibular responses emerge from the sixth month; heart rate changes are the most common response documenting the reactivity of fetuses, and attesting to autonomic arousal. Fetal tactile stimulation includes contact with the uterine wall during maternal motion, and an increasing level of self-contact between hand and body, face and mouth, including suckling behavior. A recent study (Reissland, Francis, Aydin, Mason, & Schaal, 2014) validated the hypothesis that, as gestation advances, fetuses are able to anticipate the results of their hand movements toward the mouth: they open their mouth more and more before the hand contact, and less in response to fortuitous contact. This implies that fetuses can experience both *pleasurable touch and pain*, and even anticipate the pleasure of sucking their thumb. As regards *chemical senses*, the amniotic fluid, which contains a number of fragrant

substances, is continuously replaced around the oral and nasal receptors due to inhaling and swallowing by the fetus. Taste and smell perception have been demonstrated in mammalian fetuses, and experiments show that human newborns respond to fetal stimuli: any amniotic odor appears to be attractive to newborns, but they orient more to the odor of their own amniotic fluid when it is paired with an amniotic sample from another fetus (Schaal, Hummel, & Soussignan, 2004). Fetuses can thus encode the individual chemosensory profile of the amniotic fluid in which their chemoreceptive systems have matured, where aromas derived from the maternal diet play a major role; moreover, this odor atmosphere is remembered for several days to months, testifying to transnatal learning and the building of preferences for familiar odors and flavors (Mennella, Turnbull, Ziegler, & Martinez, 2005) The *auditory system* also becomes functional before birth, and recordings of the fetal sound environment show that attenuation of surrounding stimuli does not prevent the mother's voice, or speech and music located near the mother, emerging from the uterine background noise (over 100 Hz). It is noteworthy that an important part of this background noise comprises cardiovascular sounds, including the maternal heartbeat. The emotional power of heartbeat is well-known to musicians. The responses of the fetus to auditory stimuli are heart rate and motor responses, including startling, in the fetus, while heart deceleration in response to the mother's voice suggests the same calming effect as in children and adolescents.

Although limited, in utero *visual* sensitivity is also documented, both with eyelids open (beginning around the fifth month) and through closed eyelids; cerebral activity in the womb can now be recorded and shows that, although the visual pathways develop mainly after birth, visual stimuli reach and activate the brain very early, but with no indication of early emotional response.

To sum up, the autonomic components of emotional response are mature around birth, although changes occur in the emotional and reward circuits during childhood and adolescence, allowing more and more emotional regulation (McCrory, Sebastian, & Viding, 2013).

3 Multisensory integration

3.1 Smell, taste, touch, and visual associations

Psychophysical and neuroimaging chemosensory studies have highlighted the importance of smell and taste interactions, and the role of congruency in cross-modal integration. In the sphere of food in particular, congruency has been defined as the extent to which sensory stimuli are appropriate for combination when eating or drinking a given foodstuff (Schifferstein & Verlegh, 1996). Past and recent studies suggest that congruency is a key factor in modulating the cross-modal integration of chemosensory stimuli, especially when the sensory cues belong to the same object. Studying *smell–taste interactions*, Schifferstein and Verlegh (1996) showed that the pleasantness of odor–taste mixtures correlates positively with the degree of congruency between the two types of stimulus: for example, whereas the congruent pair strawberry/sucrose is

more pleasant than its components, for incongruent mixtures the converse is true; two components need to form a harmonious (or congruent) combination in order to be pleasant. At the neural level, De Araujo, Rolls, Kringelbach, McGlone, and Phillips (2003) showed that a congruent odor–taste combination (strawberry/sucrose) was perceived as more pleasant than an incongruent one (strawberry/monosodium glutamate), and that increase in congruency ratings correlated positively with anteromedial orbitofrontal activity. Likewise, Small et al. (2004) observed that a congruent odor–taste mixture (vanilla/sweet) was perceived as more pleasant than an incongruent mixture (vanilla/salt). Moreover, whereas perception of the congruent odor–taste mixture induced additional activation to that in response to its components in the anterior cingulate cortex, insula, and posterior orbitofrontal, prefrontal and parietal cortices, these brain areas were not activated during perception of the incongruent mixture.

A similar congruency effect was also documented in *smell–vision interaction*. Gottfried and Dolan (2003) showed that congruent pairs of visual and olfactory stimuli were detected faster than incongruent pairs and activated the posteromedial orbitofrontal cortex and the hippocampus. Even color has an effect on the perception of smells: in an fMRI study, Österbauer et al. (2005) scanned human subjects exposed to smells and colors in isolation or in congruent or incongruent combinations; activity in the posterior orbitofrontal cortex and the insula increased as a function of the congruency of the smell–color pairs.

To sum up, congruency affects perception at different levels of processing, from detection to intensity or pleasantness. In addition, this perceptual modulation is associated with neural changes in a set of sensory areas and heteromodal cortices including orbitofrontal cortex, cingulate cortex, insula, hippocampus, prefrontal cortex, and parietal cortex, which do not process incongruent stimulation in the same way.

An association between senses that is relevant for survival and crucial in parent–offspring bonding is the interaction between *smell and touch*. In newborns, the rapid forging of new expectations from smell and touch concordance is illustrated by two examples. Blass, Ganchrow, and Steiner (1984) exposed newborns to forehead caresses followed by sucrose delivery. The newborns rapidly learned to express appetitive responses while simply being stroked; however, when the sequence of stroking and consequent sweet stimulus was disrupted, the infants' appetitive responses dropped and negative responses (negative faces, crying) appeared after only two misses of the sweet reward. The other example of fast odor learning was observed in pairing body massage and a scent in term-born infants; after just 10 sessions of 10-second odor–touch pairing, 1-day-old infants expressed positive head orientation when the odor was re-presented the next day (Sullivan et al., 1991). Thus, the ability to form chemo-tactile expectations in neonates is precocious and highly flexible (Schaal et al., 2004) enabling learning during feeding and caretaking.

3.2 Audio-visual associations in adults: Voice, faces, and cultural differences

Like in smell and taste integration, congruency between facial expression and emotional prosody influences emotional processing (De Gelder & Vroomen, 2000). Emotional prosody can alter facial emotion perception (Massaro & Egan, 1996)

independently of attention and even despite an explicit instruction to ignore one modality (Ethofer et al., 2006).

Does this integration occur in sensory areas or in associative areas processing emotion? Klasen, Kenworthy, Mathiak, Kircher, and Mathiak (2011) addressed this question by constructing dynamic facial stimuli (angry, neutral, and happy) on the one hand and dynamic vocal stimuli (pseudo-words with angry, neutral and happy tones) on the other, in order to tightly synchronize lips and speech when presented together. Stimuli were presented in congruent and incongruent pairs, and in isolation. Subjects were to rate which emotion they perceived as being expressed: neutral, angry, or happy. Emotion was better recognized for the congruent emotional expressions. The ventral cingulate cortex exhibited differential reactions to congruency and incongruency for all emotion categories and can thus be considered a central structure for supramodal representation of complex emotional information across sensory channels.

Cultural differences in emotion perception have been reported, mainly for facial expression and to a lesser extent for vocal expression. Sauter, Eisner, Ekman, and Scott (2010) showed that a number of primarily negative emotions have vocalizations that can be recognized across cultures, while most positive emotions are communicated by culture-specific signals; similarly, Cordaro, Keltner, Tshering, Wangchuk, and Flynn (2015) found that some but not all vocalizations were recognized by inhabitants of a remote village in Bhutan. However, the way in which the perceiver combines auditory and visual cues may itself be subject to cultural variation. Recent research investigated cultural differences between Japanese and Dutch participants in the multisensory perception of emotion. A face and a voice, expressing either congruent or incongruent emotions, were presented in each trial. Participants were instructed to judge the emotion expressed in one of the two sources. The effect of to-be-ignored voice information on facial judgments was stronger in Japanese than in Dutch participants, whereas the effect of to-be-ignored face information on vocal judgments was weaker. This result indicates that Japanese people are more attuned than Dutch people to vocal processing in the multisensory perception of emotion. This provides evidence that multisensory integration of affective information is modulated by the perceiver's cultural background (Tanaka et al., 2010). These results are also in line with the finding that Japanese speakers use visual information less than English speakers do in interpreting audiovisual speech (Sekiyama & Tohkura, 1991). The lesser reliance on the face and greater reliance on the voice by Japanese subjects may be related to the fact that Japanese people control the facial display of their own feelings (Ekman, 1972; Matsumoto, Takeuchi, Andayani, Kouznetsova, & Krupp, 1998).

4 Conclusions and perspectives: from senses to emotions and from emotions to senses

The above-cited literature suggests that somatosensory, olfactory, gustatory, auditory and visual environmental objects all have emotional features that are detected by our sensory channels, are very often processed quickly, and covertly influence behavior.

Moreover, the literature in the field suggests that natural situations usually recruit several sensory channels simultaneously. This is particularly important for the perception of emotional cues in the perception of food, whereby smell, taste, touch and visual associations are of great importance in the construction of flavor. In social interactions, integration between visual and auditory cues facilitates individual recognition. Complete adult emotional feelings, however, also rely on memory and knowledge, which in turn influence perception.

Indeed, beyond the classical bottom-up view of affect induction by sensory input, previous knowledge and experience of emotions have a retroactive influence on sensory input processing. Theories of embodied cognition suggest new ways of looking at how we process emotional information (Niedenthal, 2007). These theories suggest that perceiving and thinking about emotion involve perceptual, somatovisceral, and motor re-experiencing ("embodiment") of the relevant emotion in the self. According to this embodied concept of emotional processing, high-level cognitive processes, such as language and thought, need partial reactivation of sensory, motor and affective states in order to reconstruct the original neural configuration accompanying the initial emotion: to represent knowledge of emotion, our brain recruits parts of modality-specific states during perception, interoception, and action. That experiencing an emotion, perceiving an emotional stimulus, and retrieving an emotional memory involves overlapping mental processes is illustrated by the fact that one person's emotional expressions and gestures are visibly imitated by observers, and that this imitation is accompanied by self-reports of the corresponding emotional state (Niedenthal, Barsalou, Ric, & Krauth-Gruber, 2005). Conversely, facial muscular simulation of negative or positive emotion influences the comprehension of emotional sentences: a study in which participants had to judge whether sentences described a pleasant or unpleasant event while holding a pen between the teeth (to induce smiling) or between the lips (to inhibit smiling) showed that inhibition of smiling lengthened response time to pleasant events and accelerated response time to unpleasant events. Thus, feedback from the face, even when it does not result from any emotional feeling, facilitates the comprehension of sentences when it is congruent with the emotional meaning of the event (Havas & Matheson, 2013).

As an example of conscious top-down influence, a study using actors showed that (1) people smelling bad odors showed brain activation in the insula and (2) people who observed actors' facial expression of disgust when smelling odors from a glass showed activation of the same region of the anterior insula; for disgust at least, there is a common substrate for feeling an emotion and perceiving the same emotion in others. This suggests that understanding the facial expression of disgust displayed by others involves activation of neural substrates normally activated during the actual experience of the same emotion: the left anterior insula and the right anterior cingulate cortex (Wicker et al., 2003).

Knowledge of previous experiences thus influences the way we process sensory input. Language also has a profound influence on the processing of sensory input: giving different names to the same olfactory stimulus induces different brain activations (Bensafi et al., 2014), and influences sniffing and skin conductance (Djordjevic et al., 2007). The influence of naming on odor perception has also been attested in

preschool children (Bensafi, Rinck, Schaal, & Rouby, 2007). Merely reading a familiar odor's name, such as "cinnamon," activates olfactory cerebral regions (González et al., 2006), as if our brain was processing an odor. Sensory messages are so interconnected with thinking, feeling, moving, and remembering that experimenters should take account not only of perceivers' previous experiences and expectations, the verbal information available, and the social and physiological context of the measurement, but also of their own behavior and emotional state when performing any objective measurement.

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The Psychophysiology of Emotions

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Greg J. Norman[1], Elizabeth Necka[1] and Gary G. Berntson[2]
[1]Department of Psychology, The University of Chicago, Chicago, IL, United States
[2]Department of Psychology, The Ohio State University, Columbus, OH, United States

1 Introduction

The link between affective states and psychophysiological activity has been central to the study of behavior for well over a century. With his publication of *The expression of the emotions in man and animals*, Charles Darwin (1872) provided a foundation for over 140 years of research into the nature of emotions and their physiological and behavioral manifestations. Darwin suggested the existence of distinct kinds of emotional expressions, both somatic and visceral, that were relatively well conserved across phylogeny, and gradually evolved as a result of their adaptive function. A decade later, William James (1884) first articulated his highly influential theory of emotion where he suggested the subjective experience of certain emotions was the result of particular changes in somatovisceral and behavioral responses. Walter Cannon (1927) provided an early challenge to the Jamesian explanation of emotions as a manifestation of specific patterns of somatovisceral activity. Cannon argued physiological responses were the consequence, not the cause, of emotional processes, and that physiological responses were too undifferentiated to account for the variety of distinct emotional feeling states. Cannon's views were subsequently strengthened when early research failed to demonstrate replicable and generalizable emotion-specific patterns of physiological activity (Harlow & Stagner, 1932). Subsequent work conducted by Schachter and Singer (1962) also appeared to provide strong evidence that the same pattern of physiological activity (arising from epinephrine administration) could result in the experience of different emotions depending on situational cues, which at the time, lent further evidence to the view that emotions were not caused by specific patterns of activity in peripheral physiological systems (although this perspective has now been thoroughly criticized on a number of grounds, see Friedman, 2010). The consensus view of the relationship between emotion and psychophysiological activity was again challenged with the publication of a seminal paper by Ekman, Levenson, and Friesen (1983) where they attributed much of the previous inconsistency between emotions and physiological functioning to a variety of methodological limitations, such as failure to equate the intensity of different emotions and lack of appropriate synchronization between physiological recordings with the likely onset and offset of the elicited emotion. In their study, Ekman et al. measured heart rate, finger temperature, skin resistance, and forearm flexor muscle tension as participants completed two sets of tasks designed to elicit anger, fear, sadness, happiness, surprise, and disgust.

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In one task, participants were asked to remember and relive past emotional episodes. Participants also completed a directed facial action task in which they were asked to contract sets of muscles to produce facial expressions associated with each emotion. The authors found that in addition to differentiating positive from negative emotions, combinations of physiological measures could differentiate some negative emotions (eg, fear) from others (eg, anger). Subsequent work suggested that the degree of emotion-specific physiological activity was context-dependent such that the specificity was greatest in real-world emotion induction procedures (Stemmler, 1989), and that different emotion induction procedures appear to elicit different patterns of physiological activity (Zajonc & McIntosh, 1992). Such findings led to a series of meta-analyses conducted by Cacioppo, Gardner, and Berntson (1997) and Cacioppo, Berntson, Larsen, Poehlmann, and Ito (2000) on all published studies comparing the effects of at least two discrete emotions on at least two measures of autonomic nervous system (ANS) functioning. Although the results were mixed, these analyses found some evidence of emotion-specific ANS responses. Similarly, a recent systematic review (Kreibig, 2010) on the topic of emotion-specific patterns of autonomic functioning found some evidence that different emotions were associated with various patterns of ANS response. While the review found that there were some differences in ANS correlates across emotions, it also found that no basic emotion was entirely unique across the ANS measurements. Subsequent studies have employed multivariate approaches and reported some success in finding emotion-specific patterns of ANS function. For example, Stephens, Christie, and Friedman (2010) had participants view emotion-inducing music and affective films, while recording various ANS measures. Pattern classification analysis found that ANS variables were able to correctly classify predicted emotions at a rate of 44.6%. Using a comparable approach, Kragel and Labar (2013) found that autonomic measures predicted distinct affective states at a rate of 58.0%. While such findings are a clear improvement over previous univariate approaches, they are far from demonstrating discrete emotion-specific patterns of ANS responses.

Largely in response to the work mentioned above, a number of contemporary perspectives on the psychophysiology of emotion have developed more nuanced models of the relationship between affective states and neurobehavioral processes. For example, the somatovisceral afference model of emotion (SAME; Cacioppo, Berntson, & Klein, 1992) provides a general framework for conceptualizing the various routes through which ascending information from the periphery can mold emotional processes, while simultaneously integrating both basic and dimensional perspectives of emotion. At one extreme of the continuum, discrete emotional experiences can result from the apperception of distinct somatovisceral patterns (eg, Ekman et al., 1983; James, 1884; Levenson, Ekman, & Friesen, 1990). There is overwhelming evidence that ascending visceral information can have relatively dramatic influences on affective processes (Berntson, Sarter, & Cacioppo, 2003). For instance, work by Harrison, Gray, Gianaros, and Critchley (2010) found that aspects of disgust were related to distinct patterns of autonomic responses with “nauseating” disgust being associated with an increased rate of muscular contraction of the stomach and right insula activity and “bloody disgust” being associated with parasympathetic regulation

of the heart and activity in the left insula. Consistent with James' views on emotion, the dissociation of these peripheral autonomic changes in response to different types of disgust predicted activity within the insula. Furthermore, it has also been shown that emotional judgments are influenced by transient variations in cardiovascular signaling that influence the activity of midbrain structures, such as the periaqueductal gray (Gray et al., 2012). Specifically, cardiac cycle and baroreceptor activation are associated with increased intensity ratings of expressions of disgust in conjunction with an attenuation of evoked cardiac responses to both happy and disgusted faces (Gray et al., 2012). Conditions associated with aberrant visceral signaling, such as irritable bowel syndrome and Crohn's disease, have also been shown to influence a broad range of affective and cognitive processes (Kennedy et al., 2012; Mayer, 2011). A recent study found that intragastric infusion of fatty acid reduced subsequent subjective and neurobiological responses to experimentally induced sad emotion through a mechanism likely dependent on vagal afferent signaling (Van Oudenhove et al., 2011). Furthermore, these findings are consistent with a growing literature on somatovisceral influences on cognitive processes, including decision making, memory, and attention (Bechara, Damasio, Tranel, & Damasio, 2005; Garfinkel et al., 2013; Ohira et al., 2013) and the literature on the influence of the immune system on affect and behavior through, in part, modulation of vagal afference (Dantzer et al., 2008).

On the other extreme of the SAME continuum, attributional processes instigated by an active perceptual processing of undifferentiated physiological arousal generate discrete emotional experiences. As noted above, the work by Schachter and Singer (1962), while influential, contains within it a series of assumptions regarding the influence of epinephrine injection on ANS activity that dramatically limit one's ability to draw conclusions from their results. However, there is evidence that individual differences in the awareness an individual has of the activity of their internal organs, termed interoceptive awareness, can modulate emotional intensity without strongly influencing valence ratings of the emotional stimuli. For example, Herbert, Pollatos, and Schandry (2007) found that individuals who scored high on measures of interoceptive awareness, measured by the ability to accurately track their cardiac cycle, showed greater P300 and slow wave amplitudes in response to both positive and negative emotional pictures in addition to reporting higher levels of emotional arousal as compared to individuals low in interoceptive awareness. Barrett, Quigley, Bliss-Moreau, and Aronson (2004), found that greater interoceptive awareness was related to more apparent contrast in self-reported emotion activation and deactivation during an experience sampling procedure. These findings suggest that individual differences in the ability to accurately represent the activity of the viscera alter the way individuals subjectively perceive emotions.

Occupying the middle ground between the extremes proposed by William James on one hand and Schachter and Singer on the other, are situations where the ascending somatovisceral information is somewhat vague, necessitating an active perceptual processes whereby these patterns are rapidly evaluated to produce distinct emotional experiences (Cacioppo et al., 1992). It is within this middle ground that the ability to discern signal from noise becomes most difficult, necessitating immediate and spontaneous disambiguation. This process has been likened to the perceptual activities



Figure 4.1 A young or old woman?
Source: Adapted from Boring (1930).

associated with viewing ambiguous visual scenes (Fig. 4.1). Even though the figure itself is unchanging, top-down processes allow viewers to perceive two very different images: a young woman facing left or an elderly woman facing right (Leeper, 1935). Clearly, in this example the image remains constant and what is changing is the processing of the sensory information leading to the perception of one or the other image but not both simultaneously. Therefore, the same visual information can lead to two different and discrete perceptual experiences, even in a sensory system known for its contrast sensitivity, just as Schachter and Singer (1962) argued that the same incoming sensory information may lead to more than one discrete emotion. Thus, if individuals are susceptible to visual illusions such as that displayed in Fig. 4.1, where it is clear the object being viewed remains stable and unchanging, it is reasonable to propose that the perception of somatovisceral states, which are in continuous flux as the result of neural and endocrinological signals, could be subject to comparable perceptional illusions whereby a priori assumptions regarding the nature of the particular context (ie, threatening, exciting) are able to alter the real-time interpretation of physiological states leading to the experience of different emotions with the same pattern of sensory input. This view is consistent with the model recently put forward by Seth and Critchley (2013) incorporating expectations of somatovisceral responses to situational contexts, and the potential mismatch with ascending visceral information into models of emotions (also see Seth, Suzuki, & Critchley, 2011). By this account, "somatovisceral illusions" represent the result of an active perceptual process by which ambiguous patterns of physiological activity are immediately and spontaneously disambiguated to produce distinct emotional experiences. This view is

in accord with robust findings in the literature that discrete emotional percepts can occur even when the measured autonomic changes do not fully discriminate the emotions that are experienced (Cacioppo, Berntson, Klein, & Poehlmann, 1997; Cacioppo et al., 2000), and that autonomic activation can alter the intensity, if not the nature, of emotional experience (Critchley & Harrison, 2013). While this has been viewed by some to be grounds for minimizing the role of somatovisceral afference on emotion, the SAME model outlined above provides three routes by which somatovisceral afferents may influence emotional experience: emotion-specific autonomic patterns, somatovisceral illusions, or cognitive labeling of unexplained physiological arousal. From this perspective, the traditional tendency to view the mechanisms underlying emotion in terms of a simple central–peripheral dichotomy is untenable.

In the next section, we highlight general neuroarchitectural features underlying psychophysiological processes and discuss some potential implications that the broad distribution and re-representation of information across the neuraxis has on our understanding of the relationship between affective processes and psychophysiological measurement.

2 Re-representation of neural function and the psychophysiology of emotion

At approximately the same time that Darwin and James were laying the foundation for various aspects of the contemporary study of the relationship between emotion, psychophysiology, and evolutionary function, the noted neurologist John Hughlings Jackson (1884) provided an early description of the hierarchical structure and the re-representation of function across levels of neural hierarchy. Jackson's view has particular relevance for understanding affective processes, the ANS and their interactions as it suggests that the underlying neural systems responsible for processing efferent and afferent neural information, and behavioral responses, are distributed across spatial and temporal timescales. Jackson's conceptualization of the nervous system was based on the observation that information was processed at multiple levels within the neuraxis and that the evolutionary appearance of "higher-level" neural structures (ie, cortex) did not necessitate the replacement of more primitive neural organizations (ie, brainstem). Rather, Jackson noted that the brain was organized in a re-represented manner, whereby information was processed at various levels of the neuraxis, each mining the information with different analytical capacities and temporal pressures. For instance, primitive protective responses to potentially noxious stimuli apparent in the pain-withdrawal reflexes at the level of the spinal cord can effectively operate even in the absence of communication with the brain. These primitive protective responses are embellished at higher levels of the nervous system providing organisms a further-expanded behavioral and motivational repertoire that can capitalize on experience-dependent associative knowledge, distributed information-processing networks, and cognitive strategies that anticipate and prepare for or avoid aversive

encounters altogether (see Berntson, Boysen, & Cacioppo, 1993). This suggests that the evaluation of stimuli is not the result of a unitary or discrete process, rather, affective processes occur in temporal layers that are the result of the re-representation of information at various levels of the neuraxis. The evolutionary layering of higher processing levels onto lower substrates has an adaptive advantage in that lower and more efficient processing levels may continue to be utilized, and may be sufficient in some circumstances. Reflex responses to noxious or threatening stimuli, for example, provide a rapid, somewhat rigid, response aimed at immediately removing the organism from the source of aversion. The rapid and reflexive actions are typically followed by more complex motivational and affective processes that subsequently guide behavior based upon prior experiences and contextual cues. Moreover, learned anticipatory processes may promote more strategic avoidance of adaptive challenges prior to their occurrence and are capable of modulating the initial reflexive responses to stimuli. The increasing amount of information that must be processed and integrated by progressively higher-level systems may lead to neurocomputational bottlenecks which require a slower and more serial mode of processing. Based on hierarchical interconnections, higher-level systems may depend heavily on lower-level systems for the transmission and preliminary processing and filtering of afferent sensory and perceptual data and for implementing sensory motor subroutines that support executive outputs. The advantages and disadvantages associated with higher-level (integrative, flexible, but capacity limited) and lower-level (rapid, efficient, but rigid) processing were a likely source of evolutionary pressure for the preservation of lower-level substrates, despite higher-level elaborations and re-representations.

The re-representation of information across the nervous system suggests that sensory (both interoceptive and exteroceptive) information relevant to the experience of emotion, and associated physiological responses, are processed across a distributed set of neuroaxial networks leading to different temporal responses. Such conceptions of the nervous system have important theoretical and methodological implications for the psychophysiology of emotion. For example, although fear may appear to be a discrete phenomenal experience, it is now clear that fear can come in many flavors (ie, fear of predation, fear of starvation, fear of pain) each associated with the integration of information at different levels of the neuraxis which are subsequently associated with distinct neurobehavioral and physiological responses that extend across different temporal scales (Gross & Canteras, 2012). The intentionality and context-dependency of fear, and other emotions, may help explain why emotion-specific patterns of neurobehavioral and ANS activity can be quite variable across individuals. Of course, such complexity does not mean that basic emotions do not exist nor does it suggest the impossibility of ever finding tight emotion-specific patterns of physiological activity, rather, it implies that even with the most basic emotions there exists a broad distribution of physiological, motivational, and behavioral responses that can be expressed in a context-dependent fashion. In the following sections, we will discuss in more detail the relationship between the re-representation of function across the neuraxis and its potential influence on understanding the psychophysiology of emotion.

3 Re-representation of function: the psychophysiology of emotion

3.1 Examples from cardiovascular autonomic measures of emotion

Walter Cannon (1929) proposed that a primary role of the ANS was in maintaining the constancy of the *internal mileau*, a regulatory process he termed "homeostasis." Cannon viewed the sympathetic branch as the primary homeostatic regulator, with the parasympathetic branch serving to fine-tune reactions across organs. Historically, the two autonomic branches have been considered to be reciprocally regulated by central systems (Fulton, 1949), a view that continues to be promoted in the contemporary literature (Malliani, 1999). There is ample evidence for a reciprocal mode of autonomic control in simple reflex responses such as the baroreceptor–heart rate reflex. Reciprocal control of this type would have considerable regulatory advantage as reciprocal changes would synergistically amplify actions at the end organ and expand the dynamic range of control of the heart (Berntson et al., 1993). The homeostatic model of autonomic function dominated early conceptions of the relationship between affective processes and autonomic functioning, and behavioral–autonomic relations were often viewed as hierarchical extensions of homeostatic processes. In a hierarchical system, rostral levels could access a wider range of response mechanisms, but the actions of these systems would be constrained by the more primitive organizations at lower levels. Hence, this model of neurobehavioral–autonomic relations predicts that the basic reciprocal mode of control apparent in brainstem reflexes might be expected to manifest in behavioral contexts as well.

However, it is now clear that the nervous system is not organized in a strict hierarchical fashion. Indeed, descending pathways originating in cortical structures are capable of bypassing intermediate levels and thereby directly influence brainstem structures regulating motor output (Porter, 1987; Wakana, Jiang, Nagae-Poetscher, van Zijl, & Mori, 2004). Conversely, ample evidence exists that ascending visceral information is equally capable of bypassing intermediate levels and directly influencing cortical processes (Berntson et al., 2003). This organizational pattern, previously described as a neural heterarchy (Berntson & Cacioppo, 2000), contains the components of hierarchical systems, as higher levels are in continuous communication with lower-level systems via intermediate levels, but have the additional capacity to interact over widely separated levels via direct connections (Fig. 4.2). In addition to the well-known anatomy of somatomotor systems (Porter, 1987; Wakana et al., 2004), this pattern of organization is also apparent in both the ANS (Berntson & Cacioppo, 2000; Critchley, 2005) and hypothalamic–pituitary–adrenal (HPA) axis (Radley, Williams, & Sawchenko, 2008; Sullivan & Gratton, 2002). Of particular importance to the study of affective processes and associated psychophysiological activity, this provides a means through which psychological states can yield antihomeostatic effects (eg, concurrent increases in blood pressure and heart rate) on the ANS and HPA axes. For example, although baroreflex responses may entail tightly regulated

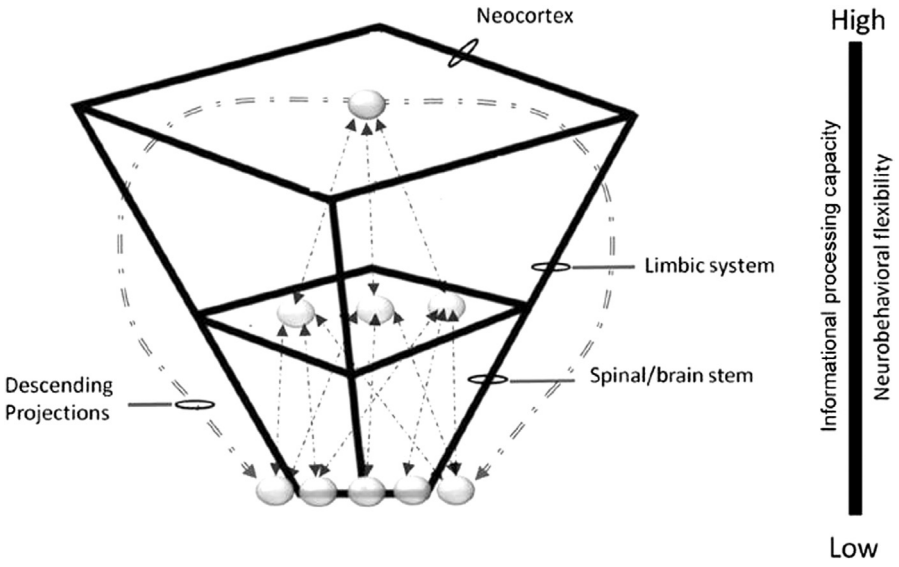


Figure 4.2 Heterarchical information processing in the neural axis. The lowest levels are characterized by more reflexive or bipolar modes of activation. As one moves to higher levels of the neuraxis, activation patterns are capable of more complex bivariate activation patterns. Furthermore, heterarchical projections allow higher levels to bypass intermediate levels and directly modulate lower levels. This pattern allows higher-level cognitive and emotional processes to directly influence basic motor responses to create complex behavioral patterns. Right: higher levels of the neuraxis can be categorized as having increasing behavioral complexity and informational-processing capacity.

reciprocal patterns of autonomic control, the autonomic branches may change reciprocally, independently, or coactively in behavioral contexts (Berntson et al., 1993, 1994). This has necessitated an expansion in the simple reciprocal bipolar model of autonomic control, in which autonomic states are considered to lie along a single continuum with maximal sympathetic (and minimal parasympathetic) activity at one end and maximal parasympathetic (and minimal sympathetic) activity at the other. Although this model may apply to reflexive brainstem circuits, the greater output flexibility of higher neural systems necessitates a bivariate model of autonomic space with sympathetic activity along one axis and parasympathetic activity along the other.

In addition, there may be far greater individual differences in autonomic responses arising from the operations of rostral neural systems in psychological contexts. For example, the heart rate responses of human subjects to orthostatic stress and to standard psychological stressors (mental arithmetic, speech stress, reaction time task) are similar when analyzed at a group level (Berntson et al., 1994; Cacioppo, Uchino, & Berntson, 1994). Analysis of the separate contributions of the two autonomic branches by the use of single and dual pharmacological blockades revealed that the orthostatic stress (transition from sitting to standing) yielded a rather consistent response across subjects, characterized by a highly correlated sympathetic activation and

parasympathetic withdrawal. However, psychological stressors yield a more varied pattern of response across subjects, with no overall correlation between the responses of the autonomic branches. A subset of participants displayed a predominant increase in sympathetic activity, others a predominant parasympathetic withdrawal, and others varying combinations of these responses. Although there were considerable individual differences in the responses, individual response patterns were stable across the three psychological stressors (Berntson et al., 1994). These findings are consistent with a much broader literature (Cacioppo, Tassinary, & Berntson, 2007), highlighting the ability of physiological systems to achieve the same end-organ response (heart rate in this case), through the manipulation of different underlying processes (ie, different patterns of sympathetic and parasympathetic response). Thus, in addition to elucidating some of the complexities of the affect system and its relation to behavior, the notion of re-representation of function across the nervous systems provides some insight into the dynamic heterarchical regulation of autonomic processes and the inherent difficulty associated with finding strict emotion-specific ANS signatures.

4 Electrodermal skin response

In addition to the analysis of cardiac functioning described above, estimates of autonomic output can be determined through the measurement of electrodermal activity (EDA). The basis for such measurement derives from the innervation of the eccrine sweat glands by the sympathetic nervous system. Importantly, the eccrine sweat glands are outside the control of parasympathetic responses and this fact allows for relatively unbiased estimates of sympathetic output. EDA is widely used within psychological contexts, as it is thought to reflect variations in emotional and neurophysiological arousal. Thus, EDA has been used as an objective index of affective processes, in controlled experimental contexts where extraneous variables are accounted for, and has been shown, for example, to be readily elicited by threatening stimuli.

Similar to cardiac autonomic activity, electrodermal measures are also influenced by higher subcortical and cortical brain areas associated with cognitive and affective processes. These areas include the amygdala, anterior cingulate cortex, and prefrontal cortex among others, and EDA responses can be elicited by electrical stimulation of each of these structures. This neuroautonomic coupling confers utility on psychophysiological measures as markers of affective processes. In fact, visceral/autonomic responses may not only reflect but also impact psychological processes. As discussed in detail above, somatovisceral feedback has variously been speculated to be important in the evocation or regulation of emotion and behavioral guidance. Performance in decision-making tasks is associated with anticipatory EDA responses prior to risky or suboptimal choices, and this reactivity predates conscious awareness of the outcome contingencies and has been suggested to guide learning and future adaptive choices. In this paradigm, damage to the ventromedial prefrontal cortex results in dysregulated emotional processes associated with abnormalities in strategic decision-making characterized by a failure to change disadvantageous behavioral patterns (see Bechara & Naqvi, 2009). While typical individuals alter their behavior to avoid

punishment, patients with ventromedial prefrontal damage continue using the same pattern of behavior, even if this behavior is repeatedly associated with punishing outcomes. These patients also display abnormalities in the generation of EDA responses that manifest as a reduction in normal anticipatory arousal in the decision-making task. The deficit in anticipatory autonomic arousal may contribute to the behavioral deficit, as this feedback somatovisceral afference may normally serve to bias emotional behavior and sculpt strategic decision-making processes (see Bechara & Naqvi, 2009). Consistent with Jackson's view of the evolutionary representation of function, the association between sympathetic output and decision-making is likely the result of higher-level (eg, prefrontal cortex) structures "listening" to more primitive lower-level processes that reflect rapid changes in neurophysiological states in response to environmental stimuli. Measurement of EDA or other psychophysiological responses may thus provide a window into the psychological processes that reflect the activity of neurobiological structures important in integrating emotion and cognitive responses.

5 Neuroendocrine factors

Hormones are in continuous reciprocal interaction with the operations of the central nervous system and play a particular role in the generation of affective responses. The acute elevation of stress hormones represents an adaptive process that serves to coordinate metabolic, cardiovascular, and behavioral responses to environmental and neurophysiological perturbations. However, when negative affect, and the subsequent release of stress-related hormones becomes chronic, it can predispose individuals to a myriad of pathophysiological processes. The most well-studied stress hormone system is the HPA axis. The HPA consists of multiple peptides and hormonal signaling molecules that orchestrate broad alterations in metabolic functioning. The cascade is initiated by the detection of threat stimuli leading to an increase in corticotropin-releasing hormone (CRH) within the hypothalamus. The increased CRH then induces the systemic release of adrenocorticotropin-releasing hormone (ACTH) from the anterior pituitary, which subsequently increases the release of cortisol (or corticosterone in rats and mice) from the adrenal cortex. Cortisol levels are continuously monitored by nearly every cell of the body through activation of intracellular glucocorticoid receptors. Finally, the system is subject to servo control, as it is inhibited by high levels of cortisol binding at receptors in the hippocampus which serve to inhibit further production and release of CRH. Given the broad effects of HPA function on metabolic, immunological, and neurobiological functioning, psychophysiologists routinely quantify circulating levels of cortisol and ACTH as an index of psychological stress. While this research has provided numerous important empirical and theoretical insights into the interface between physiology and psychology, important interpretative caveats exist for the application of such measures to psychophysiological science. For example, circulating levels of ACTH and cortisol are released in a pulsatile manner, necessitating the measurement across multiple time points, or other approaches to provide an integrated metric. Furthermore, circulating levels of HPA

hormones display large diurnal variations with the highest levels typically observed in the early morning, requiring attention to the timing of measurements. In addition, alteration in diurnal variation in the HPA axis output may itself be a relevant metric, as it has been found to be sensitive to various psychophysiological conditions such as depression and anxiety.

Similar to the autonomic measures mentioned above, neuroendocrine functioning is regulated by the neural heterarchies generating affective states. For example, even under conditioners where strong negative emotions are generated in participants, there exists considerable variability in HPA axis output with some individuals showing very large cortisol responses, while others display only moderate to minimal HPA axis activity. It is now clear that much of this variability can be explained by individual differences in the activity of higher-level cortical structures, such as the orbitofrontal cortex. Indeed, participants who tend to have decreased activity in the orbitofrontal cortex tend to show much higher HPA axis activity under conditions of psychological stress (Wang et al., 2005), a result that is likely the result of decreased tonic inhibitory signaling directly from orbitofrontal cortex to the hypothalamus (Pruessner et al., 2008). Therefore, neuroendocrine correlates of affective processes are also subject to the influence of neural heterarchies, and an appreciation of this relationship allows for a more comprehensive understanding of the relationship between emotion and psychophysiological responses.

6 Psychophysiological relations in emotion research

By definition, psychophysiological processes represent interactions between psychological (ψ) and physiological (φ) domains. Important to the measurement of psychophysiological processes, psychological relations are assumed to have some association with physiological processes that can be comprised of five general relationships that characterize the mapping between elements in the psychological and physiological domains (Cacioppo & Tassinary, 1990) (Fig. 4.3).

1. No significant association between psychological and physiological domains.
2. One-to-one: psychological domain is associated with one, and only one, physiological process.
3. One-to-many: in which elements in the psychological domain are related to more than one element in the physiological domain.
4. Many-to-one: in which two or more psychological elements are associated with a single element in the physiological domain.
5. Many-to-many: in which two or more psychological elements are associated with multiple elements in the neurophysiological domain.

The first such relationship depicts relations that represent irrelevant sources of variance in psychophysiological associations and need to be accounted for in order to avoid spurious associations between psychological and physiological domains. Unfortunately, one-to-one relationships are not common in psychophysiology. One approach to this problem is to characterize the physiological elements of a one-to-many relationship as

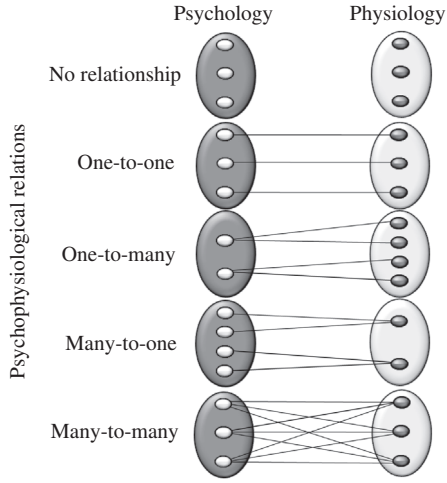


Figure 4.3 Schematic of psychophysiological relations consisting of: (1) No significant association between psychological and neurophysiological domains. (2) One-to-one: the psychological domain is associated with one, and only one, neurophysiological process. (3) One-to-many: in which elements in the psychological domain are related to more than one element in the neurophysiological domain. (4) Many-to-one: in which two or more psychological elements are associated with a single element in the neurophysiological domain. (5) Many-to-many: in which two or more psychological elements are associated with multiple elements in the neurophysiological domain.

comprising of a combination of psychological elements. Similarly, the consolidation of physiological elements of many-to-many relationships into particular patterns of activation may serve to simplify relations into a many-to-one or even one-to-one relationship. However, caution should be applied in such instances as the inherent complexity of psychophysiological relations, particularly in emotion research, may not always be reducible to one-to-one or even one-to-many relationships.

7 Conclusions

The nature of emotions, their neurobiological foundations, and their psychophysiological manifestations continues to be one of the most intense areas of research in the behavioral sciences. While considerable debate still exists as to the exact nature of the relationship between affective processes and psychophysiological measures, a number of contemporary models, bolstered by both technological and conceptual advances, have made advances in explaining the complex relationship between emotion and psychophysiology. Such advancements in our understanding of the psychophysiology of emotion have made it clear that much of the debate that has occurred in the field over the past century has generally resulted from methodological constraints. For example, previous studies typically restricted measurement

to a handful of physiological processes, each with different temporal resolution and unique temporal dynamics associated with affective responses. As discussed above, many such systems are dually regulated by the sympathetic and parasympathetic branches of the ANS which can obscure underlying relationships between affective states and autonomic responses. For instance, aversive conditioned stimuli can produce coactivation of the sympathetic and parasympathetic branches system, yielding accelerated, decelerated, or even unchanged heart rate, depending on the relative strength of sympathetic versus parasympathetic activation (see Berntson, Cacioppo, & Quigley, 1991). Additionally, the standard measures used to determine potential patterns of ANS response to discrete emotions (vascular and cardiac functioning, skin conductance) are not necessarily representative of the intrinsic sensory apparatus that conveys somatovisceral information through the nervous system. That is, although our measures are quite sensitive with regard to detecting changes in variables such as skin conductance, heart rate, or blood pressure, they are not necessarily good measures of how that afferent information is transmitted and represented within the brain. In fact, there is considerable evidence that the individuals vary a great deal with regard to their sensory and perceptual representation of somatovisceral states (Critchley & Harrison, 2013). Therefore, though over a century of research has been dedicated to understanding the psychophysiology of emotions, there is still much left to explore. Theoretical, empirical, and technological advances are instrumental for not only advancing our understanding of what emotions are, but also in understanding their complex relationship to psychophysiological processes, and why the relationship differs across contexts and people.

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Behavioral Measures of Emotion

5

Rubén Jacob-Dazarola[1], *Juan Carlos Ortíz Nicolás*[2] *and Lina Cárdenas Bayona*[3]
[1]School of Design, Universidad de Chile, Santiago, Chile [2]Institute of Architecture, Design and Art, Autonomous University of Ciudad Juarez, Ciudad Juarez, CH, México
[3]Department of Design, Universidad de Chile, Santiago, Chile

1 Behaving emotionally

In a toy store, Peter laughs and runs from one side to another continuously. Every now and then, he goes back with his mother to show her a different toy and with a broken voice and full of excitement, he explains to her how it works and to which of his favorite TV shows it belongs. Then, he runs again and disappears in the aisles.

When mom says it is time to leave the store, Peter takes a step back and with eyes wide open, he starts whining that he does not want to leave yet and in a matter of seconds, he starts throwing a tantrum. At this point Peter has his face on the floor, and his mother tries to convince him to leave the store. After a while, Peter stands up with his slumped shoulder and eyes still full of tears looking at the floor. Slowly, he accepts his mother's hand to walk to the exit.

Almost all of us have witnessed (or have started) a similar situation as the described above. Peter's mom and certainly every person who observed the scene can recognize many of the behavioral reactions and triggered emotions that Peter experienced. When Peter laughs, screams and runs out of control, we are able to distinguish that he is full of joy. When he steps back with eyes wide open, we are able to recognize clear signs of surprise. On the other hand, the explosive crying and the tantrum show high levels of anger and frustration. Peter experienced emotions of joy, surprise, anger, and frustration.

Emotions have been described as episodes of interrelated and synchronized changes in human beings that occur in response to the evaluation of external or internal stimuli and have some personal relevance (Scherer, 2005). They are typically event-focused, adaptable, short-lasting, of variable intensity, and have an impact on human behavior (see Frijda, Kuipers, & ter Schure, 1989). In addition, current emotional theories tend to agree that they are a multidimensional phenomenon. Therefore, in order to study and understand them, it is important to consider the emotion's characteristics.

In relation to behavior, it has been suggested that it is self-propelled movement producing a functional interaction between an animal and its environment, such as finding a mate or fleeing from a predator (Aunger & Curtis, 2013, 2015). Three propellers have also been suggested: *pre-mammalian*, that is, a bad taste will cause a gagging reflex; *motivated behavior*, these are goal-oriented and are related to undertaking day-to-day tasks, for example waking up at 7:00 a.m. on weekdays; *complex behavior* is also goal-oriented, and is related to long-term objectives, for example losing weight

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or saving for retirement (Aunger & Curtis, 2013). Therefore, this view of behavior is a multisensory expression and it can be linked to motives, as in the case of motivated and complex behavior.

The aim of this chapter is first to briefly establish what an emotion is and what its different dimensions are, and second, to identify and review the behavioral reactions that are involved in emotions, with a focus on three modalities: vocal, facial, and body expressions. We also review the interactions between these modalities. The third aim is to explain the impact of behavioral reactions on product design.

This chapter is divided into six main sections. The first describes the different dimensions of emotions. The second section introduces behavioral characteristics of emotions. The third discusses the role of behavior in emotions. The fourth, introduces measuring methods to identify emotions based on behavior. The fifth, discusses the role of behavior triggered by emotions in product design. Finally, the sixth section draws the conclusions of the chapter.

2 Hulk… Emotional! The different dimensions of emotions

One of the first attempts to define emotion was introduced in the article *What is an emotion?* William James (1884) establishes the body as the center of the emotional experience. He stated that emotions are "sensations from bodily changes produced by the perception of external stimuli." Therefore, when an emotion is experienced, especially when it is intense, the body undergoes certain reactions, and these reactions arise directly and subsequently from the perception of stimuli.

Most recent views on emotions tend to agree that they are a multidimensional phenomenon. It has also been suggested that they follow a process at which the different dimensions emerge gradually and not at once. Thus, emotions can be analyzed based on the experience of each dimension. For example, some scholars (Scherer, 1993, 2000, 2005; Smith & Kirby, 2001) have suggested *component processes* that include five subsystems. The recent views align, in some degree, with James' ideas, particularly when he mentions that the body undergoes certain reactions, for example, physiological and behavioral.

To explain the multidimensional characteristics of emotions we rely upon Hulk, the well-known character of Marvel comics. Bruce Banner, the peaceful Hulk's alter ego is constantly striving to control his emotions. Bruce knows that when something disrupts his peace of mind or a situation overwhelms him, Hulk emerges full of anger (Fig. 5.1). The following dimensions gradually emerge during the emotional process and some are more likely to be conditioned and modified by immediate dimensions than others:

- *Cognitive process*: It has been suggested that emotions help a person evaluate whether a stimulus enhances positive or negative emotions. For example, Bruce Banner appraises a stimuli based on its hedonic tone response, that is, whether the stimulus is positive or negative. Thus, Bruce



Figure 5.1 The changes experienced by Bruce Banner / Hulk illustrate the different dimensions that emerge during the emotional process. Image created by Andre Koekemoer and reproduced with permission of the author ("Lou Ferrigno - Hulk" 2011(c), http://www.andrekoeks.com).

Banner can appraise whether an enemy represents a real danger for him or not. It is important to remember that this is Bruce Banner's appraisal and others can appraise it differently.

- *Physiological processes*: The assessment of a given situation, whether positive or negative, triggers physiological change in an individual, for example, it affects the nervous and circulatory systems. It also modifies hormonal levels and the heart rate. The changes occur to prepare the individual's body to adapt to the current situation properly. In the case of Bruce Banner, his transformation is one of the most recognizable comic moments. He starts to hyperventilate, his heart rate increases, his eyes turn green and he starts sweating. Hulk's transformation is starting.
- *Facial and vocal expressions*: Some expressions and gestures are associated with particular emotions, and they act as a communication channel about individual intentions and actions. Hulk's roar and its characteristic phrase "Hulk smash!" are a clear example of this dimension.
- *Thought–action tendencies*: Cognitive processes and physiological changes stimulate behavior. For example, Bruce Banner aims to consciously be relaxed and he may think in positive scenarios. Nevertheless, when Bruce Banner is gone and Hulk emerges, he is full of anger. This enhances a behavior tendency to attack and crush any possible threat. Hulk waves his hands, in synthesis showing an aggressive behavior.
- *Subjective emotional experience*: The changes and modifications that have occurred in Bruce Banner act as a basis of the emotional experience, which is subjective in nature and the individual may be aware of. Based on this awareness a person sometimes can reflect on the emotional experience. When the danger has passed, Hulk rests, calms down, the physical symptoms are lessened and Banner takes control again. At this moment, Bruce is aware of the destruction caused by Hulk. He may regret the consequences and consider options to avoid Hulk's reemergence.

3 The historical role of behavior to identify emotions

In the study of emotions, one of the fundamental proposals related to behavior corresponds to the evolutionary ideas of Paul Ekman (Ekman, 1999; Ekman & Oster, 1981; Ekman, Sorenson, & Friesen, 1969). He proposed the existence of a group of basic emotions (anger, joy, fear, disgust, sadness, and surprise) that are innate, universal, and transcultural. Basic emotions can also be expressed and recognized, among other things, by the behavior of those who experience them, for example, through facial gestures.

Other perspectives on emotions challenge the universal perspective. LeDoux (1999) argues that social factors determine the capabilities to externalize manifestations of complex emotions, that are acquired mostly based on the context in which the individual exists. In other words, some emotions are not innate. These ideas are in line with social constructionism theory (Averill, 1980; Plutchik, 2003). In this theory, complex or secondary emotions are constructed from the primary emotions and they can be developed even in adulthood. For example, Averill (1979, 1980) argues that emotions are an appraisal of environmental stimuli and they can define stereotypical patterns of acceptable responses, which fit the environment based on patterns and valuations that are particular to each individual's culture. Each person then behaves in a certain emotional pattern, a stereotype validated by his/her culture that corresponds to voluntary actions that "appear" to be involuntary. Prinz (2004) claims that although it is frequently assumed that emotions, such as anger, are involuntary, it is often used voluntarily and in a "strategic" way, for example, to make clear that an individual is annoyed and/or is preparing to attack. In social constructionism terms, anger does not correspond to an animal reflex. It is rather a sophisticated behavioral configuration to define what is acceptable or relevant in a particular context and to achieve certain objectives, for example, establishing or defending a territory.

Other scholars have also challenged the limited consensus among the different perspectives on emotion beyond their vast differences (Barrett, 2006). This scholar questions the limited consensus among the different perspectives on emotion beyond their vast differences. People think they can recognize an emotion when they see it, and therefore, assume that emotions are events with defined limits that can be recognized with some precision based on a "set" of reactions linked to a particular emotion. However, the author presents evidence of the emotional construction that is particular to each individual and influences the emotional experience, for example, knowledge, culture, context, reactions to the environment in which the person lives, to name a few. From this perspective, emotions are not simple reflections or a predetermined set of reactions, they correspond to concrete actions of perception based on information gathered from the outside world at a specific time. According to Barrett, emotions vary from culture to culture, from moment to moment, and from person to person. This implies that the behavioral signs of apparent sadness in someone could be reinterpreted as another emotion in a different person (see chapter: "Navigating the Science of Emotion" for the most recent contributions).

This brief review allows us to establish that the different emotional theories that have been defined throughout history agree, at least, on the existence of behavioral components, consisting of actions, attitudes, and perceptible physical manifestations, both voluntary and involuntary. It has also been established that behavior is fairly recognizable to others, at least in certain contexts (see chapters: Theoretical Approaches to Emotion and Its Measurement, Navigating the Science of Emotion, for a discussion about different theories).

The analysis of emotions based on a person's behavior has enabled humans to modify and moderate their own behavior to the situation in which the person is immersed. This shows the potential of measuring emotions based on behavior. In addition, we can recognize an emotion relying upon our senses with a high degree of success.

4 The role of behavior in emotions

4.1 To recognize emotions

Scherer and colleagues (Bänziger, Tran, & Scherer, 2005; Scherer, 2005) suggest some strategies to identify emotions; interestingly, behavior is an important element to do so. The following elements are involved when recognizing emotions:

- *Event focus*: Emotions are elicited by stimulus events (internal and external). In the short story at the beginning of this chapter the event that triggers positive emotions is Peter's visit to the toy store. On the other hand, he starts to experience negative emotions when he leaves the store.
- *Appraisal-driven*: The eliciting event and its consequences are relevant to major concerns of the person. In other words, if the event is irrelevant for Peter, he may not experience positive or negative emotions.
- *Response synchronization*: There is synchronization between the relevance of the event for the person and the context where it occurs. Emotions are means to prepare a person to appropriate response to events. Peter reacts with wonder when he sees all the toys at the store and with disappointment when he has to leave.
- *Rapidity of change*: Events, and their appraisal, change rapidly. This often occurs due to the introduction of new information or reevaluations of the situation. Peter experiences happiness and a few seconds later anger. This is the result of Peter's evaluation of the new context of the information.
- *Behavioral impact*: Emotions prepare adaptive action tendencies and their motivational underpinnings. Peter reacts with clear differences in his behavior that are the result of the emotions that he is experiencing. When he experiences joys he laughs and smiles. When he experiences anger he reacts with temper tantrums.
- *Intensity*: Intensity may be linked to the relevance of the events that provide the context that triggers the emotion, and it is influenced by personality traits, moods, and the subjective reality in general. Furthermore, there is a correlation between intensity and consequent behavior. For example, Peter experienced high levels of joy and anger. This can be inferred based on his behavioral reactions.

- *Duration*: Emotions imply massive response mobilization and synchronization as part of specific action tendencies. This explains why they are short in their duration. Otherwise, emotions could deplete energy resources of the person quickly. When Peter reacts with temper tantrums he invests lots of energy, because he is crying, kicking, and resisting leaving the store. If he maintains his tantrum for a couple of hours his hydration will go down, his muscles get tired and his energy reserves will deplete rapidly.

Emotions involved the activation of many elements, one of which is behavior. It is clear that there are particular reactions, gestures, or body movements that help identify the emotions that another human is experiencing.

4.2 To classify emotions

The classification of emotions has been researched from two fundamental viewpoints: one, emotions are discrete and fundamentally different constructs; or two, emotions are characterized on a dimensional basis in groupings (see chapter: Theoretical Approaches to Emotion and Its Measurement).

- *The discrete approach* suggests that emotions are distinguishable among others and the differences are based on facial expressions and biological processes. The idea of discrete emotions is synthesized in universal emotions, these are the ones that any human can experience and recognize.
- *The dimensional approach* suggests that subjective feelings can be described by their position in a three-dimensional (3D) space formed by the dimensions of valence (positive–negative), arousal (calm–excited), and tension (tense–relaxed) (Wundt, in Scherer, 2005).

Emotions have also been classified as utilitarian and aesthetic (Scherer, 2005). It has been suggested that *utilitarian emotions* facilitate our adaptation to events that have important consequences for our well-being. Such adaptive functions are the preparation of action tendencies (fight, flight), recovery and reorientation (grief, work), motivational enhancement (joy, pride), or the creation of social obligations (reparation) (Scherer, 2005). On the other hand, *aesthetic emotions* are related to appreciating qualities of beauty in art or art performance. It is well established that music, pictorial art, and sculptures trigger emotions in people that may not have a utilitarian reason (Bartlett, 1999; Dillman-Carpentier & Potter, 2007; Scherer & Zentner, 2001). Other scholars (Bradley, Codispoti, Sabatinelli, & Lang, 2001) suggest that emotions and emotional responses in general are useful for a variety of functions, not only practical or aesthetic. For example, in relation to disgust, Reeve (1994) argues that it serves to promote healthy habits and hygiene and Averill (1979) notes that sadness has the function of social cohesion, especially with those who are in similar situations. Attention may also be useful in works of art or product design (see Desmet, 2002; Lazarus, 1982, 1991).

It is clear that classification takes into account the behavioral aspect of emotions, for example, universal emotions. It is also considered in the potential reactions that the person performs in a particular situation.

4.3 To measure emotions

Emotions can be recognized and classified. However, when they have to be measured there are some challenges because they are multidimensional in nature. Therefore, it is relevant to measure all the components instead of parts. For example, arousal is a component and it can be measured, however, this dimension does not offer a full picture of the experienced emotion. It can also measure the valence of the emotion and then we can assume that the experienced emotion is positive and high in arousal. Nevertheless, this approach ignores other elements such as behavior. Scholars have also suggested detailed approaches to measure emotions. For example, Scherer (2005) report five aspects:

- The continuous changes in appraisal processes at all levels of central nervous system processing.
- The response patterns generated in the neuroendocrine, autonomic, and somatic nervous systems.
- The motivational changes produced by the appraisal results, in particular action tendencies.
- The patterns of facial and vocal expression as well as body movements.
- The nature of the subjectively experienced feeling state that reflects all of these component changes.

Based on Scherer's ideas, it can be inferred that current methods tend to focus on particular emotion components, which are effective and incomplete at the same time. Scherer (2005), however, also acknowledges the complexity of measuring the five aspects that he suggests.

Meanwhile, Mauss and Robinson (2009) conducted an extensive review on the state of art about emotion measurement, and refer to methods based on:

Self-reports: These are undertaken with questionnaires that are answered by individuals who experience different emotional states; with interviews when they report their experience and reports that detail moment-to-moment experiences. Self-reports can also be verbal and nonverbal, for example, when using characters or faces that represent particular emotions.

Physiological aspects

Autonomic measures. These methods rely on the autonomic nervous system (ANS). Indices of ANS activation can be assessed based on electrodermal (ie, sweat gland) or cardiovascular (ie, blood circulatory system) responses (see chapter: "The Psychophysiology of Emotions" for a complete review).

Startle response magnitude. This method is based on the startle response, a reflex to a sudden, intense stimulus, which is a universal reflex that involves multiple motor actions, including tensing of the neck, back muscles, and eye blink (Vrana, Spence, & Lang, 1988, in Mauss & Robinson, 2009).

Brain states. There is evidence that there is a physiological correlation of emotions with the brain rather than in peripheral physiological responses. Therefore, there are methods to measure emotions based on electroencephalography, neuroimaging, and magnetic resonance imaging.

Behavior: Most of the research that focuses on the emotional phenomena acknowledges that it is possible to infer the emotional state based on actions, behavioral tendencies, gestures, and body expressions (Frijda, 1986; Lang, Bradley, & Cuthbert, 2013). It is therefore possible to measure emotions based on behavior. This issue, which is the main topic of this chapter is detailed in the next section.

5 Behave yourself! Measuring emotions based on behavior

Behavioral theories (Skinner, 1938; Watson, 1913, 1925) consider emotions as conditioned responses that are triggered by a neutral stimulus and associated with an internal stimulus, which evokes responses in the individual that are perceptible to others. Interestingly, there is a general consensus in the field of emotional research that admits the perceptual reactions or obvious manifestations that emerge when experiencing emotions, what other scholars call body expressions. It has also been argued that the manifestations tend to be the most visible and familiar signs of emotion (Van den Stock, Righart, & De Gelder, 2007).

There are various approaches to model behavior. Lang (1968) defined the existence of behavior dimensions, that is, verbal, somatic, and overt-motor. Other scholars (Mauss & Robinson, 2009) also mention vocal, facial, and body components of behavior that can be measured. A recent view of behavior argues that it is derived from an individual's attitude to a particular stimulus, and it consists of three elements: cognition, emotion, and intention (Tsaur, Luoh, & Syue, 2015 based on the ideas of Assael, 1999, and DeBruicker, 1979).

Remembering Peter's tantrum, he shouts and protests and these are part of the vocal/verbal dimension. He also shows his disappointment, based on his facial gestures, for example, sad eyes and a slightly downturned curved mouth, and body expressions, for example, his posture is downwards. Therefore, facial gestures and somatic or body expression are also involved.

It is also important to report that when experiencing particular emotions certain reactions are automatically activated, for example, the secretion of certain body fluids. Tears are a noticeable characteristic that contributes to the assessment of a person's emotion. Other examples of these involuntary responses are sweat or rapid breath, a change in skin color, such as when the face turns red. The automatic reactions and body expressions allow the viewer to identify, with a certain level of precision, the emotions that other individuals are experiencing. Nevertheless, these reactions emerge when the intensity of the emotion is high. Therefore, they are not always visible when experiencing a particular emotion. This explains why these reactions are not considered behavior.

It should also be noted that simple observation of others' behaviors and reactions helps identify emotions. Therefore, it is a potential method to measure emotions, however, there are limitations, for example, it does not rely upon solid parameters. It could be said that behavioral observation is a natural and intuitive human approach to identify other's subjective experiences. Regarding the specific use of behavioral

manifestations of emotions it has to be considered that for each of its components (vocal, facial, body) academic research has proposed a variety of methods and techniques to record, measure, and evaluate them. Furthermore, they can be evaluated separately or together.

5.1 Vocal and verbal characteristics

Many studies have shown that vocal and verbal characteristics deliver excellent parameters to measure whether an individual is experiencing a particular emotion (Bachorowski, 1999; Gobl & Chasaide, 2003; Johnstone, 2001; Johnstone, van Reekum, Oakes, & Davidson, 2006; Laukka, Neiberg, Forsell, Karlsson, & Elenius, 2011; Mordkovich, Veit, & Zilber, 2011). The involved vocal and verbal characteristics are voice tone and volume, fluency of speech, vibration, and the verbal content itself. These vocal and verbal signals may vary from person to person, and they may present alone or mixed (or not occur). Thus, a person's evaluation based on vocal and verbal expressions is fallible, according to Juslin and Scherer (2008). However, research has also identified that vocal and verbal expressions are an accurate way to identify other's emotions based on behavior (Johnstone et al., 2006; Planalp, 1999). Furthermore, in everyday social life, vocal and verbal characteristics are usually sufficient to recognize other's emotions, with a high rate of success (Bachorowski, 1999).

Many scholars have also associated changes in voice tone and pitch to specific emotions, for example, a whispering voice could be associated with confidentiality, a strong and rough voice with anger, and a squeaky voice with boredom (Gobl & Chasaide, 2003; Laver, 1980). Research has also identified mutual relationships between vocal tone and arousal, for example, high-pitch vocal tones have been linked to high levels of arousal that fear, joy, or anger involve. The mutual relationships, however, ignore the valence of emotions. For example, anger and joy involve high levels of arousal, but they are very different in their valence, one is positive and the other is negative. They are also often considered opposite ends of the positive and the negative valence. This is a clear limitation of linking vocal tones to arousal (Mauss & Robinson, 2009). Nevertheless, studies that link pitch with the emotions indicate that the relationship is less automatic and direct. On the other hand, there are many studies that link facial gestures with emotions in very specific ways.

Simple observation and listening, that include vocal characteristics, do not constitute a formal behavioral method, however, there are established methods based on academic parameters to analyze vocal (Vogt, André, & Bee, 2008) and verbal (Yildirim, Narayanan, & Potamianos, 2011) characteristics to identify emotions. For example, Augsburg University developed a framework and tool to recognize emotions based on vocal inputs. The data are gathered online and in real time. Another tool is *EMOVoice* (Vogt et al., 2008; Wagner, Lingenfelser, & André, 2011). This tool analyzes the speech of the speaker and identifies his emotions based on the following aspects of the acoustic voice analysis (see also Kent, 1997; Kent & Kim, 2008; Weatherley-White, Stark, & DeHaan, 1966):

- Logarithmized pitch.
- Energy or intensity.

- *MFCC or Mel Frequency Cepstral Coefficients*, these are representations of speech based on human auditory perception (see also Hasan, Jamil, Rabbani, & Rahman, 2004; Muda, Begam, & Elamvazuthi, 2010).
- Frequency spectrum.
- *HNR*, *harmonics-to-noise ratio*, acoustic phonetic index voice (see also Ferrand, 2002; Severin, Bozkurt, & Dutoit, 2005).

It is also possible to find commercial tools that aim to support behavioral emotion recognition based on voice analysis. *Memotion* is an application created for smartphones that performs voice cadence and speech analysis and compares 20 seconds of recorded speech with predefined parameters to establish the speaker's emotional tone. The tool is based on 18 years of research on emotion analysis performed by Beyond Verbal Company (see webpages links in references under *Memotion (Emotion Analysis)* (2015) and Beyond Verbal (2016)). Another tool called *EMOSpeech* (link under *EMOSpeech. Speech emotion recognition* (2015) uses a tridimensional model based on Valence, Dominance, and Activation parameters. Another similar tool is *EMOVoice*, which generates information in real time about the emotions that an interlocutor, in a phone call, manifests in his voice (Vogt et al., 2008). The applications that arise from these technologies include call identifiers with very practical functions. For example, an unsatisfied client can be directed to the correct agent or supervisor in a call center.

Vocal characteristics, including speech, have proven to be an effective signal to recognize and measure emotions. This has been identified based on methods that include magnetic resonance imaging or instrumental sound measurement. Particular emotions present clear differences in brain activation levels (Johnstone et al., 2006). Volume and acoustic characteristics also activate particular brain levels (Johnstone, 2001), which are useful when studying opposite emotions, such as anger and joy. Although this does not correspond to behavioral measurement it seems to confirm the relevance of expressing emotion through the voice and speech and the ability to recognize it from vocal and verbal manifestations.

5.2 Facial characteristics

Facial behavior is one of the most frequently used methods when measuring emotions. In the last two centuries, a great deal of literature has evidenced the use of this method as a valid resource (Adolphs, 2002; Ekman, 2003; Lang, Greenwald, Bradley, & Hamm, 1993; Secord, 1958). However, there are some challenges, for example, in defining primary and secondary emotions. Facial behavior associated with primary emotions is easily recognized, conversely, secondary emotions may be more complex and difficult to read (Matsumoto, Keltner, Shiota, Frank, & O'Sullivan, 2008). Adolphs (2002) established that facial behavior can be used to express emotional responses and social communication. Both expressions can emerge simultaneously when experiencing an emotion (see chapter: "Measuring Emotions in the Face" for further research in this area).

Facial movements, eyebrow muscles, frowns, etc., are a few examples of the wide human capability to gesticulate the human face. Recent studies have shown that all 42

face muscles can originate 21 different macro-expressions linked to particular emotions (Du, Tao, & Martinez, 2014). In addition, a significant group of researchers also support the existence of micro-expressions. These last approximately 0.03 seconds and occur simultaneously with macro-expressions, which tend to last between 0.5 and 4 seconds (Matsumoto & Hwang, 2011). Porter and Ten Brinke (2008) proposed that micro-emotions appear when people are trying to hide their emotional states. Micro-expressions have also been associated with abrupt processes that are not physically evident to others.

There is a long tradition of research to understand relationships between facial expressions and specific emotions (Ekman et al., 1969; Izard, 1972; Tomkins & Mc Carter, 1964). A number of models and systems have been developed to establish a rigorous measurement of emotions based on gestures. For example, the *Facial Action Coding System* or FACS (Ekman & Friesen, 1978) identifies discrete emotions based on specific movements of the facial muscles. Other measurement methods have focused on specific aspects of the gesticulations of the human face (Izard, 1972); generic expressions (Notarius & Levenson, 1979); and the use of electromyography to measure the electrical activity of facial muscles (Benedek & Hazlett, 2005). In 2007 the *Facial Coding Expression System* (FACES) was introduced by Kring and Sloan. This method measures emotions in three forms: 1) video analysis (in training stages), 2) direct observation of facial gestures (with the basic training completed), 3) and using a database of predefined expressions. Furthermore, it considers four aspects in facial expressions simultaneously: *frequency*, *intensity*, *valence*, and *duration*.

It is easier to have access to software that measures emotions based on facial gestures in comparison to vocal characteristics of behavior, both in academia and industry. One of the challenges of the FACS systems is that they rely on bidimensional data. Therefore, the most recent tools have been improved and expanded with 3D data. The 3D data rely upon video, facial recognition algorithms, and comparison of expressions that have been previously recorded in an extensive database (Cohn, Ambadar, & Ekman, 2007). Examples of tools that were developed based on the FACS model and include 3D data are: *FaceReader* (Den Uyl & Van Kuilenburg, 2005; Lewinski, den Uyl, & Butler, 2014) (see in references under *Noldus. Facial action coding system* (2015) and *BP4D-Spontaneous* (Zhang et al., 2014)).

Facial and vocal information allow behavioral recognition of emotions based on bimodal criteria. The scarce evidence that exists in relation to identifying emotions based on bimodal information indicates that the sum of both aspects delivers better results in comparison to measuring them separately (Busso et al., 2004).

5.3 Body expressions and postures

Bodies, as well as faces, communicate emotions. Research has identified that it is possible to identify the emotions that a person experiences based on what their body communicates, even when the observer cannot see the facial gestures of the experiencer (Oberst, 2014). According to research the development of capacities of expression and recognition of body manifestations seem to be related to facial gestures (Slaughter & Heron, 2004; Slaughter et al., 2004). Research has also identified that there is little

work developed to study body language as a nonverbal means to express emotions. This may be explained because scholars have strongly focused on facial gestures. For example, Van den Stock et al. (2007) and Bernhardt (2010) argue that the undertaken studies that aim to understand body expressions in comparison with those that focus on facial gestures or vocal characteristics are significantly less and they documented only three (Argyle, 1988; Ekman, 1965; Sprengelmeyer et al., 1999). Nevertheless, body manifestations have a high value in understanding the emotions experienced by others, for example, we can infer the emotion that another person is experiencing and the intentions that accompany that emotion.

Another research issue that has been little explored is *emotional body postures* (Mauss & Robinson, 2009; Sprengelmeyer et al., 1999). The existing framework of literature supports the idea that certain postures may interact significantly with specific emotions. Mauss and Robinson (2009) identified two studies that report postures as part of emotional behavior (Stepper & Strack, 1993; Tracy & Robins, 2004). Shame and pride have been associated with contraction and expansion postures, respectively. These examples indicate that body postures also have an impact on expressing and recognizing emotions.

The analysis of the manifestations of particular emotions, including gestures, vocal expressions, and body postures to communicate and recognize emotions, are recurrent in research on emotions. For example, App, McIntosh, Reed, and Hertenstein (2011) argue that basic emotions are related to facial gestures because an individual uses them to communicate with other people and they are also important to survive. Other emotions, such as shame or pride, are associated with the social status of a person in a given context. These emotions involve manifestations that are interpreted by groups of people. Other emotions, such as love, favor touch, which is a clear behavioral expression. Van Gorp and Adams (2012) discuss behavioral reactions, such as approach or avoid, based on the evaluation of the stimuli, if it is pleasant individuals will approach the stimulus and they will reject it if the stimulus is unpleasant.

There are current systems that take advantage of body movements, for example the *VICON Motion System* (see VICON, 2015) is software that captures body movements using six cameras in a tridimensional space. The gained data help identify four emotions with a high level of effectiveness: sadness, anger, joy, and fear (Kapur, Kapur, Virji-Babul, Tzanetakis, & Driessen, 2005). Another alternative was developed by Coulson (2004). This scholar generates 3D computer figures with static postures. Observers identify six basic emotions with a high degree of success from the figures. There is also software that captures movements and compares the information with a large database to identify the experienced emotion (Bernhardt, 2010). The database relies upon previous research on body postures (*corpus of Glasgow, FABO*, and *GEMEP*; see Bänziger & Scherer, 2007; Gunes & Piccardi, 2005; Ma, Paterson, & Pollick, 2006, respectively for more details).

This area of research is promising and some scholars are suggesting that it a new area of study in the field of emotions (De Gelder, de Borst, & Watson, 2015). This indicates that body expressions and postures deliver important information in emotions.

A limited number of emotional measurement systems are based on the body's behavior (or even considered). Measurements based on the body are defined with technologies imported from neuroscience and medicine and with systems that are based on computer media. A limitation of this method is that they are performed in a controlled environment, for example, with a person sitting in front of a camera and a microphone, which limits the body gestures and may increase artificial ones. This also occurs in neurophysiological measurements that place the individual in a seated position (De Gelder & Hadjikhani, 2006). Based on these limitations, Bernhardt (2010) and previously Pantic and Rothkrantz (2003) mention that methods undertaken in controlled environments, tend to deliver "performances" of stereotypical expressions of emotions instead of spontaneous behavioral manifestations that occur in ecological contexts.

5.4 Multimodal methods and systems

The methods and systems that integrate information from more than one of the three behavioral manifestations, that is, gestures, vocal, and body manifestations, are called multimodal. These methods acknowledge that humans recognize and express emotions in an integrated way. Recent studies (De Gelder et al., 2015) suggest that the three manifestations interact together and body postures intensify gestures and vocal manifestations of the experienced emotion. Previous studies (Stekelenburg & De Gelder, 2004) had already reported significant similarities in the way in which gestures and body manifestations are processed. Thus, behavioral methods and systems to measure emotions could aim to integration the various modalities and the context where the emotion occurs (Bänziger & Scherer, 2007). This is in line with Pantic and Rothkrantz (2003), who suggest that automated systems generated to recognize emotions must include visual, auditory, and tactile aspects. They also suggest that behavioral signs should be included to acknowledge the importance of context. However, current studies in emotions tend to focus on one modality. This may occur because multimodal methods are complex. In addition, it has to be defined as the most appropriate way to integrate the different modalities in the evaluation of emotions (Busso et al., 2004).

5.4.1 Vocal and facial manifestations

Research has indicated that it is easier to recognize emotions based on multimodal manifestations (De Silva, Miyasato, & Nakatsu, 1997). For example, in Peter's story, the combination of gestures and vocal expressions helps us to understand the emotion that the kid is experiencing.

De Silva et al. (1997) study the impact that gestures, vocal expressions, and the combination of both manifestations have to identify the six basic emotions defined by Ekman. The scholars edited the vocal expressions and changed them with noncorrespondent expressions. They presented the modified stimuli to a group of participants to identify the levels of recognition of the six basic emotions. Based on the levels of recognition that they obtained, the following conclusions were established: sadness

and fear are emotions in which audio recognition dominates. Joy, surprise, and anger are emotions that are mostly recognized based on gestures. Disgust showed no predominance of any of the two manifestations. These results indicate that the integration of modalities positively influences the recognition of emotions, and that some of the modalities have a particular weight to recognize specific emotions.

In other studies on the subject (De Gelder & Vroomen, 2000) respondents were asked to observe pictures of faces with incongruent vocal expressions. The results of two experiments showed a tendency to evaluate emotions based on the voice tone, even when participants were told to ignore it and focus on the image. However, a third experiment showed an inverse effect, where emotion was evaluated on the face instead of the vocal expressions. This shows that both modalities relate, and have mutual influence, prevailing one or another depending on the situation.

5.4.2 Facial and body manifestations

Sometimes the body movements can be the first parameter to assess emotions and predominate in its manifestation. Nonetheless, in any everyday conversation we note that they emerge together. Even when there is limited physical mobility, for example, by the position of a seated person, arms and hands frequently complement the facial gestures that express our emotions, and often emphasize certain aspects. Recent studies (Aviezer, Trope, & Todorov, 2012) based on pictures of faces and bodies performing day-to-day activities, report that emotions perceived only on facial expressions changed systematically when body expressions were shown. These findings emphasize the importance of the body in the interpretation and expression of emotions.

Gunes and Piccardi (2005) present a proposal to integrate signals from face and body with video clips. They capture gestures and movements at the same time and with different cameras. They later integrate the footage in one video clip. By following this approach, they can train participants to adequately express their emotions in both modes, as separate entities, and in an integrated way. The authors documented improvements on emotion recognition when both modes were integrated instead of using only one modality, that is, facial gestures.

Finally, De Gelder et al. (2015) reported studies that showed that participants made incorrect assessments of anger and fear when the information was inconsistent between face gestures and body language.

5.4.3 Body and vocal manifestations

These two aspects may be felt less connected from each other than facial and vocal manifestations. However, body and vocal manifestation enhanced emotion integration and contribute to its recognition.

Stienen, Tanaka, and De Gelder (2011) suggest that human postures and vocal manifestations influence each other and are independent of gestures. The authors conducted an experiment in which interviewees observed images of bodily expressions of joy and anger with congruent and incongruent vocal manifestations. The images were shown at different periods of time. The results indicated that the congruence between vocal and

body manifestations influences the overall evaluation of the emotion (see Stienen et al., 2011). Previously, De Gelder and Vroomen (2000) in their study on faces and vocalizations mentioned that there were no reasons to believe that body movements and vocal expressions could be related. Recent research suggests that there is a link between these modalities (Stienen et al., 2011; Van den Stock, Grèzes, & de Gelder, 2008).

5.4.4 Facial, body, and vocal manifestations

In addition to the bimodal manifestations, recent research on emotion recognition is developing systems that integrate facial, body, and vocal manifestations. Nelson and Russell (2011) conducted a study with preschool children in which the task was to recognize four emotions, that is, happiness, sadness, anger, and fear. The emotions were shown in different video clips with four conditions: (1) only faces, (2) only body, (3) only voice, and (4) multimodal manifestations. The authors suggest that the recognition of emotions develops first on the basis of visual information (faces and body postures), then integrating vocal manifestations. A second comparison that included adults also evaluated the videos and the results indicated that adults had a high rate of success in general, and almost perfect results with the multimodal clip.

Adult's ability to properly integrate signals from different modalities of behavioral expression in the context of emotional research seems to be consistent. Caridakis et al. (2007) report that the multimodal manifestation systems increase by 10% the success of emotion recognition in comparison to unimodal systems.

There are cases in which scholars aim to integrate the three behavioral modalities in tools and tests, for example the *Multimodal Emotion Recognition Test* (MERT) (Bänziger, Grandjean, & Scherer, 2009) or *MultiMedia-enhanced Affect Semantic Indexing* (SAMMI) (Paleari, Benmokhtar, & Huet, 2009; Paleari, Huet, & Duffy, 2007). Scholars are aiming to integrate the three modalities and this is indicative of the importance of fulfilling this task in the near future.

6 Products and behavioral characteristics of emotions

During the last two decades product developers have started to become interested in human behavior. This may have occurred for at least two reasons. First, there is a shift in design from products and objects to the person who is going to use them. For example, a typical way to design a product was to define its form, manufacturing process, and material selection. Now, designers can intentionally aim to enhance particular behaviors, emotions, or experiences. Secondly, the influence of global problems in the current context has permeated the design disciplines. At present, we know that sustainability is a relevant issue for humankind and designers have reacted accordingly. For example, designers aim to change the behavior of the product or to adapt the product to match current users' behavior (Wever, van Kuijk, & Boks, 2008). For example, it is common for people to use a TV to listen to the news, therefore a new product can be designed to adapt to this behavior by, for example, switching off the screen to avoid the use of extra energy (Rodriguez & Boks, 2005).

Behavior also plays a key role in emotional design. For example, it has been used to justify the inclusion of emotions in design, for example, solutions that trigger positive emotions are consumed more often than those that elicit negative emotions (Desmet, 2012). Designers also aim to improve people's health and to accomplish it they can focus on enhancing a healthy behavior (Ludden & Hekkert, 2014) or making a person feel better, for example, well-being. Scholars have also suggested that emotions are key to stimulating a long-term relationship between users and objects (Chapman, 2005).

Research in industrial design has pointed out the relevance of analyzing emotions to create integral solutions for humans. Considering emotions is beneficial to product design because designers include the human affective side during the design process. The latter, however, involves new challenges. For example, the theory on emotional design is borrowed from psychology (see eg, Norman, 2004). Therefore, designers have to select and adapt the relevant theories to the discipline of design. Furthermore, designers are usually not trained to use complex methods and equipment to measure emotions and they do not have access to it (as neuroscientists or physicians have). Therefore, designers tend to rely upon qualitative methods to study emotions, such as ethnography, observational research, and self-report methods. For example, in 1999 cultural probes were introduced (Gaver, Dunne, & Pacenti, 1999). This tool helps gather insight from the user's perspective. With the collected data designers can emotionally empathize with users. This affective connection may help designers create products that are aligned to human needs.

Behavior is an issue of interest in the field of emotional design. Norman (2004) introduces an emotional model based on three dimensions: *visceral*, *behavioral*, and *reflective*. The visceral level is related to the immediate reactions that we feel with an object. The behavioral is related to the way a person interacts with a product. The reflective level is linked to the thoughts that an object stimulates in a person. Although Norman's theory does not offer a clear guide to implement emotional design in practice, it is a great starting point to discuss and reflect on the role of emotions in user–product interactions. For example, if a mobile phone is difficult to use the user may reject it. Therefore, designers have to focus on the behavioral level to improve the design solution. Another strategy to consider behavior in emotional design was defined by Jacob-Dazarola, Martínez Torán, and Esteve Sendra (2012). These authors suggest a model that includes 16 *interaction situations* that are often established between users and products. They report that interaction is strongly focused on usage, and the overall experience is hardly considered. Therefore, they suggest interaction events, which could be considered "events" in the overall experience, for example, the first contact that a user has with a particular product. The authors also argue that interaction events trigger emotions, for example, in the first contact emotions of surprise or satisfaction may be triggered. These emotions are also accompanied by behavior. The latter is a design opportunity and it can be used by analyzing the 16 interaction events to identify recurrent behaviors that help create integral solutions.

Behavior is also involved when studying emotions in product design. Desmet (2003) for instance, suggested five classes of product emotions: *instrumental*,

aesthetic, *social*, *surprise*, and *interest* emotions. These classes are elicited by different triggers and it is also expected that different behaviors accompanied them. Take for instance aesthetic emotions, which are related to the gratification of the senses (Hekkert, 2006). They delight or offend the senses and this can be reflected on approaching or rejecting the object that triggers the aesthetic emotions.

There is research that aims to develop a thorough understanding of particular positive emotions (Ortiz Nicolás, 2014; Ortíz Nicolás, Aurisicchio, & Desmet, 2013a; Desmet, 2012). By studying emotions based on appraisal structures and thought–action tendencies, it has been possible to identify behavioral tendencies that accompany particular emotions. For example, in the case of confidence, it was identified that a product that enhanced this emotion influences a person to maintain the product. When experiencing inspiration, a person is stimulated to be creative. And when experiencing anticipation, a person is eager to get their hands on the product that triggers this emotion. Designers can define the most relevant emotion for the project at hand by considering the behavior that they aim to stimulate in users.

Behavior is also relevant to measure emotions. Desmet (2002) developed a tool called *PrEmo*. It shows animations of a cartoon character. In each animation, the character expresses 1 of the 14 emotions in approximately 1 second that includes movement, facial expressions and gestures, and sound, for example, voice tone (see also chapter: Emotion-driven Product Design).

Potential behaviors result from human–product interactions when positive emotions have also been identified. In previous research in which two populations (users and designers) were involved and the aim was, on one hand, to identify the potential benefits that users foresee when experiencing positive emotions with a product and, on the other, the reasons that designers have to stimulate positive emotions through a design solution, the following results were indicated: users would like to experience positive emotions because they are pleasant, expected, and indicative of good product choice. Designers, on the other hand, would like to evoke these emotions because they are of interest, appropriate to their designs, and their elicitation is perceived as a responsibility (Ortíz Nicolás, Aurisicchio, & Desmet, 2013b). These results indicate the potential behaviors and motives that users and designers seek when interacting or designing products that elicit positive emotions. The results indicate the relevance to consider positive emotions in human–product interaction.

7 Conclusions

In this chapter we have focused on the behavioral characteristics of emotions and the measurement methods and systems that have been developed based on behavioral manifestations on single and multimodal ways. This chapter offers a detailed review of the state of the art in behavior and emotions. We also discuss the role of behavior in emotional design. A conclusion of this research is that measurement methods that rely upon behavior are incomplete for understanding and identifying the emotions experienced by an individual at a certain time and place. These methods, however, do not necessarily involve technology or questionnaires to identify emotions, and they

can be used in the context in which the event is occurring. Methods that rely upon technology and are used in labs can influence the emotional experience.

We also identified the three behavioral aspects that are involved when experiencing emotions, that is, voice, gestures, and body manifestations have been studied in an unbalanced manner. The three manifestations deliver information that influences emotion recognition and in some cases each manifestation has more weight than the others. In some cases, gestures may be more significant to identify emotions than voice tone, however this is not always the case. It is therefore relevant to consider the three behavior manifestations in the study of emotions.

In line with several scholars, we acknowledge that experiential, physiological, and behavioral measures are all relevant to understanding emotion. It is important, therefore, to acknowledge that methods that focus on one aspect are limited in principle. Furthermore, the components of emotions cannot be assumed to be interchangeable; this is that behavior does not automatically consider the subjective experience and vice versa.

Finally, design relies upon emotional theory developed in psychology; therefore, emotional design is limited to the progress of theory in other disciplines.

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Measuring Emotions in the Face

6

Hyisung C. Hwang[1,2] and David Matsumoto[1,2]
[1]San Francisco State University, San Francisco, CA, United States
[2]Humintell, El Cerrito, CA, United States

This chapter broadly surveys the major methods available for researchers to measure emotions in the human face. We delineate two major ways of understanding facial measurement: direct and indirect approaches. Direct approaches involve direct measurement of the facial muscle movements that are produced; researchers using direct approaches then classify the observed facial configurations as emotional expressions (or other types of classifications) based on a taxonomy or dictionary of sorts. Indirect approaches involve observer judgments of produced facial expressions; the emotions of the expressors are inferred through the obtained judgments (see Fig. 6.1 for an overview).

The most prevalent systems in use nowadays involve direct measurement of facial muscle movements, and these are based on a basic understanding of facial anatomy. Thus, we begin this chapter with a brief discussion of facial anatomy, focusing especially on the morphology of the face that allows for the production of facial movements and behaviors. We then describe the direct methods of measurement, including two major facial measurement systems in use today, the Facial Action Coding System (FACS) and the Maximally Discriminative Facial Movement Coding System (MAX), both of which are anatomically based. As we will see below, FACS is primarily used for adult humans, while MAX is primarily used for infants. We also describe a less prevalent direct approach to facial measurement involving facial electromyography (EMG). When employing direct facial measurement techniques, researchers will need to refer to "dictionaries" or references of some sort to classify the measured facial behaviors as emotional expressions. In doing so, there are multiple approaches, all differing in their definitions of emotion, which emotions are measurable in the face, and their theoretical frameworks. For this chapter, we focus on the measurement techniques themselves. After reviewing the direct methods of measurement, we then review briefly the indirect approaches, including observer judgments and communication approaches. Readers are cautioned that this chapter does not cover automated expression recognition systems as we do not believe they are mature enough for operational deployment at this point, and in any case they are based on anatomical models of the face and its measurement, which we focus on here (interested readers are referred to Buck & Miller, 2016, for a review of automated expression recognition systems). We close this chapter with a detailed example of the use of facial measurement of emotion in applied consumer products research in which we have been involved for a number of years. We hope that this example gives readers a good grounding in the use of facial measurement systems in applied research, as well as a basic understanding of the types of insights that can be gleaned from such research.

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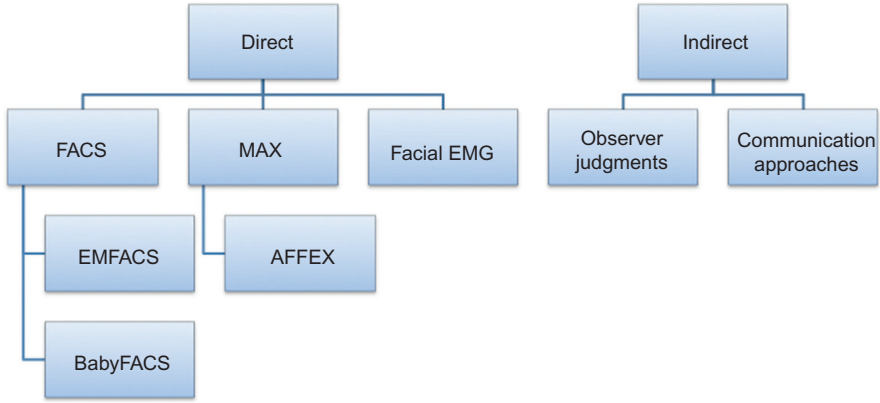


Figure 6.1 Methods to measure facial behaviors and expressions in humans.

1 Basic facial anatomy

As mentioned above, when considering measuring emotions (or any other phenomenon) in the face, it is important to have a fundamental understanding of the morphological structure of the face to know what is moving and what causes appearance changes (ACs); thus we begin with a primer on facial anatomy (much of the writing in the following section comes from Hwang & Matsumoto, 2016). The face is a complex signal system that involves many muscles that can produce many different types of movements and thus ACs. We refer to these facial muscle movements as facial "behaviors" rather than facial "expressions" because the latter term implies that there is a mental state underlying the behaviors that are being expressed. The term facial "behaviors" is more objective and makes no assumptions about such underlying states. Within the vast possible constellations of facial behaviors that can be produced, research has documented the existence of specific facial configurations that do indeed represent expressions of emotional states (see review in Hwang & Matsumoto, 2016). We reserve the use of the term facial *expressions* to those configurations that have been empirically documented to be signs or signals of emotion; some facial behaviors are also signs or signals of other mental states such as cognition as well, and should also be called *expressions*.

Facial behaviors are produced by muscle contractions in the face that move skin. They also change the shape of features, producing ACs in wrinkle patterns, bulges of skin, dimpling, and other observable, rapid signs due to the contraction of the underlying muscles. These muscle movements are known as the morphology of the face (as opposed to the structure of the face and skull, which is known as physiognomy), and facial behaviors are also referred to as morphological changes. There are 20 anatomically independent muscles in the face, all of which are innervated by a single nerve, the VIIth cranial nerve, which originates in the brainstem. There are additional muscles in the head that control movements of the jaw and neck area; these are controlled

by a different nerve (the Vth cranial nerve). The facial muscles are striated muscles, and are some of the only striated muscles in the body that are attached on one side to bone and on the other to skin. Because these muscles only move skin, they are somewhat specialized for communication. The face also includes muscles that are not attached to bone at all.

Although there are 20 structurally independent muscles in the face, they may function independently of each other or as a group. For example, the muscle that runs across the forehead (frontalis) is a single muscle (Gray & Goss, 1966); but it can produce two independent movements—one in the inner corners of the brows (*frontalis, pars medialis*) and one in the outer corners (*frontalis, pars lateralis*). That single muscle, therefore, functions as two separate muscles. The muscles that bring the brows down and together are actually comprised of three muscles (the corrugator muscle group: *corrugator supercilli*, *depressor supercilli*, *depressor glabellae*), even though in adults they only function together. In other words, those three muscles function as one. Regardless, the face can produce literally thousands of different facial behaviors and configurations.

There are individual differences in the presence or absence of some facial muscles, and in the degree of asymmetry in the muscle even if present. For example, zygomatic minor is not present in all humans. However, despite individual differences in the existence of the total number of facial muscles and large asymmetries in muscles, cadaver studies have demonstrated that there is uniform 100% occurrence and minimal gross asymmetry in the muscles that are required to produce what are considered to be the universal facial expressions of emotion (Waller, Cray, & Burrows, 2008). The same facial musculature that adult humans have exists in newborn infants and is fully functional for most individuals at birth (Ekman & Oster, 1979), although some muscles, such as the corrugator muscle group, may require development and/or maturation in order to function together in a coordinated fashion (Oster, 2004).

The VIIth cranial nerve, and thus facial behaviors, are under the neural control of two distinct areas of the brain, which roughly coincide with a voluntarily versus involuntary distinction (Matsumoto & Lee, 1993; Rinn, 1984). The pyramidal tract drives voluntary facial actions and originates in the cortical motor strip, whereas the extrapyramidal tract drives involuntary emotional expressions and originates in the subcortical areas of the brain (Fig. 6.2). The subcortical areas of the brain are those areas that we share with our animal relatives; these areas are concerned with body functions related to fighting, fleeing, feeding, and reproduction. The cortical motor strip is the area of the brain that is unique to humans, and controls voluntary movement. The part of our bodies that receives the largest degree of innervation from this area, and thus which is under the greatest degree of voluntary control, is our hands. The next largest part is our faces, and within the face, our lower face is more highly represented (Rinn, 1984). This makes sense because we learn to use the many muscles we have in our lower faces for eating, speech articulation, and controlling our emotions and words. Therefore when emotions are elicited, spontaneously produced emotional expressions are under the neural control of the subcortical areas of the brain. When individuals attempt to control their emotional expressions, however, those impulses are likely to emanate from the cortical motor strip.

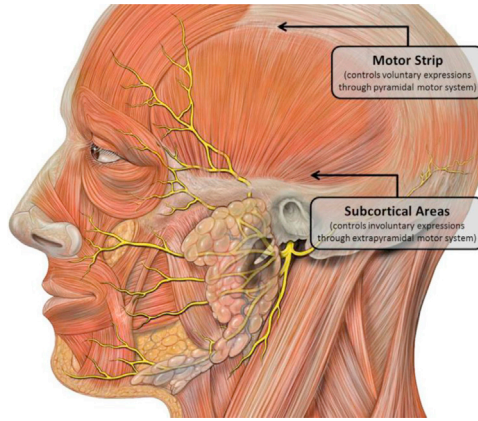


Figure 6.2 Neuroanatomical roots of facial behaviors and emotional expressions. Reprinted with permission: http://commons.wikimedia.org/wiki/Category:Medical_illustrations_by_Patrick_Lynch#mediaviewer/File:Head_facial_nerve_branches.jpg.

2 Direct measurement of facial behaviors and facial expressions of emotion

2.1 The FACS and its derivatives

FACS (Ekman & Friesen, 1978) is an anatomically based system for measuring any and all kinds of visible facial behavior from young children through adulthood. Its precursor was known as the Facial Affect Scoring Technique (FAST; Ekman, Friesen, & Tomkins, 1971). FAST included a photographic atlas that described movements in each of three facial regions: eyebrow/forehead, eyes/lids, and lower face. Coders would view each facial region separately and assign codes to the observable movements defined in the atlas. Ekman and Friesen's (Ekman, 1972; Friesen, 1972) well-known study compared the expressions of American and Japanese participants as they viewed stressful films used an adaptation of FAST that was very close to FACS. FAST and then FACS extended the concept of identifying individual facial movements as "Animation Units" first described by Hjortsjö (1969).

FACS identifies 44 independent, observable movements of the facial mimetic musculature that are called Action Units (AUs). Each AU refers to the most elemental, independent movement of the facial mimetic musculature. Most single facial muscles can move in only one way, producing one AC on the face; each of these is identified by its own AU code. As mentioned above, however, several muscles have different functions. Because the frontalis muscle across the forehead can move both on the inner and outer corners, both of these actions are identified as distinct AUs in FACS (AU 1 and AU 2), even though they refer to movements of the same single muscle. The corrugator muscle group, which lowers the brows and brings them together and is comprised of three muscles, is identified as a single AU in FACS (AU 4), even

though they refer to movements of multiple muscles. Orbicularis oris, the muscle in the lips, can be tightened and tensed, producing one AC (AU 23), or pressed together, producing a different AC (AU 24). For these reasons, AUs are based in functional, not structural, anatomy, and collectively they describe the entire range of all possible movements that can occur in the human face.

FACS coding is entirely atheoretical, and can describe any facial behavior, including emotional expressions, facial gestures, speaking, chewing, or idiosyncratic tics. Coding involves the identification of which facial muscles are innervated based on the physical and visible ACs that occur in the face. (When coding older adults, ACs are identified as those superimposed over already-existing wrinkle patterns.) Coding can also involve the rating of the intensity, laterality, and timing (onset, apex, and offset) of individual AUs. Because any of the 44 AUs can occur independently of each other, and depending on whether each AU is coded for intensity, laterality, and timing characteristics, FACS coding can be comprehensive, complex, and labor-intensive.

Researchers interested specifically in coding for emotional expressions need to take their FACS codes after coding facial behaviors and determine which codes (ie, facial configurations) are associated with emotional expressions. To date there is strong and convincing evidence for the full-face, prototypical expressions of seven emotions: anger, contempt, disgust, fear, happiness, sadness, and surprise (for a review see Hwang & Matsumoto, 2016; see Fig. 6.3). There is also empirical evidence for partial configurations of the full-face prototypes to be signals of these same emotional states (Ekman & Friesen, 1978; Ekman & Rosenberg, 2005; Matsumoto & Hwang, 2014).

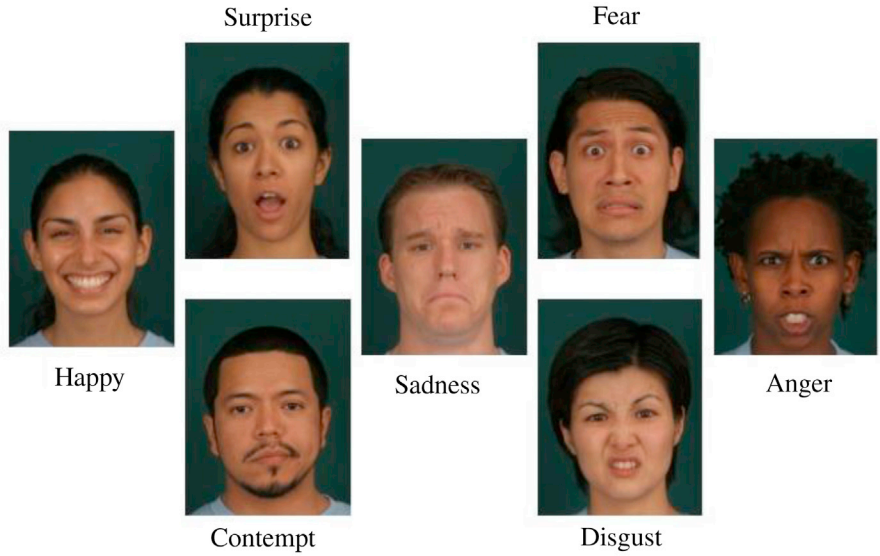


Figure 6.3 The seven universal facial expressions of emotion.
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AU matching is only one of the criteria by which facial behaviors may be considered as emotional expressions; other criteria include timing and laterality characteristics.

FACS coding is time-consuming and laborious because reliable coders should be FACS-certified and ideally have prior experiences of coding, which require detailed review and identification of each facial movement (and thus are costly). The certification process itself can take months of intense study to pass a certification test, and actual coding experience requires frame-by-frame analysis of video, oftentimes making multiple passes to catch ACs in the entire face and to code for intensity, symmetry, and timing characteristics. For these reasons, a number of derivatives of FACS have been developed for researchers solely interested in coding for emotional expressions. For instance, Ekman and colleagues developed an abbreviated version called Emotion FACS (EMFACS; see Ekman & Friesen, 1982; Matsumoto, Ekman, & Fridlund, 1991), which identifies only those AUs that were theoretically (Darwin, 1872; Tomkins, 1962, 1963) or empirically (Ekman, 1972, 1982; Ekman & Friesen, 1971; Ekman, Friesen, & Ancoli, 1980; Ekman, Friesen, O'Sullivan, & Scherer, 1980; Ekman, Sorenson, & Friesen, 1969) related to particular emotions (anger, contempt, disgust, fear, happiness, sadness, surprise) instead of identifying all 44 actions. EMFACS coding, therefore, focuses only on the identification of a smaller set of AUs or AU combinations, and not the entire repertoire of possible facial behavior, resulting in a more time-efficient coding procedure.

Although all of the facial musculature in the human adult exists and is fully functional at birth (Ekman & Oster, 1979), infant faces differ from adult faces in several ways, such as in the proportions and dimensions of the bony structures of the face, fat deposits, and elastic skin, and in the presence of specialized features, such as the sucking lip and buccal sucking pad (Oster, 2005). For these reasons, the ACs produced by facial movements in infants differ slightly from those that occur in adults; as with older adults, coding of infant faces must be done by identifying ACs that are superimposed over existing appearance. Thus, Oster (2004) has produced a modified version of FACS specialized for use with infants called BabyFACS.

Because FACS (and BabyFACS) coding is atheoretical and can describe any facial behavior in humans, ethologists interested in nonhuman primate facial expressions have used FACS as a basis to develop measurement systems in nonhuman primates as well. For years ethologists have noted the similarities between human emotional expressions and nonhuman primate expressions displayed in similar contexts (Chevalier-Skolnikoff, 1973; Geen, 1992; Hauser, 1993; Liebal, Pika, & Tomasello, 2004; Redican, 1982; Snowdon, 2003; Ueno, Ueno, & Tomonaga, 2004; Van Hooff, 1972). Previous research in this area, however, was limited because there was no method of objectively identifying nonhuman primate expressions; expressions that appeared alike were merely described and classified by researchers according to their overall appearance. Despite equivalence in morphological descriptions of expressions, what was needed was an objective, functionally anatomically based system of identifying morphological changes in nonhuman primates. Thus, a chimpanzee version of FACS (ChimpFACS) was developed that allows for identification of the specific facial muscle movements chimpanzees use in producing facial expressions. Chimpanzees have a functional facial musculature that, although not as differentiated

as that of humans, includes the same muscles that are used in human emotional expressions (Bard, 2003; Burrows, Waller, Parr, & Bonar, 2006). The chimpanzee facial musculature produces many of the similar ACs as does the human musculature, according to a comparison of the human and chimpanzee versions of the FACS (Vick, Waller, Parr, Pasqualini, & Bard, 2007). The most recent work in this area has also produced a FACS that can be used with orangutans (Caeiro, Waller, Zimmermann, Burrows, & Davila-Ross, 2013) and gibbons (Waller, Lembeck, Kuchenbuch, Burrows, & Liebal, 2012).

FACS is widely acknowledged as one of the most comprehensive and objective systems available. To our knowledge there has never been a published critique of it as a methodological system to measure facial behaviors. Formal psychometric evaluations of FACS have reported good to excellent reliabilities in the occurrence, intensity, and timing of individual AUs and for corresponding measures of emotion configurations across different emotion-eliciting techniques (Sayette, Cohn, Wertz, Perrott, & Parrott, 2001). Across three experiments that involved the FACS coding of the spontaneous expressions that were elicited, the reliability between two independent coders was nearly 90% for all AUs.

2.2 The MAX and System for Identifying Affect Expressions by Holistic Judgment

MAX is another anatomically based system to measure facial expressions of emotion (Izard, 1983, 1995). It is based on the identification of 30 ACs that can occur in three regions of the face: forehead/eyebrows/nasal root, eyes/nose/cheek, and mouth/lips/chin. While FACS was developed primarily for use with adult humans, MAX was developed for use with infants, based primarily on observations and video records of infant facial behavior in response to 20 stimuli. All the practice material for obtaining reliability consists of video or DVD records of infants' facial behaviors and expressions.

Coders make three passes through videos, coding each of the separate facial regions for ACs in a frame-by-frame fashion, assigning a number that represents the identified muscle action. The identified codes/muscle actions are then compared to a listing with the "hypothesized signal value" of the AC or combination of ACs. The combinations of ACs hypothesized to signal emotion are based not only on research with infants but also on cross-cultural research with adult humans (Izard, 1971, 1994). In addition to identifying emotions of enjoyment, surprise, sadness, anger, disgust, contempt, and fear that are unique to infants, MAX also identifies AC combinations corresponding to interest, shame, and pain. MAX is unique in that it is the first objective and anatomically based facial movement coding system to identify the expression of interest and to show that it is not altogether identical with adult expressions of interest (Langsdorf, Izard, Rayias, & Hembree, 1983; Silvia, 2006). It is also unique in identifying infant pain expressions as different from adult pain expressions (Izard, Hembree, Dougherty, & Spizzirri, 1983; Izard, Hembree, & Hueber, 1987).

MAX is based on the premise that discrete basic emotions emerge in synchrony with maturation of the underlying neural substrates and the demands of the

environment (Izard et al., 1995). That is, discrete emotion expressions emerge in ontogeny when they have a high probability of serving adaptive functions. The MAX system (and most developmental psychologists) does not contend that the emotional expressions seen in human adults emerge full face in the first months of life. Some do and some do not (Izard et al., 1995). Fear, for example, does not appear to emerge in early infancy. Interest, however, does appear to become functional in the first hours or days of life (Langsdorf et al., 1983).

Because MAX coding is laborious and time-consuming, similar to FACS coding discussed earlier, Izard and colleagues developed System for Identifying Affect Expressions by Holistic Judgment (AFFEX), or System for Identifying Affect Expressions by Holistic Judgment (Izard & Dougherty, 1980). AFFEX was based upon the premise that facial expressions could be measured by observer judgments, and that judgments of facial expressions could be improved by brief training, not certification required like FACS coders. Judges are trained to observe the whole face, identify discrete facial cues, their temporal sequence and duration, and to label the emotion directly by comparing the observed facial cues with a set of known cues for specific emotions. Unlike MAX, AFFEX requires integrating information from the whole face, utilizing holistic judgments based on simultaneously observing movement patterns in all areas of the face. A similar approach using the FACS/EMFACS system was developed as the Emotional Expressive Behavior (EEB) Coding System (Gross & Levenson, 1993).

2.3 Facial EMG

Another way to measure facial behavior directly is through the use of EMG recording. Researchers using facial EMG place electrodes on the skin of the face in the area of the muscle they intend to measure, and the electrodes detect minute electrical discharges from the muscles that are produced when innervated. The discharges are recorded and synchronized by other equipment to which the electrodes are attached. For this reason, facial EMG can detect very slight innervations of muscle activity, even those that do not result in observable changes in expression; this is clearly an advantage of this system over those based on visibly observable ACs. (There are, of course, important questions concerning the signal value of such muscle innervations, and the stimulus source that produced them.) Facial EMG also requires no coders; data are available immediately at the conclusion of recording, although often subjected to postcollection signal processing.

But there are limitations to the use of EMG as well. Facial EMG is cumbersome; facial skin must be prepared, paste that improves conductance is often applied to the electrodes, and electrodes with leads must be placed on the face. For this reason, it is impossible to attach leads to all of the possible muscles that may be involved in an expression, and most studies involve the measurement of only one to three muscle sites, and oftentimes only on one side of the face. This may draw attention to the face and produce demand characteristics. Unilateral measurement is limited because, as noted above, spontaneous emotional expressions are bilaterally displayed, with the exception of expressions of contempt (Darwin, 1872; Matsumoto & Ekman, 2004).

Moreover, facial EMG cannot measure the activity of single, independent muscles precisely. Facial EMG samples muscle *regions*, not specific muscles. Fridlund (1991) noted that

> *The facial EMG technique does not sample muscular behavior strictly confined to the single muscle underlying the electrodes (e.g., the zygomatic major). The detection region is diffuse and susceptible to the actions of adjacent muscles (Fridlund & Fowler, 1978).*
>
> *Fridlund (1991, p. 231).*

This is important because studies examining whether or not specific facial expressions occur when emotions are aroused need to involve the measurement of specific mimetic facial musculature. For instance, electrodes placed at the corners of the lips may detect innervations of zygomatic major, buccinator, triangularis, or risorius. But each is associated with different emotions: zygomatic with joy, buccinators with contempt, triangularis with sadness, and risorius with fear. Likewise, an EMG placement on the corrugator muscle group would detect activity regardless of whether the corrugator was involved by itself (possible anger), or with inner frontalis (possible sadness).

3 Indirect methods of measuring facial behaviors

3.1 Observer judgments

Another method for measuring emotional displays involves observer judgments, in which expressive behaviors are shown to observers who are asked to rate the expressions on emotion scales, or to classify the expressions into emotion categories. This method produces data concerning the signal value of emotional expressions. They are limited, however, because they cannot indicate exactly what facial behavior is occurring to produce the judgment. A judgment of happiness, for example, is likely in relation to both enjoyment and nonenjoyment smiles despite the fact that only enjoyment smiles (with the Duchenne marker—orbicularis oculi) have been theoretically and empirically linked to enjoyable emotions (Frank, Ekman, & Friesen, 1993). There probably are good socio-evolutionary reasons why non-Duchenne smiling is judged to be a sign of positive emotion; but clearly the expressions are different and research shows that Duchenne and non-Duchenne smiles create different impressions on the judge even when the lip movement intensity is controlled (Frank et al., 1993). Likewise, it is very possible that each emotion, even if displayed in the face, involve different variants. Anger, for instance, can be conveyed by a raising of the upper eyelid or a tensing and lowering of it, along with the lowering of the brows (Matsumoto, 1989). Yet these are clearly different expressions. Observer judgments will not parse which expression actually occurred, but can give information about what emotions observers think an individual is expressing. If the research question is about such inferences, which is not about facial measurement per se, then observer judgments may be an appropriate method to consider.

3.2 Communication approaches

A final approach to facial measurement we review here focuses on the communicative aspect of emotional expressions (which is related to observer judgment techniques reviewed immediately above). The dominant way of measuring emotional communication is by using a paradigm known as the Slide Viewing Technique (SVT; Buck, Miller, & Caul, 1974; Buck, Savin, Miller, & Caul, 1972). In the original SVT, expressors view a series of emotionally laden images while their facial behaviors are video-recorded. Expressors also rate the emotions they actually felt after viewing each image. The video-recorded images of the expressors are shown to observers who make two judgments: (1) what was the content of the image the expressor saw and (2) the expressor's emotional response to the image. Several different types of measures of emotion communication can be derived from these procedures. A "percent correct measure" is the percentage of slides observers correctly categorize according to what the expressors actually saw. Another measure is the "emotion correlation measure," which is the correlation between the observers' ratings of the expressor's emotion and the expressor's own ratings. Across multiple observers, an individual expressor's sending accuracy can be determined as that expressor's tendency to send accurate nonverbal emotional messages across observers. Likewise, across multiple expressors, an individual observer's receiving ability can be determined as that observer's tendency to accurately judge nonverbal emotional messages across expressors. The SVT has been widely used in studies with adults, children, individuals with brain damage, and individuals with various psychopathologies (for a review, see Buck & Miller, 2016).

3.3 Summary

Each of the methods described above for measuring facial expressions of emotion has its advantages and disadvantages. In our opinion, if the goal of a study is to examine whether or not discrete facial expressions occur when emotions are aroused, then the best options to consider are those that involve direct measurement of the musculature that produce expressions. Observer judgments or communication approaches cannot do so because they do not provide information about what specific facial muscles are innervated. Although facial EMG involves direct measurement of muscle activity, it too is limited because of the small number of measurable sites, possible demand characteristics, and crosstalk among adjacent muscles. FACS and its derivatives and MAX/AFFEX offer the best technical solutions to the problem of identifying the facial behaviors that may occur when emotions are aroused, because they directly measure the activity of specific facial muscles. If the facial behaviors to be coded come from adults, FACS may be the better solution; if the facial behaviors come from infants, MAX or BabyFACS is the solution. If the goal is to measure any kind of facial behavior, regardless of whether it is related to emotion signaling or not, then FACS is the preferred solution.

One perceived limitation of direct facial measurement techniques concerns the number of emotions that can be coded. FACS can code emotions such as anger,

contempt, disgust, fear, happiness, sadness, and surprise. MAX codes those as well as interest, shame, and pain. Although these appear to be a fairly limited set of emotions, however, it is important to note that these emotion terms refer to categories of emotion, not single emotions. Within each category, there are many variants of that category that differ essentially by intensity or the situation that elicited it. The anger category, for example, contains not only anger but also mad, enraged, hostile, pissed off, annoyed, and other synonyms of anger. Facial coding of the anger category captures all these variants of anger, as it does for the variants of all the listed emotion categories. Thus facial coding can actually capture a wide range of emotional states of the emotion categories listed above.

As discussed above, various measurements already exist to understand facial expressions and many researchers still continue to develop the quality and accuracy of the measurements. All of the efforts and endeavors are certainly valuable to the field of measurement of facial expressions. However, in the meantime it is true that researchers still struggle from developing a perfectly accurate assessment and measurement of facial expressions related to emotions. To improve its preciseness and sensitivity, more empirical data across cultures, ethnicities, and ages is necessary. Also, as we mentioned above, we focused on the emotions that have been proven as universally expressed and identified in many researches. However, there are other emotions that are more socially cultivated and communicated uniquely. Creating measurements of facial expressions of such emotions would be an interesting topic for future research.

4 An example: measurement of facial expressions of emotion in consumer research using FACS-based systems

In this section we provide an example of using facial measurement to assess emotions in applied consumer products research. Gauging emotional reactions is a cornerstone of consumer research, and the ability to do so accurately can mean the difference between huge profits or loss. Until recently the most common way emotions were assessed was by self-reports (Batra & Holbrook, 1990; Richins, 1997). But self-reports are known to be unreliable and affected by many factors that confound their interpretation (Holbrook & Batra, 1987, 1988) because self-reported information can be influenced by demand characteristics, subjective bias, and social desirability, rather than reflecting the actual experience and feeling at that moment. For that reason researchers in many applied areas have turned to biometric markers of emotional states to provide better, more objective measures of consumers' emotional reactions. Facial expressions are one such type of marker, and as discussed above are well grounded in decades of research. We believe that facial expressions of emotion have consistently been shown to be the most valid markers of momentary, transient emotions to date as the facial expressions are objectively observable (Ekman, 1993). We have been heavily involved in the application of facial measurement of emotion

in a major consumer products company in the past, and in this section we provide examples and insights from that multiyear project. For the purposes of this chapter we summarize findings across multiple studies conducted over several years (interested readers are referred to Matsumoto, Hwang, Harrington, Olsen, & King, 2011, for a full description of the studies).

4.1 Brief methods

Across the various studies, we analyzed the facial behaviors of 119 females who were recruited to participate in separate studies designed to examine their reactions to products, concepts, usage, or television ads. The products studied came from four product categories: beauty care, personal grooming, household care, and health care. Individuals participated in interviews or focus groups that lasted between 1 and 2 hours, and were videotaped interacting with the product and then talking about their reactions to the product with the researchers or with others. We focused our analyses, however, exclusively on the consumers' immediate reactions to the product, concept, or ad while they were actively engaged with it, and for a period of approximately 30 seconds after engagement while they were asked questions about how much they liked it. Thus the sampling window was typically a minute for each consumer.

We coded their facial expressions using an abbreviated version of the FACS, focusing solely on those AUs that have been theoretically or empirically related to emotion signaling (Matsumoto & Hwang, 2014; Matsumoto, Keltner, Shiota, O'Sullivan, & Frank, 2008). All coded AU combinations were then compared to the EMFACS dictionary to obtain emotion classifications (Ekman & Friesen, 1982; Matsumoto et al., 1991). We also coded for the intensity of each of the AUs on a 5-point scale (A through E). Expressions of anger, fear, sadness, and surprise can occur in either full or partial expressions. Full-face expressions are those in which AUs related to the emotion occur both in the upper and lower parts of the face; in partial expressions, emotion AUs occur in either the upper or lower face. Thus these expressions were further classified as either full or partial. Contempt and disgust can be signaled by only a single AU, and thus were not differentiated. We also differentiated between true enjoyment smiles and nonenjoyment smiles. As there is only a single facial configuration associated with these smiles, they were not differentiated according to full or partial expressions.

Video was recorded at 30 fps, and the start and end time of each AU and expression were recorded to the frame. An expression duration variable was computed by taking the difference between the two, and expressed in seconds.

We assembled all of the FACS codes and emotion classifications across all consumers and studies into a single data set, with facial event as the unit of analysis. Because an individual contributed more than one facial event, the data set violates assumptions of independence of the data, and readers are cautioned to interpret the findings presented with this caveat. The final data set included 2986 events and 8102 FACS AUs; the variables included for each event were individual FACS AUs that were coded, emotion classification of the event, expression intensity, full or partial classification, and expression duration.

4.2 Sample results

4.2.1 Emotion classifications

One of the main questions of this research was to examine exactly which types of emotions consumers typically displayed (and thus probably experienced) when interacting with the products. Despite the intent of product developers to elicit happiness in their consumers, the most frequently occurring expressions were surprisingly disgust, nonenjoyment smiles, anger, and contempt (Table 6.1). In fact, disgust, contempt, and anger accounted for 52.50% of all expressions, and it is interesting to speculate why they occurred so frequently. Nonenjoyment smiles occurred much more frequently than enjoyment smiles (26.55% vs 3.60%).

4.2.2 Expression intensities

The vast majority of the expressions were at C level or below (92.47%). Given that B level intensity refers to the minimum threshold when an AU is identifiable and C level intensity refers to a moderate-intensity level, these findings indicated that most of the emotional expressions that occurred in the research were of low to moderate intensity. Enjoyment smiles were most intense, followed by nonenjoyment smiles, fear, and anger, and then surprise, contempt, disgust, and sadness.

4.2.3 Full versus partial expressions

We compared the frequencies of partial and full-face expressions by the four emotions for which this classification was meaningful (anger, fear, sadness, and surprise). Almost all (96.77%) of the expressions were classified as partial expressions.

4.2.4 Expression duration

The mean duration across all expressions was 1.48 seconds, which is commensurate with the average lengths of expressions found in previous research (0.5–4 seconds; Ekman,

Table 6.1 Frequencies, percentages, and durations of the emotion classifications

Emotion	Frequency	Percentage	Duration (s)	% of time the emotion blended with nonenjoyment smile
Disgust	828	28.18	1.20	5.67
Nonenjoyment smiles	780	26.55	2.20	
Anger	456	15.50	1.00	9.65
Contempt	334	11.35	1.10	2.10
Fear	238	8.09	1.40	9.66
Surprise	199	6.76	1.30	16.08
Sadness	141	4.79	1.10	16.31
Enjoyment	106	3.60	1.90	

1993). They ranged from as short as 0.03 seconds to as long as 27.10 seconds. The latter figure, however, was associated with nonenjoyment smiles. Nonenjoyment smiles had the longest durations, followed by enjoyment smiles, and then all other emotions.

4.2.5 Blends involving nonenjoyment smiles

Of the total 780 times nonenjoyment smiles occurred in the entire data set, they appeared blended with other emotional expressions 176 (22.54%) times, often to soften the expression or to convey the target emotions in a polite, socially appropriate manner. Nonenjoyment smiles co-occurred with sadness and surprise 16% of the time, and with anger and fear almost 10% of the time.

4.2.6 Differences among product categories

There were no differences in the expressions as a function of product category or assessment type.

4.2.7 Differences between self-report and facial expressions of emotion

We were very interested in examining the correspondence between what consumers said about their reactions to the products and what they actually showed on their faces. One reason for doing so was our belief that facial expressions of emotion could be combined with verbal self-reports to scale those self-reports up or down depending on whether the facial expressions were congruent or not with the self-reports. That is, a consumer who says she likes a product would scale higher if she smiled compared to if she had a neutral face or showed some other negative emotions. Thus we computed the number of times the facial expression was congruent or incongruent with the verbal self-report given at the time the face was measured. The face and verbal self-reports were *in*congruent with each other a full 61% of the time, indicating that what the consumers said about their affective reactions was not supported by the observable measurement of their emotional states. This discrepancy suggests that their evaluations, if positive in their self-reports, were likely qualified by the nonpositive emotions expressed in their faces.

4.3 Summary

Facial measurement provided a valuable means of gaining insight into the world of consumer emotions. The emotion classifications produced went far beyond simple pleasant–unpleasant valenced views of emotion; instead, facial measurement produced potentially important information concerning specific, discrete emotions, including anger, contempt, and disgust.

Even though most product companies are interested in positive emotions, those were sparse, while the relative frequency of negative emotions such as anger, contempt, and disgust was large, calling into question a common view of consumer

research as one of maximizing pleasure and enjoyment. Instead, the findings strongly suggested that engagement with consumer products is not so much about being happy by maximizing pleasure, but gaining satisfaction from minimizing displeasure. In fact, many common household products (eg, diapers, household cleaners, shampoo) are created as much for avoiding or eliminating negative emotions (eg, associated with filth) as they are to produce a positive feeling. Thus it makes sense that negative emotions were displayed as frequently as they were in our samples when discussing common household products. That there were no differences in facial expressions as a function of product category also is consistent with this interpretation. Whether the same would occur with other product categories that are designed to elicit positive feelings, like foods or beverages, is an empirical question that can be addressed in the future.

Many smiles that did occur were nonenjoyment smiles. These were signs of desiring to appear pleasant or sociable, and *not* signs of true enjoyment. They may have occurred because of the very social nature of the interviews, and because of the relatively high frequency of negative emotions. That is, consumers likely expressed their negative emotions to the interviewers, who were essentially strangers, together with nonenjoyment smiles to appear to be pleasant and nonoffensive. Naïve observers may not be able to tell the difference between enjoyment and nonenjoyment smiles, which may lead some product researchers to believe unwittingly that consumer participants had more positive reactions than they actually did. Thus it becomes very important for researchers to be able to distinguish smiles of true enjoyment from the polite, social smile, if they want to get an accurate read of consumer reactions.

The expressions that occurred were very subtle, being of low to moderate intensity, occurring only in part of the face and generally for only 1 or 2 seconds. If researchers wish to leverage the information about emotions displayed by faces, they need to start with the assumption that the displays will not be full-face, high-intensity prototypes of universal facial expressions of emotion. Indeed, the same emotion can be displayed in a variety of ways, some not obvious to the naïve observer, and these subtle expressions need to be taken into account when looking for emotions in the face.

These findings demonstrated the potential utility for using facial expressions of emotion as markers in consumer research, and suggested that the emotional landscapes of consumers may be different to what is commonly thought (at least for the product categories studied). These findings also begged the question of what the source of the various observed expressions was. Expressions tell us that an emotion is occurring, but they do not tell us what they are referring to. Consumers may have had those reactions toward products, or toward the interviewers, or the procedures, or the very fact that they were in the study. Consumers may have also been displaying their emotions referentially, while talking with the interviewer about their previous or hypothesized future experiences with other products. Consumer researchers need to be careful in their methods to be able to parse out this emotional world carefully.

Consumers are not simple automatons who either liked or disliked products, as they displayed all of the seven universal emotional expressions and nonenjoyment smiles. They, like all people, are varied individuals who come to the research with a

myriad of life experiences, reactions, and biases. They animate their verbal reports and color their experiences with different emotions. Consumer researchers who want to capture the emotions of consumers toward products have a tough job, as they need to navigate, parse, and make sense of a complex emotional web that consumers weave about products.

5 Conclusion

Facial measurement offers consumer researchers, and all researchers interested in facial behavior and emotional expressions, with one of the best ways of tapping into the hidden world of people's unconscious thoughts and feelings. At the same time, however, we hope we have shown that approaching facial measurement is not easy, and it is fraught with many difficulties (eg, training and certifying human coders, analyzing facial expressions frame by frame, setting up videos and utilizing research methodologies to capture facial movements validly). These difficulties start with having experimental protocols and procedures that can cleanly parse the delicate emotional world of consumer participants and isolate the source of emotional reactions when they occur. Participants can have emotional reactions not only to products, but to the research process, environment, and/or even the behaviors of the experimenters. Thus ample consideration needs to be given to these potential sources of emotion elicitation.

Once facial behaviors are video-recorded, researchers have choices of facial measurement. Our preference is with FACS, as we believe FACS to be the best, objective system for measuring any facial behavior. Yet, as discussed above, it is extremely time-consuming and laborious, and many researchers (and companies) do not wish to spend time and resources on costly coding, which is why many search for automated solutions. Yet, as we mentioned at the outset of this chapter, we do not believe that as of now reliable automated solutions exist that can assess the complexity and sophistication of facial expressions actually produced by participants in research. The data we presented above attest to that, as no automated system can produce the type of nuanced findings reported above. And there is a good argument to be made for any researcher or organization interested in truly understanding the emotional reactions of their participants to at least initially obtain full FACS coding so that one gains perspective on the universe of behaviors one is dealing with.

Other difficulties exist vis-à-vis measuring facial expressions of emotions accurately. It is not easy to analyze emotions on faces across ethnicities as some ethnic groups have slightly different facial structures and baselines. For example, Asian upper faces are less easy to detect the intensity and ACs of certain muscles (eg, FACS AUs 5, 7) compared to European upper faces due to the different bone and skin features. Despite these types of difficulties, many researchers have conducted cross-cultural studies in facial expressions of emotions and have accumulated empirical data indicating the similarities in certain emotional expressions depicted on the face across multiple ethnic/cultural groups. Continued research across ethnicities, cultures, and ages is crucial.

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Lists of Emotional Stimuli

7

Daniel Grühn and Neika Sharifian
Department of Psychology, North Carolina State University, Raleigh, NC, United States

To advance our understanding of emotion or emotional processes, researchers have developed different lists of emotional stimuli. Research on emotion has made substantial strives based on the availability of these lists of emotional stimuli; in particular, standardized sets of words, images, faces, and film clips facilitated emotion research by allowing researchers to select appropriate stimuli and to compare findings across laboratory settings. In the early years, the primary purpose of constructing these lists was to get an idea of the structure of emotion. For example, Osgood and his colleagues (Osgood, 1952; Osgood, Suci, & Tanenbaum, 1957) used a list of opposing affective terms (eg, hot–cold) to arrive at the underlying emotional dimensions that they termed evaluation, activity, and potency. Nowadays, we typically label these dimensions as valence, arousal, and dominance, respectively. These initial attempts at deriving the structure of emotion were complemented by developing new assessment methods for different affective dimensions. For example, one widely used assessment method is the Self-Assessment Manikin (SAM), a picture-oriented instrument developed by Lang and colleagues (Bradley & Lang, 1994; Lang, 1980). The SAM was constructed as a nonverbal instrument to assess the dimensions of valence, arousal, and dominance based on the graphic depiction of manikins. It is probably the most widely used assessment method for evaluating emotional material.

Modern lists of emotional stimuli are, in contrast, primarily utilized for having a standardized set of stimuli with corresponding norms that are easy to use and easy to reproduce by other researchers, that is, modern lists provide a standard set of stimuli to compare and to evaluate the work of others. These lists provide a major advantage for emotion research in making findings comparable across studies. For example, if researchers use images from a published list, they can specify the image number for replication rather than having to provide all the images. This advantage can also be a major drawback: Using standardized lists of emotion stimuli assumes that the established norms of those lists are actually accurate or up-to-date. If norms were wrong or outdated, many studies would base their selection of emotional stimuli on the same wrong or outdated evaluations. It is, for example, easy to imagine that evaluations of emotional images provided by participants in the 1970s or 1980s differ from evaluations provided by participants in the more recent past. An image of the original World Trade Center in New York will probably be differently evaluated before 9/11 and after 9/11 in its emotional connotation. Most likely, if asked before 9/11, participants would probably have rather neutral evaluations of this image; whereas if asked after 9/11, participants might have more negative associations due to the terror attack, which might actually fade over time as the memory of the event fades away. Thus, the meaning of individual images may shift and past established norms might no longer accurately reflect the emotional connotation in the present. Additionally, an image of

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the original World Trade Center in New York would probably be evaluated differently by participants in the United States compared to participants living in China due to different contextual knowledge and historical associations with the image. That said, norms of emotional stimuli are embedded in a cultural and historical context and may not generalize to other cultural and historical contexts. Despite this drawback, modern lists of emotional stimuli provide a major advantage for researchers in many different contexts. It even gives researchers the tool—a standard—to evaluate whether norms changed over historic times (however, we are not aware of research that has done that) or whether norms systematically differ between groups.

In this chapter, we will review some major lists of emotional stimuli for words, images, faces, and film clips. In this context, we use the term "list" rather broadly to indicate a collection of stimuli. We wrote this chapter to provide researchers who are interested in utilizing emotional stimuli for experimental settings with a quick overview of different lists. Thus, our comments focus on aspects that might be relevant for researchers in making decisions about the type of emotional stimuli.

1 Comparing different types of emotional stimuli

A crucial decision for researchers in designing experiments is the choice of a specific type of emotional stimuli, that is, whether words, images, faces, or film clips will be used as emotional material. In some cases, the decision is obvious depending on the research question. If a researcher is interested in emotion recognition in facial expressions, the type of stimuli is already determined. In other situations, the decision is less obvious. If a researcher is interested in doing research on emotional memory, there is flexibility in the utilized material. Many emotional memory tasks use images or words as to-be-remembered material. But what criteria could be used to make an informed decision about the type of emotional stimuli, that is, whether it should be words or images? To make this and similar decisions easier, we propose to consider the Emotion Matrix of the emotional stimuli. The Emotion Matrix is a graphical representation of five crucial characteristics of emotional stimuli: (1) ecological validity, (2) temporal resolution, (3) controllability, (4) complexity, and (5) emotional intensity. The Emotion Matrix provides a representation of the expected range of stimuli in a stimuli category, such as words or images, on these five characteristics. We have found in our own work (Grühn & Scheibe, 2008; Grühn, Smith, & Baltes, 2005; Kunzmann & Grühn, 2005) that we frequently considered these five characteristics in the selection and decision process for emotional stimuli.

Ecological validity refers to how similar the emotional reaction is to real emotional experiences in everyday life. This characteristic assumes that most emotional experiences are embedded in a larger context of triggering the emotional episode. For example, imagine that when you first moved in with your long-term partner, your partner agreed to be responsible for washing the dishes. However, over the next few months, you continually have to remind your partner to wash the dishes. The next day you come home to find a sink full of dirty dishes, and your partner sitting

in the living room playing video games. You would appropriately become very angry about your partner's lack of participation in cleaning the house. This whole episode is embedded in the larger context of how you and your partner divided responsibilities and what expectations for the situation are. For example, you would probably not be angry if your partner would do the dishes all the time, or if you knew that your partner had a miserable day at work and just needed a few minutes to relax before doing the dishes. The contextual information that makes emotions meaningful to us is typically lost when using highly standardized emotional stimuli. Thus, most types of stimuli are rather at the low end of ecological validity than on the high end. *Temporal resolution* indicates the time it takes to process (or to use) the emotional stimuli. High temporal resolution refers to stimuli that can be processed very fast; low temporal resolution refers to stimuli that require more processing time. Typically, more processing time indicates that more context information is provided and is required to be processed in making the stimulus meaningful. *Controllability* refers to how easy or difficult it is to control stimuli in experimental settings. This includes the control of different potential confounding variables. For example, different word characteristics (eg, word frequency in common language) are relatively easily assessed and can be used to match different groups of emotional words (eg, matching positive and negative words on word frequency). Film clips, in contrast, provide an abundance of information that is difficult to control. Thus, controllability incorporates the idea of how easy it is for a researcher to ensure that findings are due to the desired effects rather than some arbitrary variable. In that sense, controllability encloses the idea of internal validity. *Complexity* is nearly the opposite of controllability. Complexity refers to how complex this type of emotional stimuli could be. Low complexity refers to stimuli with few aspects; high complexity refers to stimuli with many aspects. Given that very complex stimuli are also difficult to control in experimental settings, complexity and controllability tend to go in opposite directions. Finally, *emotional intensity* refers to how intense the emotional response could be that is elicited by the stimulus. Some stimuli, such as words, elicit rather low emotional reactions. It seems rather difficult to design an experiment with emotional words to elicit strong emotional reactions, such as crying during the experiment. On the other hand, film clips provide contextual information to allow participants to experience rather strong emotional reactions. As such, it is much more likely to observe emotional expressions of experiencing an emotion in participants viewing film clips than in participants viewing words.

For each of the following types of emotional stimuli—words, images, faces, and film stimuli—an emotion matrix is presented. Please note that the depicted emotion matrices provide only a rough portrait of these five crucial characteristics. Unfortunately, little research has been conducted in comparing different types of stimuli directly. Thus, the emotion matrices are based on our experience of working with these types of stimuli rather than based on empirical research. We hope, however, that the emotion matrix might be helpful in guiding researchers in their decision process and it might elicit more research on comparing different types of emotional stimuli in the future.

2 Emotional words

Emotional words are frequently used in emotional research settings, especially for research on memory, attention, priming, impression formation, and product evaluation. Fig. 7.1 shows the Emotion Matrix for words. Dark areas represent the expected range of word stimuli on the five characteristics. Words have major advantages for experimental designs. Words have a high temporal resolution; thus, persons can process the emotional content quickly. This either means that experiments—all other things equal—can be designed to be relatively brief in duration or that experiments can include many word stimuli to obtain improved estimates of the expected effects. Words are also relatively simple stimuli in terms of the contextual information provided to elicit an emotional response. Given that other word characteristics can be readily assessed, it is easy to control words for potentially confounding variables. This property makes words ideal for controlled experimental settings. There are, however, two drawbacks for emotion research: Emotional words provide low ecological validity and low emotional intensity. Words are stripped of context creating some ambiguity in the meaning of the word and words typically do not provide enough information to elicit strong emotional reactions. If they do, the context for the emotion is typically not provided by the word itself but by the participant. For example, a word recall task may include "baby" as a to-be-remembered word but unknown to the researcher, a participant had a spontaneous abortion and shows strong emotional reactions to this particular word. The participant brings the context for the emotional episode and the word triggers the person-specific context in creating an emotional reaction. Thus, the emotional aspect of words is often in the eye of the beholder rather than in the word itself. In normal experiment settings, such situations should occur at random and should cancel each other out over a larger pool of words and participants. One could, however, also take advantage of this property of words that they could mean different things to different persons: For example, by extending the example above, one could design a study with childless women consisting of

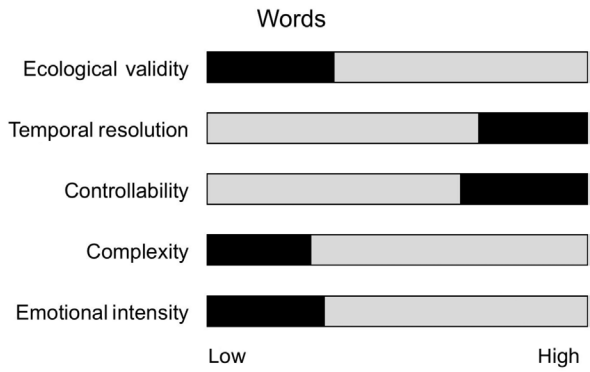


Figure 7.1 Emotion Matrix of Emotional Words. Dark areas represent the expected range for words on the five characteristics.

one group who strongly desires an own child but were unsuccessfully so far and one group who do not want to have a child. These two groups of women probably have different associations to baby-related words. A task (eg, memory or attention task) could be designed to take advantage of this difference between groups in associating different aspects with the same words. Similarly, to manipulate the meaning of the same word for different people, researchers could create a context for the words by using specific instructions or priming conditions in an experiment. That said, words are rather versatile stimuli in many different experimental settings.

There are some general findings on the usage of emotional word material that need to be considered for designing experiments for emotion research. In particular, there are three interrelated patterns that need to be considered: There are more negative words than positive words in a language (and in corresponding lists of emotional word stimuli); in contrast, positive words occur more frequently in common speech (eg, "happy" is used more often than "fearful") and tend to be shorter in length (in number of letters or number of syllables) than negative words (Grühn, 2015; Ortony, Clore, & Foss, 1987). This pattern signals that we more often use positive than negative words in our language but also that negative words are more differentiated to fit different situations than positive words (eg, Mehl & Pennebaker, 2003). When designing cognitive tasks using emotional word stimuli, these objective characteristics of word length and word frequency are typically major factors in affective cognitive processing. For example, words with a high frequency are better remembered in free recall tasks than words with a low frequency and the reverse is true for recognition tasks, in which low-frequency words are better recognized than high-frequency words (Gorman, 1961; Schulman, 1967). Given the link between objective word characteristics, such as word frequency and word length, and the memorability for these words, research on emotional memory for words as to-be-remembered material needs to control for these potentially confounding variables. Thus, a researcher interested in emotional memory for positive, neutral, and negative words should match the emotional word categories on word length and word frequency to avoid spurious effects due to these objective word characteristics rather than to the emotional connotation of the words. Similar associations between the emotional connotation of the words and objective word characteristics can be found for arousal: Typically, high-arousing words are longer words and less-frequent words than low-arousing words. Thus, lists of emotional words should ideally include subjective evaluations relevant for research on emotion as well as word characteristics relevant for cognitive processing.

Most word norms for cognitive experiments, however, do not contain emotional aspects at all (eg, Paivio, Yuille, & Madigan, 1968) or contain only ratings of emotionality, that is, from neutral to very emotional, how emotional the stimulus is (eg, Strauss & Allen, 2008). Emotionality is, however, not the same as valence or arousal. For example, "love" and "rage" are highly emotional word; however, both are on opposite ends of the valence dimension and "rage" is typically a more arousing word than "love." There are few word norms that contain valence ratings, also called goodness or pleasantness (Brown & Ure, 1969; Clark & Paivio, 2004; Rubin & Friendly, 1986). There are two widely used lists for emotion research. To assess the emotional undertone of natural language, Whissell (1989, 2009) developed a list of 8734 words

called the Dictionary of Affect containing ratings for pleasantness, activation, and imagery. The goal was to use the list to measure the emotionality of a larger segment of text or speech. Therefore, the list of words had to be large. Probably as a consequence of the large number of words, the ratings were simplified and only conducted on 3-point scales (eg, pleasantness: unpleasant—in between—pleasant). The employed 3-point-scale (compared to 7-point or 9-point scales used in this field) limits the differentiation of the words on the subjective word characteristics. That said, Whissell's Dictionary of Affect is probably a good tool for evaluating the emotional content of natural language; but it might be less ideal for selecting word material for experimental settings. One systematic attempt to assess word stimuli for emotion research is the list of Affective Norms for English Words (ANEW; Bradley & Lang, 1999). In the ANEW, valence, arousal, and dominance ratings were assessed for 1034 words on 9-point SAMs. The ANEW has been widely used in hundreds of research settings on emotion and cognition.

A drawback of the ANEW and the Dictionary of Affect is that hardly any other relevant word characteristic is included in the lists. Two recent attempts have been made to provide a more generalized framework for subjective and objective word characteristics that could advance the usage of words in research focusing on emotional, social, and personality aspects. First, Warriner, Kuperman, and Brysbaert (2013) provided valence, arousal, and dominance ratings for 13,915 English words that are directly tied to previous work assessing word frequency (Brysbaert & New, 2009) and age-of-acquisition data (Kuperman, Stadthagen-Gonzalez, & Brysbaert, 2012). Given the tremendous number of emotional words in addition to other sources of word characteristics, this list provides a unique contribution to advance the field of emotion research.

A slightly different approach has been used to develop the list of English EMOtional TErms (EMOTE, Grühn, 2015). Whereas Warriner et al. (2013) obtained few ratings for a large number of words, EMOTE was intentionally designed to provide a large number of word characteristics for a medium-size list of words. In particular, EMOTE provides subjective ratings for 1287 nouns and 985 adjectives. Both, nouns and adjectives, were rated on valence, arousal, emotionality, concreteness, imagery, familiarity, and clarity of meaning. Only adjectives were also rated on control, desirability, and likeableness. Moreover, memorability scores (ie, how easy it was to recognize a word) were obtained for the nouns from a large memory task. Ratings were complemented by word length and word frequency data. The EMOTE norms provide an easily accessible word pool for research in the socio-emotional domain that provides norms for different experimental designs. For example, the selection of stimuli for emotional memory experiments could benefit from incorporating imagery ratings or memorability ratings to improve the matching of positive and negative words. Another suggestion could be the use of the desirability or likeableness ratings for impression formation experiments. Likeableness refers to how much one likes an attribute in another person with the characteristic; desirability refers to how much one likes an attribute for oneself.

In addition to these large-scale word lists for general emotion research, some word databases have taken into account potential interindividual differences in the

perception of the emotional words. This is an issue given that most ratings were obtained from young college students rather than from a diverse background. For example, one important aspect to be considered is whether different age groups perceive emotional words—and emotional stimuli more generally—similarly. That is, if an emotional stimulus is presented to an older person, can I expect to see the same emotional reactions that I got from a younger person? If one is interested in age differences of emotional memory, that is, whether younger and older adults remember positive, negative, and neutral material differently, a crucial question is whether the to-be-remembered material provides similar emotional connotations to younger and older adults. If there are age differences in the emotional perception of the material, age differences in memory for that material would be confounded with age differences in the salience of the emotional material. To address this concern, the Age-dependent Evaluations of German Adjectives (AGE; Grühn & Smith, 2008) as well as the French Emotional Evaluation List (FEEL; Gilet, Grühn, Studer, & Labouvie-Vief, 2012) were developed. For AGE, younger and older adults were asked to evaluate the valence, arousal, control, imagery, self-relevance, and age-relevance for 200 German adjectives. For FEEL, younger, middle-aged, and older adults were asked to evaluate 835 French adjectives on valence, arousal, and imagery. Both, AGE and FEEL show substantial age differences in the evaluation of the emotional material. The pattern of findings clearly suggests that younger and older adults evaluate words differently in their emotional meaning. There are many possible reasons for these observed age differences, such as age-related or cohort-related differences in the perception and associated meaning of the word material. These differences may occur as a function of life experience, amount of exposure to certain situations or objects, or age-related biological changes. Similar differences may occur for other group comparisons.

Another interesting route in extending large-scale word lists for emotion research is the development of word lists describing different aspects of an emotional state. For example, the feeling of disgust has not only the subjective affective component of feeling "disgusted" but also corresponding bodily reactions in different forms, such as "vomiting." There are corresponding common phrases in everyday speech on these associations, such as being disgusted by something or someone that it "makes you wanna throw up." However, these and similar aspects of the emotional state are typically not assessed when asking participants for their feelings. To provide researchers with an organized list of representing different aspects of the emotional state, Ortony and colleagues (Clore, Ortony, & Foss, 1987; Ortony et al., 1987) developed a list of 585 words representing four aspects of emotional states: (1) words that represented external conditions such as subjective evaluations (eg, disagreeable, wonderful) and objective descriptions (eg, abandoned, safe), (2) words that represented nonmental internal conditions such as physical and bodily states (eg, rested, weary), (3) words that represented mental internal conditions such as cognitive states (eg, amazed, baffled) or cognitive-behavioral frames of mind (eg, stubborn, friendly), and (4) words with an affect focus, such as commonly used emotion words (eg, afraid, fear, proud). Although other lists contain similar words, the contribution of this work is to organize the words according to the associated affective meaning.

3 Emotional images

Emotional images are frequently used for emotion research. There are probably two major reasons for the frequent use of images. One reason is the availability of large-scale databases, such as the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008). These databases make it easy to use images for experimental settings. The second reason is the flexibility of using images for different purposes. This flexibility is visible in the rather wide range of all five characteristics in the emotion matrix (see Fig. 7.2). Images have low to medium ecological validity depending on the depicted content. On the one hand, some images probably require more contextual information that is not given in the image to understand fully the implications of the depicted content. For example, an image showing a group of men with guns could induce some form of fear but without further contextual information, it is unclear what the men are doing. On the other hand, some images provide enough visual information to elicit an emotional response. In this category are primarily disgusting images, such as a dirty toilet or a mutilated body. A feeling of disgust can easily be elicited with images. Emotional responses to images range from low (neutral) to medium intensity. It is rare to elicit a clear and strong emotional response just by viewing images, but images clearly have the potential to provide stronger emotional reactions than reading a corresponding emotional word. For example, the word "mountain" may elicit—if any—rather neutral emotional reactions. Images of mountains, in contrast, may vary widely in the elicited reactions from inspiring awe to neutral feelings to fear of heights.

The temporal resolution of images varies from medium to high; typically, content in images can be processed quickly; however, some images contain a lot of detail and the emotion depends on the accurate processing of all information. For example, one image in the IAPS shows a person sitting on a bench; some people in our research failed to recognize the snake approaching the person's feet in the grass. Obviously, the snake is an important detail in the image for the emotional response but it

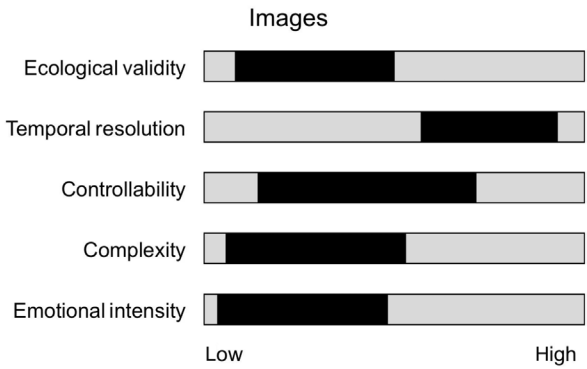


Figure 7.2 Emotion Matrix of Emotional Images. Dark areas represent the expected range for images on the five characteristics.

requires some active scanning of the image not to miss it. That said, complexity of images varies similarly from low to medium. The depicted content in images ranges from a simple pattern to household objects to people and to complex social scenes. Controllability is generally difficult for images. Images vary in many dimensions, including size, brightness, color scheme, resolution, and type of depicted content. Past research suggests that these variables influence the affective response (eg, Bradley, Hamby, Löw, & Lang, 2007; Codispoti & De Cesarei, 2007) but it is rather difficult to match images on these characteristics.

The IAPS (Lang, Bradley, & Cuthbert, 2001) is a well-known and widely used stimulus set of image material. Using Self-Assessment Manikins, images were rated on valence, arousal, and dominance. The IAPS include a wide range of scenes, including animals, people, landscapes, objects, war scenes, sexual interactions, illness, and others. Hundreds (if not thousands) of studies have selected their pictorial material from the IAPS. However, the IAPS was developed at a time where image quality was not consistently high and the image content clearly shows a large number of images from North American contexts. That said, a drawback of the IAPS is that the images appear to be outdated compared to modern standards of image quality and modern cultural contexts as well as being biased in the culturally depicted content.

To address these issues, three recent image databases have been developed: The Geneva Affective Picture Database (GAPED; Dan-Glauser, & Scherer, 2011), the Nencki Affective Picture System (NAPS, Marchewka, Żurawski, Jednoróg, & Grabowska, 2013); and the Affective Image Database (AID, Grühn, Kapkin, & Sharifian, 2015). The GAPED collected 730 images intended to cover specific themes more systematically. In particular, for negative images, there was an emphasis on including images of spiders, snakes, and scenes of moral or legal violations; for neutral images, primarily images of unanimated objected were chosen; and for positive images, mainly human and animal babies as well as landscapes were selected. Images were evaluated on valence and their social relevance. The NAPS consisted of 1256 higher-quality images covering five content categories: People, faces, animals, objects, and landscapes. Images were evaluated on valence, arousal, and approach-avoidance behavior. For studies requiring a large number of images, the AID collected 7232 images, which were categorized into a two-level hierarchy. The main level consists of five groups of images: *Animals, Humans, Objects, Indoors*, and *Outdoors*. Each main category is divided into subcategories. All images in the AID were rated on valence and arousal using 7-point versions of the Self-Assessment Manikins. These recent efforts in creating new lists of images for emotion research should further our understanding of images as emotional stimuli and should spark new endeavors into emotion research.

4 Emotional faces

Faces are an interesting subsection of images. All of the major image databases also contain portrait-like shots of faces. However, the number of these face stimuli in general image lists is rather low, which prevents a systematic utilization of face stimuli. Thus, systematic lists of emotional faces have been developed for experimental

research. The specific subgroup of faces is slightly different from images in general in the emotion matrix. Compared to images in general, emotional face stimuli have the highest ecological validity, that is, faces provide better information about the emotional state than an image of a gun. Although the ecological validity of faces is high compared to other images, it is still only in the low to medium range. We evaluate facial expressions constantly in our social partners; however, this is typically done in a dynamic fashion based on contextual information. For example, if your best friend talks about having a divorce, you know—even without looking at their face—that your best friend is not in the best mood. Thus, although we are good at decoding emotions from static facial expressions, it is rather uncommon in everyday life as a single source of information. Faces have a rather high temporal resolution; again, humans are very good at decoding facial expressions and can recognize and differentiate an angry face from a happy face quickly. Face stimuli also have the advantage that they are easier to control than other images given that the depicted object—the face—is constant. In addition, many face databases contain different emotional expressions posed by the same actor. This helps to design experiments where it is clear that the effects are due to the facial expression rather than the actor. Facial images tend to have low to medium emotional complexity, and low to medium emotional intensity. Faces typically elicit some kind of affective response—even faces with neutral expressions have some affective associations. For example, some faces might elicit more positive associations because they are rather attractive and some might elicit more negative associations because they are less attractive. We typically don't have that affective evaluation for images of neutral objects, such as an image of a table. On the other side, there are probably nonfacial stimuli that can elicit stronger emotional reactions than just viewing an emotional face. Again, seeing an image of a dirty toilet or of a mutilated body probably elicits a stronger feeling of disgust than seeing a face with a disgusting expression (Table 7.1).

Early attempts to create a normed set of facial images were made by Ekman and Friesen (1976) in the Picture of Facial Affect database (POFA). Participants were instructed with a highly controlled protocol to manipulate specific muscles that were characteristic of six discrete emotional expressions: happiness, sadness, surprise, fear, disgust, and anger. This database consists of 110 black-and-white images with participants facing forward. The Productive Aging Lab (PAL) Face database (Minear & Park, 2004) developed a facial image database that consisted of an adult lifespan sample of actors posing the expressions (19–93 years). The list consisted of 1142 black-and-white images from 576 individuals. Images consisted of neutral images where participants were forward-facing or in profile. Additional photos were taken of participants expressing a wider range of emotions, such as happiness, sadness, anger, disgust, and surprise. However, these emotional expressions do not exist for all individuals within the PAL Face database. Ebner, Riediger, and Lindenberger (2010) created the FACES database, in which face stimuli were varied systematically across age, gender, and emotional expression. The FACES database consists of 2052 facial images of 171 individuals stemming from three age groups (young, middle-aged, or older adult) and posing six emotional expressions (neutral, sadness, disgust, fear, anger, and happiness) twice.

Table 7.1 Sample lists of emotional stimuli by type of stimulus

Authors	List	Type and number	Ratings
Words			
Bradley and Lang (1999)	ANEW		Dimensional on 9-point SAMs • Valence, arousal, dominance
Whissell (2009)	DoA	8742 English words	Dimensional on 3-point bipolar scales • Pleasantness, activation, and imagery
Warriner et al. (2013)		13,915 English lemmas	Dimensional on 9-point bipolar scales • Valence, arousal, and dominance
Grühn (2015)	EMOTE-A	985 English adjectives	Dimensional on 7-point bipolar scales • Valence, arousal, emotionality, concreteness, imagery, familiarity, clarity of meaning, control, desirability, and likeableness
Grühn (2015)	EMOTE-N	1287 English nouns	Dimensional on 7-point bipolar scales • Valence, arousal, emotionality, concreteness, imagery, familiarity, and clarity of meaning Objective Word Characteristic: • Memorability
Images			
Lang et al. (2008)	IAPS	956 images	Dimensional on 9-point SAMs • Valence, arousal, dominance
Marchewska et al. (2013)	NAPS	1356 images	Dimensional on 9-point bipolar scales • Valence, arousal, and dominance
Grühn et al. (2015)	AID	7232 images	Dimensional on 7-point SAMs • Valence and arousal

(*Continued*)

Table 7.1 (Continued)

Authors	List	Type and number	Ratings
Faces			
Ekman and Friesen (1976)	POFA	110 images	Discrete Facial Expressions • Happiness, sadness, surprise, fear, disgust, anger
Minear and Park (2004)	PAL Faces	1142 images by 576 persons	Dimensional
Ebner et al. (2010)	FACES	2052 images by 171 persons	• Discrete—neutral, anger, disgust, happiness, fear, and sadness
Film clips			
Philippot (1993)		12 film clips	Discrete—6 emotions • Amusement, anger, disgust, fear, neutral, and sadness
Gross and Levenson (1995)		16 film clips	Discrete—16 emotion terms
Schaefer, Nils, Sanchez, and Philippot (2010)		70 film clips	Dimensional • Arousal on 7-point bipolar scale • Positive and negative affect on subscales Discrete—7 emotions • Anger, fear, disgust, sadness, amusement, tenderness, neutral
Sharifian and Grühn (2015)	SEEMS	21 film clips	Dimensional on 7-point SAMs • Valence and arousal Discrete—20 emotion terms

Several other emotional face databases have been developed to address specific issues: In particular, a major criticism of highly cited face databases is that they tend to use only white Caucasian individuals. Dozens of smaller facial databases exist that aimed to fill this gap, such as databases of emotional expressions of Japanese women (Lyons, Akamatsu, Kamachi, & Gyoba, 1998) or Iranian persons (Bastanfard, Nik, & Dehshibi, 2007). These databases try to address the issue that facial recognition might be influenced by cultural experiences and might correspondingly differ between different ethnic groups (Fig. 7.3).

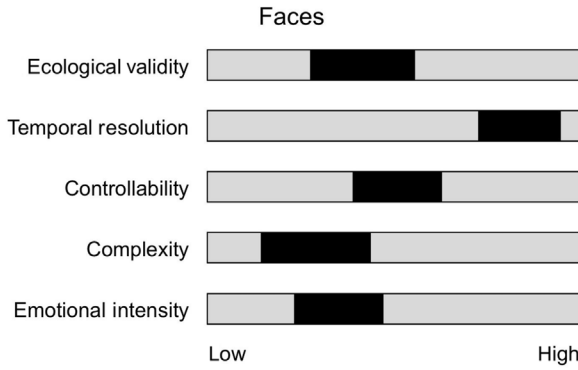


Figure 7.3 Emotion Matrix of Emotional Faces. Dark areas represent the expected range for faces on the five characteristics.

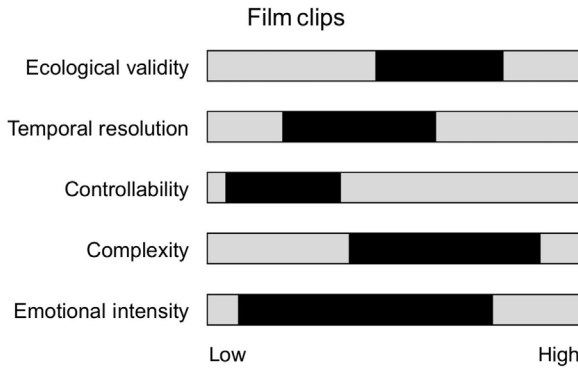


Figure 7.4 Emotion Matrix of Emotional Film Clips. Dark areas represent the expected range for film clips on the five characteristics.

5 Emotional film clips

Film clips provide rich contextual information eliciting emotional responses that are closer to real-life emotional episodes. Similar to real-life emotional episodes, the emotion is elicited dynamically rather than statically. As such, film clips have relatively high ecological validity compared to other types of emotional stimuli but are also relatively high in complexity (see emotion matrix in Fig. 7.4). The temporal resolution is low to medium; the duration of film clips typically varies from one to several minutes. Due to the high complexity and also the low to medium temporal resolution, experimental control of film clips is difficult to attain. Film clips typically vary in too many aspects to hinder effective control of the content. Film clips can, however, elicit a wide range of emotional intensities. Even neutral film clips elicit some kind of affective response; however, film clips can elicit strong emotional reactions.

Film clips are probably not as strong in eliciting emotional reactions as real-life events, such as losing a loved one, but film clips are probably the strongest elicitor of emotion available to researchers in the lab. Thus, film clips are ideal for research settings to elicit strong emotional reactions or to manipulate mood for other tasks.

In contrast to words and images, film clips are—similarly to faces—typically derived to elicit discrete emotions. Thus, ratings are typically done on discrete emotion terms rather than on dimensional ratings, such as valence and arousal. As such, a comparison of different film clips eliciting different discrete emotions is difficult. For example, is a sad film clip eliciting a 5 on a 7-point sadness item as emotional as a fearful film clip eliciting a 5 on a 7-point fearful item? There is no available clear answer to that question. Moreover, the emotion terms used to assess the subjective emotional responses vary widely in the number of emotion terms and the exact wording.

Studies using film clips typically require only a small set of stimuli to elicit an intense emotional reaction (eg, Gross, 1998; Richards & Gross, 2000). This is in contrast to studies using images and words as emotional stimuli, in which researchers typically use many stimuli (eg, Driscoll, Tranel, & Anderson, 2009; Gavazzeni, Wiens, & Fischer, 2008). Thus, there are several lists of a small number (in comparison to the large number of words or images in available lists) of film clips. We just mention here a few: In an early attempt, Philippot (1993) assessed 12 French film clips for six discrete target emotions (two film clips per emotion): amusement, anger, disgust, fear, neutral, and sadness. Findings suggested that film clips were successfully eliciting discrete feelings of amusement, sadness, and a neutral state, but film clips were less consistent in eliciting a discrete feeling of anger, disgust, and fear. Gross and Levenson (1995) selected 16 English film clips for eight discrete emotion categories (two film clips per emotion): amusement, anger, contentment, disgust, fear, neutral, sadness, and surprise. Film clips were rated on a 16-item emotion inventory. Overall, film clips intended to elicit amusement, disgust, sadness, and surprise elicited these emotions clearly. Film clips intended to elicit anger and contentment demonstrated a less clearly distinct emotion profile; and fear film clips were least successful in generating a distinct emotion profile of fear. Thus, the effectiveness of eliciting a target emotion for film clips seems to differ systematically by the emotion.

Recently, two attempts have been made to provide a systematic list of film clips. Schaefer et al. (2010) compiled a set of 70 French film clips from commercially available films across seven emotion categories: anger, fear, disgust, sadness, amusement, tenderness, and neutral. Film clips were rated based on their discreteness, intensity, and level of positive and negative affect. The results showed that most film clips were successful at eliciting discreteness and arousal. Sharifian & Grühn (2015) developed a standardized Set of Emotion-Elicitation Movie Scenes (SEEMS) consisting of 21 English film clips for eight discrete target emotions: neutral (2), sad (3), amusement (3), happiness (2), anger (3), tenderness (2), fear (3), and disgust (3) film clips. Film clips were evaluated retrospectively with a dimensional approach on valence and arousal as well as with a discrete emotion on a 20-item emotion inventory. In addition, valence was rated continuously throughout the presentation of each film clip. There are several lists that have been developed to address specific issues

or cultural aspects. For example, Jenkins and Andrewes (2012) compared the use of nonverbal and verbal contemporary film clips for emotion induction. Hewig et al. (2005) extended previous film clip sets by developing a small subset of neutral film clips. Liang, Hsieh, Weng, & Sun (2013) developed a set of 27 film clips applicable for Taiwanese culture.

In sum, film clips—due to their high similarity to real emotional experiences—are ideal stimuli to elicit strong emotional reactions in the laboratory. Film clips are, thus, often used as stimuli for mood-induction techniques or emotional reactivity studies. The high complexity and low controllability of film clips make them, however, less attractive for highly controlled experimental settings. For example, it is less easy to create a well-controlled memory task based on content presented in different film clips.

6 Future avenues

Lists of emotional stimuli have been used in many contexts for furthering research on emotion and emotional processes. Despite the widespread use of these lists, there are three major unresolved issues: First, what is the underlying structure of emotion? Second, how is the emotional structure assessed? And finally, are there systematic interindividual differences in the emotional evaluation of the stimuli?

The first question about the structure of emotion entails the broad question of whether one assumes a dimensional or a discrete approach to emotion. Most lists of words and images use a dimensional approach incorporating—among others—a valence (ie, pleasantness, goodness) and arousal dimension, whereas most lists of faces and film clips use a discrete approach of categorizing stimuli into discrete emotional categories. These two approaches obviously influence the response to the second issue of how to assess the emotional responses to the stimuli. But even without considering this broad question of whether the structure of emotion is dimensional or discrete, there are open questions within each approach. For example, there are conflicting findings about the association of valence and arousal within the dimensional approach. On the one hand, there are several lists of emotional stimuli that report a U-shaped function between valence and arousal, that is, positive and negative stimuli were evaluated as high-arousing, whereas neutral stimuli were evaluated as low-arousing. The U-shaped pattern has been found for words (Bradley & Lang, 1999) and for images (Lang, Bradley, & Cuthbert, 2001). On the other hand, there are several studies finding basically a linear association between valence and arousal that negative stimuli are high-arousing and neutral and positive stimuli are rather low-arousing. Again, this linear pattern has been found for emotional words (Gilet et al., 2012; Grühn, 2015) and emotional images (Keil & Freund, 2009). Sometimes, this conflicting pattern has been found for the same list of stimuli. For example, the U-shaped pattern between valence and arousal of the IAPS based on US college students (Bradley & Lang, 1999) has been found to be linear in a German (Grühn & Scheibe, 2008) and a Brazilian sample (Ribeiro, Sabine, & Bueno, 2005) using similar assessment methods. Obviously, the underlying association between valence and arousal is a major issue for matching stimulus material and for the interpretation of

observed effects. Unfortunately, to our knowledge, no clear explanation has yet been offered to account for the different pattern. It seems that future research on lists for emotional stimuli has to address this issue to determine under which conditions the association would be U-shaped or linear.

The second major issue—how to assess the emotional response to the stimuli—has important ramifications for interpreting the lists. For the discrete account, the exact emotion terms of describing the emotion category matters. For example, is "sad" the same as "unhappy"? Some lists using a discrete account use only a single item such as "sad" for the sadness category, whereas other lists use subscales, such as a sadness scale composed of "sad," "depressed," "blue," and "dejected." These decisions clearly affect how the stimuli are evaluated. For the dimensional account, many lists employed the Self-Assessment Manikin scales (Bradley & Lang, 1994; Lang, 1980) as a nonverbal method of assessing emotional responses. Other lists use bipolar scales (eg, positive–negative, tensed–relaxed) to assess valence and arousal. Again, it is very possible that these assessment decisions have consequences for the selection of stimuli and for the interpretation of findings. Thus, future research would benefit from a coherent framework for comparing and evaluating lists of emotional stimuli.

The assessment issue not only entails the question of how to assess the emotional response but also what to assess. In this chapter, we focused solely on self-report data—given that most lists of emotion stimuli are based on self-report data averaged across persons for the stimuli. There are, however, few attempts at complementing the subjective evaluations with more objective or performance-based responses, such as memorability data or physiological responses. Providing lists with these additional pieces of information could initiate a new wave of advancements in the field of emotion research. For example, instead of using a subjective evaluation of valence and arousal for selecting images for an experiment, it would be great to have information about the facial expression made by persons viewing an image. That could make it very easy to select images eliciting clear facial expressions, such as disgust, for an experiment. Similarly, it is very possible that some emotional images or film clips show similar subjective reactions but different physiological reactions or similar physiological reactions but different subjective reactions (for an age comparison example, see Kunzmann & Grühn, 2005). If there are such stimuli available, it may allow researchers to disentangle the subjective and physiological influences on a specific process.

Finally, more research has to be conducted on understanding systematic interindividual differences in evaluating emotional stimuli. On a practical level, if there are substantial group differences in the evaluation of emotional material, these group differences have to be taken into account when using the material and designing a study. On a theoretical level, systematic group differences may provide insights into the structure, function, and development of emotion. Thus, we would like to encourage more empirical work on generating norms for different groups that might vary systematically in the emotional evaluation of the stimuli. For example, in our own work on age differences in emotional functioning, we obtained norms for younger and older adults for German words (Grühn & Smith, 2008; see also Keil & Freund, 2009), French words (Gilet et al., 2012), and images (Grühn & Scheibe, 2008). We found substantial age differences in all of these studies suggesting to us that the

affective perception of emotional content shifts with age. It seems that the emotional structure gets simpler in old age; but more research is necessary to evaluate this claim. Nevertheless, similar findings might be obtained looking at other groupings, such as culture, occupation, or education.

7 Conclusion

Lists of emotional stimuli are advancing systematic research on emotion and emotional processes. Lists are available for every modality of emotional stimuli. In this chapter, we highlighted some of the lists for emotional words, images, faces, and film clips. The chapter was intended as a gateway into exploring lists of emotional stimuli rather than an exhaustive overview of lists for emotional stimuli. We clearly missed mentioning dozens of emotion lists and we would like to apologize for not including all lists.

We would like to emphasize how important the collection of lists of emotional stimuli is for making progress in our field. Not only for using emotional stimuli but also for comparing lists. Even if a list of emotional stimuli is already in existence for your area, it might still be important collecting data on a new list to examine potential differences. For example, it might well be that students evaluate emotional stimuli differently depending on their major; it might be that customs officials evaluate face stimuli differently than other occupations would do; it might be that French-speaking adults evaluate film clips differently than German-speaking adults; or it might be that product designers evaluate products differently than customers who buy the products. All these examples are highly speculative; but without assessing systematic lists of emotional stimuli for these groups, we will never know whether it might not be true. That said, if possible, collect ratings for your emotional material. Maybe it is the beginning of a new major list of emotional stimuli.

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Measurement of Consumer Product Emotions Using Questionnaires

8

Armand V. Cardello[1] *and Sara R. Jaeger*[2]
[1]U.S. Army Natick RD&E Center, Natick, MA, United States [2]The New Zealand Institute for Plant & Food Research Limited, Auckland, New Zealand

1 Introduction

In the past decade, the study of human emotions elicited by foods and other consumer products has grown rapidly. This rapid growth is an indication of the interest on the part of industry to identify critical drivers of consumer choice, purchase and consumption behaviors that go beyond those sensory and hedonic characteristics that are routinely measured. A number of recent studies have begun to show how product-evoked emotions can provide useful and actionable data that sensory and liking judgments cannot (Desmet & Schifferstein, 2008; King & Meiselman, 2010; Ng et al., 2013a, 2013b). This growing focus on the role of emotions in product experience has resulted in the development of a variety of measures to quantify emotional responses. Among these methods are various forms of self-report of experienced emotions, physiological methods that capture the autonomic nervous system activity that accompanies emotional responding, and various measures of motor or expressive behaviors (facial, vocal) that also accompany many emotions. All of these approaches have their origin in early clinical and academic psychology, where the study of human emotions first evolved, and where the development of standardized methods for measuring human emotions first began.

There are many techniques that have been developed to measure and study human emotions in clinical and academic settings. Among these methods are various emotion and mood checklists, such as the Multiple Affect Adjective Checklist (MAACL) and MAACL-R (Zuckerman & Lubin, 1965, 1985), the Positive Affect and Negative Affect Schedule (PANAS) (Watson, Clark, & Tellegen, 1988) and the Profile of Mood States (POMS) (McNair, Lorr, & Droppleman, 1971). Similarly, a variety of physiological indicators of emotions, such as electrophysiological recordings of skin conductance, electroencephalography (EEG), pupil dilation, heart rate, and functional magnetic resonance imaging (fMRI) were developed and are now in common use (Manning & Melchiori, 1974; Mauss & Robinson, 2009; Motte, 2009; Sequeira, Hot, Silvert & Delplanque, 2009; Winton, Putnam, & Krauss, 1984; see Kreibig, 2010 and see chapter: The Psychophysiology of Emotions, for reviews). So are a number of

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other methods for the measurement and interpretation of facial and vocal expressions (eg, Ekman & Friesen, 1982; Ekman, Friesen, & Ellsworth, 1972) and the more recent Geneva Multimodal Expression Corpus (Bänziger, Mortillaro, & Scherer, 2012; see chapter: Measuring Emotions in the Face, for a review of these measures). Although many of these methods are useful for the identification and/or discrimination of different human emotional states, many pose challenges for direct application and/or unobtrusive measurement in product research settings. For example, most clinical questionnaires are heavily focused on negative or disordered affect, while product emotions are primarily positive (Desmet & Schifferstein, 2008; King & Meiselman, 2010; Schifferstein & Desmet, 2010). Similarly, many physiological measures require the use of hard-wired sensors or artificial positioning of the body, which are intrusive and incompatible with most product testing situations. Lastly, facial and vocal expressions, while relatively unintrusive, must be indirectly interpreted, and they may be relatively poor at differentiating between subtle and/or low-level emotional responses, both of which are often found in product emotion research.

1.1 What are emotions?

The nature of current methods used to evaluate emotions is partly attributable to how emotions have been conceptualized and defined by researchers over the years. Early research in psychology led to the notion that emotions had two fundamental manifestations, an experiential component and a physiological component (James, 1884; James & Lange, 1922). Moreover, the experiential component was viewed as being valenced, varying from negative valence, for example, fear or disgust, to positive valence, for example, joy or love. Since a physiological component was essential to the notion of a "basic" emotion, early research on emotions focused on measuring the physiological correlates of emotions. Facial expressions were seen as an involuntary motor manifestation of this autonomic nervous system activity (Ekman, 1992) and have been pursued in this light. This early focus on emotions having necessary physiological or motor behavioral correlates, tended to limit the number of "basic emotions" that were postulated. Thus, in early research, this number was generally small and as few as two (pleasure and pain), as in the conceptualization by Mowrer (1960). Over time, this number grew to as many as 10 by Izard (1979) and 18 by Frijda (1986). Even Ekman, who originally postulated 6–7 basic emotions (Ekman et al., 1972) later grew the number to 15 (Ekman, 1999). This growth over time in the number of basic emotions was also partly a consequence of the evolution of the notion that the physiological component of an emotion is subject to a cognitive "appraisal" that is dependent upon both the stimulus eliciting the arousal and the environmental context in which it is elicited (Schachter & Singer, 1962). The notion of cognitive appraisal allowed for the same physiological response to be interpreted differently depending upon the situational context, which, in turn, could lead to different experienced emotions. Most recently, the definition of emotions has expanded further to include the concept of "intentionality" (Frijda, 1986; Lazrus, 1982; Roseman, 1984), which attributes an action tendency or motivational component to emotional responses, for

example, disgust motivates the individual to withdraw, while joy motivates the tendency to approach.

Today, most psychologists view the concept of emotion as a complex response pattern that has physiological, experiential, cognitive (appraisal), and intentional elements (Omdahl, 1995; Scherer, 2005), and there is little agreement on what constitutes a "basic" emotion or their number. Instead, emotions are more commonly considered to be broad families of related emotions, much like spoken languages relate to one another (Ortony & Turner, 1990). In an attempt to relate and intepret the fundamental bases of these families of emotions, Russell (1980, 2003) and Russell and Barrett (1999) proposed that all emotions are constructed from two fundamental dimensions of "core affect," which are *valence* (positive or negative) and *arousal*, which involves activation or deactivation of the nervous system. Russell's "circumplex" model of emotions is one of a number of "dimensional" models of emotions that place all emotions into a two-dimensional space in which different areas within the space contain emotions that are highly related to one another (families) and that are different from emotions falling into other, different areas in the space (other families).

The evolution of dimensional theories of emotion, the expansion in the number of basic and "extended" emotions, and the acceptance of the "familial" organization of emotions led many investigators to realize that a far greater number of emotions existed, with subtle differences among them, and that the experiential components of these emotions often can be more easily differentiated by verbal reports (words) than through inference from instrumental measures of their physiological or motor components. Such a realization, especially among researchers interested in product emotions, led to a renewed focus on measuring emotions using written surveys and questionnaires. As a consequence, some of the most common methods for assessing product emotions in the food and consumer products industries today are based on such questionnaire formats.

1.2 Objectives of this chapter

With the rapid growth in the use and number of different questionnaire techniques to capture product-evoked emotions have come such questions as "what are the important differences among the various techniques?," "how are the emotion words on them chosen?," "how many emotion words can/should be used?," "how should the intensity of emotions be captured?," "how reliable are the methods?," and "how do the data obtained by different methods compare to one another?" The objective of this chapter will be to review the available methods for obtaining product emotions from consumers using the questionnaire approach. We will address factors related to the methods themselves, their reliability, the product/stimulus being tested, and, where available, how the methods compare to one another in terms of the nature of the data collected. In a later chapter in this volume (see chapter: Methodological Issues in Consumer Product Emotion Research Using Questionnaires) by Jaeger and Cardello, we expand the analysis of these measurement issues to address their interactions with other methodological aspects of data collection.

As important as what will be covered in this chapter, is what we *will not* cover. We will not cover non-questionnaire-based methods, nor will we cover clinical or

other psychological-based questionnaires that have not been used in product emotion research. In addition, we will not attempt to delve deeply into the theoretical bases of emotions (see chapters: Theoretical Approaches to Emotion and Its Measurement, and Navigating the Science of Emotion, for reviews of emotion theory) or to shine light on the controversy regarding whether the emotion words used on questionnaires are "true" emotions or merely emotional "associations" to the product (see Thomson & Crocker, 2013 and chapter: Conceptual Profiling, for discussions). Although, we feel that a single product is unlikely to evoke 20 or more true "emotions" (those accompanied by physiological components, as in the James-Lange theory of emotions) and that much of what is discussed as "emotions" in the product emotion literature are emotional associations that result from past experiences and information related to the product, this is not to say that products do not evoke "true" emotions; only that it is extremely difficult to separate out "true" emotions from emotional associations. For that reason, the word "emotion" in this chapter is used as a conceptual rubric to cover the general construct that underlies the behavioral response of checking or rating an emotion word on a written questionnaire. That said, research directed at discerning the differences between what may be considered "true" emotions and emotional associations is an important area for future investigations.

2 Emotion lexicons and questionnaires used in product evaluation

As their name implies, emotion lexicons are lists of emotion words that have been developed for their applicability to foods, beverages or other product classes, to individual foods, beverages and products, or to specific sensory dimensions of products, for example, odor, appearance, and so on. Unlike questionnaires that contain a specific set and number of emotions, lexicons are developed to provide a rich vocabulary of emotion words upon which researchers can draw and tailor to their own specific research needs (see chapter: Lists of Emotional Stimuli, for a summary of research on emotion lists).

Emotion questionnaires used in product emotion research typically consist of a list of "emotion" words that vary in both the nature of the words used and their number. The "emotion words" that correspond to experienced emotions evoked by the product are then either checked (check-all-that-apply or CATA format) or rated (eg, using a numbered and/or labeled category or unstructured line scale that ranges from "none" or "not at all" to "very high" or "extremely"). For example, the EsSense Profile® method of measuring consumer emotions to food (King & Meiselman, 2010) uses a list of 39 emotion words that are rated on a 5-point category scale from "not at all" to "extremely," while ScentMove (Porcherot et al., 2010), a modification of the Geneva Emotion and Odor Scale (GEOS; Chrea et al., 2009) is comprised of a set of six word triads that are rated on a 10-point line scale from "not at all relevant" to "extremely relevant." While some questionnaires are designed for broad application to many different foods and beverages, for example, the EsSense Profile® method, there are also

a number of questionnaires that are targeted to specific products or attributes of the product, for example, GEOS and ScentMove, which are designed to address emotions evoked by odors or fragranced products. Although most product emotion questionnaires are word-based, some are pictorial in nature, for example, the PrEmo method (Desmet, Hekkert, & Jacobs, 2000), which presents a series of facial/body animations representing different emotions and the respondent rates each animation for how much it represents his/her experienced emotion to the product. Within these broad parameters, a number of different questionnaires exist. Although many are English-language-based, some have been translated into other languages, and some have been developed specifically for non-English speakers.

In the sections below, we outline the various product emotion lexicons and questionnaires that have been developed and used in product research. The key motivational elements for the development of the methods and their psychometric and other important methodological properties are also discussed.

2.1 English emotion lexicons

2.1.1 Richin's consumption emotions set

Perhaps the first emotion questionnaire/lexicon that was developed with relevance for product testing was the Consumption Emotions Set (Richins, 1997). Richin's goals in developing this set of emotion terms was to identify the emotional states associated with consumption experiences, assess the relevance of existing emotion measures to capture these emotions, and, lastly, to generate a set of emotion descriptors that could be used to assess emotional responding in varied product consumption situations. Starting from a list of 175 possible emotion words and reducing this number through studies of their relevance and frequency of use to describe consumption emotion experiences, the final Consumption Emotions Set (CES) has 47 emotion words grouped into seven clusters. Table 8.1 shows the emotion words that are contained in the CES.

In several studies conducted as part of the development of the CES, Richins (1997) compared the CES to other emotion questionnaires used to assess emotions in the classical psychological literature and in previous assessments of emotions evoked by advertising. Richins found the CES to perform better than these latter measures for assessing the variety of emotions present in consumption situations and for discriminating among different emotion experiences, especially those with positive valence. Although the CES was not developed to be a definitive assessment tool, the emotion words of the CES cover a broad range of consumption emotions, and the terms of the CES were intended to be used as a resource from which smaller subsets of emotion words could be selected for application to any specific research endeavor.

2.1.2 Laros and Steenkamp's hierarchical model of emotions

In an effort to analyze the structure of emotion words used in psychology and consumer behavior, Laros and Steenkamp (2005) compiled the emotion words used in 10 studies of emotions, including the emotion words in Richin's CES, and divided them

Table 8.1 The consumption emotions set (Richins, 1997)

Anger	Frustrated
	Angry
	Irritated
Discontent	Unfulfilled
	Discontented
Worry	Nervous
	Worried
	Tense
Sadness	Depressed
	Sad
	Miserable
Fear	Scared
	Afraid
	Panicky
Shame	Embarrassed
	Ashamed
	Humiliated
Envy	Envious
	Jealous
Loneliness	Lonely
	Homesick
Romantic love	Sexy
	Romantic
	Passionate
Love	Loving
	Sentimental
	Warm hearted
Peacefulness	Calm
	Peaceful
Contentment	Contented
	Fulfilled
Optimism	Optimistic
	Encouraged
	Hopeful
Joy	Happy
	Pleased
	Joyful
Excitement	Excited
	Thrilled
	Enthusiastic
Surprise	Surprised
	Amazed
	Astonished
Other items	Guilty
	Proud
	Eager
	Relieved

into emotion words having positive or negative affect. A total of 316 emotion words was compiled (Laros & Steenkamp, 2005). Of these, 173 were negative and 143 were positive. Based on this compilation, the authors concluded that existing emotion words used in the consumer research literature were easily classified into either positive or negative valence and that the emotion words in the CES were consistent with the most commonly used of the 316 emotion words in the literature. Upon further analysis of 39 "basic" emotions utilized in the psychology literature, Laros and Steenkamp proposed a hierarchical schema of emotion terms. At the superordinate level, the terms were classified as either positive or negative. At the intermediate level, four positive and four negative "basic" emotions were identified, while at the subordinate level was a set of 41 emotion words, comprised in the majority by the emotion words contained in the CES. Table 8.2 shows the hierarchy of emotion words that was developed.

In a subsequent test in which consumers rated their emotional responses to four classes of foods (genetically modified, organic, functional, or "regular"), Laros and Steenkamp (2005) utilized 33 of the total number of emotion words in Table 8.2, adding "hostility" under the basic emotion of "Anger." The results of this study were interpreted by the authors as providing support for their hierarchical model. However, the authors also pointed out that the entire hierarchy of words need not be used in any specific application. Rather, researchers can choose among the words/hierarchical clusters in the model to design a questionnaire appropriate to their own research study.

2.1.3 Thomson and Crocker's classification/lexicon of feelings

Thomson and Crocker (2013) approached the problem of emotion research from a broader conceptual perspective than most other researchers. Their approach was to put aside theoretical distinctions between the concepts of mood and emotion and, instead, to focus on the experiential characteristic common to both, that is, "feelings." Their stated objective was to develop "a lexicon of feelings" based upon a classification scheme that would be equally applicable across four target languages—English, German, French, and Italian. Starting with a review of available emotion/mood lexicons, the authors compiled a list of over 500 English words, that were then refined to eliminate synonyms and other highly redundant terms. These terms were then translated into the other languages, making additions or deletions to ensure a final multilingual list that encompassed positive, negative and neutral "feeling" words. This list of 544 words was then evaluated in two major studies. The first study was conducted in all four target countries and required consumers to evaluate 84 different sub-groupings of the words at several times during the day and to identify those words that they were experiencing at the time. In a second study conducted in the United Kingdom, 60 words that were derived from clustering of the words identified in the first study, and sorted into similar and dissimilar groupings. Based on the analysis of these data, a taxonomy of feelings was developed that contained 12 clusters of 59 feeling words, each cluster containing 2–4 words. This taxonomy of feelings is shown in Table 8.3 (see also chapter: Conceptual Profiling).

Thomson and Crocker's (2013) research is notable on two accounts. First, is their up-front acknowledgment that the terms contained in the taxonomy and lexicon are

Table 8.2 **Hierarchy of consumer emotions (Laros & Steenkamp, 2005)**

Negative affect				**Positive affect**			
Anger	**Fear**	**Sadness**	**Shame**	**Contentment**	**Happiness**	**Love**	**Pride**
Angry Frustrated Irritated Unfulfilled Discontented Envious Jealous (Hostility)[a]	Scared Afraid Panicky Nervous Worried Tense	Depressed Sad Miserable Helpless Nostalgia Guilty	Embarrassed Ashamed Humiliated	Contented Fulfilled Peaceful	Optimistic Encouraged Hopeful Happy Pleased Joyful Relieved Thrilled Enthusiastic	Sexy Romantic Passionate Loving Sentimental Warm-hearted	Pride

[a]Added as a result of empirical testing.

Table 8.3 The taxonomy of feelings, showing 59 feelings organized into 25 lower-level clusters and finally into 12 higher-level clusters (Thomson & Crocker, 2013)

Caring	*Caring, affectionate, passionate*
	Reassured, touched
	Respectful, admiring
Excited	*Excited, energetic, lively, adventurous*
	Happy, terrific, overjoyed
Sociable	*Sociable, charming*
	Light-hearted, passive, relaxed
Self-confident	*Confident, purposeful*
	Superior, wilful
Angry	*Arrogant, aggressive*
	Furious, irate
Judgemental	*Suspicious, jealous*
	Disgusted, horrified
	Disapproving, critical
Inadequate	*Shy, inhibited*
	Inferior, belittled
	Alone, neglected
Surprised	*Surprised, silly, strange*
Detached	*Disinterested, dull*
	Absent-minded, confused
Sad	*Nostalgic, regretful*
	Sad, despairing, heart-stricken
	Discontented, grumpy
Fearful	*Nervous, anxious, scared*
Fatigued	*Sluggish, subdued, tired*

not necessarily "emotion" words, but rather, can best be described as the affective dimension common to both emotions and moods—"feelings." This is an important point that relates to the issue of what product emotion questionnaires actually measure. The second notable aspect of Thomson and Crocker's work is that their taxonomy and lexicon were constructed to be applicable across several languages. As we will see, lexicons and questionnaires to evaluate product emotions have been developed in several languages. However, in today's global product markets, having multilingual techniques that can be utilized cross-culturally is becoming essential to facilitate product development within multinational companies.

2.2 Non-English lexicons

A number of non-English emotion lexicons have begun to emerge in the literature. Among these are lexicons for French, Italian and German emotion words. For

example, Zammuner (1998) published a general list of 153 Italian emotion words, which was later translated into a French lexicon by Niedenthal et al. (2004). Although neither set of authors focused their attention on food- or product-related emotion words, the lexicons were used subsequently to develop food-related emotion questionnaires, for example, Rousset, Deiss, Juillard, Schlich, and Droit-Volet (2005), who developed a French language questionnaire to evaluate meats and other products based on Niedenthal's lexicon. Similarly, Ferrarini et al. (2010) developed a lexicon of Italian words related to wine consumption that was based on existing Italian emotion lexicons and the Consumption Emotions Set (Richins, 1997), while Pineau et al. (2010) developed a list of French emotion words for use with beverages. Most recently, Gmuer, Nuessli Guth, Runte, and Siegrist (2015) developed a lexicon of 272 German emotion words from which they identified a list of 49 emotion words that were applicable to the evaluation of foods. The latter researchers also confirmed the common finding that general emotion lexicons have a greater proportion of negative terms (Thomson & Crocker, 2013) than do lexicons or questionnaires designed for use with foods, which generally have a greater proportion of positive words (Ferrarini et al., 2010; King & Meiselman, 2010; Laros & Steenkamp, 2005). Gmuer et al. (2015) also emphasized the differences in the list of German words that they identified with lists generated in different languages and with diverse cultures, providing a useful table of emotion words used in seven different domain-specific lexicons/questionnaires and three product-specific lexicons/questionnaires (Table 8.4).

2.3 Product- and domain-specific emotion questionnaires

2.3.1 The Geneva Emotion and Odor Scale (GEOS) and ScentMove

GEOS is an emotion questionnaire developed by Chrea et al. (2009) with the specific intent of addressing the emotional responses to odors. The development of the method began by gathering 480 emotion words from the general emotion literature, as well as emotions that were associated with odors in previous research. These terms were then used in a study with 210 French consumers, in which respondents were asked to rate each word in terms of its "relevance for describing an emotional state you have already experienced when smelling odors in the past." By taking the terms rated to be most relevant, the authors produced a list of 124 words that could be characterized as being either affective in nature or qualitative in nature, with only minor overlap. These word lists were then used in a second study where 24 odorants spanning a wide range of the odorant space were presented to 38 individuals. Participants rated the experienced intensity of each of the affective terms and, separately, each of the qualitative terms in response to each odorant. Through factor analysis of the resulting data, five affective factors and four qualitative factors were identified, each characterized by a subset of the most discriminating terms within each factor. In a final study conducted with 282 consumers, 36 of the terms identified as discriminating in the first study and also deemed by analysis to be representative of the five affective clusters were used to evaluate 56 odorants. Using confirmatory factor analysis, a six-factor solution was

Table 8.4 Comparison of domain- and product-specific emotion and feeling lexicons in the sensory science literature[a] (Gmuer et al., 2015)

Absent minded[g], Active[a], Admiration/Admiring[d,f,g], Adoring[f], Adventurous[a,g,k], Affectionate[a,g], Aggressive[a,g,h,k], Alone[g], Amusement/Amused/Amusing[b,c,d,f,h], Anger/Angry[c,d,f,i], Annoyed[i], Anxious[g], Approval[i], Arrogant[g,k], Astonishment[b], At ease[i], Attentive[i], Attracted[c,d,e], Belittled[g], Bland[h], Bliss[c], Boredom/Bored[a,f,i], Calm[a], Caring[g], Cautious[i], Charmed/Charming[f,g], Cheerfulness[c], Clean[d,e], Comforted/Comforting[e,f,i,k], Confident[g,k], Confused[g,i], Contempt[c], Content[b], Crabby[g], Critical[g], Curious[h,i], Daring[a], Delight[b,c], Depressed[f], Desire/Desirable[d,e,f,h,i], Despairing[g], Dirty[d,e,f], Disappointment/Disappointed[b,c,i], Disapproving[g], Discontented[c,g,i], Disgust/Disgusted/Disgusting[a,b,c,d,e,f,g,h,i], Disinterested lethargy[g], Displeasure[i], Dissatisfaction[d], Doubt[b], Dreamy[e], Drowsy[e], Dull[g], Eager[a], Easygoing[k], Elegant[h], Embarrassment[b], Energetic[a,c,d,e,f,g,k], Enthusiastic[a,c], Envy[c], Euphoric[h], Excited[c,d,g], Exhausted[g], Famished[e], Fascinated[f], Fear[c], Feeling awe[d], Feminine[k], Free[a,c], Friendly[a], Frustration[b], Fun[k], Furious[g], Glad[a], Good[a,i], Good-natured[a], Guilt/Guilty[a,b,i], Happiness/Happy[a,c,d,f,g,h,i], Heart-stricken[g], Hesitation[b], Horrible[f], Horrified[g], Impatience[b], In a good mood[e], In love[d,e,f], Indifference[b], Infatuation[c], Inferior[g], Inhibited[g], Interest/Interested/Interesting[a,b,f,h,i], Invigorated[d], Irate[g], Irritated[d,f], Jealous[g], Joy/Joyful[a,c,h], Keen[h], Lassitude[b], Light[d], Light-hearted[g], Lively[g], Loving[a], Lustful[e], Luxurious[k], Marvel[c], Masculine[k], Meditative[e], Merry[a], Mild[a], Nauseous[e], Neglected[g], Nervous[g], Nostalgia/Nostalgic[a,b,c,d,e,g], Not refreshed[i], Ordinary[k], Overjoyed[g], Overwhelming[h], Passionate[g,h], Passive[g], Peaceable/Peaceful[a,e,h], Pleasant[a,c,d,f,h], Pleasure/Pleased[a,b,c,i], Polite[a], Powerful[k], Pretentious[k], Pride[b], Protected[e], Purposeful[g], Quiet[a], Reassured[g], Refreshed[c,d,e,f,i], Regret/Regretful[b,g,i], Reinsured[d], Rejoicing[b], Rejuvenated[e], Relaxed[d,e,f,g], Relief[c], Religious feeling[f], Reminiscence[i], Repelled[e], Resentment[i], Respectful[g], Revitalized[d,e,f], Romantic[d,e,f], Sadness/Sad[c,f,g], Salivating[d,e], Satisfaction/Satisfied[a,b,c,i], Scared[g], Skeptical[i], Secure[a], Sensual[d,e,f,k], Sentimental[e], Serene[b,c,d], Serious[k], Sexually aroused[f], Sexy[d,e,f], Shivering[d], Shocked[i], Shy[g], Sick/Sickening/Sickly[d,e,f,i], Silly[g], Sluggish[g], Sociable[g,k], Soothed[d,e], Sophisticated[k], Spiritual feeling[f], Steady[a], Stimulated[d,e], Strange[g], Stressed[f], Subdued[g], Superior[g], (Un-/Pleasant) Surprise/(Un-/Pleasantly) Surprised[c,d,e,f,g,i], Suspicious[g], Tacky[k], Tame[a], Tender[a,c], Terrific[g], Thirsty[e], Thrilled[b], To feel intimacy[e], To like/Liking[b,c], Touched[g], Traditional[k], Trembling[c], Troubled[c], Trust[i], Trustworthy[k], Uncomfortable[e,f,i], Uncomplicated[k], Understanding[a], Uneasiness[b], Unhappy[i], Unpleasant[d,e,f], Vigilant[b], Warm[a,c,i,k], Well-being[c,d,f], Whole[a], Wild[a], Willful[g], Worried[a,i], Youthful[k]

Domain-specific	Product-specific
[a]King and Meiselman (2010) [b]Rousset et al. (2005) [c]Pionnier Pineau et al. (2010) [d]Chrea et al. (2009)—GEOS [e]Ferdenzi et al. (2011)—LEOS [f]Ferdenzi et al. (2011)—SEOS [g]Thomson and Crocker (2013)	[h]Ferrarini et al. (2010) [i]Ng et al. (2013a) [k]Thomson, Crocker, and Marketo (2010)

[a]Comparisons were conducted based on the English translations provided by the authors in cases in which the lists were originally published in another language than English.

Table 8.5 The emotion dimensions of the ScentMove™ questionnaire (Porcherot et al., 2010)

Happiness—Well-being—Pleasantly surprised
Romantic—Desire—In love
Disgusted—Irritated—Unpleasantly surprised
Relaxed—Serene—Reassured
Nostalgic—Amusement—Mouthwatering
Energetic—Invigorated—Clean

identified in which each factor was characterized by a subset of the 36 terms, where each factor was characterized by anywhere from 3 to 8 of the 36 terms.

Although the GEOS method was a data-driven classification, the 36 words in the factor structure were found to be cumbersome to use in commercial and product development applications. As a consequence, the GEOS method was soon adapted and streamlined to a smaller subset of emotion words (Porcherot et al., 2010). This was accomplished by selecting the three words that were deemed most representative, as measured by Chronbach's alpha, for each of the six dimensions of GEOS. The resulting "ScentMove" questionnaire is shown in Table 8.5.

The shortened ScentMove questionnaire was subsequently used in a variety of studies of shampoos and other fragranced and flavored products, with the results showing that the original GEOS and shortened ScentMove questionnaires provide similar results, and that these results provide useful discriminative information beyond hedonic information alone (Porcherot et al., 2010). Since both GEOS and ScentMove were designed for odors, these methods are limited to the characterization and evaluation of emotional responses to fragrances and/or flavor/aroma compounds (see chapter: Emotions of Odors and Personal and Home Care Products, for a full discussion of GEOS, ScentMove, and the application of emotion research to odors).

Most recently, Ferdenzi et al. (2011, 2013), using the same approach used to develop GEOS, have developed country/culture-specific emotion questionnaires for odors using consumers in Brazil, China/Singapore, and the United Kingdom/United States. Using cluster analysis and MDS scaling, they found similar clusters of word usage within geographic areas and differences between geographic regions. By combining the common emotion words across countries/cultures, the authors developed a "universal" scale for odor-specific emotions, referred to as Uni-GEOS (Ferdenzi et al., 2013). This universal scale contains nine categories of emotions and 25 corresponding emotion words that define each category. This universal Emotion and Odor Scale (Uni-GEOS) is shown in Table 8.6.

2.3.2 The EsSense Profile® method and EsSense25

In 2010, King and Meiselman sought to develop a questionnaire to measure food-evoked emotions. Their goal was to develop a method appropriate to the commercial context. By that, King and Meiselman (2010) meant a method that was appropriate

Table 8.6 The universal Emotion and Odor Scale (UniGEOS) with nine affective categories and 25 affective terms in four languages (Ferdenzi, et al., 2013)

English	French	Chinese	Portuguese
1. Unpleasant feelings			
Disgusted ($N = 7$)	Dégoûté	厌恶的	Enojado
Irritated ($N = 6$)	Irrité	恼怒的	Irritado
Unpleasantly surprised ($N = 6$)	Désagréablement surpris	不愉快的意外惊喜	Desagrada-velmente surpreso
2. Happiness/Delight			
Happy ($N = 6$)	Heureux	幸福的	Feliz
Pleasantly surprised ($N = 5$)	Agréablement surpris	惊喜的	Agradavelmente surpreso
Well-being ($N = 3$)	Bien-être	安宁	Bem-estar
3. Sensuality/Desire			
Desire ($N = 7$)	Désir	渴望	Desejo
Romantic ($N = 7$)	Romantique	浪漫的	Romântico
Sensual ($N = 6$)	Sensuel	肉欲的	Sensual
4. Energy			
Refreshed ($N = 7$)	Rafraîchi	恢复精神的	Refrescado
Energetic ($N = 6$)	Energique	精力充沛的	Energético
Revitalized ($N = 5$)	Revitalisé	恢复生机的	Revitalizado
5. Soothing/Peacefulness			
Relaxed ($N = 7$)	Relaxé	得到安宁的	Relaxado
Comforted ($N = 5$)	Réconforté	宽慰的	Confortado
Soothed ($N = 4$)	Apaisé	受安慰的	Sossegado
6. Hunger/Thirst			
Mouth-watering ($N = 5$)	Salivant	令人垂涎欲滴的	Com água na boca
Thirsty ($N = 3$)	Assoiffé	口渴的	Sedento
Famished ($N = 2$)	Affamé	极饥饿的	Faminto

(*Continued*)

Table 8.6 (Continued)

English	French	Chinese	Portuguese
7. Interest			
Amusement ($N = 3$) Interesting ($N = 2$) Impressed ($N = 1$)	Amusement Captivant Impressionné	娱乐 有趣的 印象深刻的	Diversão Interessante Impressionado
8. Nostalgia			
Sad ($N = 3$) Melancholic ($N = 1$) Nostalgic ($N = 3$)	Triste Mélancolique Nostalgique	伤心的 忧郁的 怀旧的	Triste Melancólico Nostálgico
9. Spirituality			
Spiritual feeling ($N = 1$)	Sentiment spirituel	精神感觉	Sentimento espiritual

N is the number of geographic areas (out of the seven studied) in which the term appears.

to use with most commercial foods that, by their nature, have varying degrees of positive affect associated with them (or else they would not remain in the market) and for use by regular category users, which further ensures the likelihood of positive affect being evoked. The authors pointed to the need for the development of such a method, because emotion questionnaires developed for clinical and psychological research were heavily weighted with negatively valenced emotion words, and it had previously been demonstatated that consumers overwhelmingly use positive emotions when describing foods and food-related experiences (Desmet & Schifferstein, 2008).

To develop the EsSense Profile®, King and Meiselman (2010) compiled a list of 81 emotion words taken from existing mood and emotion questionnaires, as well as terms used by consumers obtained from CLTs (Central Location Tests), online surveys, and consumer focus groups. In several tests of these terms with consumers, in which they were asked to either use the terms to describe their favorite or least favorite beverage, snack, dessert, or meal or to categorize the emotion words as being positive or negative, it was found that the vast majority of terms used by consumers were positive. The words were reduced to a final list of 39 using a variety of criteria related to choosing terms with clear positive or negative connotation, terms that would have applicability to novel, bold and ethnic flavors/cuisines, and for which the total time to administer the questionnaire would not exceed 10–15 min in an internet test or 30 min for a CLT. Table 8.7 shows the 39 words selected for the EsSense Profile®.

The EsSense Profile® requires that all emotions that are applicable to a product be either "checked" [check-all-that-apply or CATA format: see Adams, Williams, Lancaster, and Foley (2007), Meullenet, Lee, and Dooley (2008)] or rated. For rating

Table 8.7 The EsSense Profile®: 39 emotion words (King & Meiselman, 2010)

Active*	Loving*
Adventurous*	Merry
Affectionate	Mild*
Aggressive*	Nostalgic*
Bored*	Peaceful
Calm*	Pleased
Daring	Pleasant*
Disgusted*	Polite
Eager	Quiet
Energetic	Satisfied*
Enthusiastic*	Secure*
Free*	Steady
Friendly	Tame*
Glad	Tender
Good*	Understanding*
Good-natured*	Warm*
Guilty*	Whole
Happy*	Wild*
Interested*	Worried*
Joyful*	

Asterisked words are those that are contained in EsSense25 (Nestrud et al., 2016).

the emotion words, the authors proposed a 5-point category scale that ranged from 1 = "not at all" to 5 = "extremely." In addition, the basic instruction/question posed to the subjects for the CATA format was "Please select the words which describe how you feel right now" and for the rating format was "Please describe how you feel right now. Please rate each feeling" (King & Meiselman, 2010). Lastly, the method uses a 9-point hedonic scale to obtain liking/disliking ratings of the product that is administered with both formats and is completed prior to the emotion questions.

Although the EsSense Profile® is often used in its original form, the authors suggested that it was not meant to be a definitive list of emotions for use with food, but that researchers may add to or delete from the list to best tailor it to their specific product needs. In addition, the developers noted that it can be used with other traditional consumer test methodologies (eg, just-about-right scales) (King, Meiselman, & Carr, 2010). In recent research, Nestrud, Meiselman, King, Lesher, and Cardello (2016) developed a shorter version of the EsSense Profile®, known as EsSense25. This shorter version was developed through sorting and clustering studies on the original 39 emotion words to identify those words that could be safely removed from the Profile without changing the underlying structure or emotional dimensions present in the original questionnaire. The resultant EsSense25 contains 25 emotion words. These words are those that are asterisked in Table 8.7.

2.3.3 EmoSemio

EmoSemio is a product-specific questionnaire for use with chocolate and hazelnut spreads (Spinelli, Masi, Dinnella, Zoboli, & Monteleone, 2014). The questionnaire was developed using Italian as the foundational language, and its name derives from its focus on *emo*tions and the authors' use of a *semio*tic approach to develop the method. Spinelli et al. (2014) began by conducting one-on-one interviews with Italian-speaking consumers, using a modified Repertory Grid approach. Consumers tasted a variety of chocolate and hazelnut products and recounted the emotions that they experienced while tasting the products. By decomposition of the interview texts (semiotic approach), a series of 23 semantic categories (16 positive and 7 negative) was constructed. Each semantic category was then rephrased into a full sentence that would answer the question "How does it make you feel?" The use of full sentences in the questionnaire was intended to reduce the possible ambiguity that may occur when single words or simple phrases are used to describe emotional states, although the latter point has not been demonstrated. These 23 sentences and their emotional "labels" are shown in Table 8.8. As with questionnaires that utilize single words/phrases, each sentence on the EmoSemio questionnaire can be rated on a scale of "not at all" to "extremely."

Spinelli et al. (2014) compared EmoSemio to the EsSense Profile® in a study of chocolate and hazelnut spreads using 238 consumers. Although both questionnaires were found to provide additional discriminative ability among products beyond liking ratings alone, the authors concluded that EmoSemio "outperformed" the EsSense Profile® in terms of the number of emotion items that discriminated significantly among products, in spite of the fact that the number of emotions was different and many emotion items between the two questionnaires did not match semantically. It would seem clear that any differences observed between the two questionnaires are to be expected, since EmoSemio was developed in Italian and specifically for use with chocolate and hazelnut speads, while EsSense Profile® was developed in English and meant to apply to a broad range of foods and beverages.

2.3.4 PrEmo: The product emotion measurement instrument (Desmet, et al., 2000)

PrEmo (Desmet et al., 2000) was developed as a self-report approach to measuring product emotions that relies on the use of a set of cartoon animations that express 12 different emotions (boredom, desire, disgust, dissatisfaction, fascination, fear, hope, joy, pride, sadness, satisfaction, and shame) through facial and body expressions. The method can be seen as a sophisticated extension of the approach to scaling hedonics using cartoon faces (Ellis, 1968), and the major reason for the use of this approach is to avoid the use of written words that must be intepreted and can be ambiguous or ill-defined. By using a visual approach, the method may be more amenable to multilingual applications, because the method does not rely on words, but on facial and body expressions that may be presumed to be common across languages (see chapters: Measuring and Understanding Emotions in East Asia and Different Ways of Measuring Emotions Cross-Culturally, for a discussion of cross-cutural studies in emotion research). Fig. 8.1 shows the 12 characters/emotional expressions used in the PrEmo approach.

Table 8.8 EmoSemio questionnaire for chocolate and/or hazelnut spreads

	EmoSemio questionnaire sentences	EmoSemio questionnaire labels
1	It is an anti-stress: it calms me, it soothes me, it reassures me	Anti-stress
2	It relaxes me and make me feel carefree	Relaxed
3	I associate it with amusement and fun	Amused
4	It makes me feel full of energy and reinvigorated	Energetic
5	It makes me merry	Merry
6	It makes me happy	Happy
7	It satisfies me	Satisfied
8	It gratifies me, rewards me	Gratified
9	It makes me feel tender and affectionate	Tender
10	It makes me feel cuddled and loved	Cuddled
11	It communicates sensuality, it charms me	Sensual
12	It communicates security	Secure
13	I associate it to happy memories of childhood	Happy memory
14	It makes me feel good and generous	Generous
15	It surprises me	Surprised
16	It makes me curious	Curious
17	It makes me feel indifferent	Indifferent
18	It bores me	Bored
19	It makes me feel neglected, without any care for me	Neglected
20	It makes me feel sad	Sad
21	It disappoints me	Disappointed
22	It makes me feel guilty	Guilty
23	It annoys me, it makes me nervous	Annoyed

Source: From Spinelli et al. (2014).In the first column the 23 sentences of EmoSemio questionnaire are shown. For readability for each of them, in the second column, a word used to sum up its meaning is reported.

Although PrEmo is a self-report method, it is not amenable to paper ballots, because the method involves animation of the characters and is, thus, presented using a proprietary computer-based program. However, like most standard product emotion questionnaires, each of the character animations is rated from "I do not feel this" to "I do feel this strongly." As such, the method is open to a number of the same scaling and measurement artifacts to which other emotion questionaires are susceptible. In addition, it is unclear how the cartoon nature of the method might, in and of itself, evoke certain emotions, independently of any particular product.

2.3.5 Other product- and meal-specific, English language lexicons and questionnaires

Although the above methods constitute the major published and standardized, product-emotion questionnaires, a large number of product-specific questionnaires have

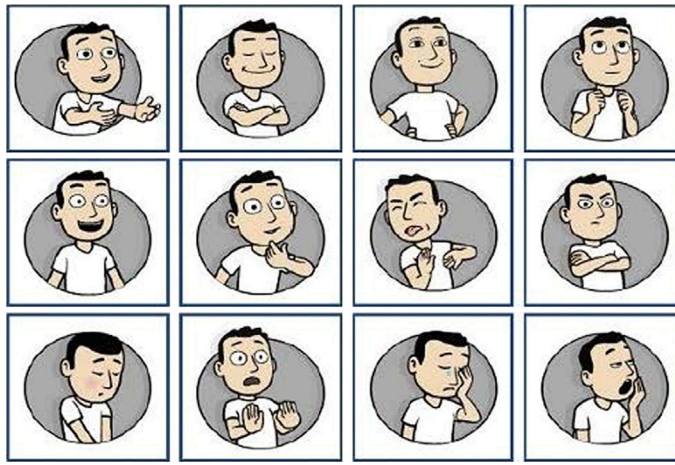


Figure 8.1 The 12 characters/emotional expressions used in the PrEmo approach.

also been developed and used in product research. Many of these questionnaires have been derived by drawing upon more standardized questionnaires and/or lexicons to identify emotion words relevant to a particular product and then presenting this list of words to consumers to check/rate the emotion words that are evoked by the product. Alternatively, the word lists are consumer-generated, either from lists or by other qualitative methods. Thus, Manzocco, Rumignani, and Lagazio (2013) developed an emotion questionnaire to assess emotional responses to photographs of fruit salads of varying freshness. Ng, Chaya, and Hort (2013b) developed a lexicon specific to black-currant squash in order to compare the approach to the EsSense Profile® and Chaya et al. (2015) recently developed a lexicon for beer, using consumer focus groups to generate relevant terms. Similarly, but at a more clinical level, White et al. (2015) developed a 13-item emotion questionnaire for adolescent mealtime emotions, of which only four emotions ("nervous," "embarrassed," "angry," and "frustrated") corresponded to those in Richin's Consumption Emotions Set, perhaps due to the more clinical nature of the former questionnaire. Nevertheless, these applications, as well as the others cited, show the versatility of self-report methods for addressing a wide range of food- and meal-related emotions.

The development of product-specific questionnaires is also not limited to questionnaires based on word lists. For example, Churchill and Behan (2010) describe the Mood Portraits™ method, which utilizes a series of photographs depicting scenes that represent different emotional states. These include, for example, a relaxed woman enjoying a massage, a peaceful pool of water, and a smoggy, industrial skyline. Fragrances are presented and the consumer views the photographs, selecting the ones that correspond to the emotions evoked by the fragrances. More recently, a similar approach using picture boards and known as Sens'n Feel™ has been developed and reported by Damilo, Dreyfuss, and Bremard (2011).

2.4 Non-English product emotion questionnaires

Several non-English domain- and product-specific emotion questionnaires have now been developed. Foremost among these are the odor-specific questionnaires developed by Ferdenzi et al. (2013, 2011), Rousset et al.'s (2005) French-based questionnaire for meat and other foods, and Ferrarini et al.'s (2010) Italian language questionnaire for use with wines. Most recently, van Zyl and Meiselman (2015) developed questionnaires for use in Spain and Mexico to evaluate the emotions evoked by beer, alcoholic and non-alcoholic beverages. When compared with comparable English questionnaires in the United States, United Kingdom, Australia, and New Zealand, these authors found more similarities in emotional responding to beverages between Mexico and the English-speaking countries than between Mexico and Spain. The authors concluded that culture may be more important than language in determining the emotional responses to beverages. The importance of cutural differences in the use of lexicons and questionnaires cannot be understated, and the reader is directed to chapters "Measuring and Understanding Emotions in East Asia" and "Different Ways of Measuring Emotions Cross-Culturally" in this volume, which cover cultural aspects of emotional responding.

3 The effect of different response formats

3.1 Basic scalar formats

Measuring emotional responses to products is no different than measuring their sensory attributes, at least in the sense of how one can quantify the responses. Among these options are using a response scale that has nominal, ordinal, interval or ratio properties. For example, in the majority of cases, respondents in product emotion research are presented with a list of emotion words and are asked to do one of a number of things. First, they may be asked to "check all that apply" (CATA). This is a nominal type of response, because the respondent, essentially, is being asked to say "yes" or "no" with regard to whether the emotion is evoked by the product. In fact, such forced-choice Yes/No formats can be deliberately implemented, so that respondents are forced to indicate whether or not each of the listed emotion words is characteristic of how they feel by responding "yes" or "no." (Piqueras-Fiszman and Jaeger, 2014). The latter requires more cognitive effort on behalf of the respondent, and therefore, reduces satisficing response behaviors in which the individual seeks to provide data with a minimal amount of effort that will be seen as satisfactory, but which is not truly optimal (Krosnick, 1991, 1999; Sudman & Bradburn, 1982).

Alternatively, the respondent may be asked to rate the intensity of the emotion using a verbal scale that ranges from "not at all" to "extremely," as in the EsSense Profile® Method. This type of scale is known as a "category" scale, because the respondent chooses one of the available labeled categories to describe the intensity of the emotion, and it is analogous in format to the classic 9-point hedonic scale (Peryam & Pilgrim, 1957), in which respondents rate their liking of a product by placing it into one of nine labeled categories "dislike extremely" to "like extremely." Although

such scales are commonly treated as interval scales, their interval nature is suspect, because we do not know whether the label "slight," (for example), is equidistant in psychological meaning from the label "moderate," as is the label "moderate" from the label "very." Thus, we cannot assume that the intervals between categories are equal, which is part of the definition of an interval scale. This is true whether or not numbers are associated with the categories during or after judgments are made. Rather, such scales should be considered to be ordinal and treated appropriately from a statistical point of view (non-parametrically). In practice, almost all investigators treat category scale data as if they are interval data and use parametric statistics.

An interval scale for rating emotion intensity is one that has true equal-interval properties. Most scalar methods used in emotion research today have not been demonstrated to have true equal-interval properties. However, visual analogue scales, such as are used in circumplex ratings of emotions (Russell, 1980; Russell, Weiss, & Mendelsohn, 1989) and in the bulls-eye approach (Piqueras-Fiszman & Jaeger, 2014; Thomson, 2015) can be argued to be interval level, because of the continuous nature of visual analogue scales and the fact that judgments of line length are known to be proportional to objective, physical line length. Thus, the bulls-eye method has been implemented in online surveys to reduce participant boredom and consists of presenting a visual graphic of a target with multiple concentric circles. The intensity rating is made along a visual analogue scale aligned with the progression towards the center of the target (ie, the bulls-eye).

To date, ratio scales for judging the intensity of emotional responses have not been used. However, nothing precludes their use. For example, the ratio method of magnitude estimation could be used by presenting a product to a respondent and instructing them to rate its emotional intensity on a scale that ranges from zero to any arbitrarily high number chosen by the respondent. Having judged this first sample, other products would be presented and the respondent instructed to judge the emotional intensity evoked by the next sample relative to the emotional intensity evoked by the first sample, such that the number assigned to the second sample stands in the same ratio to the number assigned to the first sample as does the perceived magnitude of the emotion of that product to the first one. Subsequent products would be judged in the same manner until all products have been evaluated. The resultant data can be treated as true ratio data, using the same data analytic techniques as are used for magnitude estimates of sensory attributes.

For some methods of measuring emotions, hybrid scaling or two-staged scaling can be used. Thus, the RATA method (Ares et al., 2014) has respondents first choose the emotion words that apply to the product (CATA—nominal scaling) and then has the respondent rate the selected emotion using a category scale (ordinal scaling). If only the CATA data are being analyzed, then the data are nominal (frequencies) and the statistical treatment is for non-parametric data; if the rating data are being analyzed, then the data are ordinal (or interval, see discussion above) and the statistical treatment should be in accordance with how the latter data are to be interpreted.

3.2 Best–Worst Scaling

Although rating scales and CATA questions have been the most common scaling formats used in consumer product emotion research, other scaling methods have also

been used. Best–Worst Scaling (BWS) (Finn & Louviere, 1992) has been implemented in consumer product emotion research and conceptual profiling, notably by Thomson and colleagues (Thomson & Crocker, 2014, 2015; Thomson, Crocker, & Marketo, 2010). To implement BWS, which is also known as maximum-difference scaling (max-diff), a participant is presented with a product and a set of three or more emotion words (typically 4–6). The task is to select the one word that applies most to how he/she is feeling (a.k.a., "best"), and the one word that applies least to how he/she is feeling (a.k.a., "worst"). This process is repeated for multiple word combinations, which are defined according to an experimental design (typically a balanced incomplete block design). The method takes advantage of respondents' ability to identify extreme options and has been used for hedonic scaling in a variety of sensory and consumer studies (Hein, Jaeger, Carr, and Delahunty, 2008; Jaeger and Cardello, 2009; and Mielby, Edelenbos, and Thybo, 2012). BWS, when correctly implemented is highly sensitive and has been shown to outperform rating scales in terms of discriminability (Cohen, 2003). However, concerns have been raised regarding the suitability of BWS when products must be physically evaluated, due to the logistical burden of the multiple evaluations/tastings that are required (Jaeger & Cardello, 2009; Mueller, Francis, & Lockshin, 2009). Tentatively, this can be mitigated by using split-block designs so that the number of samples to be evaluated by each participant is limited.

An advantage of the best–worst method is that it is scale-free, owing to its origins in the method of paired comparisons. There are no scale anchors or scale categories/intervals. This is an advantage for applications in cross-cultural research, where differences among consumers in different countries are known to exist with regard to scale use (Harzing, 2006; He, Van de Vijver, Espinosa, & Mui, 2014). The application of BWS for cross-cultural food-related consumer research is examplified by Dekhili, Sirieix, and Cohen (2011) and Goodman (2009). As noted, despite these benefits, the task requires multiple product evaluations/tastings, which can be fatiguing for participants (Mueller et al., 2009).

3.3 Other scaling and specialized formats for consumer product emotion research

3.3.1 Multiple-choice formats

Multiple-choice formats, in which a list of emotion terms are presented and respondents have to choose one of them (or select X from a list of Y terms) have also been used to obtain emotion data. For example, Warrenburg (2005) presented eight emotion words (happy, relaxed, sensuous, stimulated, irritated, stressed, depressed, apathetic) that spanned a two-dimensional space from negative to positive and low to high arousal to consumers. Aroma stimuli (fragrance ingredients) were used as test products (clementine and vanilla bean) and the participants were instructed to "pick the mood (*sic*) category that best matches the aroma of the sample." Results showed that, while both aromas were positive, they differed in their level of arousal. Clementine was most strongly associated with "happy" (45.5%) and "stimulated" (34.1%) while vanilla bean was most strongly associated with "happy" (27.2%) and "relaxed" (44.6%).

3.3.2 Single-item questionnaires

Outside of the field of sensory and consumer science, other measurement approaches can be found. The Affect Grid (Russell et al., 1989) exemplifies a quick means of assessing affect along the dimensions of pleasure–displeasure and arousal–sleepiness. If many products need to be screened, this single-item scale, which provides pleasure and arousal scores for each object, may be considered. Jiang, King, and Prinyawiwatkul (2014) endorse this suggestion. The Affect Grid is presented as a square consisting of 9 × 9 smaller squares that are anchored at the extreme ends by selected emotion words to indicate, for example, high arousal and unpleasant feelings (stress), high arousal and pleasant feelings (excitement), low arousal and pleasant feelings (relaxation), etc. Participants select 1 of the 81 squares to indicate how they are feeling, resulting in rapid single-item scaling.

The 12-point circumplex structure of core affect (Russell et al., 1989; Russell, 1980; Yik, Russell & Steiger, 2011) spans the same two-dimensional space. It enables a more detailed capture of affect, mood, and emotion than the Affect Grid. The circumplex approach uses 12 dimensions, which are positioned in a circumplex structure around the circumference of a circle and are rated on a 4-point or 5-point scale. Combining the single-item scale characteristic of the Affect Grid, with the 12-point circumplex structure of core affect, Jaeger and colleagues (unpublished data) created a rapid measurement approach (Fig. 8.2). It was explained to participants that each of the 12 radials on the figure had three marks and that the mark closest to the center represented "low" intensity, whereas the mark on the outer area represented "high" intensity. Participants were instructed to place a single mark on the figure to indicate how they were feeling right now. An exemplar application of this approach pertains to a household care product (liquid soap) of which two variants were presented to a sample of 94 New Zealand consumers taking part in a Central Location Test.

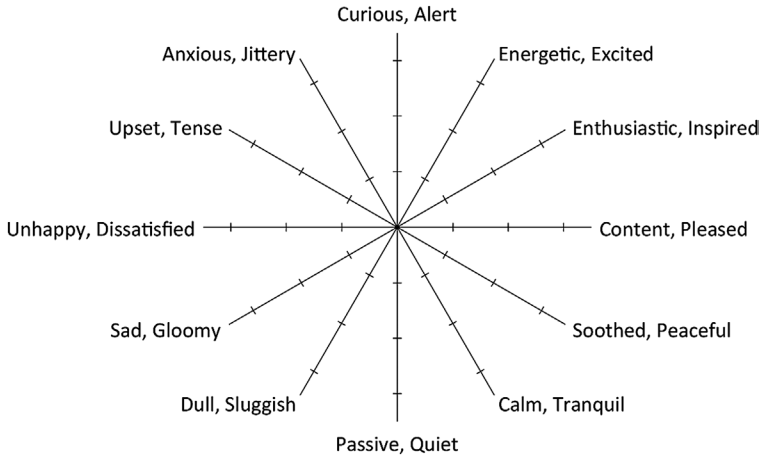


Figure 8.2 Rapid circumplex emotion questionnaire (Jaeger, unpublished data).

Table 8.9 Citation frequencies for two liquid soap samples obtained using a 12-point circumplex ballot (see Fig. 8.2). Data are from 94 New Zealand consumers

	Sample 1	Sample 2
Curious, Alert	11	15
Energetic, Excited	11	5
Enthusiastic, Inspired	10	3
Content, Pleased	18	6
Soothed, Peaceful	27	5
Calm, Tranquil	15	4
Passive, Quiet	2	6
Dull, Sluggish	1	11
Sad, Gloomy	0	7
Unhappy, Dissatisfied	2	20
Upset, Tense	2	10
Anxious, Jittery	1	6

Source: Jaeger and colleagues, unpublished data.

Data collection took less than 5 min (including a break between samples) and, based on a single data point from each participant, clear differences in the emotional character of samples were established when considering total citation frequency for each of the 12 dimensions or average scores. The former is shown in Table 8.9.

3.3.3 Temporal dominance of emotions

Recently, the temporal aspects of the emotional response to products have been examined using the approach of temporal dominance of emotions (Jager et al., 2014; see chapter: Short-term Time Structure of Food-Related Emotions: Measuring Dynamics of Responses). This approach is a form of time–intensity measurement (Cliff & Heymann, 1993; Lee & Pangborn, 1986) that has been used for many years, and is patterned after the method of temporal dominance of sensations (TDS) (Meyners, 2010, 2011). In the latter method, panelists are asked to evaluate a series of different sensory attributes on a computer screen and to indicate the most dominant sensation. As the panelist continues to taste/chew/eat the sample, the dominant sensation may change and the panelist indicates these changes. The resultant data are a record of the changes in the dominant sensation over time. In temporal dominance of emotions (TDE), an analogous procedure is used to create a temporal record of changes in emotional responding over time (Jager et al., 2014). Insofar as this method is relatively new in product emotion research, not a great deal of data are available regarding its reliability or other important aspects of methodological biases, etc. However, it seems clear that with the current level of interest in all aspects of emotional responding to food, that the TDE method will grow in importance with time.

3.3.4 Future formats for obtaining emotion data through questionnaires

Expecting an increased adoption of mobile technology for data collection, Ng and Hort (2014) proposed that more engaging and interactive ways of collecting emotion data will become common-place (eg, smartphone app, tablet app, etc.). This could be accompanied by new scaling formats specifically developed for such platforms. Mobile devices present the opportunity to measure consumer emotional responses in real time and at point of purchase and/or consumption. For example, Schifferstein, Fenko, Desmet, Labbe, and Martin (2013) have begun to examine aspects of emotional experience at different stages of product use including those of purchase, cooking, eating, and re-purchase. New methods of emotion data capture using mobile electronic devices is an important area for future research.

3.4 Reliability of scale methods

The validity of any scale or test method is inextricably linked to its reliability. A method cannot be valid, if it is not reliable. Yet, reliability is often unexamined when new methods are first presented to the scientific community. Although the EsSense Profile® method was introduced without accompanying reliability data (King & Meiselman, 2010), reliability data for the rating version were provided in a subsequent study by Cardello et al. (2012). In this study, EsSense Profile® emotion ratings were obtained for both tasted foods and food names. Data collected in this study were repeated twice with the same subjects in two different sessions separated by a week. The session-to-session reliability coefficients for individual emotions across tasted foods ranged from +0.31 for the emotion word "quiet" to +0.70 for "joyful." For food names, the reliability ranged from +0.50 for "aggressive" to +0.77 for "affectionate." For individual food items, the reliability of individual emotion words ranged as high as +0.84 for "worried" (ref: potato chips), and for food names was as high as +0.90 for "energetic" (ref: carrots). Overall, the emotion rating data were found to be more reliable for food names than for tasted foods, which was attributed to the fact that food names are more stable cognitive constructs than tasted foods, because they serve as quintessential representations of that food which do not vary, whereas tasted foods are subject to temporal variations in perception and expectations, as well as changing appetitive contexts (Cardello et al., 2012).

In a second study, the reliability of both the rating and CATA formats of the EsSense Profile® method were examined for ratings of food names. Three different emotion list lengths were examined, with all list lengths containing only words from the EsSense Profile®. Table 8.10 shows the session-to-session reliability data across the 10 emotions common to all three lists as a function of the emotion ballot length. Regardless of ballot length, the reliability coefficients for the rating data were higher than for the CATA data. While it is difficult to know for certain why there is this difference in reliability, it may well be due to the rating method requiring a greater level of attention on the part of the respondent than does the CATA method.

The above results do not mean that the reliability of the CATA method for emotions is not good. Indeed, reliability for sensory CATA data has been found to be

Table 8.10 Test–retest reliability coefficients (*r*) for the same individuals using either the rating format (Pearson *r*) or CATA format (binomial *r*) in two separate sessions as a function of the number of emotion words on the ballot

	Rating format	CATA format
Number of emotions		
10	0.81***	0.65***
25	0.82***	0.61***
39	0.77***	0.57***
Overall	0.80***	0.61***

Data are collapsed across stimuli and are based on responses to the 10 common emotions on the 10-, 25-, and 39-item ballots (Cardello et al., 2014)

***$p < .001$.

high (Jaeger et al., 2013a). In recent work, Worch and Piqueras-Fiszman (2015) have also shown good agreement among panelists using CATA formats to evaluate emotions, and they have proposed a number of new statistical tools to assess panelist performance on these tasks. However, on a relative basis, if one plans to compare the results of product testing done at two separate times, it is recommended that a rating format be used, because it is likely to produce more stable responding from session to session.

3.5 Comparison of data collected by CATA, RATA, rating scale formats

Since different scaling methods can be used to measure emotions, the question occurs as to how these different methods compare to one another. Essentially, what differences might one find when using either CATA, RATA, rating, or any other form of scaling? On the basis of measurement and psychophysical theory alone, one would assume that as the nature of the measurement level increases from nominal to ordinal to interval, that the sensitivity to stimulus and product differences should increase. Of course, this does not take into account any differences in the complexity of the scaling task, which may interact with the ability of the scale type to discern differences. For that reason, examination of the empirical data for each of the available methods is required.

In one study that compared CATA with ratings, King, Meiselman, and Carr (2013) presented results from an internet survey with ice-cream as the product category. The EsSense Profile® was used, and responses were obtained using a 5-point rating scale ($n = 3464$) or a CATA question ($n = 4248$). On average, respondents selected 5 of 39 emotion terms in the CATA format (13%). With the rating scale, 29 of 39 emotions (74%) had an average intensity exceeding "very slight to slight" (≥2.5 out of 5). On this basis, the authors concluded that CATA may serve an advantage "to reduce a long list of emotion terms for a product category under consideration." Comparing average citation frequency and average ratings for the 39 emotion terms, the authors

also concluded that, for terms with low average citation frequency (<10%), average ratings were more diverse (spanning ~1 to ~2.5 out of 5). Conversely, for emotion terms with high average ratings (>3.5), average citation frequencies were more diverse (~40 to ~53%) in some instances. This is not wholly unexpected, and points to a ceiling effect. Average ratings did not increase beyond ~3.5 out of 5, but could, at that level, have significantly different average citation frequencies (~30 to >50%). Typically, when a larger emotion list is used for product characterization, the different emotion words have stronger/weaker presence. If it is known in advance that emotion words with low citation frequencies are more important for differentiating between different product variants, then ratings may be preferable. The above authors reported what would be an expected relationship between average ratings and average citation frequencies. However, they did not show that discrimination between two or more variants of ice-cream was more nuanced when using ratings versus CATA questions.

Ng, Chaya, and Hort (2013a) also looked at this issue, comparing EsSense Profile® rating data and CATA data using a consumer-defined lexicon to evaluate emotional responses to blackcurrant squash. Their results showed no major differences in the emotional spaces produced by the two methods and no difference in product configurations. These findings parallel what has been observed in comparing rating and CATA methods for sensory data (Dooley, Lee, & Meullenet, 2010). Although the CATA data in Ng et al.'s (2013a) study were found to be more discriminating among products, this was due more to the fact that the emotion words used with the CATA data were consumer-generated and, therefore, predisposed to being more discriminating, independent of the scale type used. Insofar as CATA responses are easy to make for consumers (Adams et al., 2007; Ares et al., 2013; Dooley et al., 2010; Jaeger & Ares, 2014; Jaeger et al., 2013b), but more limited in statisical treatment, Ng et al. (2013a) recommended that a RATA approach might be best in many circumstances.

Rating and CATA data using the EsSense Profile® method were also obtained in the study by Cardello, Borgogno, Craig, and Lesher (2014) cited earlier, in which a number of emotion words were examined. For word lists containing the same number of emotion words, the CATA data always resulted in consumers using fewer emotion words than for the rating data. This is a consistent finding when comparing rating and CATA for both sensory and emotion data (Dooley et al., 2010; King et al., 2013). Fig. 8.3 from the study by Cardello et al. (2014) shows, for the same respondents and across all products and emotion words, the percentage of times that an emotion was checked on the CATA ballot as a function of the category response given on the rating ballot. As can be seen, as the rating increases, the percentage of time that respondents checked that emotion on the CATA ballot increases, but only reaches about 75%, even when ratings of "extremely" are given on the rating ballot. Looking at these data another way, one can interpret that the "threshold" for saying "yes" on a CATA ballot occurs somewhere between the intensity ratings of "moderately" and "very" on the rating ballot. Clearly, respondents use a higher criterion to check an emotion word on a CATA ballot, thereby producing fewer overall checked emotions on these ballots than when the respondent is asked to rate the emotions. Similarly, the checked emotions are those that are the strongest of those elicited by the product. The latter results suggest that rating data may provide a finer level of emotional detail

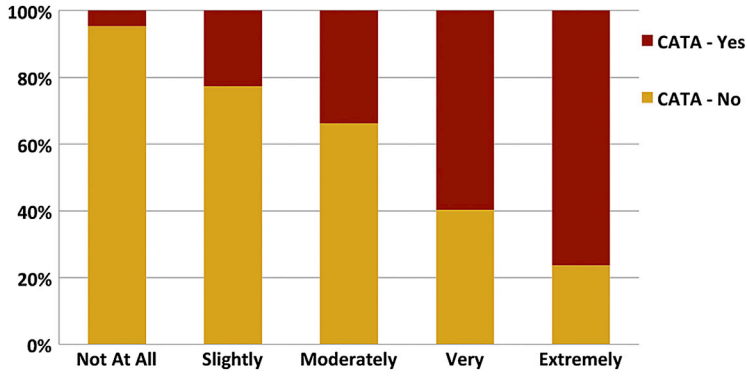


Figure 8.3 The percentage of times in which a respondent checked (CATA—yes) or did not check (CATA—no) an emotion word when he/she rated that emotion as either "not at all," "slightly," "moderately," "very," or "extremely" intense on the corresponding rating ballot. *Source*: From Cardello et al. (2014).

(additional emotions, and at lower intensity levels) than CATA data, at least in those cases where more detail is preferable to faster response acquisition.

Although the RATA method has been described only more recently as a potential form of scaling for sensory and emotion data (Ares et al., 2014), some comparisons to CATA and rating data have begun to appear. For example, Ares et al. (2014) compared the two methods for scaling sensory attributes of a variety of different food items. Using over 325 consumers, they found that the RATA method resulted in a larger number of sensory attributes being used to describe the products and a greater number of significant differences among products than the CATA method. If RATA is considered to be a hybrid of CATA and intensity rating, then it stands to reason that RATA data would result in more attributes being used and greater discrimination, just as rating data result in a greater number of attributes used and better discrimination than CATA data (see previous paragraph). With regard to sample configurations, no differences were found between the two methods by Ares et al. (2014), although the RATA configurations were found to be more stable. A subsequent study comparing these methods (Reinbach, Giacalone, Ribeiro, Bredie, & Frøst, 2014) also found no differences between CATA and RATA in terms of sample configurations.

4 Effect of stimulus formats

A wide variety of different stimuli have been used to evoke emotions in product research. Among these are actual products, product names, and product pictures. By their very nature, these different simuli are likely to elicit different levels of emotion, as well as different types of emotions, depending on the parameters of the stimulus and stimulus conditions. In this section we examine some of the pertinent research using different forms of product/stimulus presentation.

In most central location product testing, the stimulus is a physical object presented to the consumer to be tasted, eaten, felt, etc., and the task is to evaluate it for liking, emotional response, etc. However, in Internet tests, the stimulus is usually a branded or unbranded product name or a picture of the product or its packaging. Cardello et al. (2012) directly compared the emotional responses to tasted foods and food names in order to assess differential reliability to these two distinct stimulus types. The tasted foods consisted of two different styles of chocolate and two different flavors of potato chips. Correspondingly, the food names tasted were "chocolate" and "potato chips." Tasted foods and food names were evaluated by consumers using the EsSense Profile® Method (rating format) in a between-subjects design.

Fig. 8.4 from that study shows the data for the two tasted chocolates (milk and dark) and the name "chocolate" (Fig. 8.4, left) and for the two tasted chips (regular and barbeque flavor) and the name "potato chips" (Fig. 8.4, right). As can be seen in the left spiderplot, the name "chocolate" evoked significantly greater intensities of emotional response on 15 of the 39 emotions than either of the two tasted chocolates. For chips (right spiderplot), a different pattern of results was seen. Here, 24 of the 39 emotion word ratings were lower for the name "potato chip" than for the two tasted chips. The fact that the more highly emotion-evoking "chocolate" resulted in greater emotional responses to the name than to tasted versions of chocolate, while the less emotion-evoking "potato chips" produced higher ratings to the tasted versions was interpreted to reflect the fact that food names elicit memories of a "quintessential" product and its associated emotional experience. In cases like "chocolate," the remembered quintessential experience evokes emotions that are more intense than any particular tasted version. In cases like "potato chips," these experiences are not as emotionally vivid and, thus, tasted products may evoke more intense emotions. This was also interpreted to be an anologue of the differences observed between expressed liking for food names and tasted versions of those foods (Cardello & Maller, 1982), where well-liked foods result in higher liking ratings for the name of the food, while disliked foods result in higher liking ratings for the tasted versions. In a sense, products are never as good as we think of them to be nor as bad as we think of them to be. So too for emotions, it seems that products are never as emotionally intense as we think them to be nor as devoid of emotional impact as we think them to be. Interestingly, in this study the reliability of emotional responding to food names was more robust than for tasted foods, and the correlations among the product emotion profiles were high, in spite of the differences in evoked intensities.

Just as one can evaluate liking for specific sensory attributes (flavor, texture, appearance) of a product, King et al. (2013) examined the difference between emotion evaluations of product names and the aroma or flavor of different spices. For the spice name study, an internet test was conducted. For the aroma study, the spice aroma was evaluated from glass vials containing the actual spice in a CLT test, and for the flavor study, crescent rolls baked with the spice were tasted in a CLT test using two different spice concentrations. A total of nine different spices were tested and all studies used the EsSense Profile® method. Results showed that the name of the spice produced stronger emotional responses than did the other conditions, confirming the results of Cardello et al. (2012) for highly emotion-evoking products. In the aroma study, none

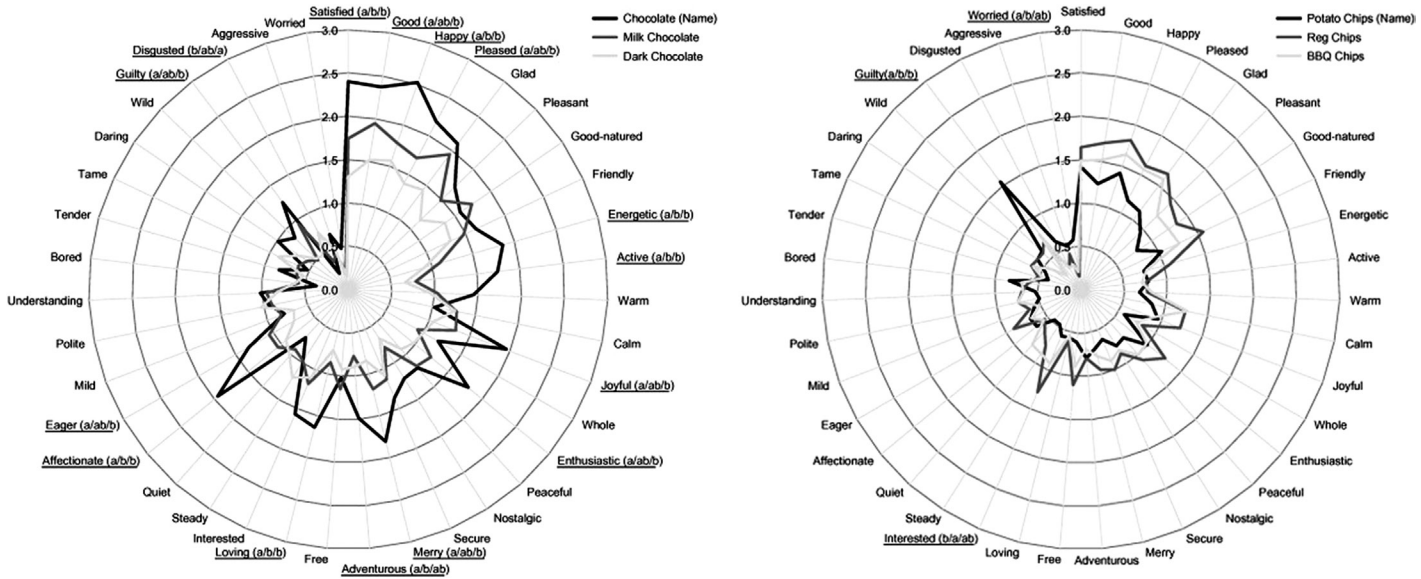


Figure 8.4 Comparison of the mean emotional responses to the food name "chocolate" and to tasted milk chocolate and dark chocolate (left) and to the food name "potato chip" and to tasted regular and barbecue flavored potato chips (right). The underlined emotions are significantly different ($p < 0.05$) and post hoc results appear after the underlined emotion (left to right = highest, intermediate, lowest mean; means with different letters are significantly different at $p < 0.05$).
Source: From Cardello et al. (2012).

of the emotions differentiated the products, as contrasted with the other stimulus formats, while the flavor study revealed multiple differences in emotions among the spices and stronger intensities for the emotions "calm," "friendly," "good," "good natured," "happy," "peaceful," "polite," "quiet," and "understanding" than the other studies. In addition, in the flavor study, the lowest concentration of spice evoked the most intense positive emotions, for example, "affectionate," "friendly," and "happy." The authors cautioned that, though their data confounded stimulus type with other study variables, for example CLT versus internet testing, that investigators "should not assume that testing in different contexts will produce the same emotion profile; emotional differences can be observed when using different test protocols and formats which include direct and indirect sensory experiences."

Names of products can also be interpreted as a measure of what the consumer "expects" from the product. A large literature exists on the role of consumer expectations on product liking and perceived sensory characteristics [see Cardello (2007) for a review]. Porcherot et al. (2012) used emotional responses to the names of odorants as a measure of expected emotions for the actual odorant. Seventeen odorants were used in the study and consumers evaluated their emotional experiences using the ScentMove™ questionnaire in three conditions: (1) name of the odorant; (2) actual odorant; and (3) name of the odorant + actual odorant. The three conditions were treated as the three conditions in a classic expectation paradigm, that is (1) expected, (2) blind, and (3) labeled. Their results showed that the odorant name (expected emotions) influenced consumer judgments of the actual odor (blind condition). Depending on the specific odorant, they observed confirmation of the expectation (expected and actual emotions matched) or disconfirmation of the expectation (mismatch between expected and actual emotions). In the latter case, they observed various levels of assimilation (movement of the emotion profile in the direction of expected values) that varied from no assimilation to complete assimilation. Contrast (movement of the emotion profile away from expected values) was not observed.

Taken together, the above studies show that a variety of different stimulus types can be used in emotion research. Depending on the nature of the stimulus, the types and intensities of the experienced emotions can vary. Moreover, these different stimulus types can be used effectively in order to explore other empirical and theoretical aspects of the role of emotions in consumer product behavior.

5 Conclusions

As noted at the start of this chapter, product emotion research is a rapidly growing area of research within academia and industry. The rapid expansion in the number and types of emotion questionnaires and lexicons, the growing variety of methods for scaling emotions, the multitude of combinations of emotion data collection procedures, and the sheer number of new applications for product emotion research, have created a situation in which it is essential to know and understand the measurement issues and problems in product emotion research, if one wants to be an active and productive researcher in the field. In this chapter, we have sought to describe many of

these measurement issues in order to provide guidance and direction to new investigators coming into this area of research, as well as to stimulate thought and ideas for new avenues of emotion research among established researchers in the area.

In summary, consumer product emotion research can be viewed as similar to other forms of consumer product research. That is, empirical decisions need to be aligned with the objectives of the research. As noted by Jaeger and Cardello (2009) regarding the choice of hedonic scale methods in sensory science:

> *Choice of scaling method needs to be made in the context of the nature and complexity of the study to be conducted, the nature of the respondents, and the nature of the test samples themselves. With numerous criteria influencing the choice of hedonic scaling methodology, we advocate that researchers be explicit about the criteria that underline their empirical work.(p. 249).*

We consider this recommendation to also apply to emotion research and to the choice of emotion methods to be used in any study. The choice of an emotion measurement instrument must be driven by the specific needs and criteria of the application. There is no "silver bullet" method. Each method has its own advantages and disadvantages, and it is incumbent on the researcher to know what these are and to make a well-reasoned selection for their specific application.

Lastly, we are aware that it is impossible to cover all measurement issues within a single chapter. Nevertheless, we hope that we have brought to light the most commonly used methods, the important issues that must be considered in choosing a method, and the most relevant research that addresses those issues. We look forward to the development of new and creative methods in this important area of consumer research, in order to further our understanding of the important role of emotions in product acceptance, choice and consumption.

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Sentiment Analysis: Detecting Valence, Emotions, and Other Affectual States from Text

9

Saif M. Mohammad
National Research Council Canada, Ottawa, ON, Canada

1 Introduction

The term sentiment analysis can be used to refer to many different, but related, problems. Most commonly, it is used to refer to the task of automatically determining the valence or polarity of a piece of text, whether it is positive, negative, or neutral. However, more generally, it refers to determining one's attitude towards a particular target or topic. Here, attitude can mean an evaluative judgment, such as positive or negative, or an emotional or affectual attitude, such as frustration, joy, anger, sadness, excitement, and so on. Note that some authors consider feelings to be the general category that includes attitude, emotions, moods, and other affectual states. In this chapter, we use "sentiment analysis" to refer to the task of automatically determining feelings from text, in other words, automatically determining valence, emotions, and other affectual states from text.

Osgood, Suci, and Tannenbaum (1957) showed that the three most prominent dimensions of meaning are evaluation (good–bad), potency (strong–weak), and activity (active–passive). Evaluativeness is roughly the same dimension as valence (positive–negative). Russell (1980) developed a circumplex model of affect characterized by two primary dimensions: valence and arousal (degree of reactivity to stimulus). Thus, it is not surprising that large amounts of work in sentiment analysis are focused on determining valence (see survey articles by Liu, 2015; Liu & Zhang, 2012; Pang & Lee, 2008). However, there is some work on automatically detecting arousal (Kiritchenko, Zhu, & Mohammad, 2014; Mohammad, Kiritchenko, & Zhu, 2013a; Thelwall, Buckley, Paltoglou, Cai, & Kappas, 2010) and growing interest in detecting emotions such as anger, frustration, sadness, and optimism in text (Bellegarda, 2010; Boucouvalas, 2002; Genereux & Evans, 2006; Holzman & Pottenger, 2003; John, Boucouvalas, & Xu, 2006; Ma, Prendinger, & Ishizuka, 2005; Mihalcea & Liu, 2006; Mohammad, 2012; Strapparava & Mihalcea, 2007; Tokuhisa, Inui, & Matsumoto, 2008; Zhe & Boucouvalas, 2002). Further, massive amounts of data emanating from social media have led to significant interest in analyzing blog posts, tweets, instant messages, customer reviews, and Facebook posts for both valence (Agarwal, Xie, Vovsha, Rambow, & Passonneau, 2011; Aisopos, Papadakis, Tserpes, & Varvarigou, 2012; Bakliwal et al., 2012; Brody & Diakopoulos, 2011; Kiritchenko, Zhu, Cherry, & Mohammad, 2014; Kiritchenko, Zhu, & Mohammad, 2014; Mohammad et al.,

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2013a; Pak & Paroubek, 2010; Thelwall, Buckley, & Paltoglou, 2011) and emotions (Aman & Szpakowicz, 2007; Bollen, Pepe, & Mao, 2009; Choudhury, Counts, & Gamon, 2012; Hasan, Rundensteiner, & Agu, 2014; Kim, Gilbert, Edwards, & Graeff, 2009; Mohammad, 2012a; Mohammad & Kiritchenko, 2014; Mohammad, Zhu, Kiritchenko, & Martin, 2014; Tumasjan, Sprenger, Sandner, & Welpe, 2010b; Wang, Chen, Thirunarayan, & Sheth, 2012). Ortony, Clore, and Collins (1988) argue that all emotions are valenced, that is, emotions are either positive or negative, but never neutral (Ortony et al., 1988). While instantiations of some emotions tend to be associated with exactly one valence (eg, joy is always associated with positive valence), instantiations of other emotions may be associated with differing valence (eg, some instances of surprise are associated with positive valence, while some others are associated with negative valence). Thus, methods for emotion classification often benefit from using valence features. The vast majority of these valence and emotion classification approaches employ statistical machine learning techniques, although some rule-based approaches, such as that of Neviarouskaya, Prendinger, and Ishizuka (2009), also persist.

Automatic detection and analysis of affectual categories in text has wide-ranging applications. Below we list some key directions of ongoing work:

- *Public health*: Automatic methods for detecting emotions are useful in detecting depression (Cherry, Mohammad, & De Bruijn, 2012; Pennebaker, Mehl, & Niederhoffer, 2003; Rude, Gortner, & Pennebaker, 2004), identifying cases of cyber-bullying (Chen, Zhou, Zhu, & Xu, 2012; Dadvar, Trieschnigg, Ordelman, & de Jong, 2013), predicting health attributes at community level (Eichstaedt et al., 2015; Johnsen, Vambheim, Wynn, & Wangberg, 2014), and tracking well-being (Paul & Dredze, 2011; Schwartz et al., 2013). There is also interest in developing robotic assistants and physiotherapists for the elderly, the disabled, and the sick—robots that are sensitive to the emotional state of the patient.
- *Politics*: There is tremendous interest in tracking public sentiment, especially in social media, towards politicians, electoral issues, as well as national and international events. Some studies have shown that the more partisan electorate tend to tweet more, as do members from minority groups (Lassen & Brown, 2011). There is work on identifying contentious issues (Maynard & Funk, 2011) and on detecting voter polarization (Conover, Ratkiewicz et al., 2011). Tweet streams have been shown to help identify current public opinion towards the candidates in an election (nowcasting) (Conover, Goncalves, Ratkiewicz, Flammini, & Menczer, 2011; Golbeck & Hansen, 2011; Mohammad et al., 2014). Some research has also shown the predictive power of analyzing electoral tweets to determine the number of votes a candidate will get (forecasting) (Bermingham & Smeaton, 2011; Lampos, Preotiuc-Pietro, & Cohn, 2013; Tumasjan, Sprenger, Sandner, & Welpe, 2010a). However, other research expresses skepticism at the extent to which forecasting is possible (Avello, 2012).
- *Brand management, customer relationship management, and stock market*: Sentiment analysis of blogs, tweets, and Facebook posts is already widely used to shape brand image, track customer response, and in developing automatic dialogue systems for handling customer queries and complaints (Bock et al. 2012; Fang, Chen, Wang, & Wu, 2011; Gupta, Gilbert, & Fabbrizio, 2013; Ren & Quan, 2012; Yen, Lin, & Lin, 2014; Yu, Wu, Chang, & Chu, 2013).
- Education: Automatic tutoring and student evaluation systems detect emotions in responses to determine correctness of responses and also to determine emotional state of the

participant (Li, Li, Jiang, & Zhang, 2014; Suero Montero & Suhonen, 2014). It has been shown that learning improves when the student is in a happy and calm state as opposed to being anxious or frustrated (Dogan, 2012).

- *Tracking the flow of emotions in social media*: Besides work in brand management and public health, as discussed already, some recent work attempts to better understand how emotional information spreads in a social network, for instance to improve disaster management (Kramer, 2012; Vo & Collier, 2013).
- *Detecting personality traits*: Systematic patterns in how people express emotions is a key indicator of personality traits such as extroversion and narcissism. Thus many automatic systems that determine personality traits from written text rely on automatic detection of emotions (Grijalva, Newman, Tay, Donnellan, Harms, Robins, & Yan, 2014; Malti & Krettenauer, 2013; Minamikawa & Yokoyama, 2011; Mohammad & Kiritchenko, 2013; Schwartz et al., 2013).
- *Understanding gender differences*: Men and woman use different language socially, at work, and even in computer-mediated communication. Several studies have analyzed the differences in emotions in language used by men and women in these contexts (Grijalva et al., 2014; Mohammad & Yang, 2011; Montero, Munezero, & Kakkonen, 2014).
- *Literary analysis*: There is growing interest in using automatic natural language-processing techniques to analyze large collections of literary texts. Specifically with respect to emotions, there is work on tracking the flow of emotions in novels, plays, and movie scripts, detecting patterns of sentiment common to large collections of texts, and tracking emotions of plot characters (Hartner, 2013; Kleres, 2011; Mohammad, 2011, 2012b). There is also work in generating music that captures the emotions in text (Davis & Mohammad, 2014).
- *Visualizing emotions*: A number of applications listed above benefit from good visualizations of emotions in text(s). Particularly useful is the feature of interactivity. If users are able to select particular aspects, such as an entity, emotion, or timeframe of interest, and the system responds to show information relevant to the selection in more detail, then the visualization enables improved user-driven exploration of the data. Good visualizations also help users gain new insights and can be a tool for generating new ideas. See Quan and Ren (2014), Mohammad (2012b), Liu, Selker, and Lieberman (2003), and Gobron, Ahn, Paltoglou, Thelwall, and Thalmann (2010) for work on visualization of emotions in text.

As automatic methods to detect various affect categories become more accurate, their use in natural language applications will likely become even more ubiquitous. This chapter presents a comprehensive overview of work on automatically detecting sentiment in text.[1] We begin in Section 2 by discussing various challenges to sentiment analysis. In Section 3, we describe the diverse landscape of sentiment analysis problems, including: detecting the sentiment of the writer, reader, and other relevant entities; detecting sentiment from words, sentences, and documents; detecting stance towards events and entities which may or may not be explicitly mentioned in the text; detecting sentiment towards aspects of products; and detecting semantic roles of feelings.

[1] See surveys by El Ayadi, Kamel, and Karray (2011) and Anagnostopoulos, Iliou, and Giannoukos (2015) for an overview of emotion detection in speech. See Picard (1997, 2000) and Alm (2008) for a broader introduction of giving machines the ability to detect sentiment and emotions in various modalities such as text, speech, and vision.

Many of the machine learning approaches for automatic detection of sentiment are supervised, that is, systems first learn a model from a set of example instances labeled with the correct sentiment. (This set of example instances is called the training set.) Then the model is able to predict the sentiment of new, previously unseen, instances. To determine the expected prediction accuracy, the model is often evaluated on a held-out portion of the labeled data called the test set. (There is no overlap between the instances in the training and test sets.) In Section 4, we discuss work on creating labeled data (training and test sets) for valence and emotion. We also summarize automatic methods to detect valence and emotion in text. Many of these approaches rely on lists of words associated with affect categories. We describe approaches to create large lexicons of term–affect associations in Section 5. Some classes of terms, such as negation words and degree adverbs, are not directly associated with sentiment, but they impact the sentiment of other terms in their vicinity. Section 6 describes work on modeling the impact of modifiers such as negation and degree adverbs on sentiment.

Language is rife with creativity in the form of metaphors, analogies, expressions of sarcasm, statements of irony, and so on. Such texts are collectively referred to as figurative language in the natural language processing community, and they are especially challenging for automatic text analysis systems. Section 7 discusses some preliminary sentiment analysis work focused on figurative language.

Since much of the research and resource development in sentiment analysis has been on English texts, sentiment analysis systems in other languages tend to be less accurate. This has ushered work in leveraging the resources in English for sentiment analysis in the resource poor languages. We discuss this work in Section 8.

Automatic text analysis systems are often evaluated on different datasets and with different settings. Thus the results reported in different articles are often not directly comparable, making it hard to assess which approach is better in practice. Further, machine learning algorithms can often "overfit" on the training data, that is, a system may predict accurately on test data that are very similar to the training data, but poorly on test data that are from a different domain or from a different time span. To address this, shared task competitions are organized to evaluate various algorithms on a common evaluation framework, with new, never before seen, datasets. Many of the sentiment-analysis-related shared tasks were organized under the aegis of SemEval (Semantic Evaluation)—a 2-day workshop, normally held in conjunction with a Natural Language Processing (NLP) conference.[2] Throughout the chapter we highlight some of the best approaches in sentiment analysis, including approaches that were most successful in these shared task competitions organized by the NLP community. Finally, in Section 9, we present future directions.

2 Challenges in sentiment analysis

There are several challenges to automatically detecting sentiment in text.

[2] http://aclweb.org/aclwiki/index.php?title=SemEval_Portal.

Complexity and subtlety of language use:

The emotional import of a sentence or utterance is not simply the sum of emotional associations of its component words. Further, emotions are often not explicitly stated. For example: "Another Monday, and another week working my tail off." conveys a sense of frustration without the speaker explicitly saying so. Note that the sentence does not include any overtly negative words. Section 4 summarizes various machine learning approaches for classifying sentences and tweets into one of the affect categories.

- Certain terms such as negations and modals impact sentiment of the sentence, without themselves having strong sentiment associations. For example, may be good, was good, and was not good should be interpreted differently by sentiment analysis systems. Section 6 discusses approaches that explicitly handle sentiment modifiers such as negations, degree adverbs, and modals.
  Words when used in different contexts (and different senses) can convey different emotions. For example, the word hug in the embrace sense, as in: "Mary hugged her daughter before going to work." is associated with joy and affection, but hug in the stay close to sense, as in: "The pipeline hugged the state border." is rather unemotional. Word sense disambiguation remains a difficult challenge in natural language processing (Kilgarriff, 1997; Navigli, 2009). In Section 5, we discuss approaches to create term–sentiment association lexicons, including some that have separate entries for each sense of a word.
- Utterances may convey more than one emotion (and to varying degrees). They may convey contrastive evaluations of multiple target entities.
- Utterances may refer to emotional events without implicitly or explicitly expressing the feelings of the speaker.

Use of creative and non-standard language:

- Automatic natural language systems find it difficult to interpret creative uses of language such as sarcasm, irony, humor, and metaphor. However, these phenomena are common in language use. Section 7 summarizes some preliminary work in this direction.
- Social media texts are rife with terms not seen in dictionaries, such as misspellings (parlament), creatively spelt words (happeee), hashtagged words (#loveumom), emoticons, abbreviations (lmao), etc. Many of these terms convey emotions. Section 5.2 describes work on automatically generating term–sentiment association lexicons from social media data—methods that capture sentiment associations of not just regular English terms, but also social-media-specific terms.

Lack of para-linguistic information:

- Often we communicate affect through tone, pitch, and emphasis. However, written text usually does not come with annotations of stress and intonation. This is compensated to some degree by the use of explicit emphasis markers (eg, Mary used *Jack's* computer) and explicit sentiment markers such as emoticons and emoji.
- We also communicate emotions through facial expressions. In fact, there is a lot of work linking different facial expressions to different emotional states (Ekman, 1992; Ekman & Friesen, 2003) (also, see chapter: Measuring Emotions in the Face). Once again, this information is not present in written text.

Lack of large amounts of labeled data:

- Most machine learning algorithms for sentiment analysis require significant amounts of training data (eg, sentences marked with the associated emotions). However, there are

numerous affect categories including hundreds of emotions that humans can perceive and express. Thus, much of the work in the community has been restricted to a handful of emotions and valence categories. Section 4.3 summarizes various efforts to create datasets that have sentences labeled with emotions.

Subjective and cross-cultural differences:

- Detecting emotions in text can be difficult even for humans. Studies have shown that the amount of agreement between annotators is significantly lower in assigning valence or emotions to instances, as compared to tasks such as identifying part of speech and detecting named entities.
- There can be significant differences in emotions associated with events and behaviors across different cultures. For example, dating and alcohol may be perceived as significantly more negative in some parts of the world than in others.
- Manual annotations can be significantly influenced by clarity of directions, difficulty of task, training of the respondents, and even the annotation scheme (multiple choice questions, free text, Likert scales, etc.). Sections 4 and 5 describe various manually annotated datasets where affect labels are provided for sentences and words, respectively. They were created either by hand-chosen expert annotators, known associates and grad students, or by crowd-sourcing on the Internet to hundreds or thousands of unknown respondents. Section 5.1.1 describes an annotation scheme called maximum difference scaling (MaxDiff) or best-worst scaling (Louviere, 1991) that has led to more high-quality and consistent sentiment annotations.

In the sections ahead we describe approaches that, to some extent, address these issues. Nonetheless, significant challenges still remain. Additionally, sentiment analysis involves a diverse landscape of tasks, each of which can be operationalized in multiple ways.

3 Sentiment analysis tasks

3.1 Detecting sentiment of the writer, reader, and other entities

Sentiment can be associated with any of the following: (1) the speaker (or writer), (2) the listener (or reader), or (3) one or more entities mentioned in the utterance. Most research in sentiment analysis has focused on detecting the sentiment of the speaker, and this is often done by analyzing only the utterance. However, there are several instances where it is unclear whether the sentiment in the utterance is the same as the sentiment of the speaker. For example, consider:

Sarah: *The war in Syria has created a refugee crisis.*

The sentence describes a negative event (millions of people being displaced), but it is unclear whether to conclude that Sarah (the speaker) is personally saddened by the event. It is possible the Sarah is a newsreader and merely communicating information about the war. Developers of sentiment systems have to decide beforehand whether they wish to assign a negative sentiment or neutral sentiment to the speaker in such cases. More generally, they have to decide whether the speaker's sentiment will be

chosen to be neutral in the absence of clear signifiers of the speaker's own sentiment, or whether the speaker's sentiment will be chosen to be the same as the sentiment of events and topics mentioned in the utterance.

On the other hand, people can react differently to the same utterance, for example, people on opposite sides of a debate or rival sports fans. Thus modeling listener sentiment requires modeling listener profiles. This is an area of research not explored much by the community. Similarly, there is little work on modeling sentiment of entities mentioned in the text, for example, given:

Drew: *Jamie could not stop gushing about the new Game of Thrones episode.*

It will be useful to develop automatic systems that can deduce that Jamie (not Drew) liked the new episode of Game of Thrones (a TV show).

3.2 Detecting sentiment from different textual chunks

Sentiment can be determined at various levels: from sentiment associations of words and phrases; to sentiments of sentences, SMS messages, chat messages, and tweets; to sentiments in product reviews, blog posts, and whole documents.

Words: Some words signify valence as part of their core meaning, for example, good, bad, terrible, excellent, nice, and so on. Some other words do not signify valence as part of their meaning, but have strong associations with positive or negative valence. For example, party and raise are associated with positive valence, whereas slave and death are associated with negative valence.[3] Words that are not strongly associated with positive or negative valence are considered neutral. (The exact boundaries between neutral and positive valence, and between neutral and negative valence, are somewhat fuzzy. However, for a number of terms, there is high inter-rater agreement on whether they are positive, neutral, or negative.) Similarly, some words express emotions as part of their meaning (and thus are also associated with the emotion), and some words are just associated with emotions. For example, anger and rage denote anger (and are associated with anger), whereas negligence, fight, and betrayal do not denote anger, but they are associated with anger.

Sentiment associations of words and phrases are commonly captured in valence and emotion association lexicons. A valence (or polarity) association lexicon may have entries such as these shown below (text in parenthesis is not part of the entry, but our description of what the entry indicates):

delighted—positive (*delighted* is usually associated with positive valence), *death*—negative (*death* is usually associated with negative valence), *shout*—negative (*shout* is usually associated with negative valence), *furniture*—neutral (*furniture* is not strongly associated with positive or negative valence)

[3] Note that words that signify valence are also associated with that valence, but words that are associated with a valence do not always signify that valence as part of their meaning.

An affect association lexicon has entries for a pre-decided set of emotions (different lexicons may choose to focus on different sets of emotions). Below are examples of some affect association entries:

> *delighted*—joy (*delighted* is usually associated with the emotion of joy), *death*—sadness (*death* is usually associated with the emotion of sadness), *shout*—anger (*shout* is usually associated with the emotion of anger), *furniture*—none (*furniture* is not strongly associated with any of the pre-decided set of emotions)

A word may be associated with more than one emotion, in which case, it will have more than one entry in the affect lexicon.

Sentiment association lexicons can be created either by manual annotation or through automatic means. Manually created lexicons tend to be in the order of a few thousand entries, but automatically generated lexicons can capture valence and emotion associations for hundreds of thousands of unigrams (single-word strings) and even for larger expressions such as bigrams (two-word sequences) and trigrams (three-word sequences). Automatically generated lexicons often also include a real-valued score indicating the strength of association between the word and the affect category. This score is the prior estimate of the sentiment association, calculated from previously seen usages of the term. While sentiment lexicons are often useful in sentence-level sentiment analysis, the same terms may convey different sentiments in different contexts. The top systems (Kiritchenko, Zhu, Cherry et al., 2014; Mohammad et al., 2013a; Tang, Wei, Qin, Liu, & Zhou, 2014; Zhu, Kiritchenko, & Mohammad, 2014) in recent sentiment-related shared tasks, SemEval-2013 and 2014 Sentiment Analysis in Twitter, used large sentiment lexicons (Rosenthal, Nakov, Ritter, & Stoyanov, 2014; Wilson, Kozareva, Nakov, Rosenthal, Stoyanov, & Ritter, 2013).[4] The tasks also had separate sub-tasks aimed at identifying sentiment of terms in context. We discuss manually and automatically created valence and emotion association lexicons in more detail in Section 5.

Sentences: Sentence-level valence classification systems assign labels such as positive, negative, or neutral to whole sentences. It should be noted that the valence of a sentence is not simply the sum of the polarities of its constituent words. Automatic systems learn a model from labeled training data (instances that are already marked as positive, negative, or neutral) using a large number of features such as word and character ngrams, valence association lexicons, negation lists, word clusters, and, more recently, features from low-dimensional vector representations of words. We discuss these approaches in Section 4.2.

Emotion classification systems assign labels such as joy, sadness, anger, and fear to sentences. They too use feature sets similar to the valence classification systems. In contrast to valence classification (for which there have been many), there has been only one shared task competition on detecting emotions—the 2007 SemEval competition Affective News (Strapparava & Mihalcea, 2007), where participants had to determine the emotions in newspaper headlines.[5] This was framed as an unsupervised

[4] https://www.cs.york.ac.uk/semeval-2013/ http://alt.qcri.org/semeval2014/.
[5] http://web.eecs.umich.edu/~mihalcea/downloads.html#affective.

task. The competition drew a small number of participants, most of whom failed to surpass the most-frequent class baseline (the accuracy obtained by always guessing the most frequent class in the dataset). However, methods of garnering supplemental training data by clever methods such as distant supervision have led to more progress in the area. We discuss some of these approaches in Section 4.3.

Documents: Sentiment analysis of documents is often broken down into the sentiment analysis of the component sentences. Thus we do not discuss this topic in much detail here. However, there is interesting work on using sentiment analysis to generate text summaries (Ku, Liang, & Chen, 2006; Liu, Cao, Lin, Huang, & Zhou, 2007; Lloret, Balahur, Palomar, & Montoyo, 2009; Somprasertsri & Lalitrojwong, 2010; Stoyanov & Cardie, 2006) and on analyzing patterns of sentiment in social networks in novels and fairy tales (Davis & Mohammad, 2014; Mohammad & Yang, 2011; Nalisnick & Baird, 2013a, Nalisnick & Baird, 2013b).

3.3 Detecting sentiment towards a target

3.3.1 Detecting sentiment towards aspects of an entity

A review of a product or service can express sentiment towards various aspects. For example, a restaurant review can gush positively about the food, but express anger towards the quality of service. There is now a growing amount of work in detecting aspects of products and also sentiment towards these aspects (Kessler & Nicolov, 2009; Popescu & Etzioni, 2005; Qadir, 2009; Su, Xiang, Wang, Sun, & Yu, 2006; Xu, Huang, & Wang, 2013; Zhang, Liu, Lim, & O'Brien-Strain, 2010). In 2014, a shared task was organized for detecting aspect sentiment in restaurant and laptop reviews (Pontiki et al., 2014). The best-performing systems had a strong sentence-level sentiment analysis system to which they added localization features so that more weight was given to sentiment features close to the mention of the aspect. This task was repeated in 2015. It will be useful to develop aspect-based sentiment systems for other domains such as blogs and news articles as well. (See proceedings of SemEval-2014 and 2015 for details about participating aspect sentiment systems.[6])

3.3.2 Detecting stance

Stance detection is the task of automatically determining from text whether the author of the text is in favor of, against, or neutral towards a proposition or target. For example, given the following target and text pair:

Target: Women have the right to abortion

Text: *A fetus has rights too!*

Humans can deduce from the text that the speaker is against the proposition. However, this is a challenging task for computers. To successfully detect stance, automatic systems often have to identify relevant bits of information that may not be present in the focus text. For example, that if one is actively supporting fetus rights,

[6] http://alt.qcri.org/semeval2014/ http://alt.qcri.org/semeval2015/.

then he or she is likely against the right to abortion. Automatic systems can obtain such information from large amounts of text about the target.

Stance detection is related to sentiment analysis, but the two have significant differences. In sentiment analysis, systems determine whether a piece of text is positive, negative, or neutral. However, in stance detection, systems are to determine favorability towards a given target—and the target may not be explicitly mentioned in the text. For example, consider the target–text pair below:

Target: Barack Obama

Text: *Romney will be a terrible president.*

The tweet was posted during the 2012 US presidential campaign between Barack Obama and Mitt Romney. Note that the text is negative in sentiment (and negative towards Mitt Romney), but the tweeter is likely to be favorable towards the given target (Barack Obama). Also note that one can be against Romney but not in favor of Obama, but in stance detection, the goal is to determine which is more probable: that the author is in favor of, against, or neutral towards the target.

Automatically detecting stance has widespread applications in information retrieval, text summarization, and textual entailment. In fact, one can argue that stance detection can bring complementary information to sentiment analysis, because we often care about the author's evaluative outlook towards specific targets and propositions rather than simply about whether the speaker was angry or happy.

Over the last decade, there has been active research in modeling stance. However, most works focus on congressional debates (Thomas, Pang, & Lee, 2006) or debates in online forums (Anand, Walker, Abbott, Tree, Bowmani, & Minor, 2011; Hasan & Ng, 2013; Murakami & Raymond, 2010; Somasundaran & Wiebe, 2009; Sridhar, Getoor, & Walker, 2014; Walker, Anand, Abbott, & Grant, 2012). New research in domains such as social media texts, and approaches that combine traditional sentiment analysis with relation extraction can make a significant impact in improving the state-of-the-art in automatic stance detection.

3.4 Detecting semantic roles of emotion

The Theory of Frame Semantics argues that the meanings of most words can be understood in terms of a set of related entities and their relations (Fillmore, 1976, 1982). For example, the concept of education usually involves a student, a teacher, a course, an institution, duration of study, and so on. The set of related entities is called a semantic frame and the individual entities, defined in terms of the role they play with respect to the target concept, are called the semantic roles. FrameNet (Baker, Fillmore, & Lowe, 1998) is a lexical database of English that records such semantic frames.[7] Table 9.1 shows the FrameNet frame for emotions. Observe that the frame depicts various roles such as who is experiencing the emotion (the experiencer), the person or event that evokes the emotion, and so on. Information retrieval, text summarization, and textual entailment benefit from determining not just the emotional state but also from determining these semantic roles of emotion.

[7] https://framenet.icsi.berkeley.edu/fndrupal/home.

Table 9.1 The FrameNet frame for emotions

Role	Description
Core	
Experiencer	The person that experiences or feels the emotion
State	The abstract noun that describes the experience
Stimulus	The person or event that evokes the emotional response
Topic	The general area in which the emotion occurs
Non-core	
Circumstances	The condition in which Stimulus evokes response
Degree	The extent to which the Experiencer's emotion deviates from the norm for the emotion
Empathy target	The Empathy target is the individual or individuals with which the Experiencer identifies emotionally
Manner	Any description of the way in which the Experiencer experiences the Stimulus which is not covered by more specific frame elements
Reason	The explanation for why the Stimulus evokes an emotional response

Mohammad, Zhu, Kiritchenko, and Martin (2015) created a corpus of tweets from the run up to the 2012 US presidential elections, with annotations for valence, emotion, stimulus, and experiencer. The tweets were also annotated for intent (to criticize, to support, to ridicule, etc.) and style (simple statement, sarcasm, hyperbole, etc.). The dataset is made available for download.[8] They also show that emotion detection alone can fail to distinguish between several different types of intent. For example, the same emotion of disgust can be associated with the intents of "to criticize," "to vent," and "to ridicule." They also developed systems that automatically classify electoral tweets as per their emotion and purpose, using various features that have traditionally been used in tweet classification, such as word and character ngrams, word clusters, valence association lexicons, and emotion association lexicons. Ghazi, Inkpen, and Szpakowicz (2015) compiled FrameNet sentences that were tagged with the stimulus of certain emotions. They also developed a statistical model to detect spans of text referring to the emotion stimulus.

4 Detecting subjectivity, valence, and emotions in sentences and tweets

Sentiment analysis systems have been applied to many different kinds of texts including customer reviews (Liu, 2015; Liu & Zhang, 2012; Pang & Lee, 2008), newspaper

[8] Political Tweets Dataset: www.purl.org/net/PoliticalTweets.

headlines (Bellegarda, 2010), novels (Boucouvalas, 2002; Francisco & Gervás, 2006; John et al., 2006; Mohammad & Yang, 2011), emails (Liu, Lieberman, & Selker, 2003; Mohammad & Yang, 2011), blogs (Genereux & Evans, 2006; Mihalcea & Liu, 2006; Neviarouskaya et al., 2009), and tweets (Agarwal et al., 2011; Aisopos et al., 2012; Bakliwal et al., 2012; Brody & Diakopoulos, 2011; Mohammad, 2012a; Pak & Paroubek, 2010; Thelwall et al., 2011). Often the analysis of documents and blog posts is broken down into determining the sentiment within each component sentence. In this section we discuss approaches for such sentence-level sentiment analysis. Even though tweets may include more than one sentence, they are limited to 140 characters, and most are composed of just one sentence. Thus we include here work on tweets as well.

4.1 Detecting subjectivity

One of the earliest problems tackled in sentiment analysis is that of detecting subjective language (Wiebe & Riloff, 2005; Wiebe, Wilson, Bruce, Bell, & Martin, 2004). For example, sentences can be classified as subjective (having opinions and attitude) or objective (containing facts). This has applications in question answering, information retrieval, paraphrasing, and other natural language applications where it is useful to separate factual statements from speculative or affectual ones. For example, if the target query is "what did the users think of iPhone 5's screen?," then the question answering system (or information retrieval system) should be able to distinguish between sentences such as "the iPhone has a beautiful touch screen" and sentences such as "iPhone 5 has 326 pixels per inch." Sentences like the former which express opinion about the screen should be extracted. On the other hand, if the user query is "what is iPhone 5's screen resolution?," then sentences such as the latter (referring to 326 pixels per inch) are more relevant. (See Wiebe and Riloff (2011) for work on using subjectivity detection in tandem with techniques for information extraction.) It should be noted, however, that if a sentence is objective, then it does not imply that the sentence is necessarily true. It only implies that the sentence does not exhibit the speaker's private state (attitude, evaluations, and emotions). Similarly, if a sentence is subjective, that does not imply that it lacks truth.

A number of techniques have been proposed to detect subjectivity using patterns of word usage, identifying certain kinds of adjectives, detecting emotional terms, and occurrences of certain discourse connectives (Das & Bandyopadhyay, 2009; Hatzivassiloglou & Wiebe, 2000; Lin, He, & Everson, 2011; Pit, 2006; Riloff & Wiebe, 2003; Su & Markert, 2008; Wang & Fu, 2010; Wiebe et al., 2004). Opinion Finder is one of the most popular freely available subjectivity systems (Wilson et al., 2005).[9]

4.2 Detecting valence

There is tremendous interest in accurately determining valence in sentences and tweets. Surveys by Martínez-Cámara, Martín-Valdivia, Urenalópez, and Montejoráez

[9] http://mpqa.cs.pitt.edu/opinionfinder/.

(2012), Liu and Zhang (2012), and Pang and Lee (2008) give excellent summaries. (The Martinez survey focuses specifically on tweets.)

In natural language systems, textual instances are often represented as vectors in a feature space. For example, if the space has only four features (f1, f2, f3, and f4), and each of these features is binary, that is they can have values 0 or 1, then an instance for which f1 is 0, f2 is 1, f3 is 1, and f4 is 0, can be represented by the vector <0, 1, 1, 0>. Training and test instances are converted into such feature vectors, which are in turn processed by the machine learning system. The number of features can often be as large as hundreds of thousands, and traditionally, these features have known meanings. For example, whether the instance has a particular word observed previously in the training data, whether the word is listed as a positive term in the sentiment lexicon, and so on. (Some work using uninterpretable features is described further ahead in the context of word embeddings.)

Word and character ngrams are widely used as features in a number of text classification problems, and it is not surprising to find that they are beneficial for valence classification as well. Features from manually and automatically created word–valence association lexicons, such as the General Inquirer (GI) (Stone, Dunphy, Smith, Ogilvie, & Associates, 1966), the NRC Emotion Lexicon (Mohammad & Turney, 2010; Mohammad & Yang, 2011), and SentiWordNet (SWN) (Esuli & Sebastiani, 2006), are also commonly used. Other features used by classification systems include those derived from parts of speech, punctuations (!, ???), word clusters, syntactic dependencies, negation terms (no, not, never), and word elongations (hugggs, ahhhh).

More recently, significant improvements in classification accuracy have been obtained through low-dimensional continuous representations of instances and words (Collobert et al., 2011; Le & Mikolov, 2014; Mikolov, Sutskever, Chen, Corrado, & Dean, 2013). The phrase "low-dimensional" refers to the notion that these vectors have only a few hundred dimensions, and continuous refers to the real-valued nature of the dimensions (that is the dimension does not have just 0 or 1 values, but can have any real number value). These continuous word vectors, also called embeddings, are induced from a large corpus through neural networks (a particular kind of machine learning algorithm). The word vectors learned from the corpus are such that words that occur in similar contexts tend to be closer to each other in the low-dimensional space. However, unlike traditional feature vectors, these new dimensions are not directly interpretable, that is, it is not clear what any particular dimension signifies. First Socher et al. (2013), and then Le and Mikolov (2014), obtained significant improvements in valence classification on a movie reviews dataset (Pang & Lee, 2008) using word embeddings. Work by Kalchbrenner, Grefenstette, and Blunsom (2014), Irsoy and Cardie (2014), Zhu, Sobhani, and Guo (2015), and others is further exploring the use of recursive neural networks and word embeddings in sentiment analysis.

A number of shared task competitions on valence classification have been organized in recent years, including the 2013, 2014, and 2015 SemEval shared tasks titled Sentiment Analysis in Twitter (SAT), the 2014 and 2015 SemEval shared tasks on Aspect Based Sentiment Analysis (ABSA), the 2015 SemEval shared task Sentiment

Analysis of Figurative Language in Twitter, and the 2015 Kaggle competition Sentiment Analysis on Movie Reviews.[10]

The SAT and ABSA tasks received submissions from more than 40 teams from universities, research labs, and companies across the world. The NRC-Canada system came first in the 2013 and 2014 SAT competitions (Mohammad, Kiritchenko, & Zhu, 2013b; Zhu, Kiritchenko et al., 2014), and the 2014 ABSA competition (Kiritchenko, Zhu, Cherry et al., 2014). The system is based on a supervised statistical text classification approach leveraging a variety of surface-form, semantic, and sentiment features. Notably, it used word and character ngrams, manually created and automatically generated sentiment lexicons, parts of speech, word clusters, and Twitter-specific encodings such as hashtags, creatively spelled words, and abbreviations (yummeee, lol, etc.). The sentiment features were primarily derived from novel high-coverage tweet-specific sentiment lexicons. These lexicons were automatically generated from tweets with sentiment-word hashtags (such as #great, #excellent) and from tweets with emoticons (such as :), :(). (More details about these lexicons is in Section 5.) Tang, Wei, Qin, Liu et al. (2014) created a sentiment analysis system that came first in the 2014 SAT sub-task on a tweets dataset. It replicated many of the same features used in the NRC-Canada system, and additionally used features drawn from word embeddings.

4.3 Automatically detecting and analyzing emotions

Paul Ekman and others have developed theories on how some emotions are considered more basic than others (Ekman, 1992; Ekman & Friesen, 2003; Plutchik, 1980, 1991). These emotions are said to have ties to universal facial expressions and physiological processes, such as increased heart rate and perspiration. However, not everybody agrees on which set of emotions are the most basic. Ekman (1992), Plutchik (1980), Parrot (2001), Frijda (1988), Shaver, Schwartz, Kirson, and O'Connor (1987), and others proposed different sets of basic emotions. Even more controversially, the very theory of basic emotions has been challenged in recent work (Barrett, 2006; De Leersnyder, Boiger, & Mesquita, 2015; Lindquist, Wager, Kober, Bliss-Moreau, & Barrett, 2012). Nonetheless, much of the effort in automatic detection of emotions in text has focused on the handful of proposed basic emotions. Recall that labeled training data are a crucial resource required for building supervised machine learning systems. Compiling datasets with tens of thousands of instances annotated for emotion is expensive in terms of time and money. Each instance must be annotated by more than one person (usually three to five) to determine how much people agree with each other on emotion annotations. Asking for labels from a large set of emotions increases cognitive load on the annotator. Asking annotators to label the data one emotion at a time, repeated for a large number of emotions, increases the cost of annotation.

[10] http://aclweb.org/aclwiki/index.php?title=SemEval_Portal; http://alt.qcri.org/semeval2015/task10/; http://alt.qcri.org/semeval2015/task12/; http://alt.qcri.org/semeval2015/task11/; http://www.kaggle.com/c/sentiment-analysis-on-movie-reviews.

Thus, focusing on a small number of emotions has the benefit of keeping costs down. On the other hand, work focused on a small set of emotions means that there are fewer resources and systems that can handle non-basic emotions. Further, different emotions may be more relevant for different cultures (De Leersnyder et al., 2015).

Below we summarize work on compiling textual datasets labeled with emotions and automatic methods for detecting emotions in text. We group the work by the emotion categories addressed.

- *Work on Ekman's Six*: Paul Ekman's set of basic emotions includes: joy, sadness, anger, fear, disgust, and surprise. Since the writing style and vocabulary in different sources, such as chat messages, blog posts, and newspaper articles, can be very different, automatic systems that cater to specific domains are more accurate when trained on data from the target domain. Holzman and Pottenger (2003) annotated 1201 chat messages for the Ekman's six emotions as well as for irony and neutral classes. Alm, Roth, and Sproat (2005) annotated 22 Grimm fairy tales (1580 sentences) for Ekman emotions.[11] Strapparava and Mihalcea (2007) annotated newspaper headlines with intensity scores for each of the Ekman emotions, referred to as the Text Affect Dataset.[12] Aman and Szpakowicz (2007) annotated blog posts with the Ekman emotions. These datasets have been used by its creators to develop supervised machine learning algorithms to classify instances into one of the six Ekman classes (or neutral). Other works that have developed classification systems on these datasets includes work by Chaffar and Inkpen (2011) (on Text Affect and datasets created by Alm and Aman); Mohammad (2012) (on Text Affect and Aman datasets); and Kirange et al. (2013) (on Text Affect).
- *Work on Plutchik's Eight*: Robert Plutchik's set of basic emotions includes Ekman's six as well as trust and anticipation. Fig. 9.1 shows how Plutchik arranges these emotions on a wheel such that opposite emotions appear diametrically opposite to each other. Words closer to the center have higher intensity than those that are farther away. Plutchik also hypothesized how some secondary emotions can be seen as combinations of some of the basic (primary) emotions, for example, optimism as the combination of joy and anticipation. See Plutchik (1991, 2001) for details about his taxonomy of emotions created by primary, secondary, and tertiary emotions.

  Brooks et al. (2013) annotated 27,344 chat messages between 30 astrophysics collaborators with 40 affect categories inspired by Plutchik's taxonomy emotions. Mohammad (2012a) polled the Twitter API for tweets that have hashtag words such as #anger and #sadness corresponding to the eight Plutchik emotions.[13] He showed that these hashtag words act as good labels for the rest of the tweets, and that this labeled dataset is just as good as the set explicitly annotated for emotions for emotion classification. Such an approach to machine learning from pseudo-labeled data is referred to as distant supervision. Suttles and Ide (2013) used a similar distant supervision technique and collected tweets with emoticons, emoji, and hashtag words corresponding to the Plutchik emotions. They developed an algorithm for binary classification of tweets along the four opposing Plutchik dimensions. Kunneman, Liebrecht, and van den Bosch (2014) studied the extent to which hashtag words in tweets are predictive of the affectual state of the rest of the tweet. They found that hashtags can vary significantly in this regard—some hashtags are strong indicators of the

[11] https://dl.dropboxusercontent.com/u/585585/RESOURCEWEBSITE1/index.html.

[12] http://web.eecs.umich.edu/~mihalcea/downloads.html#affective.

[13] http://saifmohammad.com/WebPages/lexicons.html.

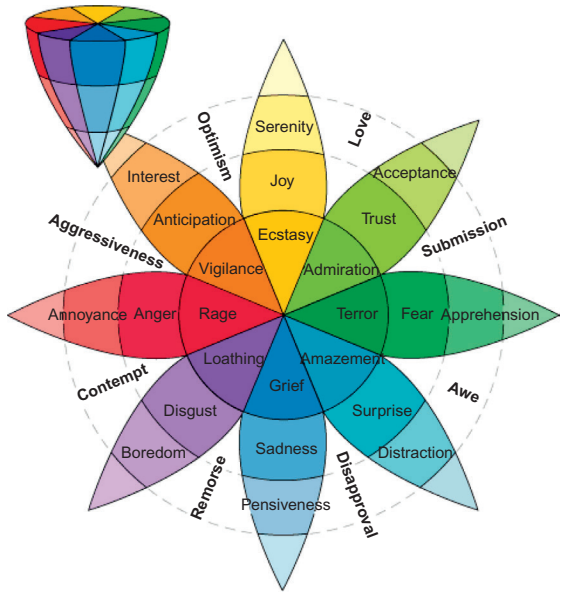


Figure 9.1 Set of eight basic emotions proposed in Plutchik (1980).

corresponding emotion whereas others are not. Thus hashtag words must be chosen carefully when employing them for distant supervision.

- *Work on other small sets of emotions*: The ISEAR Project asked 3000 student respondents to report situations in which they had experienced joy, fear, anger, sadness, disgust, shame, or guilt.[14] Thomas et al. (2014) applied supervised machine learning techniques on the ISEAR dataset for seven-way emotion classification. Neviarouskaya et al. (2009) collected 1000 sentences from the Experience Project webpage and manually annotated them for 14 affectual categories.[15] Experience Project is a portal where users share their life experiences. These shared texts are usually rife with emotion.

  Pearl and Steyvers (2010) developed an online Game With a Purpose (GWAP) where participants were asked to generate labels for politeness, rudeness, embarrassment, formality, persuasion, deception, confidence, and disbelief. Then other participants would label these messages to determine whether multiple people agree that the message belongs to the same category.

  Bollen et al. (2009) analyzed 9,664,952 tweets posted in the second half of 2008 using Profile of Mood States (POMS) (McNair, Lorr, & Droppleman, 1989). POMS is a psychometric instrument that measures the mood states of tension, depression, anger, vigor, fatigue, and confusion.

  Wang et al. (2012) compiled a set of 2.5 million tweets with emotion-related hashtags using the distant supervision technique. The emotion-related hashtags correspond to seven

[14] http://emotion-research.net/toolbox/toolboxdatabase.2006-10-13.2581092615.

[15] www.experienceproject.com.

emotion categories: joy, sadness, anger, love, fear, thankfulness, and surprise. They also developed a machine learning algorithm to classify tweets into these seven emotion categories and found the most useful features to be unigrams, bigrams, sentiment and emotion lexicons (LIWC, MPQA, WordNet Affect), and part of speech.

- *Work on emotion-labeled datasets in languages other than English*: Wang (2014) annotated Chinese news and blog posts with the Ekman emotions. Wang also translated Alm's fairy tales dataset into Chinese. Quan and Ren (2009) created a blog emotion corpus in Chinese called the Ren-CECps Corpus. The sentences in this corpus are annotated with eight emotions: expectation, joy, love, surprise, anxiety, sorrow, anger, and hate. Sentences not associated with any of these eight categories are marked as neutral. The corpus has 1487 documents, 11,255 paragraphs, 35,096 sentences, and 878,164 Chinese words.

  The 2013 Chinese Microblog Sentiment Analysis Evaluation (CMSAE) compiled a dataset of posts from Sina Weibo (a popular Chinese microblogging service) annotated with seven emotions: anger, disgust, fear, happiness, like, sadness, and surprise.[16] If a post has no emotion, then it is labeled as none. The training set contains 4000 instances (13,252 sentences). The test dataset contains 10,000 instances (32,185 sentences). Wen and Wan (2014) developed a model to detect emotions in this corpus by combining lexicon-based and SVM-based methods.

  Sun, Quan, Kang, Zhang, and Ren (2014) created a Japanese customer reviews corpus with the same eight emotions used in the Chinese Ren-CECps Corpus: expectation, joy, love, surprise, anxiety, sorrow, anger, and hate. The annotated corpus has 3264 sentences. Each adverb and sentence was manually annotated for association with the eight emotions and also the degree of emotion intensity (0.1–1.0). They also created an adverb emotion lexicon which contains 687 adverbs and their associations with the eight emotions.
- *Large sets of emotions*: Distant supervision techniques proposed in Mohammad (2012a), Purver and Battersby (2012), Wang et al. (2012), Suttles and Ide (2013), and others have opened up the critical bottleneck of creating instances labeled with emotion categories. Thus, now, labeled data can be created for any emotion for which there are a sufficient number of tweets that have the emotion word as a hashtag. Mohammad and Kiritchenko (2014) collected tweets with hashtags corresponding to around 500 emotion words as well as positive and negative valence. They used these tweets to identify words associated with each of the 500 emotion categories, which were in turn used as features in a task of automatically determining personality traits from stream-of-consciousness essays. They show that using features from 500 emotion categories significantly improved performance over using features from just the Ekman emotions.

As seen above, there are a number of datasets where sentences are manually labeled for emotions. They have helped take the field forward by allowing researchers to understand what it means to annotate text for affect categories, and by helping develop supervised machine learning emotion classifiers. Even though features from word ngrams, part of speech, and term–emotion association lexicons are commonly used, new features based on continuous word representations are now leading to more accurate emotion classification, just as in valence classification. However, a number of questions remain unexplored. For example, can the large amounts of textual data (and self-labeled data as in tweets with emotion-word hashtags) be used to infer if indeed there are some emotions that are more basic than others or whether there is a

[16] http://tcci.ccf.org.cn/conference/2013/pages/page04_eva.html.

taxonomy of emotions? Are some emotions indeed combinations of other emotions (optimism as the combination of joy and anticipation)? Can data labeled for certain emotions be useful in detecting certain other emotions? Can automatic systems that detect degree of valence, arousal, and dominance be used to infer emotions such as joy, sadness, fear, etc.? And so on.

There is new work on developing word representations not only from text corpora but also from collections of images that the words are associated with (Hill & Korhonen, 2014; Kiela & Bottou, 2014; Lazaridou, Bruni, & Baroni, 2014). (An image and a word can be considered associated if the caption for the image has the word, the image is a representation of the concept the word refers to, etc.) This bridges the gap between text and vision, allowing the exploration of new applications such as automatic image captioning (Karpathy, Joulin, & Li, 2014; Kiros, Salakhutdinov, & Zemel, 2014). Future work can explore how emotions should influence such multimodal word representations (text–vision, text–audio, etc.) so as to obtain even better representations for emotions. Such multimodal representations of emotions will be useful in tasks such as captioning images or audio for emotions and even generating text that is affectually suitable for a given image or audio sequence.

5 Capturing term–sentiment associations

The same word can convey different sentiment in different contexts. For example, the word unpredictable is negative in the context of automobile steering, but positive in the context of a movie script. Nonetheless, many words have a tendency to convey the same sentiment in a large majority of the contexts they occur in. For example, excellent and cake are positive in most usages whereas death and depression are negative in most usages. These majority associations are referred to as prior associations. Sentiment analysis systems benefit from knowing these prior associations of words and phrases. Thus, lists of term–sentiment associations have been created by manual annotation. These resources tend to be small in coverage because manual annotation is expensive and the number of words and phrases for a language can run into hundreds of thousands. This has led to the development of automatic methods that extract large lists of term–sentiment associations from text corpora using manually created lists as seeds. We describe work on manually creating and automatically generating term–sentiment associations in the subsections later.

5.1 Manually generated term–sentiment association lexicons

One of the earliest works exploring term–sentiment associations was by Osgood et al. (1957) who in their book, *Measurement of meaning*, describe an experiment in which they asked respondents to state where various words lie within several semantic dimensions. These semantic dimensions were formed by bipolar adjectives such as adequate–inadequate, good–evil, and valuable–worthless. Factor analysis of these ratings showed that the three dimensions across which people judge a word most (in decreasing order) are evaluation (good–bad), potency (strong–weak), and

activity (active–passive). Evaluativeness can be thought of as the same dimension as valence (positive–negative). The General Inquirer (GI) lists words associated with various semantic categories including evaluativeness for about 3600 terms (Stone et al., 1966). These include about 1500 words from the Osgood study. The MPQA Subjectivity Lexicon, which draws from the General Inquirer and other sources, has valence labels for about 8000 words (Wilson, Wiebe, & Hoffmann, 2005). The MPQA lexicon categorizes terms into strongly positive, weakly positive, strongly negative, and weakly negative. Hu and Liu (2004) manually labeled about 6800 words and used them for detecting sentiment of customer reviews. The Affective Norms for English Words (ANEW) provides valence, arousal, and dominance ratings for 1034 English words (Bradley & Lang, 1999).[17] AFINN (Nielsen, 2011) has valence ratings for 2477 English words. The ratings range from –5 (most negative) to +5 (most positive) in steps of 1.[18]

A new trend in creating large amounts of human-annotated data is crowdsourcing. Crowdsourcing involves breaking down a large task into small independently solvable units, distributing the units through the Internet or some other means, and getting a large number of people to solve or annotate the units. The requester specifies the compensation that will be paid for solving each unit. In this scenario, the annotators are usually not known to the requester and usually do not all have the same academic qualifications. Natural language tasks are particularly well-suited for crowdsourcing because even though computers find it difficult to understand language, native speakers of a language do not usually need extensive training to provide useful annotations such as whether a word is associated with positive sentiment. Amazon Mechanical Turk and CrowdFlower are two commonly used crowdsourcing platforms.[19] They allow for large-scale annotations, quickly and inexpensively. However, one must define the task carefully to obtain annotations of high quality. Checks must be placed to ensure that random and erroneous annotations are discouraged, rejected, and re-annotated.

The NRC Emotion Lexicon (Mohammad & Turney, 2010, 2012) was created by crowd-sourcing, and it has associations towards positive and negative sentiment as well as the eight Plutchik emotions—joy, sadness, fear, anger, anticipation, trust, surprise, and disgust (Plutchik, 1962, 1980). Respondents were biased to individual senses of a word by priming the target word with another word relevant to a particular sense. They were asked whether a term was strongly associated, moderately associated, weakly associated, or not associated with the target. The lexicon has valence and emotion associations for about 25,000 word senses. A word-level version of the lexicon was created by taking the union of associations of all the senses of a word. It has valence and emotion labels for about 14,000 words. This version also collapsed the strong and moderate associations into one associated category and the weak and no associations into one not associated category. The listing of words in the

[17] http://csea.phhp.ufl.edu/media/anewmessage.html.

[18] http://www2.imm.dtu.dk/pubdb/views/publication_details.php?id=6010.

[19] https://www.mturk.com/mturk/welcome http://www.crowdflower.com.

not-associated category is useful to distinguish between words for which we know they are not associated with the Plutchik emotion categories and words for which we do not know whether they are associated with any of the Plutchik emotions. The terms that are not marked to be associated with any valence are also useful as seed words that can be used to generate larger lists of neutral expressions (Bravo-Marquez, Frank, & Pfahringer, 2015).

Warriner, Kuperman, and Brysbaert (2013) created a crowdsourced lexicon with valence, arousal, and dominance annotations for 13,915 terms. A subset of entries in the lexicon corresponded to words in ANEW. For these terms, the authors show that the valence annotations obtained by crowdsourcing have high correlation with the ratings in ANEW. The correlation is lower for arousal and dominance, but that is not very different from other independent comparisons of arousal and dominance ratings.

All of the lexicons described so far in this section have been widely used in natural language processing research. However, none of them provides real-valued scores indicating degrees of association of terms with valence or emotion categories.

5.1.1 Real-valued sentiment scores from manual annotations

Words have varying degrees of associations with sentiment categories. This is true not just for comparative and superlative adjectives and adverbs (eg, worst is more negative than bad) but also for other syntactic categories. For example, most people will agree that succeed is more positive (or less negative) than improve, and fail is more negative (or less positive) than deteriorate. Downstream applications benefit from knowing not only whether a word or phrase in positive or negative (or associated with some emotion category), but also from knowing the strength of association. However, for people, assigning a score indicating the degree of sentiment is not natural. Different people may assign different scores to the same target item, and it is hard for even the same annotator to remain consistent when annotating a large number of items. In contrast, it is easier for annotators to determine whether one word is more positive (or more negative) than the other. However, the latter requires a much larger number of annotations than the former (in the order of N^2, where N is the number of items to be annotated).

An annotation scheme that retains the comparative aspect of annotation while still requiring only a small number of annotations comes from survey analysis techniques and is called maximum difference scaling (MaxDiff) or best-worst scaling (Louviere, 1991).

The annotator is presented with four terms and asked which word is the most positive and which is the least positive. By answering just these two questions five out of the six inequalities are known. If the respondent says that A is most positive and D is least positive, then:

$$A > B,\ A > C,\ A > D,\ B > D,\ C > D$$

Each of these MaxDiff questions can be presented to multiple annotators. The responses to the MaxDiff questions can then be easily translated into a ranking of all the terms and also a real-valued score for all the terms (Orme, 2009). If two words

have very different degrees of association (eg, A>>D), then A will be chosen as most positive much more often than D and D will be chosen as least positive much more often than A. This will eventually lead to a ranked list such that A and D are significantly further apart, and their real-valued association scores are also significantly different. On the other hand, if two words have similar degrees of association with positive sentiment (eg, A and B), then it is possible that for MaxDiff questions having both A and B, some annotators will choose A as most positive, and some will choose B as most positive. Further, both A and B will be chosen as most positive (or most negative) a similar number of times. This will result in a list such that A and B are ranked close to each other and their real-valued association scores will also be close in value.

MaxDiff was used for obtaining annotations of relation similarity of pairs of items by Jurgens, Mohammad, Turney, and Holyoak (2012) in a SemEval-2012 shared task. Kiritchenko, Zhu, and Mohammad (2014) used the MaxDiff method to create a dataset of 1500 Twitter terms with real-valued sentiment association scores. They also conducted an experiment to determine the reliability of the sentiment scores by randomly dividing the responses into two groups and comparing the sentiment scores obtained from the two groups. On average, the scores differed only by 0.04, showing good reliability.

Real-valued valence association scores obtained through MaxDiff Annotations were used in subtask E of the 2015 SemEval Task Sentiment Analysis in Twitter (Rosenthal, Nakov, Kiritchenko, Mohammad, Ritter, & Stoyanov, 2015) to evaluate automatically generated Twitter-specific valence lexicons. Datasets created with the same approach will be used in a 2016 task determining sentiment intensity of English and Arabic phrases to evaluate both English and Arabic automatically generated sentiment lexicons.

5.2 Automatically generated term–sentiment association lexicons

Automatic, statistical, methods for capturing word–sentiment associations can quickly learn associations for hundreds of thousands of words, and even for sequences of words. They can also learn associations that are relevant to a particular domain. For example, when the algorithm is applied on a text of movie reviews, the system can learn that unpredictable is a positive term in this domain (as in unpredictable story line), but when applied to auto reviews, the system can learn that unpredictable is a negative term (as in unpredictable steering).

Hatzivassiloglou and McKeown (1997) proposed an algorithm that uses word usage patterns to generate a graph with adjectives as nodes. An edge between two nodes indicates either that the two adjectives have the same or opposite valence. A clustering algorithm then partitions the graph into two subgraphs such that the nodes in a subgraph have the same valence. They used this method to create a lexicon of positive and negative words.

Turney and Littman (2003) proposed a minimally supervised algorithm to calculate the valence of a word by determining whether its tendency to co-occur with a

small set of positive seed words is greater than its tendency to co-occur with a small set of negative seed words. SentiWordNet (SWN) was created using supervised classifiers as well as manual annotation (Esuli & Sebastiani, 2006). Mohammad, Dunne, and Dorr (2009) automatically generated a sentiment lexicon of more than 60,000 words from a thesaurus.

Mohammad et al. (2013a) employed the Turney method to generate a lexicon (Hashtag Sentiment Lexicon) from tweets with certain sentiment-bearing seed-word hashtags such as (#excellent, #good, #terrible, and so on) and another lexicon (Hashtag Sentiment Lexicon) from tweets with emoticons.[20] Since the lexicons themselves are generated from tweets, they even have entries for the creatively spelled words (eg, happpeee), slang (eg, bling), abbreviations (eg, lol), and even hashtags and conjoined words (eg, #loveumom). Kiritchenko, Zhu, and Mohammad (2014) proposed a method to create separate lexicons for words found in negated context and those found in affirmative context; the idea being that the same word contributes to sentiment differently depending on whether it is negated or not. These lexicons contain sentiment associations for hundreds of thousands of unigrams and bigrams. However, they do not explicitly handle combinations of terms with modals, degree adverbs, and intensifiers.

Other recent work on valence lexicons includes Tang, Wei, Qin, Zhou, and Liu (2014), Chetviorkin, Moscow, and Loukachevitch (2014), Chetviorkin et al. (2014), and Makki, Brooks, and Milios (2014). Tang, Wei, Qin, Zhou et al. (2014) proposed a method to determine large valence association lexicons from tweets using a neural network architecture and a continuous representation approach. They evaluate their approach by measuring usefulness in tweet valence classification tasks. Chetviorkin et al. (2014) proposed a method for constructing domain-specific valence lexicons.

6 Modeling the impact of sentiment modifiers

Negation, modality, degree adverbs, and other modifiers impact the sentiment of the term or phrase they modify.

6.1 Negation

Morante and Sporleder (2012) define negation to be "a grammatical category that allows the changing of the truth value of a proposition." Negation is often expressed through the use of negative signals or negator words such as not and never, and it can significantly affect the sentiment of its scope. Understanding the impact of negation on sentiment improves the automatic detection of sentiment.

Automatic negation handling involves identifying a negation word such as not, determining the scope of negation (which words are affected by the negation word), and finally appropriately capturing the impact of the negation (see work by Jia, Yu,

[20] http://www.purl.com/net/lexicons.

and Meng (2009), Wiegand, Balahur, Roth, Klakow, and Montoyo (2010), Lapponi, Read, and Ovrelid (2012) for detailed analyses of negation handling). Traditionally, the negation word is determined from a small handcrafted list (Taboada, Brooke, Tofiloski, Voll, & Stede, 2011). The scope of negation is often assumed to begin from the word following the negation word until the next punctuation mark or the end of the sentence (Kennedy & Inkpen, 2005; Polanyi & Zaenen, 2004). More sophisticated methods to detect the scope of negation through semantic parsing have also been proposed (Li, Zhou, Wang, & Zhu, 2010).

Earlier works on negation handling employ simple heuristics such as flipping the polarity of the words in a negator's scope (Choi & Cardie, 2008; Kennedy & Inkpen, 2005) or changing the degree of sentiment of the modified word by a fixed constant (Taboada et al., 2011). Zhu, Guo, Mohammad, and Kiritchenko (2014) show that these simple heuristics fail to capture the true impact of negators on the words in their scope. They show that negators tend to often make positive words negative (albeit with lower intensity) and make negative words less negative (not positive). Zhu et al. also propose certain embeddings-based recursive neural network models to capture the impact of negators more precisely. As mentioned earlier, Kiritchenko, Zhu, and Mohammad (2014) capture the impact of negation by creating separate sentiment lexicons for words seen in an affirmative context and those seen in negated contexts. These lexicons are generated using co-occurrence statistics of terms in affirmative context with sentiment signifiers such as emoticons and seed hashtags (such as #great, #horrible), and separately for terms in negated contexts with sentiment signifiers. They use a hand-chosen list of negators and determine scope to be starting from the negator and ending at the first punctuation (or end of sentence).

6.2 Degree adverbs, intensifiers, modals

Degree adverbs, such as barely, moderately, and slightly, quantify the extent or amount of the predicate. Intensifiers, such as too and very, are modifiers that do not change the propositional content (or truth value) of the predicate they modify, but they add to the emotionality. However, even linguists are hard-pressed to give out comprehensive lists of degree adverbs and intensifiers. Additionally, the boundaries between degree adverbs and intensifiers can sometimes be blurred, and so it is not surprising that the terms are occasionally used interchangeably. Impacting propositional content or not, both degree adverbs and intensifiers impact the sentiment of the predicate, and there is some work in exploring this interaction (Lu & Tsou, 2010; Taboada, Voll, & Brooke, 2008; Wang & Wang, 2012; Xu, Wong, Lu, Xia, & Li, 2008; Zhang, Zeng, Xu, Xin, Mao, & Wang, 2008). Most of this work focuses on identifying sentiment words by bootstrapping over patterns involving degree adverbs and intensifiers. Thus, several areas remain unexplored, such as identifying patterns and regularities in how different kinds of degree adverbs and intensifiers impact sentiment, ranking degree adverbs and intensifiers in terms of how they impact sentiment, and determining when (in what contexts) the same modifier will impact sentiment differently than its usual behavior.

Modals are a kind of auxiliary verb used to convey the degree of confidence, permission, or obligation. Examples include can, could, may, might, must, will, would,

shall, and should. The sentiment of the combination of the modal and an expression can be different from the sentiment of the expression alone. For example, cannot work is less positive than work or will work (cannot and will are modals). Thus handling modality appropriately can greatly improve automatic sentiment analysis systems.

7 Sentiment in figurative and metaphoric language

There is growing interest in detecting figurative language, especially irony and sarcasm (Carvalho, Sarmento, Silva, & De Oliveira, 2009; Filatova, 2012; González-Ibánez, Muresan, & Wacholder, 2011; Reyes, Rosso, & Veale, 2013; Veale & Hao, 2010). In 2015, a SemEval shared task was organized on detecting sentiment in tweets rich in metaphor and irony (Task 11).[21] Participants were asked to determine the degree of sentiment for each tweet where the score is a real number in the range from –5 (most negative) to +5 (most positive). One of the characteristics of the data is that most of the tweets are negative; thereby suggesting that ironic tweets are largely negative. The SemEval 2014 shared task Sentiment Analysis in Twitter (Rosenthal et al., 2014) had a separate test set involving sarcastic tweets. Participants were asked not to train their system on sarcastic tweets, but rather apply their regular sentiment system on this new test set; the goal was to determine performance of regular sentiment systems on sarcastic tweets. It was observed that the performances dropped by about 25–70%, thereby showing that systems must be adjusted if they are to be applied to sarcastic tweets. We found little to no work exploring automatic sentiment detection in hyperbole, understatement, rhetorical questions, and other creative uses of language.

8 Multilingual sentiment analysis

A large proportion of research in sentiment analysis has focused on English. Thus there are fewer resources (sentiment lexicons, annotated corpora, etc.) for other languages than in English. This means that automatic sentiment analysis systems in other languages tend to be less accurate than their English counterpart. Thus work on multilingual sentiment analysis has mainly addressed mapping sentiment resources from English into morphologically complex languages. Mihalcea, Banea, and Wiebe (2007) used English resources to automatically generate a Romanian subjectivity lexicon using an English–Romanian dictionary. The generated lexicon was then used to classify Romanian text. Wan (2008) translated Chinese customer reviews to English using a machine translation system. The translated reviews were then annotated using a rule-based system that uses English lexicons. A higher accuracy is achieved when using ensemble methods and combining knowledge from Chinese and English resources.

[21] The proceedings will be released later in 2015.

Often, companies, organizations, and governments need to convey information in many languages. With capabilities in automatic translation improving every year, it is tempting to produce text in one language (say English) and translate into other languages using an automatic system. One might then want to manually inspect the translations to correct for errors. However, translations may not always preserve the sentiment in the source text. Balahur and Turchi (2014) conducted a study to assess the performance of sentiment analysis techniques on machine-translated texts. Opinion-bearing English phrases from the New York Times Text (2002–2005) corpus were split into training and test datasets. An English sentiment analysis system was trained on the training dataset and its prediction accuracy on the test set was found to be about 68%. Next, the training and test datasets were automatically translated into German, Spanish, and French using publicly available machine-translation engines (Google, Bing, and Moses). The translated test sets were then manually corrected for errors. Then for German, Spanish, and French, a sentiment analysis system was trained on the translated training set for that language and tested on the translated-and-corrected test set. The authors observe that these German, Spanish, and French sentiment analysis systems obtain accuracies in the low 60s (and thus not very much lower than 68%). However, the languages explored in this study are linguistically close to each other.

Salameh, Mohammad, and Kiritchenko (2015) and Mohammad, Salameh, and Kiritchenko (2015) conducted experiments to determine loss in sentiment predictability when they translated Arabic social media posts into English, manually and automatically. As a benchmark, they use manually determined sentiment of the Arabic text. They show that an English sentiment analysis system has only a slightly lower accuracy on the English translation of Arabic text as compared to the accuracy of an Arabic sentiment analysis system on the original (untranslated) Arabic text. This does not imply that translation does not have an effect on valence. On the contrary, Salameh et al. (2015) and Mohammad et al. (2015) show that even with manual translations of text, cultural differences can lead to significantly different valence associations between speakers of the two languages. They also showed that automatic Arabic translations of English valence lexicons improve the accuracy of an Arabic sentiment analysis system. The translated lexica and corpora are made freely available.[22] The experiments with automatic translations and automatic sentiment analysis systems show that in languages where a strong sentiment analysis system does not exist, using an English sentiment analysis system on English translations of text from that language is a viable option.

Some of the areas less explored in the realm of multilingual sentiment analysis include: how to translate text so as to preserve the degree of sentiment in the source text; how sentiment modifiers such as negators and modals differ in function across languages; understanding how automatic translations differ from manual translations in terms of sentiment; and how to translate figurative language without losing its affectual gist.

[22] Lexicons and corpora for Arabic sentiment analysis: www.purl.org/net/ArabicSA.

9 Summary and future directions

This chapter summarized the diverse landscape of problems and applications associated with automatic sentiment analysis. We outlined key challenges for automatic systems, as well as the algorithms, features, and datasets used in sentiment analysis. We described several manual and automatic approaches to creating valence- and emotion-association lexicons. We also described work on sentence-level sentiment analysis. We discussed preliminary approaches to handle sentiment modification by negators and modals, detecting sentiment in figurative and metaphoric language, as well as cross-lingual sentiment analysis—these are areas where we expect to see significantly more work in the near future. Other promising areas of future work include: understanding the relationships between emotions, multimodal affect analysis (involving not just text but also speech, vision, physiological sensors, etc.), and applying emotion detection to new applications.

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Conceptual Profiling

10

David M. H. Thomson
MMR Research Worldwide, Wallingford, Oxfordshire, United Kingdom

1 Background

1.1 The case for conceptual profiling

Conceptual profiling is a process for accessing implicit or associated meaning. All "objects" have associated meaning and it is widely held that this has a profound influence on our thoughts and our behavior (Greenwald, Klinger, & Schuh, 1995).

Conceptual profiling was developed by the author and co-workers at MMR Research Worldwide, as an alternative to direct measurement of emotion. The underpinning science, methodologies and data analyses tools are published in detail in a series of six articles (Crocker & Thomson, 2014; Thomson, 2010, 2015; Thomson & Crocker, 2014, 2015; Thomson, Crocker, & Marketo, 2010).

By analogy with sensory profiling, the conceptual profile of an object may be defined as the degree of association of a series of conceptual descriptors with that object. Conceptual profiling has much in common with brand personality profiling (Aaker, 1997) in which brands are ascribed human-like personality traits. Personality traits can be considered conceptual associations, although in most applications of conceptual profiling, the conceptual lexicon extends well beyond what might be construed as personality traits to encompass a more extensive array of emotional, functional and abstract conceptualizations.

The rationale for seeking an alternative to direct measurement of emotion, as proposed, for example, by Zentner, Grandjean, and Scherer (2008) for music, King and Meiselman (2009) for foods, and Ferdenzi et al. (2011) for odor, is that direct measurement presupposes that emotion is experienced consciously. Whether or not emotion is conscious by definition is a moot point (Ellis, 1995; Ellis & Newton, 2010) but it has long been recognized that much of the mental processing that influences and otherwise motivates human behavior occurs below the level of conscious awareness (Hasher & Zacks, 1984). Consequently, restricting measurement to thoughts that are immediately conscious is obviously limiting. With conceptual associations (or implicit associations), there is no assumption that the phenomena are actually experienced. For example, with the color purple, notions such as "confident," "modern," "genuine," "powerful," "classy," and "sophisticated" (see later for a detailed explanation) don't normally come to mind, yet these associated conceptualizations are likely to have a fairly immediate influence on how we react to purple-colored objects. Conceptualizations, such as those just described, are intrinsic to the object that triggered them, whereas emotions are intrinsic to the individual. This distinction

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is important. In any form of measurement, whether it be physical or psychological, understanding the nature of the phenomenon that the experimenter is attempting to capture and quantify is a prerequisite.

The consensus amongst theorists is that emotion is a multicomponent phenomenon which includes cognitive processes, physiological reactions, motor expressions, action tendencies, and feelings (Scherer, 2005). Consequently, the subjective affective experience (feeling) should be construed as only one aspect of emotion. This, of course, is the aspect that is potentially measureable when we allude to direct measurement of emotion. However, it should also be recognized that other aspects of emotion, such as the physiological reaction, are potentially measureable by other means. Henceforth, for the sake of clarity, when considering emotion measurement in this chapter, the author is alluding to measurement of the subjective affective experience (feeling) aspect of emotion.

Johnson and Stewart (2005) define emotion as a mental state or feeling with a specific referent. Although their definition of emotion as a "feeling" may be too narrow (Scherer, 2005), the idea of a specific referent triggering the emotion is important. In other words, emotion is triggered by a person, object, or event ("referent object" hereafter). This implies a causal relationship between the referent object and the emotion(s) that it engenders. The nature, intensity, and duration of the emotion(s) will depend on the fundamental nature of the referent object, the psyche of the individual, the context in which individual and referent object interact, and the mental status of the individual at the moment of interaction. This means that a particular referent object could, in theory, trigger a spectrum of different emotions across different individuals in different contexts. However, it transpires that there is a considerable degree of universality across individuals from within a particular culture, in the nature of the emotions triggered by a particular referent object (Johnson & Stewart, 2005). This implies that there is something that is intrinsic to the referent object that gives it the capacity to trigger particular emotions and that these intrinsic characteristics are enduring, as is their capacity to confer particular emotional outcomes. Emotion, by contrast, is intrinsic to the perceiving organism. It depends on the psyche of the individual concerned and their physiological and psychological state at that precise moment in time. Moreover, it is transient.

The nature of these intrinsic characteristics can be readily understood by imagining a square panel of purple color, printed on a sheet of paper or displayed on a screen. Depending on the resolution of the printer or the screen, this colored panel would be characterized, perhaps, using descriptors such as purple-ness, blue-ness, red-ness, lightness/darkness, roughness/smoothness, and glossiness/matiness. These are the sensory (or perceptual) characteristics of the colored panel and most people would be able to identify and describe them with little or no prompting. If the same people were asked to elaborate on what the color purple meant to them, what it made them think about or how it made them feel, most would struggle to understand the question and why it is being asked, never mind answer it! However, it is readily determined using conceptual profiling that the color purple is associated with concepts such as confident, modern, genuine, powerful, classy, and sophisticated. (The experimental procedures used to reveal these associations are described later.) These associations

are referred to as latent associations (Stafford-Clark, 1965), implicit associations (Greenwald et al., 1995), or conceptual associations (Thomson, 2010).

Although conceptual associations are largely non-conscious at the moment of interaction between referent object and person (we don't think about them at the time), they may become conscious through subsequent (albeit assisted) introspection. Classical Freudian psychoanalysis would therefore characterize conceptual associations as preconscious rather than unconscious (Stafford-Clark, 1965), thereby distinguishing them from other unconscious mental phenomena which are fundamentally inaccessible via introspection. Accordingly, the spectrum of mental activity that controls our behavior on a moment-by-moment may be thought of as comprising a blend of the conscious and the non-conscious; the latter comprising the preconscious and the unconscious. Although the relative proportion of each of these is fundamentally inestimable, considered wisdom suggests that the conscious aspect represents only a tiny proportion of the total (Hasher & Zacks, 1984; Kahneman, 2003; Zimmerman, 1989). It is the capacity of conceptual profiling to access the preconscious, thereby revealing previously hidden insights, that makes it especially valuable to brand, packaging and product designers.

To summarize, there are several compelling reasons for considering conceptual profiling as an alternative or an adjunct to direct measurement of emotion:

- Emotion is a mental state or feeling with a specific referent (ie, we feel emotional about something). There is a direct causal relationship between emotion and the conceptualizations associated with the triggering referent. In short, conceptual associations trigger emotions.
- Conceptual associations are intrinsic to the referent object. These associations are strong and enduring. In contrast, emotion is intrinsic to the perceiving organism and is fleeting.
- Branded goods are referent objects in the context of emotion. Branding, packaging, and the product per se are aspects of the referent object upon which designers and developers can exert a direct influence. The capacity to capture and benchmark the conceptual profiles of all three aspects of the referent object, and thereafter to monitor the effects of design and development, is fundamental to influencing the emotional outcomes triggered by branded goods.
- Direct measurement of the subjective experience of emotion is, by definition, limited to conscious experience. In contrast, conceptual profiling extends beyond the conscious into the preconscious, thereby increasing potential reach well beyond what might be captured through direct measurement of emotion.

Irrespective of the relative merits of conceptual profiling versus direct measurement of emotion, both are fairly recent additions to the researcher's toolkit and neither is, as yet, fully integrated into the new product development process.

1.2 The need for something different

The multitude of branded products that most human beings interact with in everyday life and the sentiments and values these espouse through branding, advertising, and other forms of marketing, are likely to exert a considerable influence upon our emotions. Consequently, branded goods should be thought of not just as vehicles for

delivering functionality along with some degree of immediate sensory pleasure (or otherwise) but also as vehicles for triggering a spectrum of emotional outcomes. It figures therefore that the branded products included in an individual's consumption repertoire must, at the very least, exceed some sort of minimum threshold of inclusion in terms of the combination of functionality, pleasure, and emotional outcomes delivered, otherwise they surely wouldn't form part of their repertoire. Some may exceed the individual's minimum threshold of inclusion by a considerable margin, some may offer a compromise between what's delivered versus price and others may simply be the best available.

Fifty to sixty years ago, even in highly developed markets such as the USA and the principal economies of Europe, many products were sub-optimal in terms of the functional equities and the immediate sensory pleasure that they delivered. Presumably, consumers chose them because they were all that was available and better than nothing. During the ensuing years, the large brand owners, with their sophisticated research and development functions and manufacturing practices, gradually improved the functionality and sensory quality of products, often to the point of excellence. This gave them a significant advantage over minor brands and the manufacturers of retailer own-label products. However, these days, thanks to the ready availability of advanced manufacturing technology and sophisticated sensory optimization tools, functional and sensory excellence is within the grasp of fairly modest manufacturing businesses. Consequently, most retailer-branded goods and most of the "minor brands" sold at very low prices by discounters (such as Aldi and Lidl in Europe) are usually functionally competent or better and often quite close to the sensory optimum for the category.

Almost all of the major brand owners have responded to this challenge through new product development. Consequently, every year, many thousands of new products are launched across the key markets of the world. Unfortunately, most of these new products and almost all new brands fail in-market. According to Nielsen, 76% of new products launched in the United Kingdom failed in their first year (O'Reilly, 2014). Nielsen also reviewed 3463 new consumer packaged goods (CPG) products launched in the US market during 2012 and found that only 14 of these (0.4%) could be acclaimed as what they describe as "Breakthrough Innovation Winners"; that is, products that have all the key elements of success (Nielsen, 2014a). A similar review of the South East Asia market (Nielsen, 2014b) identified just 35 "Breakthrough Innovation Winners" from 2500 CPG product launches (1.4%). This is in spite of the fact that many (although certainly not all) of these new products and brands would have been channelled through an innovation process that is guided by consumer research and where market potential may also have been evaluated pre-launch using research-driven volumetric tools such as Nielsen's BASES (www.nielsen.com). This suggests that current research methodologies are failing to predict longer-term product adoption!

In defense of the market research industry, creating a new CPG product that has the potential to succeed in a mature market, is very challenging. With foods and beverages, for example, most consumers will not increase their total consumption to accommodate a new product in their repertoires so they obviously need to substitute an existing product, either in whole or in part, to accommodate the new one. Invoking substitution is a tall order! Consumers may try new products out of curiosity or

because the price is discounted, but affecting long-term substitution is quite a different matter. After all, in circumstances where choice is abundant, a product that is established within an individual consumer's repertoire must be satisfying their needs and desires to some considerable extent, otherwise it wouldn't form part of their repertoire. To succeed, a new product must achieve the same end either to a greater extent or to the same extent but differently or cheaper. There are, of course, many reasons why new products fail but, in the final analysis, the primary reason for failure is because too few consumers have adopted it into their longer-term repertoires. It really is that simple!

Since functional competence and sensory excellence are within the grasp of almost all manufacturers, few products fail these days because they aren't fit for purpose or because of poor sensory quality. With this in mind, brand owners have recently turned their attention to the emotional outcomes triggered by their products and how these might be optimized to maximise longer-term adoption. This, in turn, has led to the development of new tools such as EsSense® (King & Meiselman, 2009) for the direct measurement of emotions triggered by foods and beverages and to the re-deployment of established tools such as facial coding (Hill, 2007) to capture emotional outcomes by indirect means. Various other techniques have also been deployed, including conceptual profiling (Thomson et al., 2010) and Implicit Association Testing (Greenwald et al., 1995), as a means of accessing the "hidden" conceptualizations associated with products that trigger the emotional outcomes. (This idea is explained in detail later in the chapter.)

However, rather than continuing to "throw" new methodologies at the problem of poor predictive validity, in the hope that one of them might eventually bring new insights that will steer product developers towards more successful products, surely it's time to take a step backwards in order to develop a more coherent understanding of what might be happening in the mind that motivates behavior. The Duality of Reward Hypothesis attempts to do this!

1.3 Duality of Reward Hypothesis

Pioneering work conducted by Olds and Milner in the 1950s (Olds, 1956; Olds & Milner, 1954) identified discrete areas of the rat brain that seemed to deliver some form of positive affective experience when stimulated by a tiny electrical current. The rats quickly learned to self-stimulate by pressing a bar with their snouts, thereby completing an electrical circuit. On occasions, the rats would self-stimulate up to 2000 times per hour, seemingly preferring to do so rather than eat, drink, or sleep, ultimately leading to their demise. The parallels with human addictive behavior are obvious (Kalivas & Volkow, 2005). Other pioneers of affective experiences as reward, include Mowrers' (1956) two-factor theory of learning, Young's (1959) idea of conditioned, anticipatory affective arousal as an incentive to execute behaviors, and Atkinson's (1964) achievement motivation theory. These and other works led to the fundamental generalization that behavior is driven by reward. Today, it is generally recognized that reward is something that happens in the mind. Although it seems probable that parallel physiological events should occur in the brain, any relationships

that may exist between psychological phenomena and the corresponding physiological phenomena are likely to be complex (Kringelbach & Berridge, 2009).

Reward may be positive or negative (valence). Positive reward motivates us to begin and to continue doing whatever it is that's triggering reward. It also encourages us, through learning, to repeat this behavior at the next appropriate opportunity. Negative reward motivates us to attenuate or stop the triggering behavior and to avoid repeating it again. The greater the reward the greater the motivation to either start, continue, attenuate or stop the reward-triggering behavior.

The Duality of Reward Hypothesis, as proposed by this author, postulates two aspects of reward: (1) "reward via immediate sensory pleasure" and (2) "reward via emotional outcome."

It is envisaged that "reward via immediate sensory pleasure" is the aspect of reward that's experienced there and then when, for example, something tastes nice (or tastes nasty) or when experiencing discomfort or pain. It also influences other primal behaviors such as motivating us to participate in sexual intercourse through the pleasure of the human orgasm, motivating us to drink when thirsty, motivating us to eat when hungry, and motivating us to stop eating when satiated (Hetherington & Havermans, 2013).

The key features of "Reward via immediate sensory pleasure" are that it is triggered by stimulation of the senses and that the pleasure thus engendered is both immediate and apparent. Consequently, we are motivated to expectorate intensely bitter- or intensely sour-tasting substances immediately and we are motivated to withdraw from the source of pain immediately because they are unpleasant. Conversely, we are motivated to eat sweet-tasting substances because they are pleasant. The evolutionary basis of this is not difficult to imagine: Bitterness and sourness are associated with toxicity and pain with physical damage to the flesh. Sweetness is associated with sugar; a safe source of readily accessible energy for fuelling the body and most especially for fuelling the fight-or-flight response. The principle of "reward via immediate sensory pleasure" is summarized schematically in the top part of Fig. 10.1.

Finer and more subtle control may occur via alliesthesia, which is defined as the dependence of the experience of pleasure or displeasure on the internal milieu of the organism. Consequently, a stimulus capable of ameliorating the state of the internal milieu may be perceived as pleasant, whereas a stimulus that upsets the internal milieu may be unpleasant (Cabanac, 2009). Alliesthesia is thought to be involved in the fine control of appetite.

Presumably, evolution would have selected on the basis of this reward mechanism because the behavioral consequences it motivates have made us more successful in terms of living long enough and being healthy enough to procreate and thereafter surviving long enough until our offspring also reach sexual maturity, so that the cycle of life may begin again (Darwin, 1859).

"Reward via emotional outcome" is more complex. Emotional outcomes are hypothesized as psychological end-states caused by internal or external triggering events (Moors, 2009). Attaining particular emotional outcomes can be positively or negatively rewarding. The valence and magnitude of the reward that derives from a particular emotional outcome depend on the psyche of the individual, their lifetime

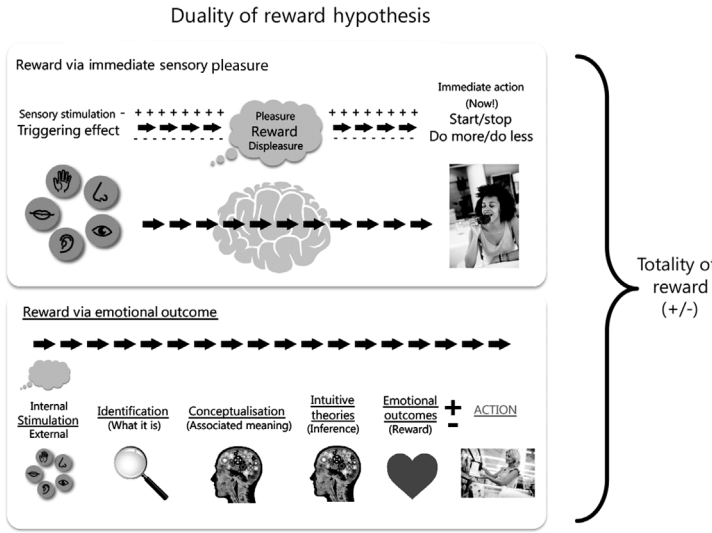


Figure 10.1 Schematic representation of the "Duality of Reward Hypothesis."

of learned experiences, their mental and physical states at the moment of triggering, and the context in which the triggering event occurs.

Internal triggering is where we recall things from our memory, such as laughing and joking with a particular friend, which leads to happiness (emotional outcome). Recall may be deliberate (through cognitive thought processing) or the memory may come-to-mind automatically. External triggering occurs when we interact with "objects" (eg, brands, products, advertisements, books, music, art), with other living things (eg, people, pets) and where we participate in "events" (eg, social gatherings, work, and other routine aspects of daily life), all of which can lead to an ever-changing array of emotional outcomes (and consequently, an ever-changing reward profile).

Some aspects of emotional outcome may be experienced there and then, as feelings of happiness, eagerness, or contentment, for example, or as feelings of sadness, anxiety, uncertainty, etc. Such obvious feelings may influence behavior immediately and knowingly. Other aspects of emotional outcome may not be experienced directly but indirectly as the urge to start, continue or stop doing something without necessarily knowing the reason why. Other aspects of emotional outcome may impact sometime after the triggering event; experienced perhaps as an inexplicable glow of self-satisfaction or as unattributable pangs of guilt or self-doubt. Feedback mechanisms allow the various outcomes to be factored into subsequent reward predictions. The key elements of "reward via emotional outcome" are summarized schematically in the bottom part of Fig. 10.1.

Since "reward via emotional outcome" is characteristic of the most highly evolved animals, especially humans, and "reward via immediate sensory pleasure" is more widespread amongst lower orders, it is tempting to assume that the latter may have

evolved earlier than the former. However, even if this were the case, the two are hardly independent. If something delivers a lot of "reward via sensory pleasure," the chances are that it may also deliver rewarding emotional outcomes and that one may augment the other (just think of eating chocolate). Conversely, few people experience much in the way of immediate sensory pleasure when they taste beer for the first time. However, beer has the capacity to deliver positive emotional outcomes because of the social context in which it is normally consumed and also because of the intoxicating effects of alcohol, so many of us eventually learn to derive pleasure from its sensory characteristics! There may also be tensions between the two aspects of reward. For example, we may be induced to do something, such as eat chocolate, because the sensory characteristics deliver positive "reward via immediate sensory pleasure" but we are dissuaded from doing so by the prospect of negative "reward via emotional outcome," driven by concerns about becoming obese or diabetic. There may also be tensions within "reward via emotional outcome." Someone may seek the calming effect and relaxation that eating chocolate can deliver, but this may be in conflict with the negativity associated with others' perceptions of indulgence and greed. The consequences of this offsetting of reward will differ across individuals, depending on the relative potency of the various aspects of reward to that individual. It may also differ within the same individual depending on the context in which the offsetting takes place so we may, for example, choose to eat chocolate in one set of circumstances but an apple or a banana in other seemingly similar circumstances.

As mentioned previously, the subjective affective aspect of emotion is defined by Johnson and Stewart (2005) as a mental state or feeling with a specific referent. It is hypothesized that it is the conceptualizations associated with the referent that trigger emotion. In the example presented immediately above, chocolate is the "referent" and concerns about health and wellbeing are the emotional outcomes that motivate our behavior in terms of choosing whether or not to eat chocolate on a particular occasion. Chocolate and concerns about health and wellbeing are linked, in this case, by the intuitive theory that chocolate contains high levels of fat and sugar and that overconsumption of these nutrients may be unhealthy (Carey, 2009). "High levels of fat," "high levels of sugar," "overconsumption," "nutrients," and "unhealthy" are all concepts associated with chocolate. According to Carey (2009) referent objects, concepts, and emotional outcomes are all interlinked through intuitive theories to create a massive, multidimensional "knowledge structure" that is stored in the memory. Interaction with the referent object induces us, knowingly or otherwise, to access a particular part of the "knowledge structure" and it is the content of the part accessed that ultimately engenders emotional outcomes and reward.

It is proposed that all aspects of "reward via immediate sensory pleasure" and "reward via emotional outcome," whether experienced or not, whether immediate or subsequent, and whether positive or negative, integrate to deliver "totality of reward" and it is the integration of the two aspects of reward that finally influences our behavior (Fig. 10.2). This unremitting process of integration, which will almost always occur below the level of conscious awareness, leads to constant fluctuations in "totality of reward" and hence in behavior motivation, as the events of life impinge upon us on a moment-by-moment basis.

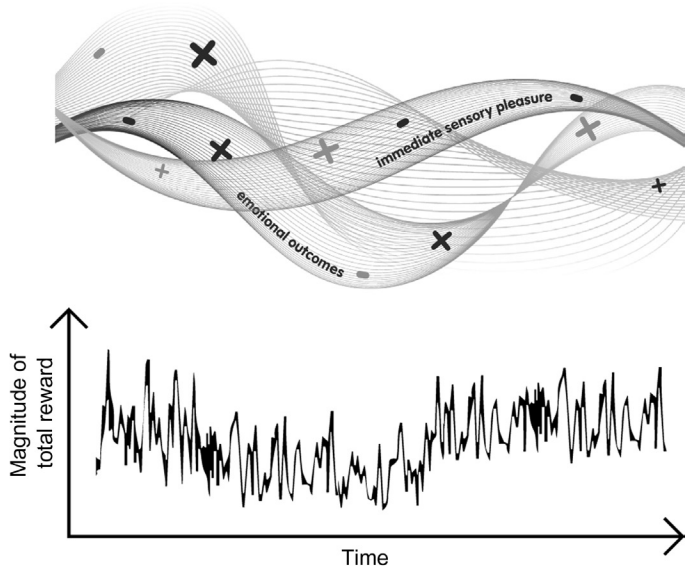


Figure 10.2 Schematic representing constant integration of Reward via immediate sensory pleasure and Reward via emotional outcome to yield Totality of Reward. Based on the "Duality of Reward Hypothesis."

As a footnote, the case for two aspects of reward is hardly new: Plato (c. 428–c. 348 BCE) proposed two aspects of "happiness" described (in ancient Greek) as hedonia ("pleasure") and eudaimonia ("human flourishing"). Plato's happiness could possibly correspond with "totality of reward," hedonia to "reward via immediate sensory pleasure," and eudaimonia with "reward via emotional outcome." It is also rather interesting that two physiologically discrete reward areas have been identified in the brain, the first, as previously mentioned, by Olds and Milner (1954) and the second by Kringelbach and Berridge (2009). The latter investigators have associated these discrete reward areas with hedonia and eudaimonia.

1.4 Liking in the context of "totality of reward"

As proposed in the Duality of Reward Hypothesis (above), "totality of reward" is an abstract phenomenon that cannot be accessed, captured and measured by thinking about it, largely because so much of "reward via emotional outcome" (one of the two primary components of "totality of reward") impacts below the level of conscious awareness. If so, the implications for consumer research and brand and product development are obvious; we cannot directly access and capture the final determinant of longer-term choice and purchasing behavior (ie, "totality of reward"). This may account, at least in part, for the lack of predictive validity and, consequently, for the launch of so many new products and brands that are preordained to fail.

This does not imply, as some have suggested (Graves, 2010; Lindstrom, 2008), that research which invokes cognitive thought processing is unfit for purpose. Quite the contrary in fact! However, it does suggest that consumer research, as a scientific discipline, should perhaps take a step backwards and attempt to provide a better theoretical understanding of some of its most common metrics, most especially liking.

When we eat something or, more generally, when we do something, we very readily form an opinion about how much we "like" or "dislike" whatever it is we're eating or doing. Even without thinking about it, the feeling of "liking" (or "disliking") automatically comes to mind; we simply cannot avoid it and it is very difficult to ignore, especially when extreme. Because "liking" comes to mind so readily, it is easy for us to measure it on a (hedonic) scale and it is also easy for us to tell each other how much we "like" (or "dislike") what we're eating or doing.

But what is it that we're actually capturing when we think about "liking" or measure it on a scale?

Anecdotally, we know that we don't always buy things (behavior) just because we "like" them. In short, "liking" alone isn't always sufficiently motivating. Conversely, we sometimes end-up buying things or doing things we don't really "like" or maybe even "dislike." (Few people like beer when first tasted yet it forms part of the consumption repertoire of a vast number of adults.) Also, from a research perspective, mean liking ratings or other intimations of product "liking" aren't reliable predictors of longer-term consumption behavior. (I really like Mars Bars but haven't bought one for over 10 years.)

Based on the hypothesis that behavior is driven by the "totality of reward," this leads to the conclusion that whatever it is that comes to mind when we think about "liking" is not equivalent to the "totality of reward." (There may be special circumstances when the two are equivalent but this is likely to be the exception rather than the rule.) This realization has led to the notion of "beyond liking"!

Of course, we can never know for sure what influences whatever it is that comes to mind when we think about "liking," nor can we know for sure how this might differ from "totality of reward," but we can make some educated guesses. Because "liking" comes to mind immediately, it seems plausible that "reward via immediate sensory pleasure" and those emotional outcomes that are immediate and obvious, are likely to be key contributors. It is also possible that "liking" could be shaped to some extent by aspects of emotional outcome that occur below the level of conscious awareness. If so, it's possible that the difference between "totality of reward" and "liking" lies in the extent to which emotional outcome influences the former versus the latter; that is, that "liking" somehow embraces or captures less of "reward via emotional outcome" than "totality of reward." In other words, measured "liking" is a subset of "totality of reward." Let's refer to this difference in the extent of emotional outcome captured by measured "liking" and "totality of reward" as ΔE.

Needless to say, this is difficult to "prove." However, we do know that mean liking ratings for the *taste* of a product are usually higher in the branded versus the unbranded condition provided, of course, that the brand is appreciated to some extent. But why should this be so? Brands are entirely conceptual in nature. By revealing the brand we are inadvertently inducing participants to "cast their nets a little wider" so

that they capture emotional outcome to a greater extent (and therefore ΔE is likely to be smaller). If the brand is appreciated, the extra aspects of emotional outcome inadvertently included will net-out to be positively rewarding. Consequently, when "liking" comes to mind in the branded condition, it will reflect a higher degree of reward (and a greater proportion of "totality of reward") and so the mean liking rating for the *taste* of the product in the branded condition is higher (when rationally, this should be unaffected).

It is possible to capture aspects of emotional outcome by direct questioning, as with EsSense (King & Meiselman, 2009). However, by definition, these will be the aspects of emotional outcome that are accessible to conscious thought processing, otherwise they couldn't be captured! Consequently, it's likely that these more accessible, "front-of-mind" emotional outcomes will influence what comes to mind when we think about "liking" and this may be why the sum total of positive or negative emotion captured by EsSense invariably correlates with measured "liking" or "disliking" (Ng, Chaya, & Hort, 2013); that is, because it is a primary contributor to "liking."

The challenge, in trying to capture what lies beyond "liking" (and therefore what lies beyond the obvious) is to access those aspects of emotional outcome that are fundamentally inaccessible by direct means (ie, ΔE). This may seem like an impossible challenge ("How can what is fundamentally inaccessible possibly be accessed?") unless, of course, it's possible to predict which emotional outcomes are triggered by the product in question. This idea is explored in Section 1.5.

1.5 Predicting emotional outcomes from conceptual associations: A new idea

We become aware of the fundamental nature of any product either by experiencing its sensory characteristics directly (which stimulates recall that allows us to identify the product) or by seeing or hearing descriptions of the product. Either way, "liking" comes to mind immediately and automatically. This probably reflects the immediate pleasantness (or unpleasantness) of the sensory characteristics of the product, infused with the memory of past emotional outcomes.

All objects carry with them what might be described as associated "conceptual baggage." As mentioned earlier, the color purple is generally associated with concepts such as confident, modern, genuine, powerful, classy, and sophisticated, whereas yellow is associated with happy, fun, energetic, and youthful. These are known as conceptual associations. All "objects" have conceptual associations. This includes people, which is why we're so readily influenced by the appearance of someone (height, bulk, conformation, skin, hair and eye color, apparent age, etc.) or by the sound of their voice, when forming an opinion about them. (This is the basis of IAT.)

Although this "conceptual baggage" exists purely in the mind of the individual, within any given culture there is likely to be some degree of commonality across individuals in the conceptualizations associated with particular objects because of shared heritage and common cultural experiences. Because of this commonality, these conceptual associations are considered to be characteristic of the object and the array of conceptualizations associated with the object are its "conceptual profile."

The conceptual profile of an object determines how we feel about the product and what it means to us. This, in turn, determines which emotional outcomes are triggered (ie, conceptual associations → emotional outcomes). In practical terms, this means that choice of the color yellow versus purple in the branding of a product, for example, could lead to very different emotional outcomes and that the nature of the "difference" between purple and yellow is likely to be fairly consistent across individuals. It would therefore be of fundamental importance that the color selected for branding or packaging should be consonant with the pre-existing conceptual profile of the brand so that it augments rather than detracts from the brand message.

If we are willing to entertain the hypothesis that the conceptual profile of any object is largely preconscious rather than unconscious, this suggests that it is accessible and may be captured and measured quite readily using various conceptual profiling techniques. This leads to the possibility that the profile of emotional outcomes triggered by an object may be predicted from its conceptual profile! If so, this would lead to highly illuminating but hitherto inaccessible insights into how brands and products differ from each other in delivering reward.

The conceptual profile of any product derives from three sources; the fundamental nature of the product (ie, it's chocolate, it's Single Malt Scotch whisky (SMSW), it's shampoo, etc.) and known as the "category effect", the sensory characteristics that differentiate that particular product from others within the same category (the "sensory effect"), and also the claimed or anticipated functional characteristics that further differentiate it from other products within category. The sensory and functional characteristics of the product also define it as belonging to a particular product category, which means that they have a dual role; that is, giving it an identity and shaping its conceptual profile. Consequently, there are six things that we should know about any (branded) product, in order to have a comprehensive understanding of how the fundamental nature of the product will influence consumer behavior:

1. *Sensory profile*—readily captured and measured using trained sensory assessors most especially but also using consumers.
2. *Functional profile*—readily captured and measured using category-aware consumers.
3. *Conceptual profile*—readily measured with consumers using conceptual profiling.
4. *Liking*—very readily captured and measured using consumers (although this yields an incomplete picture of reward).
5. *Emotional outcomes*—only the most accessible of these can be measured directly but those all-important emotional outcomes that exert their influence below the level of conscious awareness (ie, ΔE) *cannot*!
6. *Totality of reward*—the final arbiter of behavior but fundamentally unmeasurable.

Although *totality of reward* cannot (within the confines of current knowledge and technology) be captured and quantified, being able to predict the emotional outcomes triggered by a product, including those that cannot be captured because they exert their influence below the level of conscious awareness (ie, ΔE), would provide much greater insight into the potential of any brand or product to deliver positive or negative reward. This would be a major step forward in understanding why we *do what we do* and why we *buy what we buy* (and, perhaps of greater importance why we *don't* do and *don't* buy what we and others might expect us to) which would hopefully take us

beyond the hit-and-miss approach to brand, product and packaging development that currently delivers far more misses than hits.

Prediction of emotional outcomes from conceptual associations is the subject of ongoing methodological development at MMR Research Worldwide.

2 Conceptual profiling methodology

There are two practical aspects to conceptual profiling: (1) concept description and (2) quantification of the degree of association between concept and object.

2.1 Concept description

2.1.1 Use of words and the issue of counterintuitiveness

Using words to elucidate and label conceptual associations is fundamental to the process of conceptual profiling, as originally conceived (Thomson, 2010; Thomson et al., 2010). This is based on the premise that language evolved as a means of communicating thoughts (Chomsky, 1967) and therefore it is highly likely that words would have evolved to describe those concepts that are important in defining and otherwise giving meaning to the objects, places, beings, and events that impinge upon us in everyday life. However, using words to elucidate thoughts is sometimes criticized because of the inference that word–concept associations are consciously made and inherently rational (Penn, 2006) and this therefore precludes the possibility of non-conscious or seemingly counterintuitive associations.

The issue of apparent counterintuitiveness is important. Consider the following example: Milk chocolate is a comfort food in many cultures. One of the key conceptualizations associated with milk chocolate is trustworthiness (Thomson et al., 2010), however, it would be inappropriate to provide research participants with a portion of milk chocolate and then ask them to eat it and rate the chocolate for trustworthiness on a scale of 1–100, because the question is counterintuitive! However, the problem doesn't lie with word association as such but with the method of questioning and the use of classical forms of direct scaling.

As with all objects, words have conceptual associations in terms of their literal meaning (eg, "trustworthy" literally means worthy of trust) and their related meaning ("trustworthy" alludes to related concepts; authentic, reliable, creditworthy, responsible, dependable, honest, true, faithful, honorable, etc.). The related meaning is analogous to a cloud of conceptual association that augments the literal meaning of the word, thereby providing a degree of flexibility in how it is interpreted and used idiomatically. Milk chocolate is construed as "trustworthy" not because it is "worthy of trust" but because it consistently delivers sensory pleasure and various sought-after emotional outcomes to some people. The desirability of these emotional outcomes and the consistency with which milk chocolate seems to deliver them, means that it is construed as being reliable, dependable, faithful, and true, in the same way that a good friend would be. Making this association does not necessarily involve logical,

rational interpretation of the meaning of "trustworthy"; it is something that people just do intuitively, often below the level of conscious awareness.

Earlier it was posited that non-conscious mental activity may be subdivided into preconscious and unconscious. According to Freud, the latter is fundamentally inaccessible by definition, even to the most sophisticated psychoanalytic techniques. By the same token, preconscious mental activity is fundamentally accessible. It's quite difficult to imagine that words should provide an inadequate means of elucidating and labeling our thoughts, otherwise why would language have evolved?

In summary, it is incumbent upon researchers to find ways of allowing respondents to allude to the broader meaning of words, without actually stopping to think about it too much, rather than using direct scaling techniques that tend to channel respondents more towards literal meanings. This issue is revisited in the quantification section below.

2.1.2 Concept description—developing a conceptual lexicon

The principle underpinning development of a conceptual lexicon is broadly similar to that applied to a sensory lexicon in that it should be comprehensive enough to fully describe and discriminate amongst the range of objects being investigated whilst avoiding replication and redundancy. Irrespective of whether conceptual profiling is applied to fully branded products, unbranded products, or packaging, lexicon development usually starts with a comprehensive, desk-based review conducted by researchers of the key brands in the immediate and adjacent product categories. Print, TV and web advertising, on-pack copy, websites, and all other product and category narratives are thoroughly scrutinized to establish a draft lexicon of conceptual terms. Brand owner input is vital at this stage, in order to ensure subsequent "buy-in" within the organizsation, but preconceived ideas and other sources of bias need to be resisted robustly. Depending on the category, this could amount to well over 100 terms and will include emotional, abstract and functional conceptualizations. This is usually followed by several iterations of qualitative discussion where target consumers, existing category users, and users of specific brands interact with unbranded products, unbranded packaging (to explore the influence of form), and fully branded products, to generate a list of conceptual terms from scratch. Towards the end of the discussion group, the draft lexicon of terms obtained via the earlier phase of desk research is introduced so that it can be integrated and reconciled with the respondents' own lists. The task of the qualitative moderator thereafter is to encourage participants to remove any perceptual (sensory) and affective terms, to segregate the emotional and abstract terms from functional terms (thereby creating two lexicons), resolve any disputes, remove obvious replication and redundancy, and challenge any doubtful terms.

If conceptual profiling is to be conducted exclusively on unbranded products (which is often the case within our organization), it is extremely important that lexicon development should focus on conceptualizations associated with between-product sensory differences as well as those that characterize the category as a whole. Experience suggests that this can be achieved most effectively by involving category users that have been pre-screened for sensory acuity, articulacy, communicativeness, and genuine interest in the product. Specialist sensory moderators trained in

conceptual profiling are normally required. In circumstances where it proves too difficult to reduce the conceptual lexicon down to a practical number of terms through qualitative discussion, quantitative data-driven techniques, usually involving CATA (check all that apply) and cluster analysis, can often be used to great effect.

Vocabulary development will typically yield lexicons of 20–30 emotional and abstract terms and 15–25 functional terms, depending on the product category. Although the actual number of terms in a lexicon is something that should be determined and not predefined, subsequent experimental design is made much easier if the number of terms is highly factorable and prime numbers are avoided. It is important that the conceptual lexicon should include relevant negative terms as brands and products are often differentiated on the basis of what they are not!

Experience obtained working in English, Mandarin, Japanese, and most of the major European languages suggests that this vocabulary development procedure works equally well across all languages and cultures. By way of example, the conceptual lexicon developed by MMR Research Worldwide for the Single Malt Scotch whisky category is shown in Table 10.1 (emotion and abstract concepts only). In this particular case, the initial vocabulary was developed in English, interpreted by a bilinguist, presented to several groups of Mandarin-speaking Scotch whisky consumers for refinement, elaboration and rationalization and then presented back to a reconvened group of native English-speaking whisky drinkers.

Table 10.1 Bespoke conceptual lexicon for the Single Malt Scotch whisky category. "Must have" conceptual associations define the category and must be communicated via branding. "Must not haves" should be avoided

Key 10		**Other 15**
Classy	Arrogant	Cheerful
Comforting	Boring	Complex
Distinctive	Cheap	Conservative
Genuine		Contemporary
Sophisticated		Deceptive
Traditional		Dominating
Trustworthy		Feminine
		Free-spirited
		Friendly
		Intriguing
		Masculine
Must Haves	*Must Not Haves*	Sensual
For Single Malt	For Single Malt	Serious
Scotch whisky	Scotch whisky	Simple
		Youthful

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Table 10.2 MMR's General Conceptual Lexicon in English and Mandarin

Adventurous 有冒险精神的	Fun 有趣的	Sensual 感性的	Carefree 无忧无虑的	Classy 有格调的	Cheap 俗气的、廉价的
Arrogant 傲慢的	Inspiring 鼓舞人心的	Powerful 强有力的	Friendly 友善的	Masculine 男子气概的	Genuine 真实的、纯正的
Comforting 令人舒适的、抚慰的	Irritating 烦人的/恼人的	Easygoing 随和的	Happy 愉快的	Modern 现代的	Serious 严肃的
Confident 自信的	Energetic 精力充沛的	Trustworthy 值得信赖的	Traditional 传统的	Boring 乏味的	Unique 独特的
Feminine 女性化的	Sophisticated 精致的、精深的	Simple 简单的	Aggressive 有侵略性的	Pretentious 装腔作势的,自命不凡的	Youthful 青春的

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As described above, the development of a conceptual lexicon is highly category-specific and requires investment of time and resource. However, once developed, and assuming that this has been done thoroughly, the conceptual lexicon becomes an asset that can be applied repeatedly and rapidly without the need for further development. Nonetheless, development of a bespoke, category-specific conceptual lexicon for each study can be quite time-consuming and obviously there are associated costs. With this in mind, we reviewed the many conceptual profiling studies conducted by MMR Research Worldwide in the English language over the past 5 years and identified a shortlist of 30 conceptual terms identified (Table 10.2), based on frequency of use, general applicability, and discriminatory power. This has proved more than adequate for initial screening but otherwise the development of bespoke, category-specific conceptual lexicons is recommended, especially for new product or brand development purposes.

2.2 Quantification of degree of conceptual association

Profiling of emotion and abstract conceptualizations is normally conducted separately from functional conceptualizations. This is especially the case with unbranded products where the associations between product and emotion/abstract conceptualizations are often much weaker (less obvious) than they are for functional conceptualizations. In practice, this means that functional conceptualizations are more readily accessible via cognitive thought processing and therefore will inevitably dominate and overwhelm the emotional/abstract conceptualizations. We have found that functional conceptualizations can be readily quantified using CATA, whereas emotion/abstract conceptualizations usually require more sophisticated methodologies such as best–worst scaling.

2.2.1 Best–worst scaling

With conceptual profiling, the measurement processes must be able to accommodate the possibility of apparent counter-intuitiveness. Best–worst scaling (BWS), also

known as maximum difference scaling, is an indirect method of scaling that has been found to be particularly useful for measurement of "soft" or abstract attributes that may be counterintuitive and otherwise not readily quantified (Flynn, Louviere, Peters, & Coast, 2007; Lee, Soutar, & Louviere, 2008). Respondents are required to choose one item or attribute that they think is the best/largest/most in respect of some property x and one that is the worst/smallest/least of the same property from a series of sets that contain different combinations drawn from a larger master set of items. In the context of conceptual profiling, the items are conceptual descriptors (words) and the property x is the degree of association of a conceptual descriptor with the object. In a typical conceptual profiling study, respondents are presented with the object to be profiled (brand, unbranded product, pack, etc.) and a sequence of sets of four or five conceptual descriptors drawn from a lexicon of terms developed (as above) for the product or category. For each set of four or five terms they are asked to choose the terms most and least strongly associated with the object. The choice data can be analyzed in various ways to yield a set of values, often called scale values or utilities, on a difference scale (Suppes & Zinnes, 1963) representing the underlying dimension of interest (Finn & Louviere, 1992; Marley & Louviere, 2005).

The application of BWS to conceptual profiling and the associated data analysis procedures are described in detail by Thomson et al. (2010) and Thomson and Crocker (2014). Subsequent to this, we have developed a variant of BWS where the best–worst exercise described above is augmented by a "calibration" best–worst exercise in which the roles of the conceptual terms and objects are reversed. Referred to as two-way best–worst scaling (two-way BWS), this procedure represents a major methodological advancement because it overcomes the problem of relativism in BWS thereby facilitating direct comparison of the conceptual profiles of different objects within the same study (Crocker & Thomson, 2014); something that is otherwise precluded and has hitherto restricted the usefulness of BWS.

2.2.2 *Bullseye method*

The practicalities of two-way BWS dictate that it is best implemented as a standalone study or as a discrete part of a larger study. However, there are obvious cost and timing implications in doing so. To this end, MMR Research Worldwide has developed and validated an alternative measurement tool referred to as "bullseye" (Thomson & Crocker, 2014). This is an online implementation that was originally developed within our organization to make continuous rating scales more engaging in online surveys. Respondents drag and drop a sequence of conceptual terms, drawn from the conceptual lexicon and presented according to a rotated design, onto an image of concentric circles resembling an archery target (Fig. 10.3). We consider that placing a word on a target requires a fairly low level of conscious cognitive processing and therefore it goes some way to foster an intuitive rather than a rational response. The distance from the center of the target is taken as the strength of the association between the conceptual term and the object being profiled. There are two variants of the technique: "disappearing bullseye," in which the target is cleared before the next term is placed; and "non-disappearing bullseye" in which the terms are left on the target. The cards

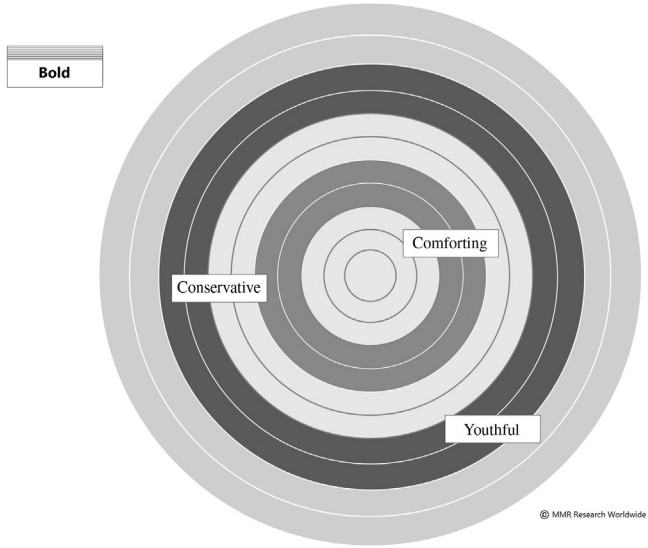


Figure 10.3 Bullseye conceptual profiling interface (interface is colored on computer screen and word cards are smaller).

are smaller than shown in Fig. 10.3 and in the "non-disappearing" variant can be superimposed. The latter variant tends to give less "noisy" data (ie, lower standard errors), presumably because the retained terms act as a frame of reference for the subsequent terms. This method and the associated data analysis procedures are described in detail by Thomson and Crocker (2014).

MMR has used bullseye widely over the past few years as part of its Brandphonics® process. Whilst it is undoubtedly less discriminatory than two-way BWS, with thoughtful application it is sufficiently discriminatory for many purposes and is highly compatible with the requirement for speed. We often combine bullseye and BWS within a single study where the former is used for conceptual profiling of brands and the latter for conceptual profiling of unbranded products where the conceptual content is less accessible.

3 Conceptual profiling—examples and case studies

3.1 Conceptual profiling of color

3.1.1 Impact of color on feelings and behavior

It is widely recognized that color influences the way we feel and how we behave. This is because colors have conceptual associations that trigger emotional outcomes that may be positively or negatively rewarding to some extent, thereby motivating us to behave in one way or another. The nature of these associations and, consequently,

their impact on behavior, differs depending on the hue, shade, and saturation of the color and, of course, the psyche of the individual concerned, which may in turn be determined by their cultural background. Consequently, choice of color décor in domestic, corporate or public spaces, for example, can have a very direct and immediate influence upon our feelings and how we behave (Levy, 1984). In the same way, choice of color in the design of brands, products, and packaging can have a profound influence on consumers' buying behaviors (Aslam, 2006). Valdez and Mehrabian (1994) and Terwogt and Hoeksma (2001) provide further elaboration on the relationship between color and feelings.

Although the conceptual profile of any object obviously depends on the fundamental nature of the object itself (category effect) this can be modified, sometimes quite radically, by changing its color (sensory-specific effect). This suggests that color per se has intrinsic conceptual associations that are invariant of the "host" object that it adorns. By standardizing the presentation of color, in this case by using a square swatch of color represented on a screen, it is possible to explore the "pure" conceptual content of color per se. This case study also provides an opportunity to showcase three particular features of conceptual profiling; MMR's General Conceptual Lexicon™, two-way best–worst scaling (two-way BWS) and segmentation of respondents based on differences in conceptual association across a common set of objects.

3.1.2 Experimental procedures in brief

By way of example, this case study compares the conceptual profile of the color purple versus the color yellow and scopes differences in the way that UK consumers conceptualize the color orange. These data are drawn from a much larger study of the conceptual profiles of 12 colors (Table 10.3), selected to represent a broad spectrum of familiar and readily discriminable colors (Gains, 2013). The study was conducted

Table 10.3 RGB hexadecimal values for 12 colors used in conceptual profiling

Color	RGB hexadecimal values
Black	R:0, G:0, B:0
White	R:255, G:255, B:255
Red	R:234, G:0, B:0
Yellow	R:255, G:255, B:0
Green	R:45, G:181, B:45
Blue	R:0, G:0, B:255
Brown	R:84, G:42, B:0
Orange	R:255, G:111, B:13
Purple	R:75, G:0, B:150
Pale Pink	R:250, G:202, B:233
Grey	R:166, G:166, B:166
Pale Blue	R:205, G:255, B:255

in the People's Republic of China and the United Kingdom using matched samples of 300 respondents per country, drawn from approximately equivalent social strata. There was an equal split of males and females and a spread of ages from 18–65 years.

Data capture was on-line, with the colors represented as approximately 100 mm × 100 mm squares on computer screens. (It is recognized that respondents may not have seen exactly the same colors or square size because of differences in screen performance.) MMR's General Conceptual Lexicon (Table 10.2) was used in combination with two-way BWS (Crocker & Thomson, 2014).

As mentioned previously, two-way BWS comprises a profiling exercise preceded by a calibration exercise. Respondents profiled 6 from 12 colors, selected according to a fully rotated design, thereby rendering 150 complete sets of data for each color in each country. The calibration exercise was conducted across all respondents using a common sub-set of 15 terms extracted from the general conceptual lexicon. In the first place, respondents were shown three of their six colors along with 1 of the 15 calibration terms and asked to identify which of the three colors was most strongly associated with the term and of the remaining two colors, which was least strongly associated with the term. This was repeated for the remaining 14 terms and then the entire calibration exercise repeated with the respondent's second set of three colors. The calibration exercise served the further purpose of familiarizing respondents with all six colors prior to conceptual profiling (see Section 3.2.1).

For the profiling exercise, each respondent was presented with one color at a time. Six sets of five from 30 conceptual terms were created using a fully rotated design so that each word appeared once. For each set of five terms, respondents were asked to identify the conceptual term most closely associated with the color and from the remaining four terms, which was least associated with that color. This exercise was conducted for all six sets of five terms so that each color was profiled by each respondent using all 30 conceptual terms. The entire exercise was repeated for the respondent's five remaining colors.

All statistical analysis for two-way BWS was performed as outlined in Crocker and Thomson (2014) using SAS version 9 (SAS Institute). The choice data were analyzed using the maxdiff model (Marley & Louviere, 2005) and modeled using conditional logistic regression as in Thomson et al. (2010). Prior to calibration, the scale origin for each color in each country was set to the mean of zero, to simplify the anchoring procedure. The orthogonal BWS calibration exercise allows the conceptual profile data for each color to be rescaled on a common origin. Consequently, the primary output is a set of directly comparable scale values for each conceptual term for each color within each country. The larger the positive scale value, the stronger the association between conceptual term and color. Conversely, the larger the negative scale value, the weaker the association.

A significance test for comparing any two colors on a particular conceptual term was constructed using the between-profile LSD. The LSD is somewhat complicated to calculate because the error variance has contributions from both the profiling and calibration exercises and the former is not straightforward to estimate; Crocker and Thomson (2014) give full details.

Best–worst data can be segmented by Latent Class Analysis on the raw choice data, or by estimating individuals' conceptual profiles and segmenting on those by Latent Class Analysis or some other method. We prefer the latter approach.

3.1.3 Yellow versus purple

The conceptual profiles for yellow and purple are summarized in Fig. 10.4. (Only the UK data are presented here.) To facilitate comparison, the conceptual profile of yellow is used as the reference against which purple is compared. The conceptual terms most strongly associated with yellow and consequently with the largest positive scale values are on the left of Fig. 10.4 through to those that are least strongly associated on the right. The scale values for purple are then superimposed on top of this in the same rank order to reveal the extent of the differences.

In total, the conceptual profiles of yellow and purple differ across 21 from 30 conceptual terms. Some of these differences are relatively large. From this it may be concluded that yellow is conceptualized as happy, fun, energetic, youthful, carefree, and friendly; in each case, significantly more so than purple. Conversely, yellow is not boring, masculine, aggressive, arrogant, serious, or irritating. Purple, on the other hand, is characteristically confident, powerful, genuine, classy, sophisticated, and

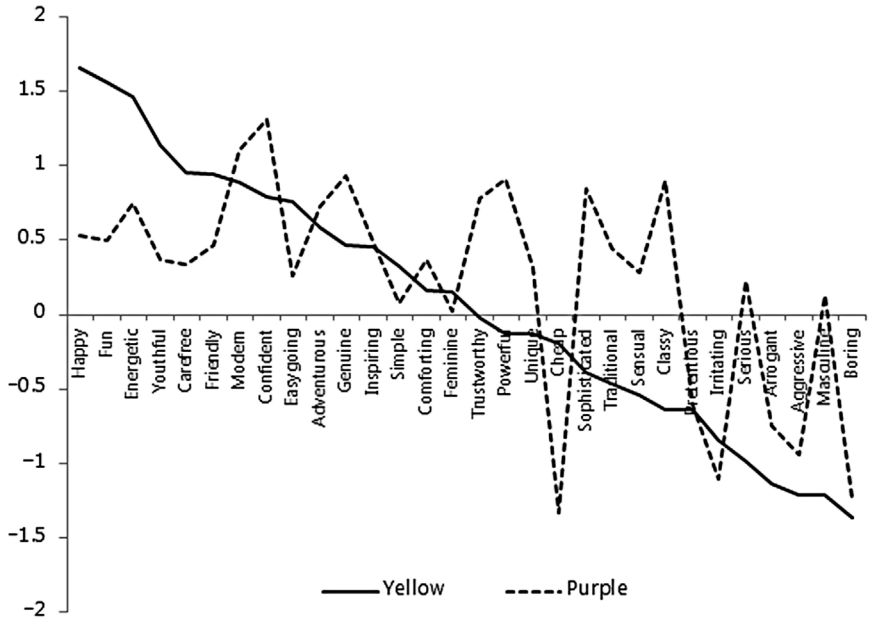


Figure 10.4 Conceptual profiles of color yellow (solid line) and color purple (broken line). *Y*-axis represents magnitude of scale value (strength of association between conceptual term and color).

trustworthy; significantly more so than yellow. Purple also differs from yellow in that it is much more masculine, serious, sensual, traditional, and much less cheap.

Whilst the nature of these conceptual associations and the differences between colors may be somewhat as expected, obtaining quantitatively robust conceptual profiles for color is entirely novel. The conceptual profiles of yellow and purple are presented here merely to illustrate the methodology. (Conceptual profiles for all 12 colors in the United Kingdom and China will be presented elsewhere.)

3.1.4 Commonality

It is proposed that people who share common cultural origins or are raised and educated in essentially the same social environment should, to some considerable extent, conceptualize the world around them in broadly the same way because of common influences and values. We explore this assumption in detail for color elsewhere. Suffice to say that in comparing the UK and Chinese data for color, it was established that some colors are conceptualized very similarly within and across the two countries (eg, light blue and pink—data not shown) whereas other colors (eg, orange and brown) seem to be conceptualized differently. On further analyses of the data for orange, it was established that there were two major conceptual segments within each country representing two very different points of view in each case. Across the countries, two of the segments conceptualized orange similarly and the other two very differently, suggesting some degree of commonality across countries but also that there are major differences within and between countries.

By way of example, the two UK conceptual segments for orange are presented in Fig. 10.5. This in the same format as Fig. 10.4, except that UK Segment 1 forms the baseline against which UK Segment 2 is compared. There were significant differences across 19 from 30 of the conceptual terms, some of which are obviously vast. The differences between segments were similarly large in China. Again, a full analysis will be presented elsewhere but this example demonstrates that differences do sometimes exist in the way that people within a reasonably tight cultural group conceptualize the world around them and that this can be captured using a combination of conceptual profiling and segmentation analysis. These data suggest that the color orange communicates a mixed message and therefore that it could affect and influence people differently when used in branding. This is contrary to the goal of "consistency of message" that most marketers seek for their brands.

3.1.5 Further comment on the use of words

As mentioned previously, associating words with emotions and concepts is sometimes criticized because it is thought to engender rational and literal interpretation, thereby precluding the possibility of seemingly irrational and counterintuitive associations. This is less likely to be the case with BWS because the respondent's task is not to quantify the magnitude of the term on a scale but to identify which words from a set of four or five are most strongly and least strongly associated with the object. There is no inference or requirement that any of the words should be rationally associated with the object nor is there any need for rational interpretation of the word. When this is

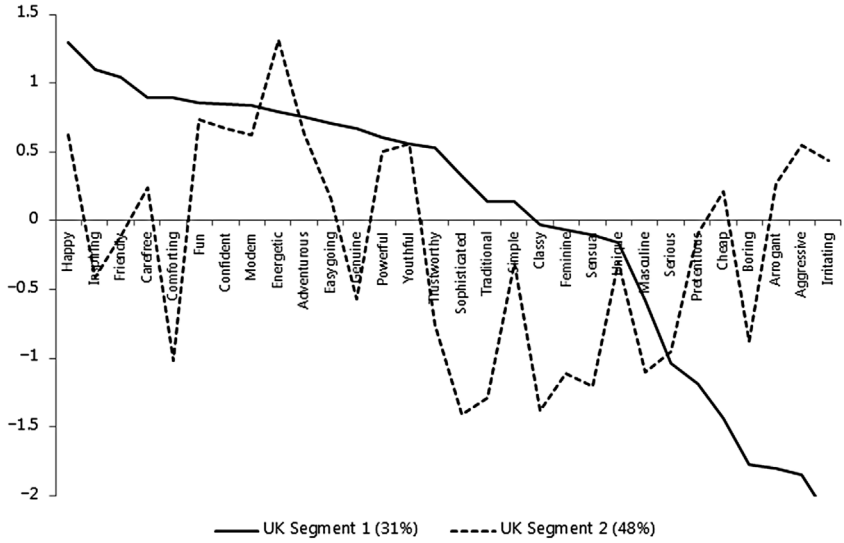


Figure 10.5 Conceptual profile of color orange for UK Segment 1 (solid line) and UK Segment 2 (broken line). *Y*-axis represents magnitude of scale value (strength of association between conceptual term and color).

the case, the respondent's task is to select the least inappropriate term based on whatever motivations drive their choice. The respondent's choice of term also depends on the meanings of the other conceptual terms included in each set. In most cases, the respondent will instinctively choose a term without necessarily giving a great deal of thought to its meaning, presumably based on the preconscious conceptualizations associated with the various others words in the set.

In our experience, presenting respondents with a list of conceptual terms and asking them to check all that apply (CATA) may be quite effective in some circumstances because the respondents' choices of terms may also be quite instinctive and there is no requirement for quantification. In practice, we generally find that CATA is less sensitive than BWS, possibly because BWS encourages respondents to make word choices even when the association may seem somewhat counterintuitive. However, since CATA is much faster and cheaper to implement, we often use it for preliminary screening purposes or for capturing functional conceptualizations which are generally much more accessible than emotional or abstract conceptualizations.

3.2 Conceptual profiling of unbranded products

3.2.1 Category effect versus sensory-specific effect

It is becoming more widely recognized that the conceptual profiles of brands and corresponding products should be consonant so that the meaning associated with the brand is augmented rather than diminished by the meaning associated with the

product (Thomson & Crocker, 2015). We refer to this as brand–product consonance (Thomson, 2015) and we believe it to be fundamental to the success of most new products.

Brands are merely bundles of conceptual associations. Advertising and other forms of marketing allude to these conceptual associations either directly or indirectly, which means that consumers who are familiar with the brand should, knowingly or otherwise, be influenced by the conceptualizations associated with the brand (Aaker, 1997). Conceptualizations associated with the unbranded products (ie, when consumed without reference to branding) are less prominent partly because they are likely to be lodged more deeply within the preconscious but also because marketers have traditionally paid much less attention to the conceptual profile of the product when communicating with consumers (Lindstrom, 2005). Consequently, capturing the conceptual profile of an unbranded product can be quite challenging. The problem is accentuated when trying to differentiate the conceptual profiles of several unbranded products that have broadly similar sensory profiles. For example, when working with dark chocolate, Thomson et al. (2010) established that biplots used to associate products with corresponding conceptual terms were sometimes dominated by the first dimension and that conceptual differentiation amongst the products was only made explicit on the second and third dimensions. The problem was even more acute in a study of the EsSense profiles of unbranded blackcurrant juices reported by Ng et al. (2013), where almost 85% of the variation in the data was associated with the first principal component of the plot and as little as 6% with the second principal component. In the latter study, this would suggest that differences in the EsSense profiles of the unbranded juices were trivial whereas, in all probability, they were not.

This problem is caused by dominance of the "category effect" (see Section 1.5) when unbranded products are profiled one at a time. The category effect occurs when respondents inadvertently construe each successive sample of the unbranded product as an exemplar of the category. In doing so, they fail to focus on the nuances of the sensory characteristics that are particular to each sample, thereby allowing the conceptualizations associated with the category to dominate the conceptual profiles of the individual products. The effect of these sensory differences on the conceptual profiles of unbranded products (known as the "sensory-specific effect") can be quite substantial. This matters because optimizing the conceptual profile of an unbranded product to obtain the best achievable match with the corresponding brand is as important as optimizing liking (or possibly even more so).

3.2.2 Minimizing the dominance of "category effect"

Thomson and Crocker (2014) explored the effect of two different data capture techniques (BWS versus bullseye—see Sections 2.2.1 and 2.2.2) combined with two different familiarization procedures (intensive familiarization with the products to highlight sensory differences versus a simple warm-up procedure). The research was conducted in the United Kingdom using six unbranded orange juices (Tropicana, Innocent, Tesco Clementine, Sainsbury's from-concentrate, Sainsbury's organic, and Asda Florida) judged via sensory profiling to sample the UK orange juice sensory

universe. (We were aware from previous commercial research that unbranded orange juice was particularly challenging.)

Respondents were aged 21–64 and regular orange juice drinkers. They were allocated to one of four matched cells:

- Cell A—BWS preceded by intensive familiarization
- Cell B—Bullseye preceded by intensive familiarization
- Cell C—BWS preceded by a simple warm-up
- Cell D—Bullseye preceded by a simple warm-up.

A bespoke conceptual lexicon comprising 24 emotion and abstract terms was developed using the procedures described earlier (Section 2.1.2). Full details of the methodology and data analyses procedures are presented in Thomson and Crocker (2014).

The results are summarized in the four biplots shown in Fig. 10.6 where the conceptual terms are plotted in the body of each biplot and the products represented as vectors radiating from the origin. Key information includes the variance explained by

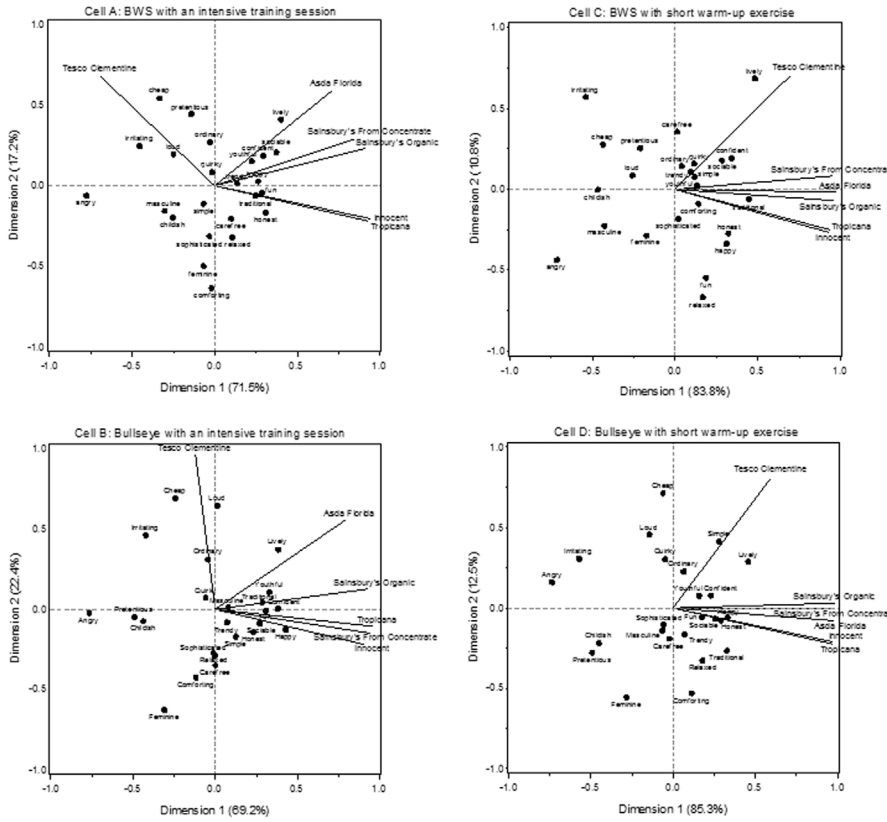


Figure 10.6 Conceptual biplots from the four cells profiling orange juice.

the first and second dimensions, the angles between product vectors and the angles between the product vectors and Dimensions 1 and 2 of the biplots.

The importance of intensive familiarization is immediately clear. With the simple warm-up procedure for BWS and bullseye, only the conceptual profile of Tesco Clementine is differentiated whilst the vectors representing the other juices are clustered around the positive end of Dimension 1. Intensive familiarization increased the spread of the juice vectors due to better differentiation of the sensory profiles and hence the conceptual profiles. BWS delivers marginally better differentiation than Bullseye with or without intensive familiarization.

Some commentators have suggested that intensive familiarization oversensitizes respondents to interproduct differences, thereby exaggerating the sensory-specific effect and consequently exaggerating differences in the products' conceptual profiles. We disagree on the basis that someone who becomes very familiar with the sensory characteristics of a product through frequent consumption will be influenced by the sensory-specific effect as well as the category effect. Indeed, it is our contention that some of the research procedures reported to date, especially those that present the unbranded products one at a time (monadically), tend to desensitize the process and mask the conceptual differences by allowing the category effect to dominate (Thomson & Crocker, 2014).

Although development of two-way BWS post-dates the foregoing research, it transpires that the calibration exercise implemented as a preliminary to conceptual profiling in two-way BWS (see Section 3.1) has proved to be a very effective intensive familiarization tool, thereby fulfilling two objectives and making the whole process much more efficient. Consequently, two-way BWS is our first-choice method for conceptual profiling of unbranded products.

3.3 Brand–product conceptual consonance

3.3.1 Rationale for a derived index of fit-to-brand

The importance of brand–product consonance was mentioned earlier (Section 3.2.1). In short, it is desirable that the conceptual profile of a product should be congruent with that of the corresponding brand and vice versa, so that the non-conscious communication from branding is augmented rather than diminished by that of the product. Consequently, when new products are developed, marketers are always keen to understand whether the product "fits" with the brand. This is known as "fit-to-brand" and it is very common to include a fit-to-brand question (along with an associated scale) when researching new products.

The inclusion of any external scale in a questionnaire presupposes the existence of a corresponding internal continuum within the mind. Although it is obviously impossible to confirm or refute the existence of mental continua, it is possible to garner evidence in support of the hypothesis that a particular internal scale might exist. For example, it seems very likely that most people share a common qualitative interpretation of the meaning of sweetness and a common quantitative interpretation of an ordinal progression of sweetness magnitude. There are compelling reasons why

this should be the case; sweetness is associated with sugars, which are safe sources of readily accessible energy for fuelling the fight-or-flight response as well as other metabolic functions. Consequently, evolution may have selected on this basis because enhanced capacity to perceive and quantify sweetness made individuals more successful in terms of surviving to reach sexual maturity, procreating, and then living long enough thereafter to nurture their young. The same rationale applies to liking and liking measurement (see Section 1.4 for a comprehensive explanation). This raises the question as to whether or not human beings will have evolved an internal scale of fit-to-brand. After all, brands are less than 200 years old! Anecdotally, there is some evidence that humans can perform such a task. In our experience, this is especially the case in the context of automotive design where brand and product conceptualizations are more likely to be substantial, well-defined, and communicated powerfully through advertising. However, with unbranded foods and beverages, where conceptual associations are much less obvious, when researchers direct respondents to think about fit-to-brand, it is very likely that they will revert to the closest matching mental phenomenon, which is probably liking. This may explain why measures of fit-to-brand are highly correlated with corresponding measures of liking. (In our commercial experience, correlation coefficients of >0.9 are not uncommon.) Consonance between brand and corresponding product depends on a full spectrum of emotional outcomes, many of which may occur below the level of conscious awareness and therefore may not be captured when liking comes to mind. This leads to the a priori assumption that all that ultimately contributes to fit-to-brand isn't captured when we consciously think about fit-to-brand or try to quantify it on a scale.

Previously, it was noted that conceptual associations may exist in the preconscious and therefore they are more likely to be accessible than emotional outcomes. Consequently, by capturing the conceptual profiles of a brand and the corresponding unbranded product via conceptual profiling (as described above), plotting one against the other and then calculating the correlation coefficient, it is possible to derive a fairly comprehensive indirect measure of fit-to-brand that embraces more of emotional outcome than liking. By relating this derived index of fit-to-brand to subsequent post-launch sales volumes it has been possible to establish that a fit-to-brand index (r) of ≥ 0.8 is probably necessary to imbue a new product with a realistic chance of success (Thomson, 2015). In practice, achieving this level of consonance is difficult and many of the newly launched products that we have monitored, including Cadbury's Bournville Deeply Dark (see below) have failed to reach this threshold. Perhaps this explains why so many new products fail in-market. The root cause, of course, is inability to capture ΔE (see Section 1.4) and consequent upon this, failure to match the emotional outcomes delivered by brand and product.

3.3.2 Case studies—derived index of fit to brand

Some years ago (c. 2009), Cadbury launched a new brand of dark chocolate in the UK called Cadbury's Bournville Deeply Dark (Deeply Dark, hereafter). Although Cadbury's Bournville dark chocolate had been sold in the United Kingdom since 1908, newly launched Deeply Dark involved radically new branding and the sensory

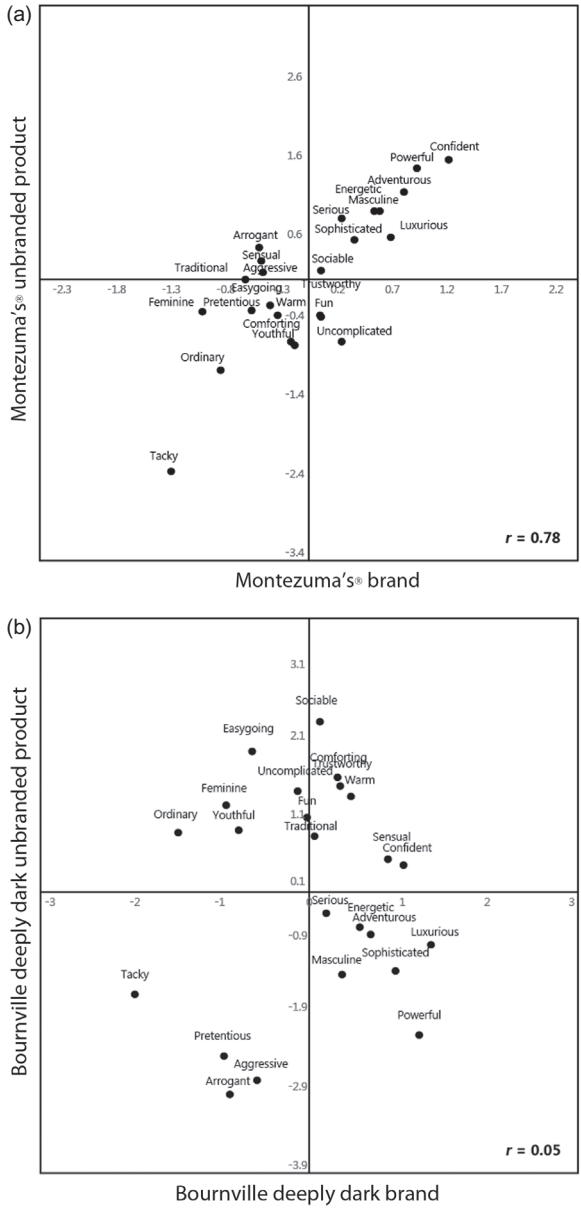
profile of the chocolate was different from that of the long-established product. At roughly the same time, Montezuma's 73% Cocoa Very Dark Chocolate (Montezuma's hereafter) was also launched. As part of an internally funded study of the wider chocolate market in the United Kingdom (Thomson & Crocker, 2015; Thomson et al., 2010), MMR Research Worldwide evaluated the Deeply Dark and Montezuma's brands along with the corresponding unbranded chocolate, using a combination of established research tools and conceptual profiling. The sensory profiles of Deeply Dark and Montezuma's are very different.

Both brands were admired greatly by the research participants but the mean liking rating for the unbranded Deeply Dark chocolate was significantly ahead of all the other chocolates included in this study. Unbranded Montezuma's chocolate, on the other hand, attained one of the lowest mean liking ratings in the product set. Surprisingly perhaps, Deeply Dark was withdrawn from the UK market before we had a chance to complete the study but Montezuma's is thriving in 2015. There are many reasons why a large company such as Cadbury might withdraw an underperforming product whereas a smaller company such as Montezuma may have more modest ambitions for their new products. Whatever the reason, it's perfectly clear that liking for the unbranded product was not the primary determinant of success in this case.

In order to probe this further, conceptual profiling of brand and product was conducted using a bespoke conceptual lexicon of 24 emotion and abstract terms along with BWS. In Fig. 10.7a and 10.7b, the conceptual profiles of the unbranded chocolates are plotted against the corresponding brands. For Montezuma's (Fig. 10.7a) there is a high degree of consonance ($r = 0.78$). This implies that whatever Montezuma's branding is communicating is also delivered to a considerable extent by the chocolate per se. For Deeply Dark (Fig. 10.7b) there is no correlation ($r = 0.05$). For example, the brand communicates "powerful" but the product is not conceptualized in this way. Conversely, the product communicates "easygoing," "ordinary," "feminine," and "youthful" to a much greater extent than the brand. Clearly the sensory characteristics that define unbranded Deeply Dark did not deliver what the brand seemed to be promising and the implied contradiction and disappointment may have discouraged trialists from repurchasing.

It is less certain whether or not brand–product consonance is essential with long-established brands. On behalf of Annandale Distillery Company Ltd, MMR Research Worldwide conducted conceptual profiling on a large number of well-known and less well-known Scotch whisky brands along with the corresponding unbranded products. Although many of the brands look visually different from each other, it transpires that the conceptual profiles of the brands are not well differentiated from each other, largely because of the dominance of the category effect (ie, each brand was effectively an exemplar of the Single Malt Scotch whisky category). This should be of considerable concern to the Scotch whisky industry as single malt whiskies from other countries such as Yamazaki (Japan) and Kavalan (Taiwan) are serious competitors. Paradoxically, the conceptual profiles of the various unbranded products are very well differentiated.

Data for two well-known Single Malt Scotch whiskies, Lagavulin® (www.lagavulin.com) and The Glenlivet® (www.theglenlivet.com), have been extracted from the



Figures 10.7 Plot of conceptual profiles of Montezuma's branding versus unbranded product (a) and Bournville Deeply Dark branding versus unbranded product (b).

main study and are presented here. Lagavulin® is a peated (smoky) single malt where a relatively large proportion of the stock is matured in ex-sherry casks. The Glenlivet® is an unpeated single malt where much of the stock is matured in ex-bourbon casks. Consequently, these two single malts have very different sensory profiles.

Conceptual profiling of brand and product was conducted using a bespoke conceptual lexicon of 25 emotion and abstract terms (see Table 10.1). Full details are provided in Thomson (2015). In Fig. 10.8a and 10.8b, the conceptual profiles of the unbranded whiskies are plotted against the corresponding brands. For Lagavulin® there is a high degree of consonance ($r = 0.80$). Again, this implies that whatever Lagavulin's® branding communicates is being delivered to a considerable extent by the product per se. For The Glenlivet® there is no correlation ($r = 0.27$). Clearly, the sensory characteristics that define the unbranded liquid do not deliver what the brand seems to be promising. This is a classic example of brand–product dissonance. In spite of this, The Glenlivet® substantially outsells Lagavulin®. However, Lagavulin® normally retails at almost twice the price of The Glenlivet® and whilst the latter is often sold on discount, the former is seldom discounted and is experiencing growing demand. It is possible that The Glenlivet's® market position may be vulnerable because of the inherent weakness caused by brand–product dissonance.

There are many factors that determine the success of a new product. However the decision whether or not to buy a new product is influenced by the conceptualizations associated with the brand and the impact they have on consumers, immediately and in the longer term. If the product communicates the same conceptualizations as the brand, it should reinforce its impact (Lindstrom, 2005). Whilst it is possible that a small degree of disruptive dissonance could take a brand in a different and better direction (Schulkin, 2013), dissonance will usually have an undermining effect. Because a new product must fight for a share of existing consumption by displacing established products from individuals' repertoires, any inherent weakness in the product is likely to reduce the probability of success.

The foregoing raises the question as to whether or not the sensory characteristics of a new or existing product should be optimized to maximize liking or to maximize brand–product consonance. We believe that brand–product consonance (fit-to-brand) should be an important consideration in the sensory optimization process or, at the very least, vigorous efforts should be made to minimize brand–product dissonance. Consequently, it is recommended that decision-making action standards based primarily on achieving a minimum mean liking rating should be qualified to take cognisance of brand–product consonance.

4 Overview

The conceptualizations associated with the objects, people, places, and events that impinge upon us on a moment-by-moment basis exert considerable influence upon our feelings and this, in turn, influences the way in which we react and otherwise behave. Conceptualizations exert an influence by triggering emotional outcomes that

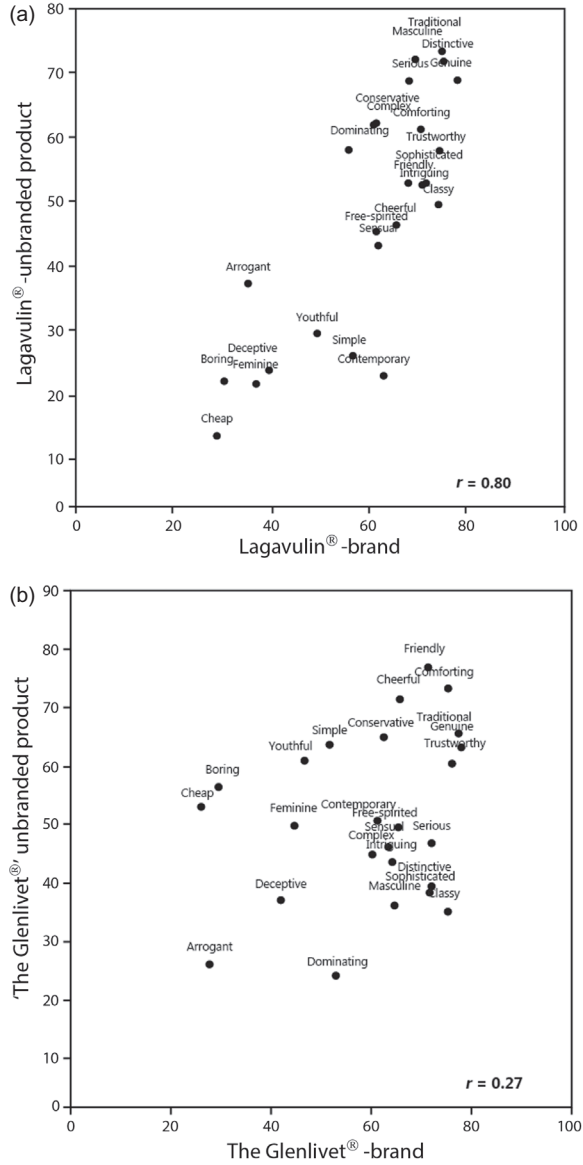


Figure 10.8 Plot of conceptual profiles of "Lagavulin®" Single Malt Scotch whisky branding versus unbranded product (a) and "The Glenlivet®" branding versus unbranded product (b).

are positively or negatively rewarding to some extent. We learn to modify our behavior to maximize positive reward and minimize negative reward (which will often be in conflict) thereby leading to a state of personal, psychological equilibrium (a form of "psycho-homeostasis") that most people find satisfactory, most of the time.

Recognizing the importance of conceptual association and its role in influencing behavior adds an extra dimension to the process of brand, pack, and product development because it brings new information to the fore. Robust quantitative procedures have been developed recently and subjected to scientific scrutiny, making it possible to capture the conceptual profile of almost anything in a practical, reliable and affordable manner. Hopefully, this will add to the body of brand and product knowledge and consumer understanding, thereby assisting in the development of new brands and products that have a real chance of success as opposed to the prevailing near-certainty of ignominious failure.

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Short-term Time Structure of Food-related Emotions: Measuring Dynamics of Responses

11

Gerry Jager
Division of Human Nutrition, Wageningen University, Wageningen, The Netherlands

1 Introduction

Research on emotions was long guided by the notion that emotions are unitary and relatively static phenomena (Scherer, 2005, 2009). For many years the predominant experimental paradigm in emotion research has been the use of static stimuli, for example pictures of people displaying facial expressions of emotions, and subsequently the recording of summative judgments (a single "snap shot" rating taken after the stimulus has finished) (McKeown & Sneddon, 2014; Russell & Barrett, 1999). The obvious benefit of this approach is that it permits a high level of control over emotional expression in terms of quality and intensity. This has yielded a wealth of information on emotion measurements and an extensive literature in the field of emotion research as covered in other chapters in this book. However, ignoring the intrinsic dynamic nature of emotions, the use of static "snap shot" emotion stimuli and time-averaged judgments comes at a price in terms of ecological validity (McKeown & Sneddon, 2014). In this chapter, therefore, I will adopt a dynamical perspective on emotions and its measurement. Central to a dynamical perspective is that emotions, like many other perceptions, are not viewed as single discrete responses but rather as series of dynamic events that unfold over time, including the point of view that our perception of emotion is influenced by the presence or absence of dynamic information. Such a perspective, however, implies continuous responses of emotions over time and the continuous monitoring of their dynamics as they evolve over time. As a consequence, we need a toolbox to measure the dynamics of emotional responses in a reliable and reproducible way, and adequate data-processing techniques and statistical approaches.

In this chapter I will adopt examples of modern theories on emotions, the so-called componential appraisal models (see Moors, Ellsworth, Scherer, & Frijda, 2013; for an overview). One of these models is the Component Process Model (CPM) by Scherer and colleagues (Grandjean & Scherer, 2008; Sander, Grandjean, & Scherer, 2005; Scherer, 2009). The CPM defines emotions as dynamic episodes involving a complex process of continuous change in all its subsystems, both central, the brain, and peripheral, the bodily or physiological signals such as changes in heart rate (HR), and facial expressions; the subjective, conscious experience, the feelings one becomes aware of. The CPM will only be discussed briefly and with a focus on its dynamical nature. For in-depth information on the CPM the reader is kindly referred to chapter "Theoretical Approaches to Emotion and Its Measurement" by David Sander.

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After introduction of the CPM, I will continue with a description and explanation of the methodology required to capture the evolution of emotions over time. The methodology is different from methods and tools available to measure emotions when considered to be unitary and more or less static events. Although my goal is to apply this framework to all emotions, the content of the present chapter contains ample work on food-related emotions and their measurement, as this is my own field of research. The chapter concludes with a discussion of the main implications of measuring temporal dynamics of multicomponent emotions. This will include the identification of the most important current needs in terms of knowledge gaps and methodological developments and a glimpse on where filling these knowledge gaps and the development of novel tools may bring us.

1.1 The architecture of emergent emotion processes

If we want to measure dynamics of emotions, we need to know what exactly we are going to monitor or compute in the first place. After more than a century of debate, there is little agreement on what an emotion really is, let alone what its underlying architecture is and the order in which the different emotion components unfold. Several chapters in this book discuss or give an overview of the major emotion models that emerged out of different schools of thought. In this chapter, I will use a contemporary appraisal theory of emotion, that is, the CPM (Grandjean, Sander, & Scherer, 2008; Kuppens, Stouten, & Mesquita, 2009; Sander et al., 2005; Scherer, 2001, 2005, 2009; Scherer & Grandjean, 2008) to illustrate the challenges encountered when talking about temporal dynamics of emotions and how to measure them. The CPM considers emotions as bounded episodes in time, having a clear onset (event, stimulus) and an offset (subjective feeling). The offset can be somewhat fuzzy due to the recursive nature of the emotional episode, which contains feedforward and feedback loops between the distinct elements. These elements include the event or stimulus itself, its appraisal (evaluation in terms of relevance, importance, and valence), the subsequent action tendencies (eg, approach or avoid) and co-occurring bodily symptoms and expressions (eg, HR and facial expressions), and its subjective experience (conscious feeling of an emotion) (see Fig. 11.1a). Appraisal models assume an emotion architecture that is based on an individual's subjective evaluation or appraisal of events that cause specific reactions in different people. Essentially, our appraisal of an event is what causes an emotional or affective response. Several appraisal models, in particular Scherer's CPM model (Scherer, 2009) assume the emergence of *patterns* driven by recursive appraisal processes on multiple levels that follow a lawful sequence. Fig. 11.1a shows the basic architecture of the CPM model, including the dynamic, recursive emotion processes following an event: multilevel appraisal (evaluation of events), physiological elements (bodily symptoms of an emotion), action tendency (motivational component for the preparation and direction of motor responses such as approach, and fight-or-flight responses), central representation elements (ie, facial and vocal expression), and eventually the conscious feeling (the subjective experience of an emotional state once it has occurred). In Scherer's CPM an emotion experience is said to require all of these elements/processes to become coordinated and synchronized for a short period of time, driven by appraisal processes (Scherer, 2005, 2009).

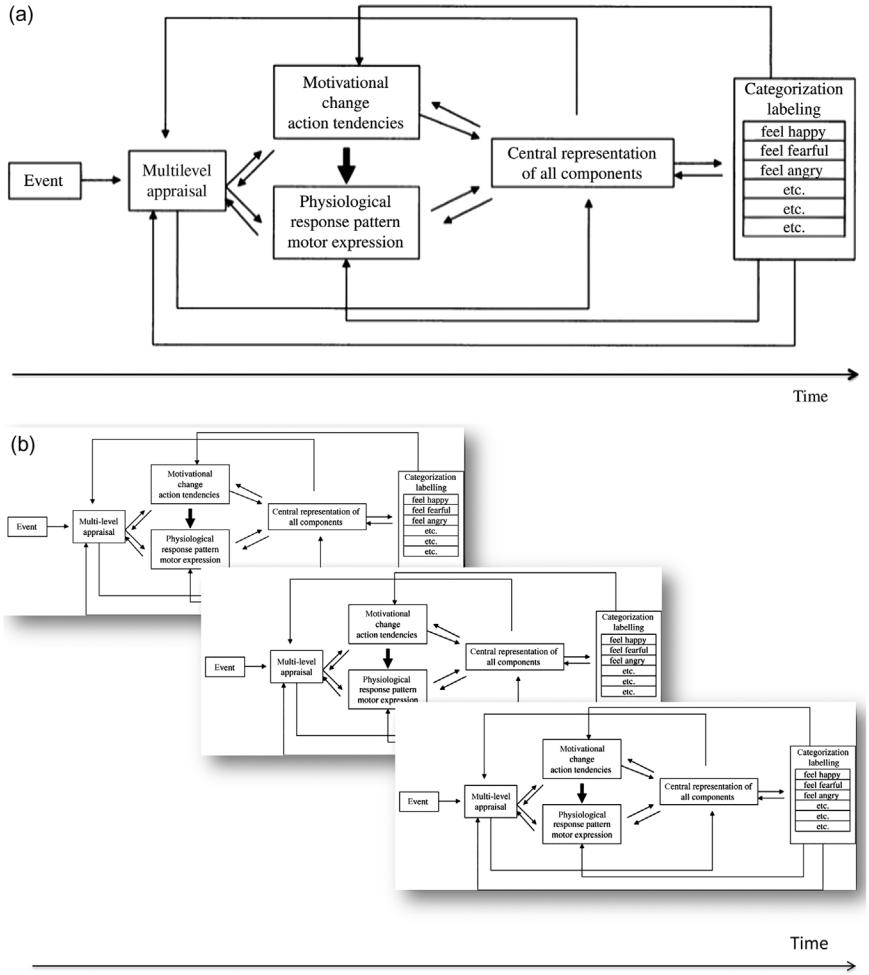


Figure 11.1 Component Process Model. (a) Schematic overview of the CPM. (b) Modified version of (a) that represents a repetition in time of the CPM sequence of events. *Source*: Scherer (2009).

The CPM provides a sequence of events that effectively describes the recursive nature and coordination involved in an emotional episode, and it is not difficult to conceive the temporal nature of this sequence. It is a logical assumption that depending on the time points during this sequence of events in which emotion components are probed, different elements or components of the emotion episode will prevail which each have their own dynamic or temporal features. However, the CPM sequence of events can also be seen as repetitive in that the whole sequence is repeated in time, as is illustrated in Fig. 11.1b. Here, the idea is that different events/stimuli follow up on one another, and each induces this CPM sequence of events, making up a complex, multifactorial emotional experience that can be monitored and probed over time.

There are several considerations that have to be taken into account when measuring temporal dynamics of emotions, such as type of measure (eg, physiological or autonomic nervous system (ANS) responses, facial expressions, or subjective experience), the timeframe across which emotions are measured (eg, milliseconds, seconds, minutes), sampling type (continuous, intermittent). But before these considerations are discussed in more detail there is one other concept that needs to be introduced in relation to the temporal dynamics of emotions, *affective chronometry.*

1.2 Affective chronometry

Affective chronometry (Davidson, 1998) describes the temporal dynamics of affective responding. It involves the study of individual differences in temporal features of affect such as *response latency* (ie, time between the onset and peak intensity of an emotion), *recovery time* (ie, time for an emotion to dissipate), and *rate of change*, which refers to how rapidly affect increases (enhancement rate) or decreases (decay rate) over time (Davidson, 1998; Hemenover, 2003). Hence, it is about the shape and the amplitude of intensity profiles of emotions and how they relate to duration. Davidson and colleagues argue that time-course variables are critical in understanding individual differences in emotion regulation, given a stimulus of a certain intensity. For example, it is possible that one person has a strong initial response to a negative stimulus but then returns quickly to baseline state when the negative challenge terminates or ceases to be relevant, whereas another person has a slower onset and more moderate response to a negative stimulus, but takes a prolonged period of time to return to baseline state (Davidson, 1998, 2003, 2004). Affective chronometry can reveal important features of affective style, which is highly relevant in the context of this chapter. It describes time-course parameters such as "rise time to peak" and "recovery time," which can be measured and modeled with the available methods and statistical approaches. Individual differences in affective chronometry have been linked to personality traits such as neuroticism and extraversion. For example, in a study by Hemenover (2003) it was found that so-called positive affect augmenters (extraverts, emotionally stable participants) who watched emotion-inducing videos (either positive or negative videos) showed slow rates of positive and rapid rates of negative affect decay. For negative affect augmenters (introverts, neurotics) the opposite pattern was observed, that is, those participants showed slow rates of negative and rapid rates of positive affect decay. The discriminative ability seems to be in the latter part of the emotional response, the recovery time. This has been confirmed by recent neuroimaging work from the group of Davidson (Schuyler et al., 2014), where the authors strongly advocated that apart from the initial reactivity to an emotional stimulus, the subsequent recovery or prolonged response is as important, but often overlooked. In this study on individual differences in brain activity patterns in the amygdala, a key area involved in emotion processing, it was shown that the expression of neuroticism, an emotional personality trait, was not predicted by one's initial neurophysiological reactivity to a negative challenge, but by a person's ability to recover from that challenge after it ceased to be present. Greater amygdala reactivity during recovery (measured by area under the curve (AUC) metrics) predicted greater trait neuroticism (Schuyler et al., 2014).

1.3 Temporal dynamics of emotions and its measurement—key considerations

The work on affective chronometry already illustrates a number of parameters that are relevant and potentially different from single time point measurements of emotions. Whereas parameters such as frequency and intensity are actually relevant to both static and dynamic emotion measurements, others, such as response latency (time between onset and peak intensity of an emotion) and recovery time (time for an emotion to dissipate), imply a more typical temporal approach. These parameters are, however, not the only considerations to be taken into account when discussing temporal dynamics of emotions and its measurement. Others involve focus, type of measure, time window, and sampling type, which will be described in more detail below.

1.3.1 Focus

My usage of the term focus here is meant to define the specific "unit of consideration" when talking about the short-term time structure of emotions. This unit of consideration can be either the time course or temporal unfolding of a distinct emotional experience corresponding to affective chronometry. Alternatively, the focus can be on multiple emotions or emotion dimensions that co-occur or alternate, which is, for example, what is assessed with the Temporal Dominance of Emotions (TDE) method (Jager et al., 2014), to be discussed later in this chapter.

1.3.2 Type of measure—channel of information

Temporal measures of emotions reflect a broad array of options, from self-report measures, such as repeated measurements across stimuli with emotion questionnaires (King, Meiselman, & Carr, 2013), to (neuro)physiological measures, such as ANS responses (He, Boesveldt, De Graaf, & De Wijk, 2014) or brain activity patterns (Brosch & Sander, 2013). These measures can be classified in terms of being explicit or implicit, or depending on the different aspects of the emotion sequence tapped into as described by appraisal theories of emotions. For example, whether the measure is directed at the subjective feeling (the conscious end result of the sequence) or at the physiological component (bodily sensations such as HR). Different types of measurements for temporal dynamics of emotions will be discussed in more detail in the next section of this chapter.

1.3.3 Timeframe and duration

When thinking about temporal dynamics of emotions and how to measure them, the timeframe under consideration is an essential one. Several theorists have speculated on the duration of an emotion, that is, how long emotions can last, with estimates ranging from a few seconds at most (Ekman, 1984), to minutes or hours (Frijda, Mesquita, Sonnemans, & Van Goozen, 1991). Those who study specific emotional components as they are unfolding (eg, facial expressions (Ekman, 1984)) in general use shorter estimates than those who study self-reported emotional experience (eg, feelings

(Frijda et al., 1991)). As Rosenberg (1998) explains in her review article on levels of analysis and the organization of affect, for those studies that report that emotional experiences can last for hours, it is possible that such long estimates refer to moods instead of emotions, or to the continuous elicitation of several instances of the same or related emotions. Alternatively, one channel of information about emotions may yield very brief episodic data (eg, ANS responses like HR and skin conductance), whereas another might give longer-lasting indices of emotions (eg, ratings of subjective feelings). According to Rosenberg (1998) this could stem from methodological differences between the assessment arrays, reflecting differences in temporal resolution between measurement tools. In addition, variability in timeframes could be due to differences in the quality of how elements of emotions become manifest in each channel. For example, in the subjective conscious experience of an emotion, the accompanying brief bursts detectable in facial expressions and/or autonomic physiological responses may not be represented distinctly in consciousness, and therefore may be experienced as one long emotion (Rosenberg, 1998). This being said, the type of temporality that I have in mind for this chapter is more on the short-term time structure of emotions, that is, from milliseconds to seconds and minutes, and this is to a certain extent driven by the methodologies used to measure the different elements of emotions as they unfold.

1.3.4 Sampling type

There are different ways in which dynamics of emotion responses can be sampled, including continuous or intermittent, time-averaged sampling modes. Also, repeated single measurements at distinct time points are an option. In the food and consumer domain, food-related emotions can be measured, for example, before, during and after consumption of a food, or across repeated exposures to a product.

2 Measuring temporal dynamics of emotions

Fig. 11.1 depicts a schematic representation of the emotions process decomposed in its distinguishable components. The emotion process is triggered by a person's encounter with some event or stimulus. If the event is appraised as meaningful in some way, an emotional response will ensue. That response can be characterized by a coordinated and correlated set of changes in (neuro)physiological, expressive (facial/bodily expression, action tendencies) and experiential (subjective experience) systems. This particular distinction suits my purpose here as I can use it to discuss the measurement of temporal dynamics in these experiential, expressive, and (neuro) physiological systems involved in the emotion process.

2.1 Measuring dynamics in subjective emotion experiences—the experiential system

Subjective emotion experience is commonly measured using self-report instruments such as questionnaires and rating scales. The outcome parameters can be single or

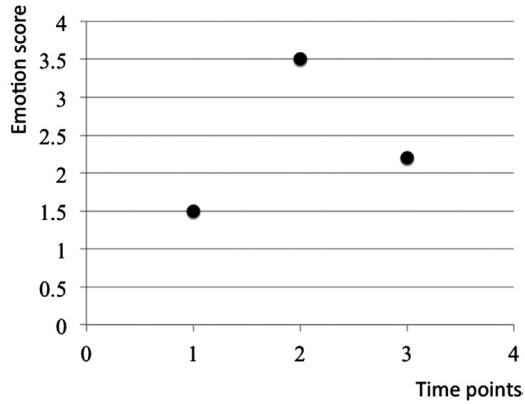


Figure 11.2 Repeated emotion scores (fictitious) display in a two-dimensional graph.

composite scores. When treated as distinct points in time, such scores can be graphically displayed as "dots" in a two-dimensional graph with on the *y*-axis the scale, and on the *x*-axis sampling rate as distinct time points. A fictitious example is illustrated in Fig. 11.2.

Hence, one way to measure the temporal dynamics of emotions is to repeat measurements at fixed time points, for example, prior to, immediately after and after an interval of several minutes following the emotion-inducing event or stimulus, and then examine changes in emotions over sampling times. Examples of studies that applied this approach are studies by King et al. (2013) and Hormes and Rozin (2011). King et al. (2013) measured emotion responses with the EsSense Profile, a list of 39 food-related emotion attributes rated on a 5-point scale (see chapter: Emotions Elicited by Foods) and compared responses for increased numbers of food samples tested. The results, reported as mean emotion scores per sample tested, that is, as discrete emotion responses intermittently sampled across number of samples tested, showed that some emotions, such as calm, interested, quiet and satisfied, have decreased intensity with increased numbers of samples tested (King et al., 2013). The study by Hormes and Rozin (2011) assessed the temporal dynamics of positive and negative affect and ambivalence (a ratio measure between mean positive and negative affect) in relation to consumption of chocolate. Participants completed the Positive and Negative Affect Schedule (PANAS), a questionnaire containing 20 items rated on a scale of "1 = very slightly or not at all" to "5 = extremely", at three time points prior to, immediately after, and 30 minutes following the opportunity to consume chocolate. What is interesting in this study is that although self-reported ambivalence and positive and negative affect were sampled intermittently, that is, at three discrete time points, the affect scores were depicted graphically as lines. This suggests the authors envisaged one emotional response to "blend" into the next one, which is suggestive for an emotional episode unfolding over time and continuous sampling of this response, whereas actual sampling was intermittent at three fixed time points with a substantial interval of 30 minutes between the second and the third rating.

Alternatively, self-report subjective emotional experiences can also be treated as processes that unfold over time, where one sampling (one "dot" in Fig. 11.2) is unfolded and considered as an episode with an intrinsic temporal dynamic to be explored. Here, affective chronometry (Davidson, 1998) becomes useful to describe the temporal dynamics of affective responding. Temporal dimensions are episode duration and intensity profiles which can be combined into curves with several distinctive time course variables, such as shape, peak amplitude, and AUC (see Fig. 11.3 for illustration).

In the remainder of this section two methods to capture the temporal properties of emotions will be explained in more detail: (1) measuring variability in the shape and intensity profiles of emotion episodes and how they relate to duration (Heylen, Verduyn, Van Mechelen, & Ceulemans, 2015) and (2) measuring TDE, as applied in the food domain (Jager et al., 2014).

2.1.1 *Time-intensity profiles of emotion episodes*

Heylen et al. (2015) reported on a method to explore variability in the shape and amplitude of intensity profiles of anger episodes in relation to duration. Anger is typically perceived as a short-lasting emotion with an explosive onset (Frijda, 2007).

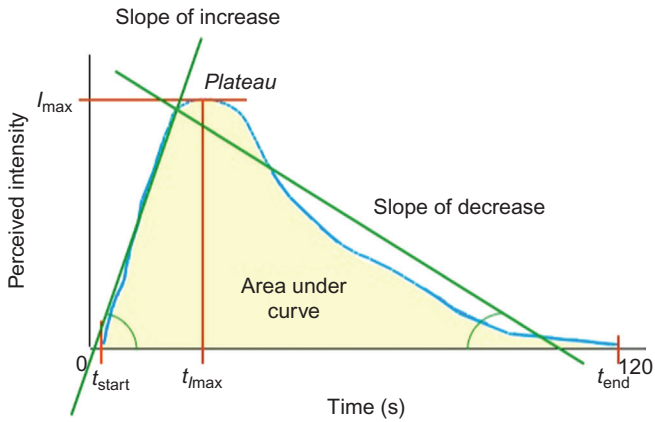


Figure 11.3 Schematic emotion response curve displaying features/parameters that can be distinguished. Perceived intensity is depicted on the *y*-axis with I_{max} as maximum (peak) intensity. Time (in seconds) is depicted on the *x*-axis, marked by parameters of interest such as t_{start} (onset emotion curve), t_{Imax} (time when intensity reaches its maximum), and t_{end} (end of emotion curve with a "fuzzy" demarcation, as an emotion may not completely return to baseline/zero). Parameters that can be calculated are response latency (time between t_{start} and t_{Imax}), recovery time (ie, time between t_{Imax} and t_{end}), slope of change, which refers to how rapidly affect increases (slope of increase) or decreases (slope of decrease) over time, and AUC.
Source: Davidson (1998) and Hemenover (2003).

The aim of the study by Heylen et al. (2015) was to investigate whether variability in time course variables for anger profiles can be explained or predicted on the basis of differential appraisals and emotion regulation strategies used by individuals. However, this is less relevant for my present purpose, which is to focus on the methodology they used to measure variability in shape and intensity profiles of emotion episodes, so I will not discuss the outcomes in terms of the aim of the study. Heylen et al. (2015) asked their participants to recall several anger episodes that were elicited by specific events. For each episode, participants had to estimate the duration of the episode by indicating how many hours, minutes, and/or seconds the episode lasted. In addition, they were asked to draw the associated anger profiles as accurately as possible. For this, they were presented with a two-dimensional grid (one for each recalled episode), where the *y*-axis represented emotional intensity divided into six intervals with labels ranging from "no emotion" to "very high." *y*-Coordinates were stored with a resolution of 375 pixels with "no emotion" corresponding to 0 and the label "very high" to 350. The *x*-axis represented the time dimension ranging from 0 to a number that corresponded to the answer that a participant gave on a previous duration question. The *x*-coordinates were stored with a resolution of 475 pixels, where the start of an episode was stored as time point 1 and the end as time point 475. The remaining 473 time points were selected equidistantly over the entire duration of the episode. Thus, as reported durations could be quite different between participants and between episodes, the shape inferences in the resulting intensity profiles pertain to relative timing differences, not absolute ones (Heylen et al., 2015; Verduyn, Delvaux, Van Coillie, Tuerlinckx, & Mechelen, 2009; Verduyn, Van Mechelen, & Frederix, 2012). To disentangle and summarize the shape and amplitude differences among the intensity profiles, the authors used a statistical technique called K-spectral centroid (K-SC) clustering. K-SC clustering groups profiles into K clusters according to their shape, and these shape differences can be interpreted by examining the cluster centroids, and by providing an amplitude coefficient for each profile (for more details on K-SC clustering see Heylen, Ceulemans, Van Mechelen, & Verduyn, 2014; Yang & Leskovec, 2011). The results showed that based on a goodness-of-fit versus number-of-clusters plot, with K-SC clustering two prototypical shapes (clusters) could be distinguished with different clusters (see Fig. 11.4).

The left panel in Fig. 11.4 shows the first cluster, which the authors named the early-blooming cluster. This type of anger episode is characterized temporally by a relatively short response latency resulting in a peak (cluster centroid) situated at the beginning, followed by recovery time. Within the cluster, variability in peak amplitude was observed and classified as high, average and low peak amplitude. The second cluster (right panel, Fig. 11.4) was characterized by a longer period of intensity accumulation, resulting in a peak relatively late in the episode, and followed by a recovery time that resembled the accumulation time. Again, within the cluster, different peak amplitudes could be distinguished. These findings neatly illustrate that by exploring the temporal dynamics within emotion episodes, one can add unique information helpful to emotion categorization, in this case for two "types" of anger response (Heylen et al., 2015). These different types may not be observed when time-averaged means are used as output parameters. Hence, exploring the dynamics

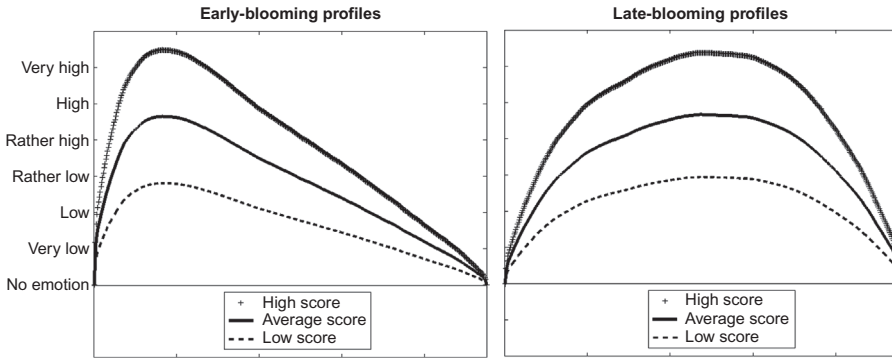


Figure 11.4 Reconstructed intensity profiles obtained through K-SC analysis.
Source: Heylen et al. (2015).

of emotions leads to novel insights in the temporal processes underlying the up- and down-regulation of specific emotions.

2.1.2 Temporal Dominance of Emotions

TDE is a novel method to measure the temporal evolution of dominant emotional attributes over time (Jager et al., 2014). It is based on the Temporal Dominance of Sensations (TDS) method as applied in sensory and consumer research in the food domain (Pineau et al., 2009). Because the method of TDE is based on TDS, I will shortly introduce the basics of TDS methodology including the representation of TDS data in dominance curves and the method to compute these curves. In sensory science the evaluation of the temporality of sensory perception of foods and beverages is an important topic of investigation. Sensory attributes, such as taste (sweetness, sourness, bitterness, saltiness), flavor (eg, fruity, cocoa), and texture (eg, crispy, creamy) are not perceived constantly during the consumption of a particular food. With TDS methodology, the evolution of sensory attributes such as sweetness (taste) and creaminess (texture, melting sensation) can be monitored, for example, when eating a piece of chocolate. In addition, it can be examined how these sensory temporal dynamics characterize a particular food product, and how they can differentiate between food products, for example, two different brands of milk chocolate. In line with the notion that sensory perception is dynamic during eating, we recently argued that food-evoked emotions should also be conceived as a series of dynamic events that unfold during consumption, a concept that was denoted TDE (Jager et al., 2014).

The temporal aspects of the perception of a given emotional attribute in a product can also be studied using time-intensity (TI) methodology (Cliff & Heymann, 1993), which is comparable to the method used to delineate anger intensity profiles in the study by Heylen et al. (2015), as described above. However, when several attributes or emotions are salient at the same time or show overlap, TI quickly becomes very time-consuming because only one attribute can be assessed during a single evaluation

(Cliff & Heymann, 1993). The reason is that TI measurements require high concentration and a more analytical mind-set from the panelist as it involves constant monitoring of both the quality (eg, is the monitored attribute "anger" or is it "jealousy"?) and the intensity of a sensation over time. Even after extensive training, participants find it difficult to do this for two or more attributes at the same time (Cliff & Heymann, 1993). With TDS and TDE it is possible to record multiple attributes (to a maximum of 10–12) simultaneously over time (Pineau et al., 2012), which is a big advantage for complex food products that commonly combine multiple relevant sensory and affective attributes and their evolution during consumption. It is important to note that TDS and TDE are based on the concept of "dominance," which is different to "intensity." The dominant attribute is commonly defined as the one that is the most striking perception at a given time point, the one that catches the attention the most. This can also be the most intense attribute, but not necessarily so (Pineau et al., 2009). The method of TDS and TDE consists of presenting to the panelist a list of 10–12 relevant attributes on a computer screen. The panelist is then asked to sample a particular food, and subsequently to assess which of the attributes presented on the screen is perceived as dominant. In the course of the evaluation, when the panelist considers that the dominant attribute has changed, he or she has to select the new dominant attribute, and so on, until the perception ends. Panelists are free to choose the same attribute several times or to never select an attribute when it is not judged as dominant (Jager et al., 2014; Labbe, Schlich, Pineau, Gilbert, & Martin, 2009; Meyners & Pineau, 2010a, 2010b; Pineau et al., 2009, 2012).

TDS curve computation is explained in Fig. 11.5. This figure exemplifies curve computation for sensory attributes of a food (eg, taste, texture), but the principle is equal for food-related emotions, where the sensory attribute names are replaced by affective ones.

The procedure considers each attribute separately. For each point of time, the proportion of panelists that assessed the given attribute as dominant is computed. After smoothing, these proportions are plotted against time and called dominance curves. The higher the peaks of the curves, the higher the proportion of panelists that reported a specific attribute to be dominant at a given time point, indicating stronger consensus by the panel. For each product, dominance curves of all the attributes are depicted in the same graph. Note that these curves solely rely on the selection of an attribute as dominant or not, but do not reflect the intensity of the sensation at any given time point. After construction of the curves of all attributes per panelist, the raw timescale (in seconds) is transformed into a 0–100% scale, where 0% represents the start of the consumption period (ie, when the participant puts the sample into his/her mouth) and 100% is the end of the consumption period and no sensation is reported anymore. Similar to the study by Heylen et al. (2015) described above, the actual durations of the event may differ between panelists. To allow for comparison across panelists, the timescales are standardized, meaning that the resulting dominance curves pertain to relative timing differences, not absolute (Pineau et al., 2009). Finally, to enable better interpretation of the graphical displayed dominance curves, two lines can be drawn, one called "chance level" which is the dominance rate that an attribute can obtain by chance. Its value, P_0, is equal to $1/p$, p being the number of attributes.

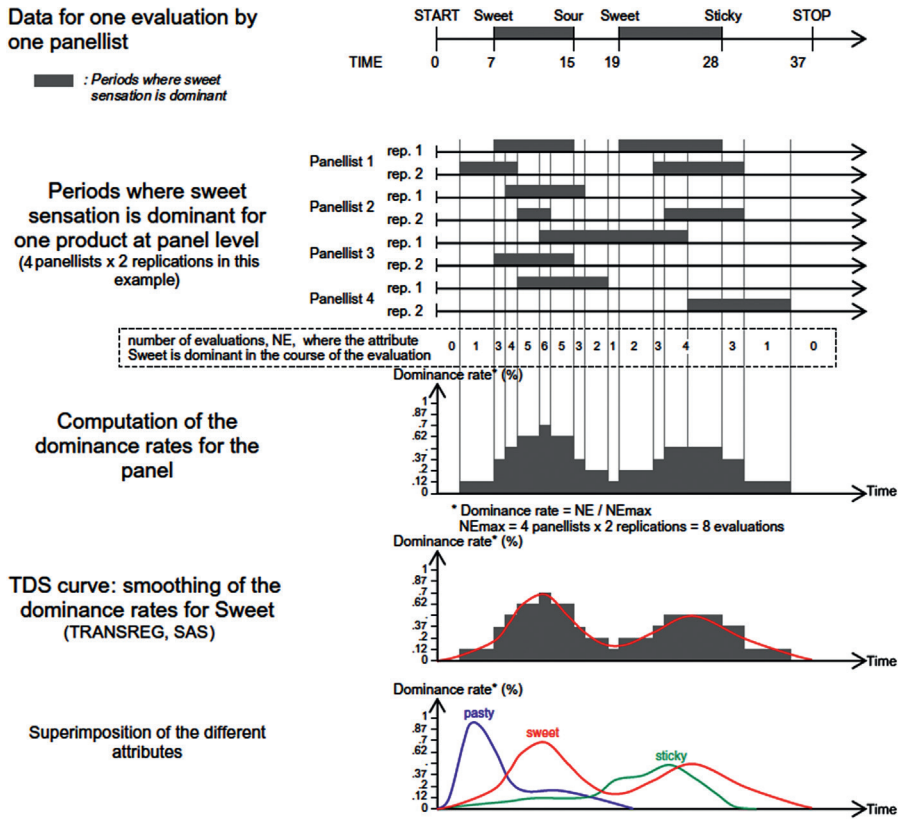


Figure 11.5 Methodology to compute TDS curves.
Source: Pineau et al. (2009).

The second is the "significance level," which is the minimal value this proportion should equal to be considered significantly higher than P_0. It is calculated using the confidence interval of a binomial proportion based on a normal approximation: $P_s = P_0 + 1.645\sqrt{P_0(1-P_0)/n}$. For more details on dominance curve computation I refer to the work of the group of Schlich and colleagues (Labbe et al., 2009; Meyners & Pineau, 2010a, 2010b; Pineau et al., 2009, 2012).

As stated above, we recently proposed that food-evoked emotions can be conceived as a series of dynamic events that unfold during consumption. We used the TDE method to test this assumption in a study where panelists consumed samples of five commercially available dark chocolates while assessing TDS and TDE (Jager et al., 2014). A first objective of this study was to test the validity of the TDS method for measuring temporal aspects in food-evoked emotions during consumption. In other words, is this method suitable to capture dynamics in food-evoked emotions (TDE) during eating? A second objective was to determine possible relationships and interactions between dynamic sensory and emotion perceptions. More specifically,

when people are reporting the sensory attribute sweetness to be dominant at a given time during chocolate consumption, can this be related to specific emotions (eg, happy) becoming dominant in a similar timeframe? As stated before, however, the focus of this chapter is on measuring dynamics in emotion responses, so I will focus on the TDE method instead of the results of this study in relation to its objectives. In short, participants performed an experiment consisting of three tests. The first test involved sampling five pieces (10 g each) of five different types of commercially available dark chocolates with different cocoa content (ie, 70% and 85% cocoa) and flavors (ie, orange, blueberry, mint) with TDE. After evaluation of all samples with TDE, participants proceeded to the second test, where they were presented with all five chocolate samples again, now to evaluate them with TDS. After completing the TDS part for each sample, subjects were asked to taste the five chocolate samples once more and to rate overall liking for each chocolate on a 9-point hedonic scale. TDE and TDS measurements in this study were run using a software package called TimeSens (http://www.timesens.com). This web-based program allows running TDE experiments, includes automatic data logging, and offers extensive options for (statistical) data analysis. For the remainder, I will only describe the TDE data and its analysis. For data analysis, the TimeSens program allows computation of time-standardized temporal dominance curves according to the methodology described above (Pineau et al., 2009). For illustration purposes, Fig. 11.6a and 11.6b depicts TDE dominance curves for two of the five chocolates tested, that is, 70% cocoa plain dark chocolate (Fig. 11.6a) and orange-flavored dark chocolate (Fig. 11.6b) (for complete results of all products see Jager et al., 2014).

TDE curves of the 70% cocoa dark chocolate are different from those of the orange-flavored dark chocolate in terms of salient emotional attributes. The emotional attributes describing the plain dark chocolate were *bored*, *calm*, and to a lesser extent *energetic*, where the sequence indicates that bored is dominant throughout the main part of the evaluation process, whereas calm and energetic become dominant mainly during the second half of the evaluation. For the orange-flavored dark chocolate the TDE curves show that a quarter of the way through the evaluation process, the dominant attribute reported was *interested*. After approximately 40% of the evaluation period, other peaks entered for *happy*, *energetic*, and *loving*.

In addition to TDE curves, TimeSens can generate so-called difference curves, a graphical representation of lines representing the differences between the dominance rates across time of two samples to be compared (say A-B) or two groups of samples (group A—group B) when the difference is significantly different ($\alpha = 0.05$) from 0 (Pineau et al., 2009). Fig. 11.7 shows the difference curves comparing the two plain dark chocolates (70% and 85% cocoa) and the three flavored ones (blueberry, orange, and mint).

The study by Jager et al. (2014) indicates conceptual validity of the TDE method and the relevance of studying the temporal dynamics of emotion responses in this case associated with consumption of foods. The TDE measurements revealed differences not only in the type of emotions but also in the temporal evolution of dominant emotions across different chocolate samples, enabling a good distinction especially between plain dark chocolates and flavored dark chocolates. These findings illustrate

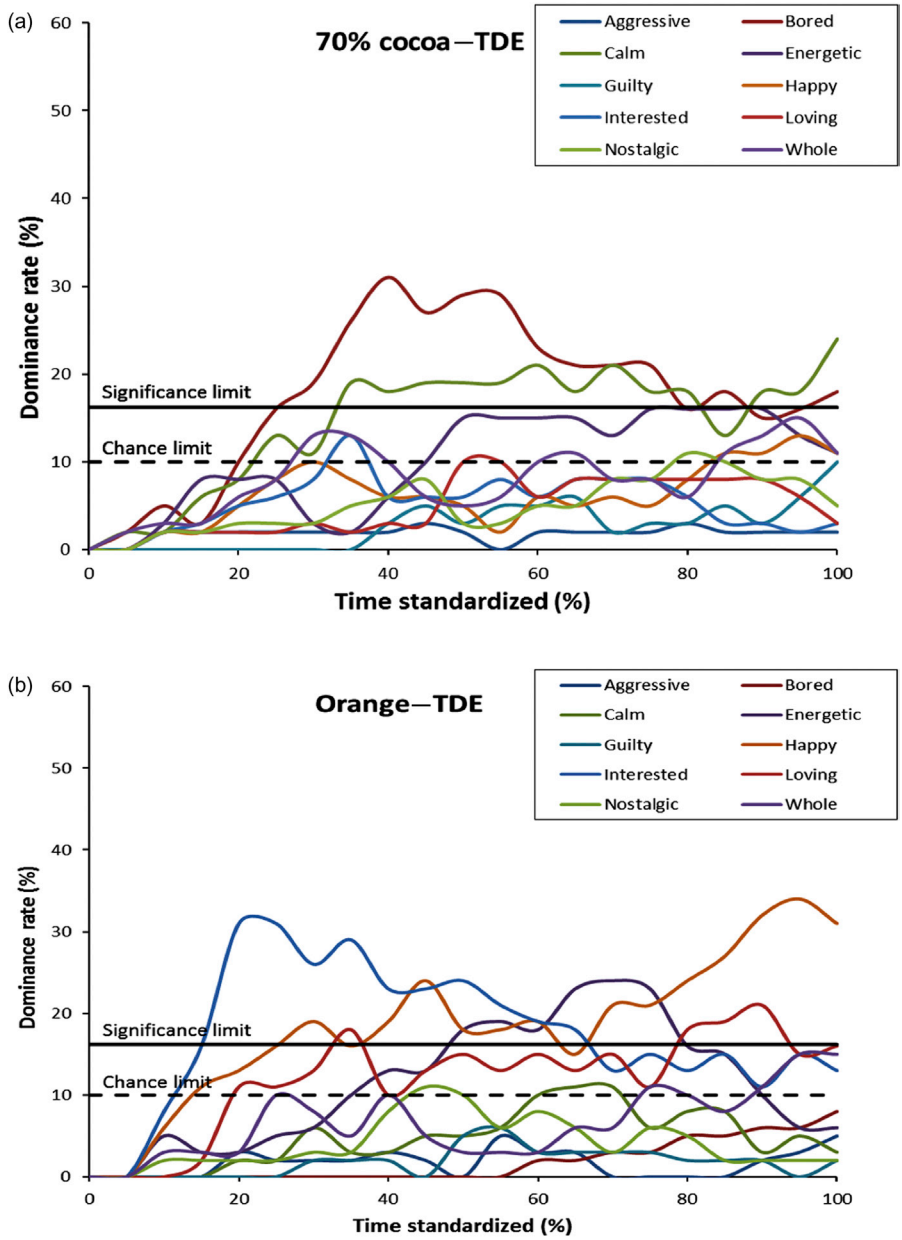


Figure 11.6 Graphical representation of TDE curves for (a) 70% cocoa dark chocolate and (b) orange-flavored dark chocolate.

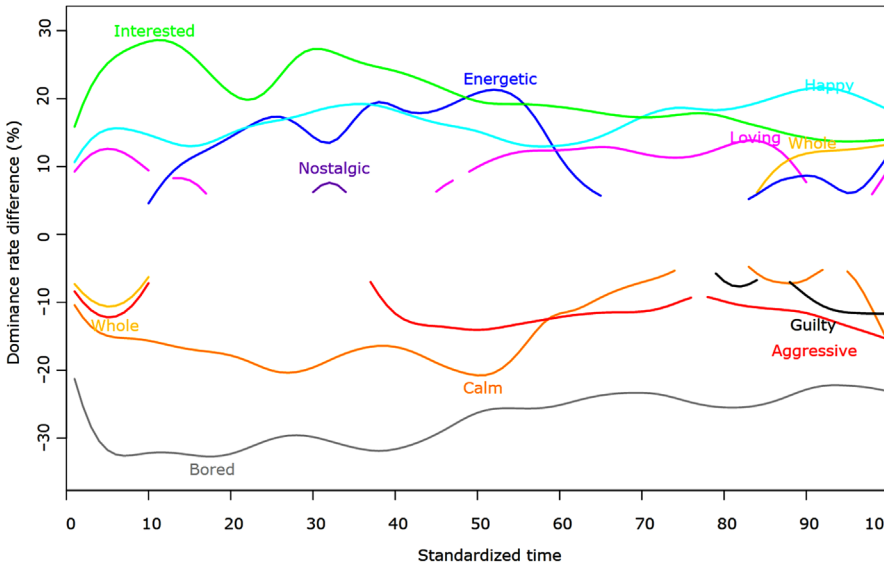


Figure 11.7 Graphical representation of the difference in emotion dominances (TDE) between the flavored and the plain dark chocolates. Curves drawn above the *x*-axis denote emotions being significantly higher in dominance rates in the flavored chocolates, whereas curves below the *x*-axis denote emotions significantly higher in the plain chocolates.

the added value of the TDE method, as the aspect of temporal evolution over (consumption) time is not captured with currently available static emotion measures (eg, self-reported ratings on emotion questionnaires) in sensory and nutrition research.

2.2 The (neuro)physiological and expressive systems

To recap, the emotion process is triggered by a person's encounter with some event or stimulus, and if the event is appraised as meaningful in some way, an emotional response will ensue. This response is characterized by a coordinated and correlated set of dynamic changes in (neuro)physiological, expressive (facial/bodily expression) and experiential (subjective experience) systems. In the previous sections several approaches to measure dynamics in the experiential system, that is, subjective emotion experiences, were discussed. In the next section, I will address the expressive system, more specifically, the dynamics in emotion responses as expressed by facial expressions. The interested reader is referred to chapter "Facial Scaling of Emotions" dedicated to measuring emotions in the face by Hyisung C. Hwang and David Matsumoto.

2.2.1 Measuring dynamics in facial expressions

Expression and recognition of emotions in real life are dynamic by nature and rely on timing and temporal sequences. The relevance of relative timing and temporal

evolution of facial signals stands out from studies showing that people are sensitive to "false" timing of facial display when considering the sincerity or deceptiveness of an emotional expression, for example, abrupt endings or beginnings of a smile (Ekman, Friesen, & O'sullivan, 1988). Another example is that fear expressions are often confused with surprise when people evaluate static facial stimuli in the form of still photographs (Lemay, Kirouac, & Lacouture, 1995). In addition, facial dynamics have been shown to improve the recognition of subtle emotional expressions (Ambadar, Schooler, & Conn, 2005; Wehrle, Kaiser, Schmidt, & Scherer, 2000). Despite their importance, facial dynamics have been studied far less than their static counterparts, and even fewer studies have been published to date on methods to systematically assess facial dynamics in the emotion field. There are a number of interesting papers, however, that are discussed below.

2.2.2 Measuring temporal dynamics in facial expressions

What do we know about the temporal unfolding of emotional facial expressions and their measurement? In 1980 Paul Ekman published the Facial Action Coding System (FACS), which has been updated several times since (Bartlett et al., 2000; Ekman, Freisen, & Ancoli, 1980; Ekman & Rosenberg, 2012; Ekman, Rosenberg, & Heller, 1998). FACS describes movements of individual facial muscles to systematically categorize the physical expression of emotions. FACS is a now a computed automated system that detects faces in videos, extracts the geometrical features of the faces, via so-called Action Units (AUs), which are a contraction or relaxation of one of the facial muscles, and then produces temporal profiles of each facial movement (Bartlett, Hager, Ekman, & Sejnowski, 1999; Ekman & Rosenberg, 2012). The latest development is FACSGen 2.0 (http://www.affective-sciences.org/facsgen-2010), a new animation tool for creating realistic, both static and dynamic, 3D facial expressions based on FACS (Roesch et al., 2011). However, FACS does not fully capture all aspects of the temporal unfolding of the emotion, such as the effect of order or the detailed dynamics of facial movements, particularly the irregularity of the expression's unfolding. There is now considerable evidence that the processing and perception of facial expressions of emotion are influenced by the presence or absence of dynamic information (Hess, Kappas, Mchugo, Lanzetta, & Kleck, 1992; Hess & Kleck, 2012; Tcherkassof, Bollon, Dubois, Pansu, & Adam, 2007). Thus, pauses and stepwise intensity changes, such as the number of onset, offset and peak phases that the expression contains, are significant parameters. For example, a smile can develop or "increase" from a neutral facial expression to a full smile, and then relax back or "decrease" again to neutral. Interestingly, this "timeline" factor has been shown to involve temporal asymmetries in expression dynamics, that is, the extent to which increase and decrease of an expression follow the exact same motion trajectory of facial muscle movements. Humans are sensitive to the distinct aspects (directionality and timeline) of temporal sequence in facial dynamics as demonstrated in a neuroimaging study by Reinl and Bartels (2014). In this study, stimulus material consisted of short movie clips of faces of actors showing fearful expressions starting from neutral face, going to peak expression, and relaxing back to a neutral expression. These video recordings were later cut to

show either an increase or a decrease in emotional intensity ranging from low to high fear expression or vice versa. Duplicates of these movies of increasing and decreasing fear expressions were then created in two orders, either the original frame order or the reversed frame order. In total, four dynamic movie conditions were applied: increasing and decreasing fear in original frame order, and decreasing and increasing fear in reversed frame order. Participants were exposed to each of these movie conditions while recording their brain activity patterns with functional magnetic resonance imaging (fMRI). The results showed differential response patterns in several areas of the brain involved in face processing and emotion recognition, indicating sensitivity for emotion-direction (increasing or decreasing emotion) and timeline (natural or reversed, artificial order). The authors argue that these findings implicate that directionality and timeline are critical properties of the facial expression with impact on the transmission of social meaning. The direction of emotional expression change (increase or decrease) affects ecological meaning, for example, a change from neutral to fearful may require a different response from an observer than the opposite direction. In addition, different brain activity in response to the direction of timeline (natural vs reversed frame order) indicates people's sensitivity to prototypical sequences of muscle movements during natural facial expressions or prototypical unfolding of facial dynamics (Reinl & Bartels, 2014). Hence, the order, speed, and timing of muscle movement making up facial expressions are relevant parameters to be assessed in dynamic emotion measurements (Ekman & Rosenberg, 2012; Reinl & Bartels, 2014; Wehrle et al., 2000). As the studies described above show, measuring temporal dynamics in facial expressions requires tools for creating dynamic facial expressions. I have already mentioned FACS (Ekman & Rosenberg, 2012) and the systems based on FACS such as FACSGen 2.0 (Roesch et al., 2011), but there are other tools available. Wehrle (1995) developed the Facial Action Composing Environment (FACE); a tool for creating 3D animated facial expressions in real time, including head and eye movements. FACE permits researchers to systematically vary different aspects of the dynamics of facial expressions, but in order to enable such systematic control and manipulation it relies on a database of synthetic images of faces. Alternatively, researchers make use of short movie clips of natural faces, for example, of actors showing distinct emotional expressions tailored to a specific study aim (see, eg, Reinl & Bartels, 2014). Movies can also be obtained from databases such as the Video-Face-Database of the MPI Tübingen (Kaulard, Cunningham, Bülthoff, & Wallraven, 2012).

When considering the literature on the temporal aspects of facial expressions, a methodological consideration discussed is the qualitative difference between spontaneous and deliberate facial expressions. Deliberate facial expressions, for example, recordings of actors instructed to show certain emotional expressions, have been criticized for being simulated, and neither natural enough nor emotional (Wallbott & Scherer, 1986). It is, however, problematic to gather recordings of natural facial expressions displaying various emotions, that is, realistic material to be judged by observers. An interesting approach to tackle this problem is described by Tcherkassof et al. (2007), who used a paradigm of emotion-eliciting tasks (eg, a gambling task where subjects are frustrated in their goal of winning) in combination with a device to covertly record subjects' facial expressions. The resulting movies were then used

to collect real-time emotional recognition, that is, observers' dynamic judgments of facial expressions along the same temporal dimensions as they manifested themselves during the recordings (Tcherkassof et al., 2007).

2.2.3 *Combining (neuro)physiological measures and facial expressions—temporal dynamics*

In componential emotion theory, such as the CPM (Scherer, 2009) it is proposed that the result of the appraisal process (the central emotion component) drives or initiates the response changes in subsequent peripheral emotion response components such as (neuro)physiology, facial expression, and subjective feeling. A prerequisite is the occurrence of synchronization (or coherence) between central appraisal processes and peripheral psychophysiological response changes. This central notion has been addressed in two recent studies (Gentsch, Grandjean, & Scherer, 2014; He et al., 2014) that are worthwhile of discussion here as these studies nicely illustrate the current state of affairs in terms of available methods to measure the temporal dynamics in different emotion response components (eg, appraisal, (neuro)physiology, and facial expressions) and provide us with novel data-processing and statistical approaches to connect the different components of emotion responses in time. Gentsch et al. (2014) examined the synchronization process between two emotion components—the central appraisal and peripheral facial expression components. They had participants play a monetary gambling task where appraisal was manipulated by using feedback stimuli on (non)reward and (lack of) control. The authors investigated cortical markers of the appraisal process in event-related potentials (ERPs) and the associated appraisal-driven response changes in facial expression in facial muscle activity (electromyography), which were concurrently recorded in response to the feedback stimuli during the gambling task. A detailed description of the central appraisal process, data processing, statistical approach, and results is outside the scope of this chapter. For those interested I refer to chapter "Contemporary Theories of Emotion" and to the original paper by Gentsch et al. (2014). The main finding of this study, however, showed that early cognitive processes (between 200 and 300 ms after onset of the feedback stimuli), related to the early feedback-related negativity component in the ERP signal associated with unrewarding events (negative appraisal) primarily affected the upper face muscle activity (eg, frowning). Later-onset appraisal processes related to event categorization (pleasant/unpleasant) reflected in the P300 ERP component (between 350 and 600 ms after onset of feedback stimuli) predominantly drove cheek region muscle activity (eg, smiling response). What we can learn from studies like this is that it is possible with the current methodology to measure temporal dynamics across different components of the emotion response with very high temporal resolution, that is, within timeframes of milliseconds to seconds. A second experiment that is illustrative for the importance of taking the time dimension into account during measurement of temporal dynamics in emotions concerns a study in the food domain on the dynamics of ANS responses and facial expressions to odors (He et al., 2014). The rationale of this study was that our like or dislike of certain products may be more dependent on unarticulated/unconscious motives and associations (Wansink, 2004) than on conscious cognitive

or affective processes. Unarticulated/unconscious motives and associated processes may be better captured by physiological and behavioral measures (facial expressions) of the ANS that are faster and do not require conscious processes (Greenwald, Poehlman, Uhlmann, & Banaji, 2009). As such, facial expressions and physiological responses of the ANS, such as HR and skin conductance responses (SCR), have been used extensively to measure emotional responses in the expressive system to food-related or other stimuli. However, the focus has been more on time-averaged means (eg, Danner, Sidorkina, Joechl, & Duerrschmid, 2014; De Wijk, Kooijman, Verhoeven, Holthuysen, & De Graaf, 2012), but far less on the dynamic features over time of physiology responses and facial expressions, that is, the temporal development of each measure. In the study by He et al. (2014), physiological responses and facial expressions were measured continuously in response to presentation to odor stimuli with a different valence, relatively negative (fish odor) or positive (orange odor) valence. Odors were presented via an olfactometer, a computer-controlled device that allows for tight experimentally controlled administration of odor stimuli (intermittent) via a nosepiece placed directly into a nostril of the participant (Boesveldt, Frasnelli, Gordon, & Lundström, 2010; Lundström, Gordon, Alden, Boesveldt, & Albrecht, 2010). During the experiment participants were seated in a comfortable chair, fitted with the olfactometer nosepiece, and with electrodes placed on the palm of the hand (SCR) and chest (HR). Participants were asked to orient to and look directly towards a webcam camera that recorded facial expressions. For details on the physiological data acquisition I refer to the original paper (He et al., 2014), but a bit more detail on the recordings and analysis of the facial expressions is relevant for this section. Facial expressions were analyzed using FaceReader software (Noldus Information Technology BV). This software enables automated classification of facial expressions into the six basic or universal emotions described by Ekman (1992): happy, sad, angry, surprised, scared, and disgusted and a neutral state. FaceReader analyses these facial expressions on a frame-by-frame basis, that is, at 25 Hz and results correspond between 70% and 99% for the different facial expressions with results of human observers (Terzis, Moridis, & Economides, 2011, 2012). A more detailed description of the science behind FaceReader can be found at: http://info.noldus.com. Data analysis of the processed images of the facial expressions was combined with the raw physiological data (SCR, HR) using Observer XT 10.5 software (Noldus Information Technology BV), based on pre- and postodor presentation time series of responses (for details see He et al., 2014). The results are summarized in Figs. 11.8 and 11.9, and showed differential temporal unfolding of emotions in reaction to the two odors (fish, orange), as seen in differential evolution of facial expressions and physiological responses. Compared to the pleasant orange odor, the unpleasant fish odor triggered higher HRs and SCR, lower skin temperature, fewer neutral facial expressions, and more disgusted and angry expressions. Notably, the balance between these responses was continuously changing depending on their timing.

This study demonstrates that when results are not averaged across time, facial expressions and physiological expressions become rapidly stimulus-specific (in this case specific for pleasant and unpleasant odors) and are dynamic in nature. Consequently, emotion responses to the same stimulus may produce very different

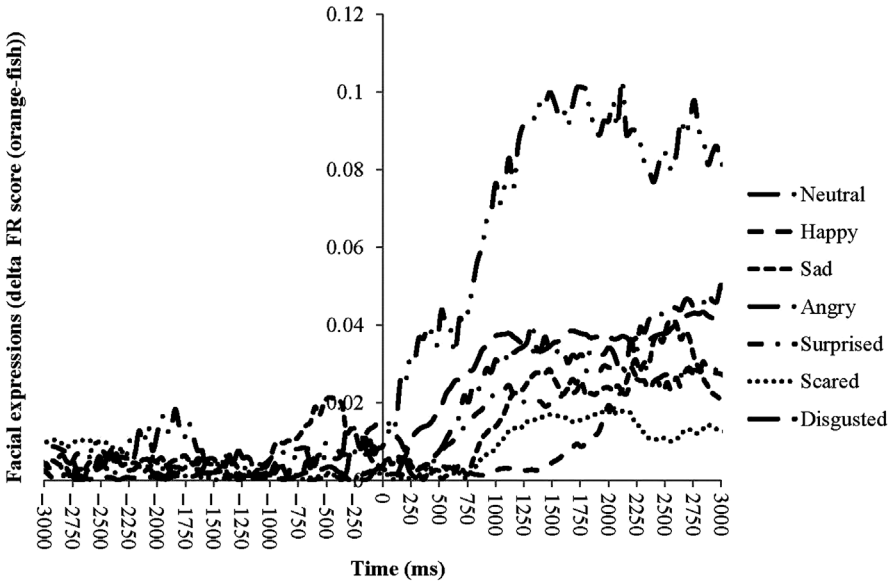


Figure 11.8 Sequential unfolding of differences in facial expressions between the unpleasant fish odor and the pleasant orange odor over time following the odor presentation at $T = 0$. *Source*: He et al. (2014).

patterns of results depending on the timeframe at which they are assessed. For example, in the study by He et al. (2014) fast responses around 500 ms were dominated by negative facial expressions such as disgust, increased HR, and skin temperature, whereas slower responses reflected more positive facial expressions, lower HR, and decreased skin temperature.

3 Implications and future recommendations

Studies investigating the dynamics of the emotion process report findings that are partly overlapping with findings originating from studies that took a more conventional "static" approach, such as working with time-averaged mean scores (He et al., 2014). However, measuring dynamics in emotion responses adds a novel dimension by revealing a pattern in different components of emotion responses that develops over time. Several studies supported the notion that different facial expressions (happy, angry, fearful) and the associated physiological responses (changes in HR, skin conductance) develop at their own specific rate over time. Consequently, responses to the same event or stimulus may produce very different patterns of results depending on the time or stage in the emotion process at which they are assessed. Hence, the main

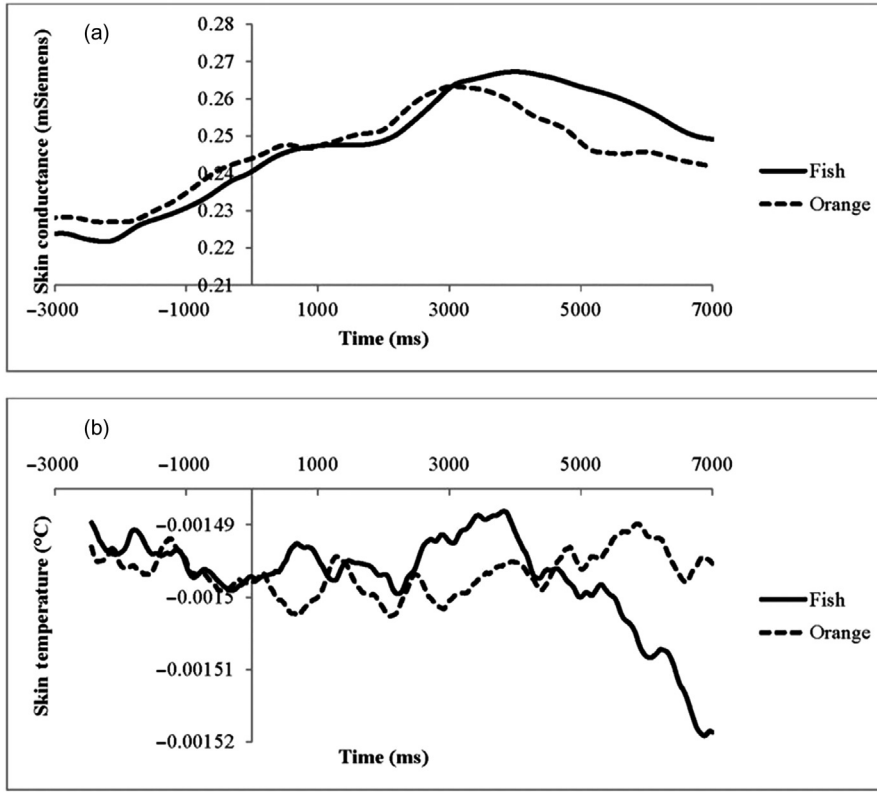


Figure 11.9 Effects of fish and orange odor on (a) HR and (b) skin conductance over time following the odor presentation at $T = 0$.
Source: He et al. (2014).

implication of taking a dynamical approach to emotion measurements appears to be that we can learn from and discover a unique, though highly relevant, part about the emotion process that will remain hidden with the use of more static measures.

The predominant experimental paradigm within emotion research, which has been referred to as the standard method (McKeown & Sneddon, 2014; Russell, 1994), limits itself to the use of static stimuli, for example, still pictures of people displaying posed or acted emotional facial expressions. This approach has benefits, as it permits a high level of control over the emotional expression at the focus of investigation, and it is easier to perform in a variety of research settings. However, what these stimuli poorly represent is the dynamic real-time emotional stream of information, the true nature of emotion processes, and also likely the basis upon which the machinery of our emotional perception has evolved (McKeown & Sneddon, 2014).

Investigation and measuring of dynamics in emotion responses come with a number of conceptual, methodological and technical challenges. For one, increased

computational power, rapid developments in technology that provided us with novel techniques such as EEG, fMRI, biosensors to record ANS responses, and software programs such as Observer NT and FaceReader (Noldus Information Technology BV) have led to new data-gathering techniques allowing for continuous ratings of emotion components over time. This kind of data has been labeled *intensive longitudinal data* or *functional data* (Levitin, Nuzzo, Vines, & Ramsay, 2007; McKeown & Sneddon, 2014; Walls & Schafer, 2012) and with this, emotion research has entered the era of "big data." A potential drawback of this exciting development is that emotion measurements may increasingly require high-tech equipment and, therefore, become selectively confined to the lab, whereas I believe that we should keep focus on emotion research in naturalistic settings as well. For example, in my own field of research, which is on food-related emotions, eventually we want to test the validity of our theoretical concepts and models in a consumer context such as a retail setting. To date, however, it has been impossible to work with much of this high-tech equipment and systems in such real-life settings, although it may become increasingly common to utilize modern smartphones, tablets, and body sensors as data-gathering devices (Miller, 2012).

Another challenge with studies incorporating continuous self-report measures on emotion responses is a statistical one. Often, this type of measurement requires participants to monitor their perceived emotion over time, for example, by moving a mouse/slider in a one- or two-dimensional space or to click buttons or give ratings on a computer screen at a given instance in time. It can also involve continuous or intermittent recording of physiological responses or facial expressions over time. An important statistical issue here concerns the nonindependence of the data, which violates the basic assumption of generalized linear models that the residuals of a fitted model will be independent and randomly distributed (Stevens, 1996). Time series data are correlated within participants—they are equivalent to a series of rapid repeated measures. They are also autocorrelated, meaning that the measurement at one time point strongly depends on their nearest neighbor, that is, the measurement at the previous or following point in time. Hence, this type of data requires different statistical approaches than generalized linear models to provide a solution to this particular problem in dynamic emotion perception research (McKeown & Sneddon, 2014). Potentially better statistical approaches include additive mixed models, neural network frameworks, nonlinear regression models, classification, and clustering. For the interested reader I kindly refer to an overview of different techniques by Finch, Chang, and Davis (2011). Fortunately, we can benefit and learn from other areas in psychology and affective neuroscience where network modeling techniques (Sander et al., 2005), functional data analysis (Friston & Dolan, 2010; Friston & Penny, 2011), and Bayesian statistical frameworks (Kayser & Shams, 2015) have been applied for some time now with statistical modeling constantly being improved.

In conclusion, this chapter hopefully illustrates the topicality of dynamic measures of emotion responses, an area that I believe to have full future potential for new discoveries and exciting developments.

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Measurement of Affective Responses to Exercise: From "Affectless Arousal" to "The Most Well-Characterized" Relationship Between the Body and Affect

12

Panteleimon Ekkekakis and Zachary Zenko
Department of Kinesiology, Iowa State University, Ames, IA, United States

Why is there a chapter on exercise included in a book about the measurement of emotion? Exercise, physical activity, and the movement of the human body more broadly, are not topics that readers are used to seeing in books about psychological constructs. Within affective psychology, in particular, these topics are essentially absent. Thus, most scholars would probably be surprised to learn that this was not always the case. In this chapter, we present the study of affective responses to exercise as an example of a research field that was reinvigorated and reoriented along a path to societal relevance by critically reevaluating the way in which its primary outcome of interest, namely affect, was conceptualized and measured. We describe this experience as a possible roadmap for other fields of applied psychological research facing similar measurement-related challenges. We begin with a historical review, to illustrate the epistemological processes through which this line of research was initially led astray, before we outline the corrective actions that were taken and the fruits these actions have borne.

1 History from the perspective of psychology

In the late 19th century, it was not uncommon to find extensive discussions on the feelings and emotions associated with exercise and physical exertion in the pages of the books that later came to be regarded as the foundational works of modern psychology. Bain (1855) devoted extensive parts of his *Senses and the Intellect* to the pleasures and displeasures associated with exercise, writing that tasks involving muscular contractions, such as "hard exercise or bodily toil" result in "a feeling of vigour, strength, or intense vitality," which "counts for a considerable portion of the sum of human pleasure" (p. 92). In the second edition of *The Principles of Psychology*, Spencer (1870) used the pleasure and displeasure associated with exercise as examples to illustrate the crucial function of feelings for

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adaptation: "pains are the correlatives of actions injurious to the organism, while pleasures are the correlatives of actions conducive to its welfare" (p. 279). He wrote:

> *To a person in health duly rested, the feeling that accompanies absolute inaction of the muscles is unbearable; and this inaction is injurious. On the other hand, extreme exertion of the muscles in general is alike distressing and productive of prostration, while exertion of a particular muscle pushed to a painful excess, leaves a temporary paralysis, and occasionally, by rupturing some of the muscular fibres, entails prolonged uselessness. (pp. 278–279)*

Darwin (1872), in *The Expression of the Emotions in Man and Animals*, noted that "the mere exertion of the muscles after long rest or confinement is in itself a pleasure, as we ourselves feel, and as we see in the play of young animals" (p. 77). In North America, Baldwin (1891) also addressed the pleasure and displeasure associated with exercise. In his *Feeling and Will*, which was the second volume of his *Handbook of Psychology*, he wrote that "muscular sensations are pleasurable within the range of easy effort" and even argued that "these pleasures of activity, such as pleasures of the chase, of sports, of general vigor, are more positive apparently than any other sensuous pleasures" (p. 120).

At the time, as the nascent field of psychology was attempting to establish itself as a legitimate science, discussing the interaction between bodily states and human subjective experiences made sense. These pioneers knew that the path to scientific respectability required demonstrating that psychology dealt with real, rather than metaphysical, abstract, or undefinable, phenomena. Exercise was seen as an apt and powerful example that served this purpose well. This is because everyone likely had first-hand experience with the drowsiness of extended bed rest, the invigorating feeling of a brisk walk, and the exhaustion of a hard run or a long day of physical labor. These shared experiences, all clearly emanating from and linked to the function of the physical body, illustrated in vivid fashion the indisputable physicality (ie, reality) of these subjective feelings.

For the first 70 years of the 20th century, however, under the influence of behaviorism and later cognitivism, the affective responses to exercise were effectively eliminated from psychological research and theorizing (see Ekkekakis, 2013a, for a more detailed review). Under behaviorism, the apparently self-rewarding nature of spontaneous running in rodents was a bewildering mystery to researchers. Since internal, subjective feelings of pleasure or displeasure had been banished from the scope of scientific psychology, it was inexplicable why an animal would run, protractedly and persistently, in the absence of an electric shock or the pursuit of food. Cognitivism was open to subjective states but subdued the body to a subservient role, as a physical accessory to an omnipotent, disembodied, cognitive apparatus. Cognitivist theorists readily adopted Walter Cannon's earlier critique of the James–Lange theory of emotion, viewing bodily stimuli as too diffuse and undifferentiated to be meaningful determinants of the extremely intricate and varied repertoire of human emotions. In the highly influential cognitive theory of emotion by Richard Lazarus, for example, feelings originating in the body were either discarded as mere sensorimotor reflexes

of no psychological interest or pliable raw sensory material that can be transformed into diametrically opposite experiences by merely altering the manner in which they are appraised. According to Lazarus (1984), exercise produces nothing more than "arousal."

Perhaps the most significant contributor to the neglect of the affective responses to exercise within the psychological literature was the line of research on "excitation transfer" that was initiated by Dolf Zillmann in the 1970s. Echoing the prevalent view of the time that exercise produces only undifferentiated "arousal" devoid of any affective content, Zillmann, Katcher, and Milavsky (1972) used exercise (cycling) to create in their participants a state of "excitation," which, they claimed, was subsequently "transferred" to a retaliatory aggressive behavior following a provocation. So convinced were psychologists that exercise could only produce a state of high arousal completely devoid of affect, that for decades researchers simply assumed that this was so, without testing this assumption empirically.

Among numerous such examples, in a classic study cited over 1000 times, Isen, Daubman, and Nowicki (1987) used exercise to induce what they termed "affectless arousal" (p. 1122) or "arousal devoid of any particular affective tone" (p. 1128). Believing that exercise would not influence affect, they administered a scale measuring "affective tone" (feel "positive" vs "negative") only after exercise, making it impossible to ascertain whether a change from baseline took place. Upon reflection, the authors deemed that the use of such a measure was "inappropriate … for treatments such as the exercise condition, in which … there is no apparent reason for the question and it is therefore too reactive" (p. 1125).

In another example highlighting the importance of proper measurement, Anderson, Deuser, and DeNeve (1995) used exercise to test the validity of a self-report measure of arousal. Finding that the scores on the scale increased from before to after exercise, and subsequently decreased during recovery, the authors concluded that the measure was "sensitive to changes in perceived arousal created by brief exercise" (p. 441). While this might have seemed a reasonable conclusion, closer inspection of the items of this measure reveal a nearly perfect confound of arousal and pleasure. Almost all items believed to indicate high arousal also denoted pleasure (eg, energetic, lively, vigorous, excited, sharp, alert, powerful). Conversely, almost all items believed to assess low arousal also denoted displeasure (eg, depressed, weak, drowsy, exhausted, sluggish, weary, dull, tired, worn-out, fatigued, sleepy). Therefore, the conclusion that exercise induced a state of pleasant high arousal arguably would have been more accurate.

2 History from the perspective of exercise science

Although statements extolling the benefits of exercise for mental health can be found in many ancient texts, as well as in the writings of passionate advocates for exercise and fitness from the fields of medicine, education, and physical education in the 19th and 20th centuries, formal research on this topic only began in the 1970s.

The impetus was an article published in the prestigious *New England Journal of Medicine* in December 1967 by psychiatrists Pitts and McClure (Pitts & McClure, 1967). Prompted by observations that symptoms characteristic of anxiety had been reported in response to exercise among patients with anxiety, Pitts and McClure claimed to have demonstrated that an infusion of lactate (a byproduct of glucose metabolism, which is elevated in blood in response to vigorous exercise) in patients with anxiety "reliably produces an anxiety attack" (p. 1334). In follow-up publications, Pitts (1971) more clearly implicated the elevated levels of lactate in response to exercise in causing anxiety attacks: "exercise produces both markedly enhanced anxiety symptoms and markedly increased blood lactate (as compared to normals) in anxiety neurotics" (p. 86). These statements were seized by the press and portrayed as suggesting that the avoidance of physical exertion was essential for the prevention of anxiety attacks in individuals with anxiety.

The Pitts–McClure hypothesis was unanimously refuted in subsequent studies, with commentators criticizing both the conceptual reasoning behind it and the experimental data that were used to support it. Nevertheless, the extensive publicity made many medical professionals reluctant to recommend exercise to their patients and many patients hesitant to follow recommendations to exercise. Exercise scientists, who typically also tend to be exercise advocates, quickly realized the potential ramifications of this trend and felt the need to respond.

Morgan, Roberts, and Feinerman (1971) wrote that, while the Pitts–McClure conclusions "imply that physical activity may evoke undesirable psychologic changes," this contrasts with numerous anecdotal observations, in which "'normal' individuals invariably report that they feel better following physical activity" (p. 423). Noting that "unfortunately, this 'feeling better' sensation has not been corroborated by objective psychologic data" (p. 423), Morgan et al. (1971) conducted the first experimental studies on this topic. In their first study, 120 male university professors were randomly assigned to either a bout of exercise on a treadmill ($N = 60$) or a cycle ergometer ($N = 60$), with each group further randomly subdivided into groups ($n = 15$ each) that raised their heart rate during exercise to 150, 160, 170, or 180 beats/minute. After a recovery electrocardiogram that took 5 minutes, the participants completed the Depression Adjective Check List (Lubin, 1965), which was administered with a "How you feel today" response set. In a second study, 36 university students (men and women) were randomly assigned to one of three conditions, each lasting 17 minutes: (1) treadmill walk at 3.5 miles/hour and 0% grade, (2) treadmill walk at 3.5 miles/hour and 5% grade, or (3) supine rest. Immediately after these treatments, the participants responded to the Depression Adjective Check List (Lubin, 1965) and the Institute for Personality and Ability Testing Anxiety Battery (Cattell & Rickels, 1964). No significant group differences were found in either study. Nevertheless, the authors noted that "even though significant psychologic changes were not observed, the majority of the subjects tested in these studies reported that the exercise bouts were exhilarating and they 'felt better' following the exercise" (Morgan et al., 1971, p. 425). The authors identified the "psychometric instruments" as the central culprit responsible for the inconsistency between the anecdotal reports from participants and their questionnaire data: "It is possible that the psychometric instruments were not

sensitive enough to measure psychologic changes in normal subjects" (p. 425). In response, they announced that they were "constructing a feeling better scale (FBS) in the hope of quantifying the feeling better sensation" (p. 425).

In actuality, the "Feeling Better Scale" was never developed or at least never published. The reason was the publication of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970) and the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971), which, as it turned out, provided the needed evidence of psychological benefits resulting from exercise. Morgan (1973) reported a series of small studies in which vigorous exercise (ie, at an intensity that should have resulted in substantial elevations of blood lactate concentrations) resulted in reductions in state anxiety and mood disturbance. Morgan (1973) concluded that these findings "seriously challenge the Pitts–McClure hypothesis" since they demonstrate that "muscular exertion reduces, not increases, state anxiety" (p. 114). These initial findings formed the basis of a line of research which, over the next four decades, produced hundreds of studies and dozens of reviews, overwhelmingly claiming to demonstrate that "exercise makes you feel good" (Fox, 1999, p. 413). This mantra still represents the orthodox viewpoint within exercise science. As such, it is echoed in university textbooks and the popular press alike.

There is one problem, however. If "exercise makes you feel good" were true, it would be reasonable to surmise that most people would choose to exercise and be physically active. In other words, there would not be an epidemic of physical inactivity. However, a nationwide study in the United States showed that, when physical activity was measured by objective means (by devices called accelerometers), 97% of adults failed to accumulate 30 minutes of daily moderate-intensity activity on at least 5 days/week (Tudor-Locke, Brashear, Johnson, & Katzmarzyk, 2010), which is the currently recommended minimum amount of physical activity for health promotion. This suggests that either the particular behavior of physical activity represents the starkest violation of the basic hedonistic principle that has ever been identified or there is something fundamentally wrong with the research (Backhouse, Ekkekakis, Biddle, Foskett, & Williams, 2007).

3 The dependence of the research process on measurement

The history summarized in the previous sections illustrates certain noteworthy pitfalls in the research process. In psychology, researchers relied for decades on the untested assumption that exercise produces nothing more than "affectless arousal." Even when they ventured to empirically test this assumption, weaknesses in the measurement were overlooked, leading researchers to conclude that the previous assumption was correct. Similarly, in exercise science, measurement was seen as a tool whose function was to generate empirical substantiation for a conclusion that fit a virtuous agenda, namely the promotion of salubrious exercise and physical activity.

A valuable lesson that can be learned from this past experience is that, once a certain research practice (eg, acceptance of an untested assumption, selection of a

particular measure) enters the literature, it is likely to be emulated, without critical reappraisal, perhaps even for decades. One of the factors that may motivate this tendency is the fear that, if a crucial methodological element (such as measurement) is deemed erroneous, years of previous research would be called into question. Thus, research often continues down the wrong path because the alternative (ie, taking corrective action but, in the process, possibly invalidating a portion of past findings) is considered too costly. This scenario occurs with sufficient regularity that it warranted a specific warning in the report of the Task Force on Statistical Inference of the American Psychological Association: "Innovators, in the excitement of their discovery, sometimes give insufficient attention to the quality of their instruments. Once a defective measure enters the literature, subsequent researchers are reluctant to change it" (Wilkinson, 1999, p. 596).

In psychology, dozens of published articles reproduced the notion that exercise elicits "arousal" that is devoid of any positive or negative affective content. The studies that were based on this untested assumption are still cited as valid today. In exercise science, the STAI and the POMS, the two measures selected by Morgan in the early 1970s as the only available options that quickly enabled him to respond to the Pitts–McClure hypothesis, remain the most widely used measures in investigations examining the effects of exercise (Ensari, Greenlee, Motl, & Petruzzello, 2015). In fact, extensive prior usage within this research context is explicitly cited as the main reason for their selection, an argument that is evidently found adequate and convincing by peer reviewers and journal editors alike. For example, in one study, the STAI was selected because it "is the most cited anxiety instrument in the context of exercise" (Smith, 2013, p. 373). In another, the POMS was used because it "has been used in many exercise studies" (Sibold & Berg, 2010, p. 335). In a third study, both questionnaires were used; the former "to allow for comparisons" with previous studies and the latter because it is "one of the most frequently used mood measures in sport and exercise psychology" (Johansson, Hassmén, & Jouper, 2011, p. 61).

Under normal circumstances, researchers must first decide which construct to study and, only once they have achieved clarity on this fundamental question, proceed to the equally demanding and complicated step of selecting the best instrument for assessing this construct. It is evident, however, that given the peculiar origins of research on the effects of exercise on the affective domain (ie, haste to document the "feel-good" phenomenon with whatever psychometric instrument was available), this natural progression was violated. In essence, the availability of measures at a particular historical juncture dictated the focal constructs.

It is interesting to note that this point was later conceded by William Morgan. After noting that "much, perhaps most, of the literature dealing with the psychologic effects of exercise has relied on the use of objective self-report inventories designed to measure constructs such as anxiety and depression," Morgan (1984) acknowledged that this has happened despite the fact that "the extent to which these inventories can tap the psychometric domain of significance to the exerciser has not been evaluated" (p. 134). Among the possible consequences of violating the natural progression from identifying a construct of interest to selecting an appropriate measure, Morgan wrote that "an investigator may employ an objective, reliable, valid test of anxiety or depression to

quantify the psychologic effects of exercise, only to find that no 'effects' have taken place when, in fact, there may have been numerous effects" (p. 134).

4 The importance of knowing your measure

The research on the effects of exercise on state anxiety and mood states, despite the methodological shortcomings that characterize all emerging lines of research, has been instrumental in launching the fascinating and prolific field of exercise psychology. A major focus of this field is on the effects of exercise and physical activity on numerous facets of mental health. Based on research produced over the past half century, clinical guidelines in several countries today recommend exercise as an evidence-based, cost-effective option for the treatment of adult depression. In addition, for many people, exercise and physical activity are their preferred options for regulating mood. While the achievements of this line of research are undeniable, some methodological limitations remain, with measurement being perhaps one of the most consequential. In the following sections, we critically review the three most commonly used psychometric instruments and highlight certain limitations and their implications. Identifying limitations, and appreciating their possible implications, is an important first step in initiating corrective actions and stimulating progress.

4.1 Understanding the State-Trait Anxiety Inventory (STAI)

Not surprisingly, some of the problems plaguing the measurement of emotion-related constructs in other areas of psychology have also been prevalent in the line of research investigating the effects of exercise. For example, the state-anxiety scale of the STAI (Spielberger et al., 1970) is commonly used as a general measure of "how people feel" when they exercise. However, this scale was developed to measure a very specifically defined and narrowly demarcated emotional response (ie, state anxiety), in accordance with Spielberger's highly influential cognitive theory of anxiety. Thus, in the context of this theory, a state-anxiety response is theorized to occur following an appraisal of (mainly ego-related rather than physical) threat. The state-anxiety scale of the STAI was developed to assess a constellation of cognitive, experiential, behavioral, and perceived autonomic symptoms, presumed to manifest in unison, and jointly constitute a "syndromal" response to the appraisal of threat. According to Spielberger, Lushene, and McAdoo (1977), state anxiety is an "emotional reaction or response that is evoked when a person perceives a particular situation as personally dangerous or frightening for him" (p. 242, sexist language in the original). Thus, for the STAI items to be considered valid indicators of the construct of state anxiety, it is assumed that, prior to responding to the questionnaire, the research participant was presented with a potentially threatening stimulus and that this stimulus was cognitively appraised as threatening: "If an individual appraises a specific situation as threatening, it is assumed that he will respond to it with an elevation in [state anxiety]; ie, he will experience an immediate increase in the intensity of an unpleasant emotional state characterized by consciously experienced feelings of tension, apprehension, and

heightened autonomic system activity" (p. 242). In other words, the theory upon which the STAI was based sets forth a very specific scenario in which the measure should be used and the scores should be interpreted.

Research within the context of acute exercise has uncovered an additional pitfall that had not been identified in other contexts. Specifically, in most other research situations, experimental manipulations specifically target the appraisal of threat, either trying to induce it (eg, exposing participants to a phobic object) or alleviate it (eg, through sessions of cognitive-behavioral psychotherapy). In these scenarios, the items of the state-anxiety scale respond in a more-or-less unified fashion (ie, there may be differences in the degree of change but typically not in the direction of change). This pattern of results is in line with Spielberger's theory and has, therefore, appropriately been considered evidence supporting the validity of the state-anxiety scale. However, in exercise studies, experimental manipulations are designed to change the level of autonomic activation (increase it during exercise, decrease it during recovery), not the appraisal of threat. This is a unique experimental scenario that seems inconsistent with Spielberger's theory of anxiety. Consequently, the item pool exhibits a "fission" phenomenon, with items that tap somatic activation responding in an opposite direction from others. For example, in response to a bout of exercise, participants report being less "at ease," less "calm," less "relaxed," less "steady" (all scored as indicating a higher level of state anxiety) but also, at the same time, less "nervous" and less "worrying" (Ekkekakis, Hall, & Petruzzello, 1999). Not only does this phenomenon cause a disintegration of the internal consistency of the scale but it also clearly renders the total score invalid as a measure of state anxiety as conceptualized by Spielberger.

Despite these issues, the STAI remains one of the most popular measures in studies investigating the effects of exercise on "how people feel." This is in spite of the fact that the participants are, in nearly all cases, neither trait-anxious nor state-anxious, and the experimental protocols do not involve a manipulation of the appraisal of threat (Ensari et al., 2015). Even more disconcertingly, it has become common to administer the state-anxiety scale of the STAI and then interpret the results as referring to the vast and conceptually distinct domain of "mood." For example, after a comparative evaluation of different measures that could be used to evaluate how patients with fibromyalgia feel in response to exercise bouts, the authors concluded: "we recommend … the STAI to measure exercise-induced changes in mood" (Gowans, DeHueck, & Abbey, 2002, p. 608).

4.2 Understanding the Profile of Mood States (POMS)

Like the STAI, the POMS remains a very popular measure in studies investigating the effects of exercise on how people feel, nearly half a century after it was first used for this purpose. When authors offer a specific argument to justify the selection of this particular measure, they almost invariably invoke its extensive prior use.

The most common mistake in using the POMS is the inappropriate extrapolation from the six specific states assessed by this questionnaire (ie, tension, depression, anger, vigor, fatigue, and confusion) to the content domain of "mood" in general. For example, after finding that a bout of exercise increased the score of the Vigor scale

and decreased the scores of the Tension and Depression scales, authors commonly conclude that exercise improved "mood." In other cases, researchers may find that different types or amounts of exercise did not produce significant differences in any of the POMS scales and conclude that the experimental conditions had no effect on "mood." In making this type of extrapolation, researchers are essentially putting forth the bold theoretical thesis that the global domain of "mood" can be satisfactorily reduced to the six distinct states tapped by the POMS. However, there is neither any empirical evidence that this is true nor even a claim by the developers of the POMS that this was the intent when the scale was developed (McNair et al., 1971).

In actuality, the POMS, originally named the Psychiatric Outpatients Mood Scale, was developed to capture those states that, based on clinical experience, psychiatrists considered relevant in assessing the effects of various psychotropic drugs, particularly among war veterans with anxiety or what would now be characterized as posttraumatic stress. Anxiety and depression were the primary targets. Because the inability to control outbursts of anger or hostility and to maintain adequately high levels of vigor (energy) and low levels of fatigue were commonly reported side effects of medications, these states were also included. Finally, some authors have expressed puzzlement over the inclusion of "confusion" in a questionnaire that purportedly assesses mood, although by most accounts confusion is not a "mood." This decision can be explained by the desire of the developers of this questionnaire to include a scale that assessed any disruptive effects of psychotropic drugs on judgment and mental clarity. Therefore, despite its unquestionable popularity over many years, it should be clear that using the POMS in exercise studies does not allow researchers to extrapolate findings about the effects of exercise on the global domain of mood.

4.3 Understanding the Positive and Negative Affect Schedule (PANAS)

While not as popular in exercise research as the STAI and the POMS, the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) has also been used in several studies investigating the effects of exercise on how people feel. Unlike the STAI and the POMS, both of which were developed to measure distinct states, the PANAS was developed with the express purpose of capturing two dimensions, namely Positive Affect (PA) and Negative Affect (NA), which can jointly provide an encompassing representation of a global domain of content. Therefore, in theory, by using the PANAS, researchers would be justified in extrapolating from assessing PA and NA to drawing conclusions about a broader, superordinate construct.

While this could be considered an important strength of the PANAS, the potential benefit to researchers is limited by the fact that the exact nature of the superordinate domain of content represented by the item pool is ambiguous. Some items refer to emotions (eg, proud, guilty, ashamed), others refer to mood states (eg, irritable, upset), and others refer to core affect (eg, nervous, jittery). There are even several items that seem to refer to cognitions and self-appraisals (eg, interested, strong, inspired, determined, attentive).

Secondly, the labels given to the two constituent dimensions of the PANAS, namely "PA" and "NA," have been widely misinterpreted as referring to all varieties

of pleasure and displeasure, respectively. For example, it is common to see PA used as a synonym of "happiness" and NA as a synonym of "sadness." Moreover, many researchers are convinced that, for example, PA encapsulates the full range of pleasant states, including those that involve high levels of activation (eg, excitement), medium levels of activation (eg, happiness), and low levels of activation (eg, calmness): "Positive affect comprises a range of pleasant states including happiness, excitement, and calmness. Negative affect comprises a range of unpleasant states including anger, sadness, and anxiety" (Jones, Lane, Bray, Uphill, & Catlin, 2005, p. 408). These beliefs are inaccurate, however. Although numerous authors, including the developers of the PANAS themselves, have tried to correct these misunderstandings over the years, their efforts have been largely unsuccessful.

Far from being benign, the confusion has severe and far-reaching implications. The most fundamental postulate in the development of the PANAS was that the PA and NA dimensions are orthogonal (ie, statistically unrelated). In accordance with this postulate, the items comprising the PA and NA factors of the PANAS were specifically selected to minimize the correlation between the two factors. One of the implications of this position is that one can experience both high levels of "PA" and "NA" at the same time. This has been widely misinterpreted as meaning that one can experience both pleasure and displeasure, or happiness and sadness, at the same time.

In actuality, the theoretical model that formed the basis of the PANAS clearly considers "happy" and "sad" as located at the two opposite ends of the same bipolar dimension named "pleasantness–unpleasantness" (see Watson & Tellegen, 1985, p. 221). In other words, contrary to numerous assertions in the literature, happiness is not part of PA and sadness is not part of NA. PA does not encompass all varieties of pleasure and NA does not encompass all unpleasant states. Rather, states characteristic of PA are only those that combine pleasure with high activation (eg, elated, enthusiastic, excited). Likewise, states characteristic of NA are only those that combine displeasure with high activation (eg, distressed, jittery, nervous).

Making things even more confusing, although many researchers have assumed that states like calmness and relaxation would be included in the domain of PA and states like sluggishness and drowsiness would be included in the domain of NA, this is not so. In the conceptual model of the PANAS, calmness and relaxation are, in fact, characteristic of low NA (ie, polar opposites of states like distressed and jittery). Likewise, sluggishness and drowsiness are, in fact, characteristic of low PA (ie, polar opposites of states like elated and enthusiastic).

A crucial point that is almost universally overlooked by researchers who select the PANAS for their studies is that another fundamental postulate used in the development of this measure was that all low-activation states were considered nonaffective and, therefore, were deliberately excluded from the scope of the PANAS. According to Watson and Tellegen (1985), the PA and NA dimensions are "descriptively bipolar but affectively unipolar" (p. 212). This somewhat cryptic statement means that, even though factor analyses yield bipolar factors (eg, distressed and jittery at one end and calm and relaxed at the opposite end), it is only the high-activation poles of these bipolar factors that should be considered affective: "only the high end of each dimension represents a state of emotional arousal (or high affect), whereas the low end of

each factor is most clearly and strongly defined by terms reflecting a relative absence of affective involvement (eg, calm and relaxed for Negative Affect, dull and sluggish for Positive Affect)" (p. 212).

Exercise researchers are probably greatly interested in low-activation pleasant states (eg, calmness, relaxation, serenity) and low-activation unpleasant states (eg, tiredness, fatigue boredom), as these may be relevant to how people feel after a bout of exercise. Thus, most users of the PANAS are surprised when they realize that "the PANAS scales … contain only the high-end markers and include no items assessing fatigue and serenity" (Watson & Clark, 1997, p. 276). This problem, however, has been raised repeatedly in the affect literature, where experts have issued warnings such as the following: "PANAS-PA and PANAS-NA scales do not measure all pleasant and unpleasant affective states, but rather measure only high-activation states. Researchers using those scales might assume that they are sampling the affective domain broadly, but in fact this is not so" (Feldman Barrett & Russell, 1999, pp. 12–13).

5 Three-step approach to measurement

As illustrated in the previous sections, the study of affective responses to exercise, over a period of 40 years, has undergone phases plagued by problems that can be found, in similar form, in several other areas of applied psychological research. These problems include, among others, lack of clarity about the exact nature and the limits of the construct of interest, allowing the availability of measures to dictate what construct is studied, a generally poor understanding of psychometric principles, and deep confusion about the scope and limitations of the most popular measures.

In the last few years, however, substantial progress has been made in the study of affective responses to exercise, as evidenced by several indicators. As one example, in a chapter published in the second edition of the *Handbook of Research Methods in Personality and Social Psychology*, Quigley, Lindquist, and Feldman Barrett (2014) wrote: "Exercise provides perhaps the most well-characterized way to manipulate peripheral physiological arousal producing an affective change" (p. 229). Labeling exercise as "perhaps the most well-characterized way" is significant considering that other methods have been studied not only for much longer periods of time but also by much larger groups of investigators (eg, sympathetic nervous system agonists such as epinephrine, alcohol, nicotine, opioid drugs). Certainly, the dramatic change in the psychological literature, within only the last 30 years, from viewing responses to exercise as "affectless arousal" (Isen et al., 1987) to the description by Quigley et al. (2014) above can be characterized as remarkable.

In the following sections, we outline the specific steps that have led to the transformation of this line of research, in hopes that this recipe can be applied, with similar positive results, to other fields. Specifically, a new approach to the measurement of affect has been the centerpiece of a general overhaul of the methodological platform that is used to study the effects of exercise on the affective domain. This new approach consists of using a three-tiered decision-making process for choosing a measure (Ekkekakis, 2008, 2012, 2013b) (Fig. 12.1).

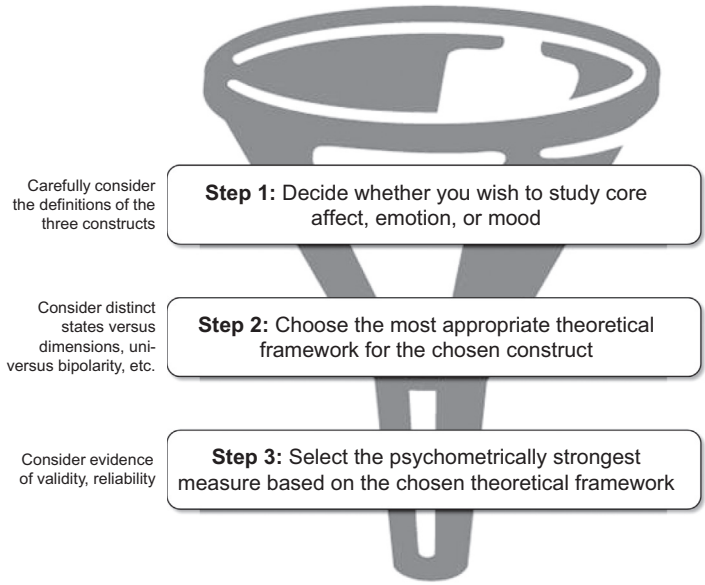


Figure 12.1 The three-step system for choosing (and justifying the selection of) a measure of core affect, emotion, or mood.

6 Step 1: Decide whether you wish to study core affect, emotion, or mood

As is common practice in most fields of psychological research, studies investigating the effects of exercise on how people feel have generally regarded the affective domain as undifferentiated and all constructs contained therein as essentially interchangeable. In other words, as alluded to in previous sections, it had become common practice, for example, to measure the emotion of state anxiety and then proceed to discuss the findings as referring to the domain of "mood." This confusion is a direct reflection of the lack of systematic attempts in psychology to draw lines of demarcation between the constructs that fall under the broad umbrella of affective phenomena. Even researchers specializing in the study of affective phenomena freely interchanged the terms "affect," "mood," and "emotion" in their writings at least until the 1990s. Since then, however, the hazards of continuing to pretend that this vast and obviously diverse domain is homogeneous became gradually apparent. As a result, leading theorists started proposing tentative sets of defining features that could begin to distinguish important constructs such as core affect, emotions (or prototypical emotional episodes), and mood (Russell & Feldman Barrett, 1999). While the inherent fuzziness of these constructs continues to present considerable challenges and consensus remains a distant and possibly unattainable ideal, a quasiconsensual classification scheme has emerged in practice. As one indication, for example, some textbooks on

emotion for undergraduate students now contain sections that attempt to explain how basic types of affective phenomena differ:

> *The term mood refers to a state that typically lasts for hours, days, or weeks, sometimes as a low-intensity background. When it starts or stops may be unclear. Whereas episodes of emotion typically have an object, moods are often objectless and free-floating. We feel emotions about specific people or events. Philosophers call the focus of an emotional experience its "intentional object." When you are angry, you usually have a very clear sense of what you're angry about (e.g., your roommate's arrogance or your dad telling an embarrassing story about your first date). When you're in an irritable mood, in contrast, it may not be obvious why you feel as you do: the intentional object is less clear.*
>
> Keltner, Oatley, and Jenkins (2014, p. 28).

Perhaps, given the complexity of the subject matter, perfect clarity and universal agreement among the members of the research community may never be achieved. Nevertheless, it should be evident that the scientific study of affective phenomena cannot advance without coming to terms with the fact, for example, that the displeasure of pain (an example of core affect), becoming angry at a coworker after a remark perceived as offensive (an emotional episode), and feeling irritable (a mood state) represent substantively distinct phenomena. The need for such distinctions is just as necessary in the context of exercise as it is in any other field of psychological research. This is because, like so many other situations or stimuli in life, exercise can induce responses in all of these classes of phenomena. Running outdoors on a hot and humid day, for example, raises core body temperature and accelerates fluid loss, causing dehydration. The bodily stress caused by these adverse environmental conditions, added to the stress of running itself, induces a strong sense of exhaustion and malaise that neither required an antecedent cognitive appraisal nor can be effectively suppressed by cognitive techniques, such as reframing or reappraisal. Sweating on the elliptical trainer in a crowded gymnasium and becoming aware of the stares of seemingly super-fit and youthful exercisers in revealing attire immediately triggers a cognitive appraisal of failing to live up to societal ideals of the perfectly toned, athletic physique. Leaving the cardiology clinic after a symptomatic treadmill test can put anyone in a negative mood for the rest of the week, causing withdrawal from family and friends, terse reactions during conversations, and an overwhelming sense of pessimism about the future. It is clear that these three scenarios involve varieties of affective responses that are experientially and mechanistically different. Therefore, a sensible approach to researching these scenarios must begin with a clear decision about which type of phenomenon (a core affective reaction, an emotion, or a mood) is involved in each of these situations.

6.1 What is core affect?

Russell and Feldman Barrett (1999) defined core affect as "the most elementary consciously accessible affective feelings… that need not be directed at anything" (p. 806). Unlike emotions (defined next), core affect is not about any particular cause

or object and can be found in "free-floating" form, unaccompanied by a cognitive appraisal, behavioral expressions, or coping attempts. In fact, one always experiences some variety of core affect. Examples of core affects include pleasure, displeasure, tension, and calmness.

Core affect is phylogenetically ancient, with deep evolutionary roots, because it is presumed to serve crucial adaptational functions. Core affect is the most fundamental motivational force, leading individuals to approach useful stimuli and avoid dangerous ones. The ability to elicit free-floating core affective responses in noncognitively mediated fashion has several adaptational advantages, including speed, reliability (due to the absence of any cognitive filtering), and a clear prioritization of behavioral options (Cabanac, 1992).

6.2 What is emotion?

In current theorizing, which is heavily influenced by the cognitivist perspective (eg, Lazarus, 1982, 1991a, 1991b), emotions are states that follow from the appraisal of a specific situation as having important implications for the well-being of the individual (eg, facilitating or endangering the achievement of an important goal). For example, if an individual interprets a situation as indicating that she or he has failed to live up to a desired standard, the result is the emotion of shame. Conversely, if the individual appraises the situation as indicating that an important, ego-enhancing objective has been achieved, the result is the emotion of pride. Emotions are generally defined as coordinated responses that involve multiple systems. Besides the cognitive appraisal at the core of the response, there is a characteristic core affective reaction (eg, a characteristic type of displeasure for shame and a characteristic type of pleasure for pride), a physiological "signature" that may be more-or-less specific to the particular emotion, a pattern of behavioral expression (most likely dictated or constrained by cultural norms), and corresponding actions and coping efforts (eg, approach or avoidance).

Emotions are always responses to a particular situational stimulus, so they are always triggered by something and are about something. The object or cause of the emotion, however, can vary. A person, thought, event, animal, or inanimate object may elicit an emotion; the cause may be real or imagined. In the context of an exercise class, an individual may cognitively appraise a social-evaluative threat and this may elicit the emotion of (social) anxiety. A cardiac rehabilitation patient recovering from bypass surgery may appraise exercise as dangerous, resulting in the emotion of fear.

6.3 What is mood?

Like emotions, moods are theorized to require an antecedent cognitive appraisal. What distinguishes moods from emotions, however, is that, unlike emotions, the stimuli that lead to the emergence of moods may not always be easily identifiable. For example, waking up in the morning in an irritable mood may be associated with a fight between the spouses the previous night; the memory of the fight itself may have faded but the unpleasant mood may linger on during the following day. Moreover, importantly, what is appraised in the case of moods may be different from what is appraised in the case of emotions. Although in emotions the object is typically specific and well-defined

(eg, a comment, a loud noise), in the case of moods the object may be unspecific and poorly defined (eg, "my life" or "the future of my children"). Thus, the cause of moods is often described as diffuse rather than specific. Moods also tend to have lower intensity and longer duration compared to emotions; moods may last for hours, days, weeks, or even months, whereas emotions typically last for seconds or minutes.

6.4 So, what should I study?

These short descriptions of core affect, emotion, and mood should help underscore that these phenomena are distinct; closely related and with fuzzy borders but nevertheless distinct. Therefore, continuing to interchange the terms or, worse, measuring one construct (eg, the emotion of state anxiety) but drawing conclusions about another (eg, mood) should be regarded as scientifically unjustified and counterproductive. As is often said, which construct an investigator should target depends on what the purpose of the research is. To return to the previous examples, if the objective is to provide a description of how an exerciser feels while running outdoors on a hot and humid day (ie, describe a response unknown in advance), without experimentally manipulating a particular cognitive appraisal, a reasonable target would be to examine the dynamics of core affect before, during, and after the run. If the goal is to study the state elicited in response to the perception that one's body shape or level of physical conditioning is being evaluated by critical observers in a crowded gymnasium, one is essentially hypothesizing that a cognitive appraisal of (ego-related) threat would occur, leading to the specific emotion of social anxiety. Finally, in a research scenario in which the investigator hypothesizes that a diagnostic treadmill test at the cardiology clinic may elicit a lasting sense of helplessness and a pessimistic outlook toward the future and life in general, a reasonable approach would be to focus on specific mood states, such as dysphoria and irritability.

7 Step 2: Choose the most appropriate theoretical framework for the chosen construct

Many investigators coming to the study of affective phenomena from other research traditions within contemporary psychology are perhaps used to working with constructs approached from one theoretical perspective (eg, the only one ever developed or one that prevailed over others in time). A characteristic example is self-efficacy, a construct derived from one particular theoretical framework (social-cognitive theory) and typically associated with one dominant definition. The consequence of approaching a construct from only one theoretical perspective is that there is also, typically, only one approach to the measurement of that construct. Thus, in several domains of psychological research, there is no formal decision-making process leading to the selection of a measure.

This is clearly not the case in the study of affective phenomena, however. Consider the aforementioned popular measures that have been used to study how people feel in response to exercise, namely the STAI, the POMS, and the PANAS. In the framework

that served as the theoretical basis of the STAI, state anxiety was conceptualized as a distinct emotional state, consisting of a cohesive cluster of symptoms. In other models of state anxiety that followed that by Spielberger, state anxiety was conceptualized instead as a multifactorial domain, consisting, for example, of cognitive and somatic factors of symptoms.

In the framework of the POMS, mood states were conceptualized as distinct states, each represented by a single unipolar factor. In addition to the commonly used (unipolar) version of the POMS, however, there is also a "bipolar" version. Instead of targeting six distinct unipolar mood states, this bipolar version targets bipolar factors (eg, anxious vs composed, hostile vs agreeable, depressed vs elated).

In the case of the PANAS, the targeted domain of content is the global domain of "mood" rather than distinct states. This global domain is presumed to be captured by the PANAS in its entirety. This is achieved not by measuring every conceivable distinct state that may be subsumed within it but rather by measuring two elemental, constituent dimensions that together define this domain, namely PA and NA. As explained earlier, the theoretical framework further postulates that PA and NA are orthogonal to each other (ie, statistically unrelated). Finally, this theoretical framework includes the controversial postulate that, although these two dimensions may be bipolar, the low-end poles are of no interest because they reflect the absence of affect and, therefore, they must be excluded from the scope of measurement.

In addition to the STAI, the POMS, and the PANAS, the literature on affective phenomena also includes numerous other conceptualizations and associated measures. Readers can appreciate that each of the fundamental postulates that comprise these theoretical frameworks has a direct impact on the measures based on these frameworks and shapes them (their scope, their limits, their internal structure) in a profound way. Altering the measure, in turn, also alters the measurements (the data) and, therefore, the conclusions the measure yields.

As Russell and Feldman Barrett (1999) warned, "some researchers use categories, some dimensions; some use bipolar concepts, some unipolar ones; some presuppose simple structure, some a circumplex, and some a hierarchy" (p. 805). Explaining the full meaning and the implications of these terms is beyond the scope of this chapter. Therefore, interested readers are encouraged to consult other sources, in which these ideas are presented in appropriate detail (eg, Ekkekakis, 2013b). What is crucial to emphasize here is that, unlike other domains of psychological research characterized by one dominant theory and one dominant approach to measurement, affective phenomena have been approached by a multitude of theoretical perspectives (one might even say an overwhelming diversity of theoretical perspectives). The differences between these theories are not subtle or trivial. The impact of these theoretical differences on measurement can be decisive. Consequently, researchers entering this field should regard the practice of presenting a measure in the Methods section unaccompanied by a supporting rationale as fundamentally inadequate. The selection of a measure of core affect, emotion, or mood must reflect a careful and well-informed decision-making process. Given the impact of measurement on the quality of the data that a study can ultimately produce, this decision-making process must be presented in sufficient detail to enable peer reviewers, editors, and other readers to evaluate it.

8 Step 3: Select the psychometrically strongest measure based on the chosen theoretical framework

In most published reports, the measures of core affect, emotion, or mood appear as de facto choices, unaccompanied by a supporting conceptual rationale. In an effort to provide at least some type of evidence to support their choice, authors occasionally add certain psychometric data (eg, an index of internal consistency). While offering some rationale may be better than offering no rationale, certain caveats are important to consider. Presenting psychometric data, such as convergent or discriminant validity coefficients or indices of model fit from confirmatory factor analyses, may be unhelpful, or even misleading, if this step is not preceded by the two previous steps outlined here. It makes little sense, for example, to argue that a certain factor model has been found to fit the data well if readers have been given no explanation for why that particular theoretical model was deemed appropriate for the study in the first place.

9 A research exemplar: The three-step approach to measurement in action

The gradual adoption of the three-step approach described here and elsewhere (Ekkekakis, 2008, 2012, 2013b) has arguably been a significant catalyst for progress in the line of research examining how people feel when they exercise. To illustrate the approach in action, we present here excerpts from a published study, in which the stated purpose was "to examine acute affective responses to exercise behavior as a predictor of future physical activity participation" (Williams et al., 2008, p. 232).

Step 1: Beginning to present their rationale for the measurement approach they used, the authors stated: "When considering the relationship between affect and physical activity, it is important to first distinguish among affect-related terms" (p. 232). They then proceeded to explain the differences between these constructs. After reviewing the previous literature, the authors arrived at the following summary statement, which establishes their reasons for focusing on core (basic) affect as their target construct:

> *All of the studies reviewed measured distinct affective states rather than basic affect. When examining the relationship between affective responses to acute exercise and future physical activity participation there are a large number of reasons to prefer basic affect over distinct affective states at the present stage of knowledge development. For example, distinct affective states such as tranquility, tension, or confusion-bewilderment do not lend themselves to any clear hypotheses concerning the relationship between affect and future behavior.*
>
> *Williams et al. (2008, p. 234).*

Step 2: Once they established their rationale for focusing on core affect, the authors proceeded to explain why they opted to adopt a dimensional perspective and, more

specifically, why they chose to focus on the bipolar dimension of affective valence as the most relevant construct for their specific purpose. Consistent with the ideas presented in this chapter, the key argument was that, given the focus of the study on motivation (eg, approach vs avoidance of physical activity), it is the bipolar dimension of valence (pleasure vs displeasure) that seems most relevant as a possible predictor of behavior:

> *Consistent with hedonic theory […], differences in positive–negative valence of basic affective responses to exercise among previously sedentary individuals may serve to reinforce or punish the behavior and in turn make future physical activity participation more or less likely. […] It is not clear which distinct affective states would have the greatest influence on subsequent physical activity, and since not all distinct affective states can be measured at one time, there would be a risk of failing to measure one or more crucial affective states.*
>
> *Williams et al. (2008, p. 234).*

Step 3: With their target construct clearly identified, and their arguments for a dimensional approach (with a particular focus on the dimension of affective valence) explained, the authors then proceeded to present their measure of choice. While reference is made to the previous use of the measure in the context of exercise research, the decision to choose this particular measure is justified primarily on the basis of the conceptual arguments presented in the preceding two steps. Here, additional information is provided about the construct validity of the measure by referencing correlations with other measures of affective valence, as well as measures of physical activity participation:

> *The Feeling Scale (FS) is a single-item, dimensional measure of the valence dimension of affect … Participants were asked to rate their present feelings on an 11-point good/bad bipolar scale with verbal anchors at +5 = very good, +3 = good, +1 = fairly good, 0 = neutral, –1 = fairly bad, –3 = bad, –5 = very bad. The FS has been used as a measure of affective valence in a number of physical activity studies […] and has been shown to be related to other measures of affective valence […], as well as present and past physical activity participation.*
>
> *Williams et al. (2008, p. 235).*

Following the three-step approach, as illustrated in this example, can reduce arbitrary decisions, can make misunderstandings and erroneous assumptions about the underlying theories easier to spot, can provide readers with the necessary information to meaningfully evaluate the reasoning behind the choice of measure, and may ultimately encourage researchers to think more systematically and critically about this crucial methodological decision. While the application of this three-step approach is slowly gaining ground, there is still much room for improvement. It is worth contemplating, for example, how much more rapid progress could be if journals required authors to fully document their choice of measures along the lines of the example shown here.

10 Conclusion and synopsis of current evidence

As illustrated in this chapter, psychologists have been speculating and introspecting about how exercise and physical activity make people feel since the dawn of psychology in the 19th century. The modern revival of this line of research in the 1960s was plagued by a variety of methodological limitations, with a haphazard approach to measurement being perhaps the most crucial and most consequential. The problems we identified in the preceding sections are not unique to this line of research, however. They are merely a reflection of the serious, widespread, and persistent problems that have long characterized the measurement of affective constructs in psychological research in general. Among the most disconcerting problems we highlighted here is the use of measures without providing an adequate rationale and without an accurate understanding of their scope and underlying theoretical bases. The specific misconceptions we identified in the use of the STAI, POMS, and PANAS are indicative of the severity of these problems and illustrate the need to reform current research and reporting practices.

The three-step approach to justifying the selection of measures of core affect, emotion, and mood in research reports was presented here as a possible remedy. The gradual adoption of this approach in studies investigating the effects of exercise and physical activity on affect over the past few years can be credited with the recent characterization of exercise as "perhaps the most well-characterized way to manipulate peripheral physiological arousal producing an affective change" (Quigley et al., 2014, p. 229). This description represents a remarkable departure from both the erroneous view within psychology that exercise produces merely "affectless arousal" (Isen et al., 1987, p. 1122) and the equally erroneous view within exercise science that the only effect that exercise has is that it "makes you feel good" (Fox, 1999, p. 413).

What contemporary research is showing instead is that the effects of exercise and physical activity on affect exhibit a dose–response pattern (Ekkekakis, 2013a; Ekkekakis, Parfitt, & Petruzzello 2011). As shown in Fig. 12.2, a short self-paced walk, for example, leads to a shift from a low-activation pleasant state (which is the baseline state for most healthy adults at rest) to a high-activation and even more pleasant state (Ekkekakis, Backhouse, Gray, & Lind, 2008; Ekkekakis, Hall, Van Landuyt, & Petruzzello, 2000). This "boost" of perceived energy is a highly sought-after effect, which many individuals pursue through various, occasionally unhealthy, means (ie, from caffeine and energy drinks to illicit substances). In contrast, strenuous exercise that causes a substantial disruption of homeostasis and prevents the maintenance of a physiological steady-state has been shown to cause a shift toward a high-activation unpleasant state associated with tension and distress (Ekkekakis, Hall, & Petruzzello, 2008; Hall, Ekkekakis, & Petruzzello, 2002). Dispelling any notions that the relationship between exercise and affect may lend itself to simplistic generalizations (eg, "exercise makes *people* feel…"), the evidence indicates considerable interindividual variability, which is maximized when the exercise poses an appreciable, though not overwhelming, challenge (Van Landuyt, Ekkekakis, Hall, & Petruzzello, 2000). As the aforementioned study by Williams et al. (2008) showed, consistent with the basic postulate of

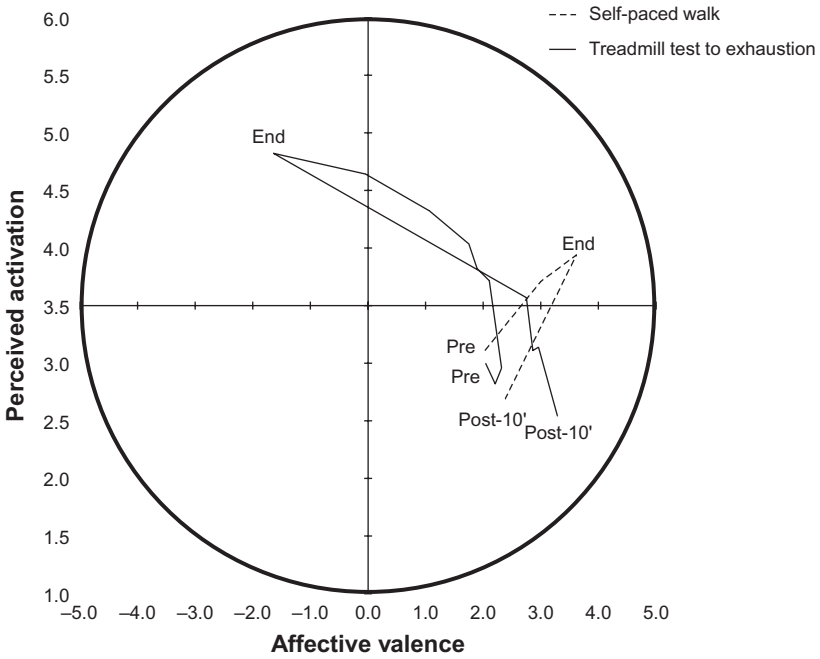


Figure 12.2 An example of affective responses to exercise, represented in "circumplex" affective space, defined by the dimensions of affective valence (pleasure–displeasure, along the horizontal axis) and perceived activation (low–high, along the vertical axis). The two experimental conditions shown are: (1) a 15-minute walk on the treadmill at a self-chosen pace and (2) a treadmill test (lasting on average for 11.3 minutes). *Pre* indicates the beginning of each activity, *End* indicates its end, and *Post-10′* indicates a time point 10 minutes after the end. Based on data reported in Ekkekakis et al. (2000) and Hall et al. (2002).

psychological hedonism, this variability in affective responses to exercise is a significant predictor of how physically active individuals choose to be in their daily lives.

In conclusion, the overhaul of the measurement approach used in the study of affective responses to exercise has proven both practical and fruitful. The adoption of the basic guidelines we outlined in this chapter has resulted in the revitalization of this intriguing line of research. We present this experience here in hopes that this approach can also be implemented in other areas of psychological research with similarly positive results.

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Methodological Issues in Consumer Product Emotion Research Using Questionnaires

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Sara R. Jaeger[1] *and Armand V. Cardello*[2]
[1]The New Zealand Institute for Plant & Food Research Limited, Auckland, New Zealand
[2]U.S. Army Natick RD&E Center, Natick, MA, United States

1 Introduction

The rapid growth of research into the emotions elicited by foods and other consumer products is a clear signal that industry continues to seek critical drivers of consumer behavior (notably, choice, purchase, and consumption decisions). In particular, there is an increasing desire to supplement insights beyond the sensory and hedonic product "diagnostics" routinely measured. In the past decade or so, product-evoked emotions have emerged as a potential new source of insight (Desmet & Schifferstein, 2008; King & Meiselman, 2010; Ng, Chaya, & Hort, 2013a) and this has led to futher development of questionnaires as a prominent way to quantify emotional responses (see chapter: Measurement of Consumer Product Emotions Using Questionnaires). Today, these are arguably the most ubiquitous methods for industry to assess product emotions in the food and consumer products sectors. Measurement of the experiential aspects of emotions using written surveys and questionnaires is therefore a pertinent topic and the focus of the current chapter.

With the rapid growth in the use and number of different questionnaire techniques to capture product-evoked emotions has come such questions as: "In what order should emotion words be listed?," "How should the intensity of emotions be captured?," "Which emotion scaling method is easiest to use for the consumer and for the researcher?," "How should emotion data be obtained when hedonic product evaluations are also desired?," "How do the characteristics of respondents influence the elicited emotions?," and "How does the product stimuli affect responses on these questionnaires?" The objective of this chapter will be to review the available data that address these and other important methodological issues that arise when employing questionaires to asses product-evoked emotions. In general, these will include factors related to the method itself, the product being tested, the environment in which the testing is done, who is doing the testing, and any person-based variables that have been shown to influence the obtained data.

Owing to the relative recency of consumer product emotion research using questionnaires, where direct data on these methodological issues are not available in the existing emotion literature, we will draw on and extrapolate methodological insights gained from the use of questionnaires in sensory product characterization, since the latter share many important similarities to the characterization of product emotions.

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Cultural factors, although highly relevant in an increasingly global society, are not considered due to a relative paucity of published papers. However, we consider this to be a probably significant determinant of the elicited emotion response and as such a worthy topic for future research.

Familiarity with questionnaires used in product-focused consumer emotion research is assumed. If lacking, we refer the reader to chapter "Measurement of Consumer Product Emotions Using Questionnaires."

2 The effect of word list length (number of emotions) and order of presentation

As seen in the preceeding section, the number of emotions included in published questionnaires and lexicons varies considerably. Many such instruments, for example, Consumption Emotions Scale (CES: Richins, 1997), Geneva Emotion and Odor Scale (GEOS: Chrea et al., 2009), and EsSense Profile (King & Meiselman, 2010) contain upwards of 35–40 emotions. Shorter versions of these questionnaires, for example, ScentMove™ (Porcherot et al., 2012) and EsSense25 (Nestrud, Meiselman, King, Lesher, & Cardello, 2016), designed for high-volume testing situations have fewer emotions, but still range around 20 words. While ScentMove™ was found to be highly correlated ($r = 0.90$) with GEOS (Porcherot et al., 2010) and multiple factor analysis (MFA) of the data showed good similarity between the dimensional representation of product spaces, similar positioning of products, and similar overall conclusions, and while EsSense25 was found to have good similarity in its dimensional structure to the full EsSense Profile, the researchers behind EsSense25 found evidence that the meaning of words changed between the longer and shorter lists and that there was evidence that the shorter list produced higher mean emotion ratings for the same emotions.

Against this background, the current section addresses whether the number of emotion words included in a questionnaire influences the elicited responses. Questions considered include "Is sample discrimination better with longer than shorter lists of emotion words?" and "Is the response to an emotion word directly influenced by whether this word is evaluated in a questionnaire that features 10 versus 40 emotion words?"

2.1 The effect of emotion word list length

2.1.1 Direct comparisons of emotion questionnaires with different list lengths

In a study directed specifically at assessing the differences produced by questionnaires containing different numbers of emotion words, Cardello, Borgogno, Craig, and Lesher (2014) compared the original 39-item EsSense Profile to EsSense25 and to a still shorter list containing only 10 emotion words that were a subset of both the EsSense Profile and EsSense25, and which had been down-selected from the longer list using the same sorting and clustering techniques implemented in Nestrud et al. (2016).

In this comparatively small-scale study, 96 consumers participated in three sessions. During each session, panelists were asked to report their emotional responses to four food names ("steamed broccoli," "potato chips," "apple pie," and "roast turkey"). During the first session, panelists from the same consumer panel were randomly allocated to one of the three questionnaire versions: the original 39-item EsSense Profile ($n = 32$), the 25-item EsSense25 questionnaire ($n = 32$), and the 10-item emotion questionnaire ($n = 32$). Among panelists using each questionnaire, half rated their emotions using a 5-point rating scale that was labeled "not at all," "slightly," "moderately," "very," and "extremely," while the other half checked their emotions using a CATA approach. In the second session, panelists received the same length questionnaire received in Session 1, but those who had previously used the rating format now used the CATA format and vice versa. Thus, questionnaire length was a within-subjects variable, while response format was a between-subjects variable. Food name order was randomized across both variables and the emotion words were presented in four different randomized orders for each ballot. During the third and final session, panelists received the same questionnaire (same number of emotions, same response format, and same randomized order) as they had received in Session 2. The purpose of Session 3 was to examine the test–retest reliability of all of the questionnaires.

Fig. 13.1 shows the mean number of emotions that were rated (ratings—left) or checked (CATA—right) on the 10-, 25, and 39-item emotion ballots. The means are averaged across emotion words and food names. As can be seen, the rating format (left) resulted in a higher mean number of responses than the CATA format (right) regardless of the number of emotions on the questionnaire ($P < 0.001$), and comparisons of the mean number of responses between rating and CATA formats for all three questionnaire lengths were also significant ($P < 0.001$). Secondly, the mean number of emotions that were rated (ratings—left) or checked (CATA—right) increased monotonically with increasing number of emotion words on the ballot. Comparison of the mean number of rated/checked emotions by the number of emotion words on

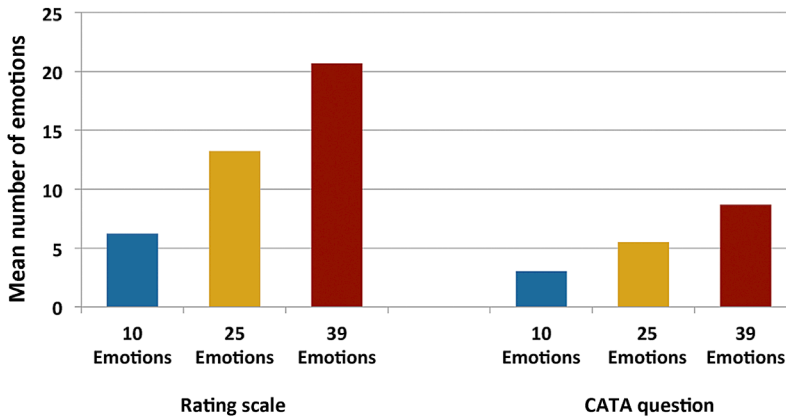


Figure 13.1 Mean number of emotions that were rated (ratings—left) or checked (CATA—right) on the 10-, 25-, and 39-item emotion ballots.

the questionnaire also showed these differences to be significant ($P < 0.0001$) for both the rating and CATA formats. Post-hoc tests showed that the mean for the 39-item questionnaire was significantly greater ($P < 0.001$) than the mean for the 25-item questionnaire and that both of these were significantly greater than the mean for the short, 10-item questionnaire for both rating and CATA formats.

Fig. 13.2 shows the mean emotion-intensity rating (ratings—left) and the mean number of times that an emotion was checked (CATA—right) for the 10 emotions common to all three questionnaires (10, 25, and 39 emotion words). As can be seen on the left, the mean emotional response decreases monotonically with the number of emotion words on the ballot. An ANOVA conducted on the mean responses by number of emotions on the questionnaire showed the effect to be significant ($F = 3.66$, $P < 0.027$, $df = 2$). Furthermore, Tukey post-hoc tests showed the 39-item and 10-item ballots to be significantly different from one another ($P < 0.05$). Although the mean intensity ratings for the 25-item questionnaire fall between these two, the mean response was not significantly different from the 39- or 10-item lists.

The right side of Fig. 13.2 shows the comparable data for the CATA format. The ordinate reflects the mean number of checks per questionnaire for the 10 common emotions across all food names. Although the 10-item questionnaire had a greater number of checks than the other two questionnaire lengths, the differences were not statistically significant.

The fact that more emotions are checked/rated when the list of emotion words is longer is consistent both with the notion that a longer list of emotion words provides "richer" data, and also with the notion that longer lists create a demand characteristic for a greater number of emotions to be checked or rated. Dissociating the emotions that are genuinely experienced from those that are the result of a demand characteristic is a difficult task, but one worthy of future research.

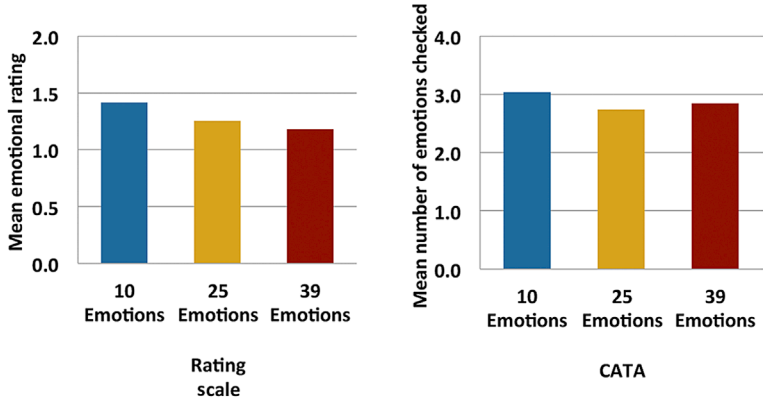


Figure 13.2 Mean emotion intensity rating (ratings—left) and the mean number of times that an emotion was checked (CATA—right) for the 10 emotions common to all three questionnaires (10, 25, and 39 emotion words).

The fact that the rating data show significantly higher mean ratings when the list of emotions is shorter (Fig. 13.2) supports the previous findings of Nestrud et al. (2016) and extends the findings from questionnaires of 39 versus 25 emotions to those containing only 10 emotion words. In contrast, the CATA data showed no significant effects of questionnaire length on the number of emotions that were checked for the 10 emotion words common to all three lists.

The above data may be interpreted as an analogue of the halo-dumping phenomenon seen in descriptive profiling. Halo dumping is a response bias that occurs when individuals are given a limited number of response alternatives with which to describe/rate a product (Clark & Lawless, 1994). This situation results in response values for salient attributes for which there are no available response alternatives being "dumped" into responses for other available attributes, producing higher mean ratings on those attributes. Just as complex sensory experiences can sometimes be difficult to deconstruct without a sufficient number and breadth of relevant sensory attributes (words), so too complex emotional experiences may be difficult to deconstruct into specific emotion words. In fact, the familial and overlapping nature of many emotion words/constructs (Ekman, 1999; Russell, 1980, 2003) makes it likely that certain emotions that do not appear on an emotion ballot may be "dumped" into the intensity ratings for other emotion attributes (words) that *are* present on the ballot. Such context-based perceptual and/or response biases must be considered when using emotion profiles containing a fewer or greater number of emotions. Although comparisons among stimuli/studies that use a common list of emotions are justified, comparison of emotion ratings obtained from questionnaires containing a different number of emotions must be viewed with caution.

In a similar study, Jaeger and colleagues (unpublished data) also directly compared effects of the number of emotions in a questionnaire. New Zealand consumers of kiwifruit ($n = 232$) evaluated images of three novel varieties of kiwifruit. Using a CATA question format, it was found that a questionnaire containing the 39 emotion words on the EsSense Profile resulted in a lower average number of selected emotion words than a questionnaire that continued the 25 emotion words retained in a reduced format of the EsSense Profile (EsSense25: Nestrud et al., 2016). The average number of selected emotions was 10.3 (SD = 8.4) and 7.6 (SD = 4.9), respectively ($P < 0.001$). When only the 25 emotion words included in both ballots were considered (ie, 25 of 39 words vs 25 of 25 words), this pattern of results held: 6.6 (SD = 4.9) and 7.6 (SD = 4.9), respectively ($P < 0.01$).

For the CATA question format, direct comparisons of the effects of the number of terms in a questionnaire have been performed in relation to sensory product characterization by consumers. Some relevant insights can be gained from that work. Ares et al. (2013) reported that citation frequency of terms increases as the number of terms in a CATA question is reduced. In other words, when a list is short, the average citation frequencies for each term is higher than the average citation frequencies for terms included in longer lists. Progressing beyond consideration of term citation frequency, Jaeger et al. (2015a) reported that the number of terms in a CATA question for sensory product characterizations by consumers has little overall effect on the derived sensory spaces. In seven studies with >700 consumers they found that shorter lists (10–17 terms)

yielded sensory product characterizations that were highly similar to those from longer lists (20–28 terms). However, there was some evidence that longer lists were associated with reduced discriminatory ability of the CATA question. Assuming that these methodological findings generalize from elicitation of sensory product characterizations to elicitation of emotional associations, it appears that citation frequencies for individual emotion words in a questionnaire are affected by the length of the CATA list. Hence, if R&D decisions are based around specific values for citation frequency, then it would be prudent to work with a standardized questionnaire. With regard to the possible reduced discriminatory ability of longer questionnaires, practitioners need to take into consideration the objectives of their emotion research. Longer questionnaires can have merit from the perspective of capturing subtle variations in experienced emotional association/consumer heterogeneity in emotional experiences.

2.1.2 Is there an optimal length of emotion questionnaires?

Practitioners using questionnaires in product emotion research may ask whether there is an optimal number of emotion words to include in empirical research. In our opinion there is not. In high-volume testing situations, where many samples need to be assessed, fewer emotion words may be desirable. Probably in such situations, a standardized list of words that are specific to the focal product category has been developed. Where investigations into the emotional footprint of a product are just beginning, it would seem more sensical to begin with a larger list of emotion words that can be reduced in length over time. In this regard consumer product emotion research is no diffferent from other aspects of product consumer research. The methods used need to be aligned with the research objectives and other empirical testing parameters. This recommendation is commensurate with sound research decisions for other consumer research methods. For example, Jaeger et al. (2015a) conclude that it is unlikely that there will be an optimal number of terms to include in a CATA list, and rather it is expected to depend on study-specific variables such as research objectives, product category, degree of difference among samples, and consumer characteristics. In this regard, best practice for implementation of CATA questions is no different to other methods/research endeavors in sensory and consumer research.

2.2 Effects of emotion word order and order of emotion elicitation versus other product responses

2.2.1 Effects of emotion word order

To date there has been a lack of consistency in published research regarding the order in which emotion words are listed in questionnaires. Alphabetical presentation of emotion words has been used (eg, Manzocco, Rumignani, & Lagazio, 2013; Piqueras-Fiszman & Jaeger, 2014a, 2014b), although randomization appears to have been more common (eg, Chrea et al., 2009; Ng et al. 2013a, 2014b; Spinelli, Masi, Zoboli, Prescott, & Monteleone, 2015). In some instances a small number of fixed presentation orders have been used (Piqueras-Fiszman & Jaeger, 2014b; Richins, 1997), and at times this aspect of empirical execution is not reported (eg, Coleman, Miah, Morris,

& Morris, 2014; Ferdenzi et al., 2013, 2010; Piqueras-Fiszman & Jaeger, 2014c; Porcherot et al., 2010; Schifferstein, Fenko, Desmet, Labbe, & Martin, 2013).

The developers of the EsSense Profile directly compared product emotion profiles elicited using an alphabetical presentation order versus randomized presentation order of words and found no significant differences. They suggested that an advantage of using alphabetical order is that consumers can get acquainted with the ballot more quickly and shorten the sample evaluation (King, Meiselman & Carr, 2013). Yet, they acknowledged that their findings may not generalize to other settings. To our knowledge there are no other published comparisons of effects of emotion word order in product research, to confirm or question this result. However, we note that Ares et al. (2013) demonstrated a bias in the sensory profiles and effects on product discrimination when CATA terms were presented in fixed order versus according to experimental designs that balance for presentation order effects.

Until further empirical evidence is gained, we recommend prudence and advocate that fixed presentation order of emotion words be used with caution, since it has also been reported to introduce systematic bias in the survey research literature (eg, Schuman & Presser, 1981; Sudman, Bradburn, & Schwarz, 1996).

This recommendation is also supported by evidence from eye-tracking studies. For the CATA question format, Ares et al. (2014c) captured visual attention by consumers when completing a sensory product characterization task. Using potato chips and plain crackers as the product categories, consumers answered CATA questions with 20 terms presented in either fixed order (31 consumers) or different orders for each sample (balancing for presentation order effects) (31 consumers). For the first sample, consumers, on average, fixated their gaze on slightly less than 90% of the CATA terms and then selected the ones which were applicable. For subsequent samples consumers changed how they answered the question, reducing the number and duration of the fixations. This was indicative of reduced cognitive processing. Presenting the terms in different order for each sample significantly increased the total number and duration of fixations, which indicates higher cognitive effort. Strategies that encourage greater cognitive engagement were recommended by the authors. Relative to fixed presentation order of terms, within-subjects, balanced presentation of the CATA terms represents a step in the right direction.

Using eye-tracking technology to investigate visual processing of CATA questions for sensory product characterization by consumers, Ares, Antúnez, Giménez, and Jaeger (2015a) provided further evidence pointing to concerns when using fixed-term presentation order, and noted the similarity of their findings to eye-tracking research for web surveys (eg, Galesic, Tourangeau, Couper, & Conrad, 2008). In summary, we advise that fixed presentation orders be used with caution, and agree with Ares et al. (2015a), who said: “If fixed term presentation order are used, then terms positioned at the bottom part [of the questionnaire] will be less visually processed. Since visual attention is a pre-requisite for information acquisition (Holmqvist et al., 2011) and consequently term selection, such terms may not be considered for selection, hereby possibly biasing the elicited sensory product characterisation.” For the sake of completion we note that these results pertain to CATA responses and may not generalize to rating scales. This is a worthy topic of future research.

2.2.2 Effects of emotion question order in product evaluations

Another aspect to consider regarding order effects concerns the order of emotion elicitation relative to other responses provided by the consumer participants. With the EsSense Profile, overall product acceptability is obtained prior to emotion scaling, and this has a certain logic, considering that liking is a global affect (positive vs negative), whereas emotion word evaluations constitute a more analytic process. Tentatively, this order is rooted in common practice in sensory and consumer research, where it is customary to obtain a global evaluation first (ie, liking) and analytic responses subsequently (ie, attribute diagnostics).

A direct comparisons of position order of the emotion questionnaire in relation to other product evaluations was performed by King et al. (2013), who found that overall acceptability was significantly reduced in three of four experimental conditions when asked after versus before the emotion questionnaire. The magnitude of this bias was larger when emotion responses were obtained as ratings than through CATA. Additional insight to question order bias can be gained from the second study reported by Ares and Jaeger (2013). Using the CATA question format, emotional associations were elicited, together with hedonic responses, purchase intentions, and sensory characterizations. One aspect of the study pertained to presentation order of the sensory CATA list, which differed across two ballot formats. Another aspect of the study, previously unpublished, pertained to the emotional responses, which were either elicited before or after hedonic and sensory responses. The product category was apples and two samples were tested. In condition 1 (58 consumers) emotion response were collected before hedonic, sensory, and purchase intent responses. In condition 2 (49 consumers), the order was sensory, hedonic, emotion, and purchase intent. A single ballot (A3 paper) was used per sample, presenting all four methods. The CATA question format was used for sensory and emotion responses. The 39 emotion words of the EsSense Profile were used (alphabetic presentation order) and the average number of selected emotion words per respondent was larger when emotion responses were elicited later in the testing sequence (ie, condition 2) (6.2 (SD = 5.6) vs 7.8 (SD = 6.1)) ($P < 0.05$). There were no instances where an emotion word was selected less frequently in condition 2 than in condition 1. This suggests that method order bias exists, and therefore that emotion data for the same products elicited under different experimental conditions will differ. The magnitude of the effect is unknown, although it seems reasonable to expect that the overall emotion profiles will be comparable. Given the paucity of published material on this issue, it is difficult to provide firm recommendations regarding order, but it may be prudent to elicit first those data which are considered to be of greatest importance to a study. In product-focused sensory and consumer research it is customary to consider the liking question as most critical, and to preserve its integrity, it will commonly be the first elicited response.

An interesting finding from this study was that the citation frequency for *calm* was almost doubled when emotional associations were elicited as the third set of responses (of four), relative to when emotional associations were elicited as the first set of responses (of four) (43% vs 22%: $P < 0.05$). *Calm* was the emotion word that differed most in frequency of use between the two experimental conditions, and this could point to unease about the testing situation and/or the emotion task. Issues relating to consumers' task perception are addressed in Section 6.

3 The effect of instructional set and frames of reference (contexts)

Many aspects of empirical execution have the potential to influence the elicited emotional associations. In this section, influences linked to the instructions given to participants regarding task completion, the consumption frame of reference and other contextual characteristics are considered with regard to their potential influence on emotional responding.

3.1 Effect of instructions to participants regarding task completion

The developers of the EsSense Profile advocate that participants are instructed in task completion without drawing attention to the emotions being scaled. They favor language that simply directs participants to taste the sample and report how they feel by rating/checking the listed words. Empirical work by Caedello and Jaeger uses a similar approach and our experience is that the elicited product emotion profiles have face validity and that the data in most situations discriminate between the samples of interest. We are not aware of empirical research that directly compares different instructions to participants, but we anticipate that this aspect of methodology may be associated with some changes in responses. Probably, they are minor relative to differences linked to product category. However, prudence suggests that if comparison of emotional profiles elicited in different studies is desired, then instructions and other aspects of data collection should remain unchanged.

In the following two sub-sections, other aspects of instructions to participants concerning task completion are considered. The first involves encouragement/discouragement of participant deliberation over task completion. The second pertains to when responses are elicited, that is, during or subsequent to sample tasting. For completeness we note that some authors do not provide the instructions to participants used to elicit emotion responses (eg, Coleman et al., 2014).

3.1.1 Direct comparison of instructions that encourage versus discourage participant deliberation

The CATA response format is easy for participants but can be associated with a satisficing response strategy. That is a response style that is characterized by a lack of careful consideration to the question. The Yes/No forced-choice question format (vs check all that apply) encourages deeper thinking/attention to the question format (Rasinski, Mingay, & Bradburn, 1994; Smyth, Dillman, Christian, & Stern, 2006) and instructions given to participants could possibly be further used to encourage deliberation.

In a study using images of kiwifruit (Jaeger, unpublished data), two instructions/data elicitation approaches were compared using a between-subjects design with 59 consumers in each group. One group of participants was instructed to: “Please think carefully and provide your answers only when you have done so” and a Yes/No forced-choice question was used. The other group of participants was given the instruction: “Please rely on your immediate reaction and provide your answers

quickly." The questionnaire format was standard CATA. Each of three fruit images (in color) were evaluated using the 39 emotion words of the EsSense Profile, and it was found that the average number of words ticked by respondents differed significantly between the two experimental treatments ($P < 0.001$). When participants performed the task "slowly," the average number of emotion words ticked by each person was 8.6 (SD = 5.6), while for the "fast" group this number was 4.6 (SD = 3.0) ($P < 0.001$).

This pattern of response held in a second study (Jaeger and colleagues, unpublished data), using the same visual stimuli but different consumers and a list of 25 emotion words (EsSense25; Nestrud et al., 2016). The average number of emotion words ticked by each person with the "slow" instruction and a Yes/No ballot was 10.1 (SD = 5.2), compared to 5.2 (SD = 3.1) ($P < 0.001$) for the "fast" instruction/standard CATA. When applied to sensory product characterization, Ares and Jaeger (2015) have previously reported the use of Yes/No forced-choice questions to be associated with an increase in the number of selected terms. Yet, the near doubling of the average number of selected terms found here is greater than previously seen, and likely due to the impact of instructions.

In light of this evidence, we consider it likely that instructions given to participants can significantly impact the elicited emotional associations. Assuming that these findings are confirmed by future research, we encourage practitioners to purposefully decide which instructions are more suited to a specific research objective—those which encourage/discourage deeper deliberation during task completion or those which encourage faster and more intuitive responding. Those who consider emotions to capture noncognitive responses may have reason to use the approach which promotes faster responding.

In this regard we note that different instructions to participants may be used at different stages in the research process. For example, Bhumiratana, Adhikari, and Chambers (2014) set out to develop an emotion lexicon for the coffee-drinking experience. In a preliminary test where an initial list of 118 terms was screened, participants were instructed to keep drinking the beverage as they went through the list of emotions. This seemed like a deliberate decision to: (1) direct participants to focus on the experienced emotions as they completed a lengthy task and (2) to align the testing process with their interest in the consumption experience which goes beyond a single sip of coffee.

3.1.2 Direct comparison of instructions that elicit responses simultaneously or subsequent to tasting of samples

A direct comparison of instructions that during-stimulus exposure elicits responses concurrent with versus subsequent to tasting of samples has, to our knowledge, not yet been performed in consumer product emotion research. However, some relevant insight regarding this methodological variant can be gained from the literature on sensory product characterization using CATA questions. Using the term "dynamics of sensory perception" Ares et al. (2013) referred to bias arising when CATA terms are assessed in the sensory evaluation process (during/after sample consumption). Study 4 by these authors compared the sensory product characterizations for apples elicited

under two different instructions: (1) complete the CATA question while eating the sample or (2) only complete the CATA question subsequent to eating the sample and focusing on the overall sensory experience. Confirming previous results by Ares and Jaeger (2013), they established that completing a CATA question while eating versus after eating a sample has an impact on sensory product characterizations and differences between samples. For example, some attributes that distinguished between samples when the CATA question was completed while eating were nonsignificant when the CATA question was completed after eating (*floral*, *earthy*, and *tropical*). Furthermore, the number of terms that discriminated between samples differed in the two conditions (14/16 vs 11/16).

With regard to product emotion research, it is possible that the elicited responses, if considered to be brief experiences, are so short-lived that they have faded by the time the sample is fully consumed and the CATA question completed. Ares et al. (2013) suggested that it may be desirable to instruct participants to consider the product experience in its totality and that the CATA question should be answered considering the overall impression of the product. If the temporal aspects of the emotional experience are thought to be of particular importance, then methods that provide temporal resolution should be considered (see chapter: Measurement of Consumer Product Emotions Using Questionnaires).

3.2 Effect of consumption frames of reference

Consumption context is widely acknowledged as an important determinant of eating experiences, emotional associations included. A bowl of cereal is most commonly associated with breakfast, but some people eat cereal as a snack, a quick lunch, or even a light dinner. The extent to which the consumption situation influences the elicited emotion responses is addressed below.

3.2.1 Evoked consumption contexts in product emotion research

Emotion responses to consumer products obtained in CLT settings are elicited in a consumption environment that is artificial, in the sense that it is not representative of any typical eating situation. Instead, we eat in natural settings, and Meiselman (2013) has urged investigators to "move beyond the laboratory" to achieve a better balance between research in controlled laboratory and natural settings.

A recent and welcome example of the measurement of affective feelings elicited in a natural setting was by Porcherot, Petit, Giboreau, Gaudreau, and Cayeux (2015) who conducted their research in an experimental restaurant. Their test product was a predinner apperitif drink (Kir, which is a tranditional French alcoholic beverage made from white wine and fruit liquor). The authors found that Kir made with raspberry fruit liquor significantly decreased negative emotion responses (measured with the ScentMove™ questionnaire), relative to Kir made with apricot and grapefruit liquor (less familiar variants of the drink).

In laboratory settings, which remain dominant in published product research, physical modifications of visual, auditory, and physical surroundings have been used to create

more "real" consumption contexts (eg, Sester et al., 2013). Considering that physical modifications of the laboratory are expensive and time-consuming, and may even surprise participants (Petit & Sieffermann, 2007), it is simpler to evoke a consumption context using written scenarios. Unlike modification of the physical testing environment, written scenarios allow consumers to individualize their consumption context by imagining specific aspects of the consumption context that are relevant to him/her. A benefit of this approach (Köster & Mojet, 2015) is that while the written scenario evokes a common context, the details of that context are unique to the consumer.

Hein and colleagues used evoked contexts in a series of laboratory studies focused on hedonic measurement (eg, Hein, Hamid, Jaeger, & Delahunty, 2010, 2012) and more recently Piqueras-Fiszman and Jaeger (2014a, 2014c) have used context evocation in product-focused emotion research. The latter authors explored how consumption contexts influence emotional responding toward foods using a checklist type of emotion questionnaire. Across different types of products, they found that the emotion associations can greatly differ when the products are imagined to be consumed in one context or another (eg, breakfast, lunch, or dinner). For example, a chocolate brownie eaten "after a special dinner" was more strongly associated with *energetic*, *friendly*, *joyful*, *loving*, *polite*, and *tender* than when eaten at a "weekend breakfast." However, in both of these situations, participants felt less *guilty* than when eating chocolate brownie for an "afternoon snack."

The written scenarios for context evocation also can vary in the detail given to participants. For example, Jaeger and Meiselman (2004) described the process of preparing a dish in considerable detail, while a short sentence was all the information provided by Piqueras-Fiszman and Jaeger (2014a, 2014c). Other authors, for example, Hersleth, Monteleone, Segtnan, and Næs (2015), have used a combination of written and pictorial information when evoking context. Readers interested in accounting for context-related factors in laboratory settings, would likely benefit from the approach recommended by Köster (2003), who promotes a situation-oriented experimental approach that integrates all contextual variables together by simulation. Low-cost options for lab studies, such as storytelling, and the use of projector slides and video clips, are suggested.

As an aside, it is also worth noting that emotion scales are being developed to capture eating and drinking in specific locations. An exemplary illustration hereof is the work by Han and colleagues (eg, Han, Back, & Barrett, 2009; Han & Jeong, 2013) to capture patrons' emotional experiences in upscale restaurants. Emotional responses are collected in situ using a questionnaire that has been carefully developed and validated. Other eating locations, such as food-courts in shopping malls, workplace canteens, school dinner halls, etc., could be considered for similar treatment. For product categories that are closely linked to a specific setting, this type of approach may also have merit, for example, for popcorn during a cinema visit.

3.2.2 *Effects of appropriateness of evoked consumption context*

In a given eating occasion, the appropriateness of the situations plays an important role in the enjoyment gained from eating and drinking (Schutz, 1988, 1994), and has been considered as a critical determinant of food choice behaviors (Köster,

2003). In Western countries, a bowl of cereal is typically considered more appropriate as a breakfast food than a dinner food. This variance in situational appropriateness may influence the consumption experience and the emotional associations to the product.

Piqueras-Fiszman and Jaeger (2014a, 2014c) uncovered evidence pointing to the use of positive emotion words being more frequent in those consumption contexts that were considered more appropriate. Conversely, negative emotion words were more frequently selected when the context was perceived as less appropriate for the product. A follow-on study (Piqueras-Fiszman & Jaeger, 2014b) further supported the suggestion that the consumption context and its perceived appropriateness might contribute to specific emotion associations. This was specifically addressed in a fourth paper by these authors (Piqueras-Fiszman & Jaeger, 2015a), which, despite still relying on evoked consumption situations, took a further step toward understanding eating in natural settings by taking into account interactions between the multiple contextual dimensions that intervene in a real situation. Appropriateness for consuming a particular food, for example, cereals for breakfast at home, may be high, but less so when one has breakfast at the office, where one is surrounded by colleagues and its appropriateness may be quite low. Hence, the appropriateness of consuming cereals at work might depend on the availability of privacy at the office. Consequently, consuming one's habitual breakfast cereals can be associated with either calmness and joy (if one is alone or in a family setting) or with worry and embarrassment if one is eating at work with others.

The experimental approach consisted of creating eating occasions varying in appropriateness. Across multiple studies which included different products, contextual dimensions, consumer populations, test locations, and emotion survey formats, the responses from 1336 consumers consistently revealed an effect of appropriateness on the emotional associations toward food products and eating occasions. Confirming the preliminary results in their earlier papers, Piqueras-Fiszman and Jaeger (2015a) reported that, on average, when eating occasions for a product were perceived as less appropriate, they were associated with a higher frequency of negative emotional responses than when the perceived appropriateness was high. Conversely, incidences of positive emotional responses increased with the appropriateness for product consumption in the eating occasion.

It also emerged that the effect of perceived appropriateness on the emotion associations was asymmetrical and product-dependent. For example, for ice-cream, regardless of whether eating occasions were perceived as very or not very appropriate, positive emotional associations were elicited. Conversely, the (imagined) consumption of an orange in an inappropriate eating occasion elicited an emotion profile that was quite balanced in terms of positive and negative emotions. The intermediate and highly appropriate eating occasions, however, featured a strong asymmetry toward the positive emotion words. Tentatively, these findings are in line with previous research showing hedonic asymmetry for emotional responses to food products (Schifferstein & Desmet, 2010). From an applied perspective, these results suggest that careful attention needs to be given to the evoked context, so that it fits the focal product and the target consumer segment.

3.2.3 Effect of stimulus and consumption frames of reference

Considering that the consumption frame of reference can significantly influence the elicited product emotion responses, it is also possible that the context provided to consumers regarding the stimulus may have an effect. Below we report on a study by Jaeger and colleagues that explored this assertion (unpublished data).

A central location test (CLT) with New Zealand adults as participants ($n = 118$: 35% female; 24–65 years old) was conducted using shortbread cookies as the product category. In a between-subjects design, two experimental treatments that induced different stimulus frames of reference were compared. Half of the consumer participants were instructed to "Think of the last time you were sitting in your living room watching TV or similar, and you were eating your favorite shortbread cookies." While imagining this situation, participants completed the EsSense Profile (CATA format) ("How do you feel?"). Four different types of shortbread cookies, commercially available in NZ supermarkets, were evaluated. The other half of the participants evaluated the same four samples, with the same emotion questionnaire, but a different set of instructions: "Think of the last time you were sitting in your living room watching TV or similar, and you were in the mood for a sweet snack." The average hedonic score (across the four cookies) was statistically equivalent in the two experimental treatments (6.2 (SD = 1.7) vs 6.0 (SD = 1.9)), and the emotion profiles were also very similar. As shown in Fig. 13.3, for only two emotions (*satisfied* and *pleased*) did the citation frequency tend to be higher in the experimental treatment that evoked the stimulus frame of reference pertaining to eating shortbread cookies. This suggests that the stimulus frame of reference (ie, last time you ate cookies) may have less of an effect on product emotion responses than consumption frames of references (ie, last time you were in the mood for a sweet snack). However, these data should be replicated with different products and stimulus frames of reference.

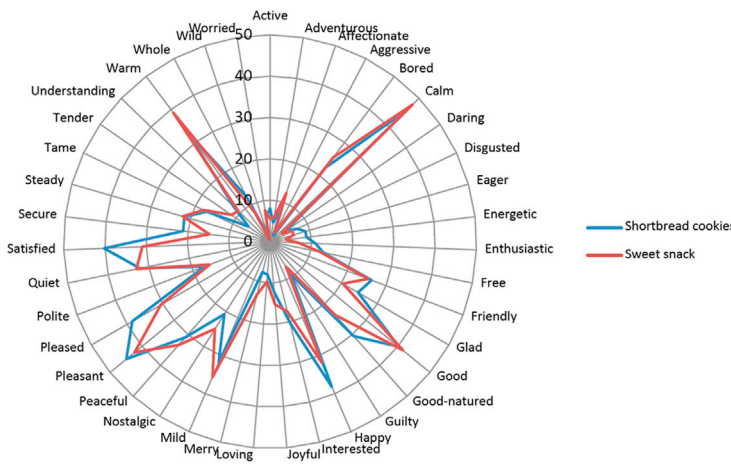


Figure 13.3 EsSense Profile responses for shortbread cookies (Jaeger et al., unpublished data). Values shown are CATA citation frequencies (%) for consumers in the stimulus frame of reference that pertained to eating shortbread cookies ($n = 59$) and consumers in the stimulus frame of reference that pertained to wanting a sweet snack ($n = 59$).

3.3 Effects of other situational and consumption-related variables

Direct tests of specific contextual factors on elicited emotion responses are relatively rare. A few examples are presented in this section and suggest that while such effects may occur, they are possibly less influential than those pertaining to context and perceived appropriateness, as described above.

Considering that questionnaire ratings can show time-of-day effects (Birch, Billman, & Richards, 1984), but acceptability ratings for tasted products do not (Kramer, Rock, & Engell, 1992), King et al. (2013) concluded that time-of-day effects in emotion responses elicited to tasted products would not occur. This was supported by the result that the average difference between mid-day and evening emotion ratings was less than 0.2 (on a scale of 5). Significant differences were only found for 7 of 39 emotions. We are not aware of others who have empirically addressed this question, but suggest that it is desirable to test products at a time of day that corresponds to the typical consumption time for the product. This would likely contribute to maintaining appropriateness of the situation, which has been shown to be important for elicited emotion responses (see Section 4).

Eating alone versus with others is considered by most people to be less enjoyable. This may influence emotion responses, especially when one is eating alone or in a public setting. In a study of students eating in a university cafeteria, Edwards, Hartwell, and Brown (2013) collected pre- and post-meal emotion ratings using a list of 47 emotions drawn primarily from Richins (1997). Upon examining the pre-meal emotion ratings, they observed that individuals who came to the cafeteria and dined alone had higher ratings for the negative emotions of *nervous*, *worried*, and *tense* than did those who dined in groups, tentatively confirming the notion that eating alone is less enjoyable. Post-meal emotion ratings for this group showed a significant decline in feelings of being *alone*, although the intensity of this emotion remained higher than in those eating in groups.

In a study that examined a related social contextual factor on emotion ratings, Piqueras-Fiszman and Jaeger (2015a) used oranges as the test product and evaluated emotion profiles for evoked eating situations that involved eating while travelling on public transport versus eating while sitting indoors by a table. The former was rated as more appropriate, and positive emotions were rated higher in the "sitting indoors" situation. Conversely, negative emotions were rated higher in the "eating while travelling on public transport" situation. Where a particular contextual feature is closely linked to a product's use, it may be important to ensure that that use is evoked when emotions are generated, otherwise, responses may translate poorly to actual consumption situations.

Moving from the social context of the meal to the physical environment in which the meal is eaten, Jacquier and Giboreau (2012) examined how the physical ambiance in a restaurant influences emotional responses. Working in an experimental restaurant, these investigators modified the ambiance in the restaurant by a combination of changes in the color theme (color of tablecloths, place settings, napkins, dishware), lighting, music, and furniture. Customers arriving at the restaurant in each of the different ambiance conditions completed pre- and post-meal emotion

ratings using a 20-item emotion questionnaire. Among the results, the researchers showed that a red-themed ambiance increased feelings of being tense after the meal, while a green-themed ambiance reduced feelings of being tense. A white-themed ambiance, on the other hand, made customers feel more *relaxed*, *serene*, and *reassured* after the meal.

In another study, both environmental and social contexts were combined to examine their effects on emotional responses. Piqueras-Fiszman and Jaeger (2014b) compared emotion responses to an image of a kiwifruit shown either by itself or on a plate with a nearby spoon and knife. The data were elicited under three evoked contexts (either to be eaten at a "weekday breakfast," at a "lunch outdoors," or at a "dinner at home with friends"). Regardless of the context, few differences between the two stimulus conditions were found (1–3 of 39 emotions). Although it is possible that these specific contextual factors may not have a large influence on the elicited emotion responses, there was some evidence that the more specific means of presenting the food stimuli (ie, picture with tableware vs picture without tableware) influenced perceived appropriateness of the product in the focal consumption context. A higher frequency of use of negative emotion words in the less appropriate consumption contexts was observed. In accordance with Köster and Mojet (2015) this could suggest that stimulus presentation and context evocation that is less, rather than more specific, may be desirable since it allows participants to imagine a more individualized consumption circumstance.

From the above data it can be concluded that the emotional state of the person, as affected by personal circumstances, or the emotional state induced by the environment in which the food is eaten or tested, can influence obtained emotion ratings. This conclusion is in keeping with other data from the general literature on moods and emotions, in which it has been shown that preexisting mood states, whether positive or negative, can influence subsequent evaluations (Clark & Isen, 1982; Gardner, 1985; Isen & Shaker, 1982; Schwarz & Clore, 1983). What this means for the researcher who wishes to conduct product emotion testing that is predictive of end-use behaviors, is that the testing situation, either real or evoked, should be ecologically valid and mimic the likely end-use environment for the product. As far as possible, such a setting should evoke the expected social and environmental context, so that the total "emotional setting" of the test environment is comparable to/representative of what will be experienced in the "real life" consumption context. While it will be impossible to recreate real-life settings 100% authentically, the emergence of immersive technology, including virtual reality, combined with smell and sound stimulation, may provide new advances. It has been suggested that immersive virtual methodology involves sensory modalities that bombard all five senses, improves the sense of presence, and elicits vivid emotional experiences (Dinh, Walker, Hodges, Chang, & Kobayashi, 1999). Applications in food-related research are starting to emerge, including in relation to emotional product associations (eg, Guttman et al., 2015; Ledoux, Nguyen, Bakos-Block, & Bordnick, 2013; Porcherot, Delplanque, Ischer, De Marles, & Cayeux, 2015).

4 Respondent-based effects

4.1 Effects of product users versus nonusers

In their original paper on the EsSense Profile Method, King and Meiselman (2010) presented data comparing product profiles obtained from respondents who differed in their frequency of use of the test products. Fig. 13.4 shows these data. As can be seen, when frequency of use increased from "never" (nonusers) to "frequently," the overall profile of emotion intensities increased. Furthermore, product users tended to focus on and have higher ratings for positive emotions, while nonusers focused more on negative emotions. These data appear consistent with the notion that a user of the product is more likely to be someone who likes the product and experiences

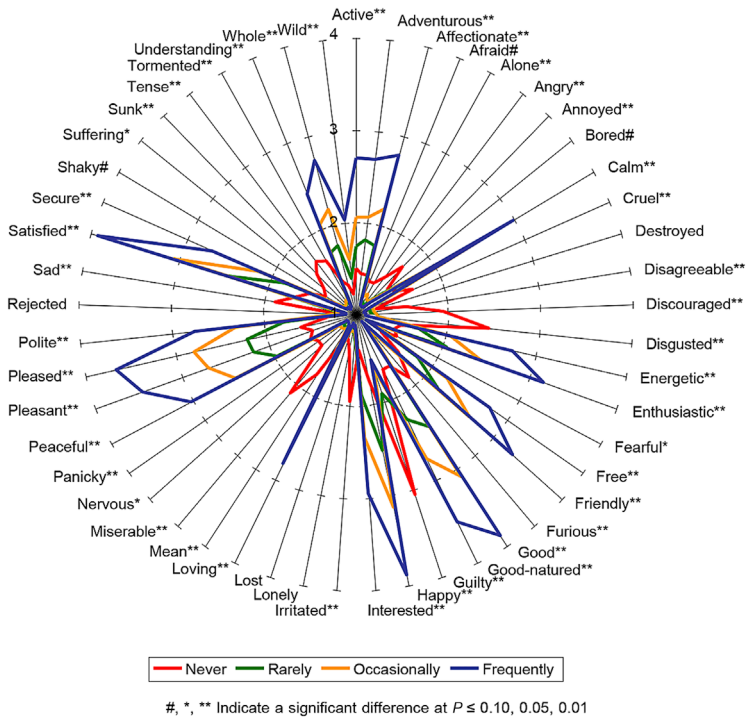


Figure 13.4 Effect of frequency of use on emotion response. Consumer profiles averaged over five different products (pizza, mashed potatoes and gravy, vanilla ice cream, fried chicken, and chocolate). Nonusers (shown in red) have a different and more negative emotional profile than users. Frequent users (blue) have the strongest positive emotions. Emotions were measured using the full list of emotions prior to the EsSense Profile.

higher and more positive emotions from it, while someone who does not use it is more likely to "dislike" the product (or find it too expensive, too unhealthy, etc.) and, in turn, find less positive emotional impact and more negative emotional tone with it.

Focusing on frequency of product use, Piqueras-Fiszman and Jaeger (2014c) elicited emotion responses for kiwifruit using a CATA format (Study 2). Two groups of New Zealand adults ($n = 302$), who were members of an established online panel, were recruited based on the frequency with which they consumed kiwifruit: higher frequency versus lower frequency (defined as 2–3 times per week when in season, and 1–2 times per month or less when in season, respectively). The two groups shared similar distributions in terms of other demographic characteristics, such as age, gender, and income ($P > 0.05$). Images of yellow-fleshed kiwifruit was used and the evoked contexts were: (1) breakfast on a weekday, (2) a packed lunch outdoors, and (3) after a special dinner at home in good company. Comparing the emotion profiles for the two groups of consumers, no significant differences between citation frequencies for any of the emotion words was found. The spiderplots clearly revealed the similarities in frequency of selection of the emotion words by the two consumption frequency groups for all of the contexts. Appropriateness ratings for consumption of kiwifruit in the three contexts were very similar for the two groups of consumers. This was put forward as an explanation for the similarity in the emotion profiles, which could override the differences in the frequency of consumption.

Jaeger and Hedderley (2013) also investigated this issue, but with conflicting results. Here, use frequency had a strong impact on EsSense Profile responses in an online survey on product concepts for snack food bars having appetite control benefits (Study 3). Significant effects (38 of 39 emotion words) were found between consumers with lower/higher consumption frequency for snack food bars. Conversely, a very different result was obtained in Study 1 where participants in a CLT tasted three different types of milk chocolate (plain, rose flavor, and sea salt flavor). Consumers who differed in frequency of eating chocolate (more/less often than once a week) did not respond differently to the EsSense Profile except for the emotion words *active* and *adventurous*. The authors concluded that, based on the available data, it was impossible to determine whether the presence/absence of effects associated with differences in frequency of use was linked to product category, stimulus presentation (text description vs tasted product), or category familiarity (chocolate has much higher market penetration than snack bars that help to control appetite). In light of this uncertainty they recommended that frequency of product use be collected as an explanatory variable in product emotion research.

4.2 Effects of gender and age

Gender and age are two variables that are very commonly used to characterize consumer participants and segment larger populations. In the literature, differences in emotional associations between male/female and younger/older consumers are, at times, reported.

4.2.1 Gender effects

Dube, LeBel, and Lu (2005) reported that men had more intense positive emotions prior to the consumption of comfort foods than did women, who had more negative emotions toward these foods. Similarly, Edwards et al. (2013) showed that men tend to have more positive associations toward meals than women. Edwards et al. (2013), in the study reported previously on university students, found males to express more positive emotions, but gender differences for negative emotions were not observed. Similarly, in a study by Piqueras-Fiszman and Jaeger (2015b) the dependence of gender and age on emotional associations with recalled typical evening meals and "memorable meals" was examined. Participants completed a survey instructing them to vividly imagine a typical evening or memorable meal and to evaluate the emotional associations to that eating occasion. The emotion lexicon of Richins (1997) was used, and responses were obtained on a 10-point scale operationalized using the bullseye format. Gender differences were found for a subset (25%) of the rated emotional associations with regards to both typical evening meals and memorable meals. Many of these emotion words had positive valence (eg, encouraged, excited, thrilled, romantic) and, on average, ratings by men were about one scale point higher.

The above findings are interesting, because other evidence from the general emotion literature suggests that women are more emotional than men (eg, Diener, Sandvik, & Larsen, 1985). Even in product tests, King, Meiselman, and Carr (2010) found that for sweet and salty snacks, 2 of 39 emotion words were significantly associated with acceptability among male participants, while for female participants 23 of 39 emotions were associated with acceptability. Clearly, the effect of gender on emotional ratings to products is not clear. It appears likely that the effect is dependent on the specific product and, perhaps, the perceived healthfullness versus indulgence attributes of the product. However, fundamental research in personality and social psychology suggests that the answer is neither simple nor straightforward (Kring & Gordon, 1998).

4.2.2 Age effects

With regard to age, Dube et al. (2005) also looked at age effects on emotional responding to comfort foods and found that older people (defined here as 55+ years old) were more positive about these foods. This contrasts with the results of Edwards et al. (2013) who found no effect of age on pre-meal emotions. In the post-meal emotion evaluations, Edwards et al. (2013) did find greater shifts in the older age groups (relative to people aged 21 years or younger), especially with negative emotion words. Specifically, the older age group was more *tense*, *angry*, *frustrated*, *discontented*, and *depressed* after consuming a meal.

Piqueras-Fiszman and Jaeger (2015b) also considered effects of age on emotional responses to recalled evening meals and memorable meals. They found that while the general pattern of emotional responding was stable across age groups (19–34 years old, 35–49 years old, and 50–70 years old), some effects were encountered for memorable meals (~20 emotion words). The differences pointed toward older people

attaching more positive emotions to memorable eating situations. Possibly, older people, having experienced more memorable meals, have a wider pool of past occasions upon which to base their recall. Alternatively, it was also found that they, compared to younger people, tended to recall the focal eating situation more vividly. This may have increased the intensity of reported emotional associations.

Despite the clarity of the findings, Piqueras-Fiszman and Jaeger (2015b) warn that further segmentation may be useful. For example, older people living alone versus with their significant other versus in institutionalized care could be very different. These authors encourage consideration of consumer sociodemographic and psychographic characteristics, a suggestion which is echoed by Ng and Hort (2014).

4.3 Emotional intensity and private body consciousness

The study of individual differences as an explanatory variable for heterogeneity in consumer responses has a long tradition in product-focused sensory and consumer research as it pertains to food and related consumer goods. But, to date, the question of whether aspects of participants' emotional psychology affects their emotional responding has only been addressed in a few published studies.

Jaeger and Hedderley (2013) began the exploration of whether individual differences in emotional awareness and experiences influence emotional associations to consumer products with the application of two established self-report measures: Emotional Intensity Scale (EIS) and Private Body Consciousness (PBC). Emotional Intensity (EIS-R: Geuens and de Pelsmacker, 2002) is a 17-item scale that captures individual differences in self-reported intensity of positive and negative emotions experienced in daily life, for example, being complimented, attending a fun party, being surprised with a gift, being criticized, or watching a sad movie. The scale was developed to explain differences in affective, cognitive and behavioral responses among people. There are two subscales: EIS-R-POS and EIS-R-NEG. The scale measuring trait PBC (Miller, Murphy, & Buss, 1981) was developed to explore how internal bodily changes are perceived, and is focused on awareness of changes in heartbeat, dryness of mouth, bodily tensions, hunger sensations, and body temperature. On a 5-point scale respondents answer questions like "I can often feel my heart beating" and "I am very aware of changes in my body temperature." Since heart rate and body temperature are among the instrumental measures currently in use in emotion research (eg, Kreibig, 2010; Lawton, Kleban, Rajagopal, & Dean, 1992; Sequeira, Hot, Silvert, & Delplanque, 2009), it is possible that people who are more aware of such changes within themselves may also have stronger product-specific emotional experiences.

Jaeger and Hedderley (2013) implemented a conventional approach to analysis of these trait data. Following a triadic split of averaged scores across each EIS-R subscale, groups of people characterized as "low" (L), "medium" (M), and "high" (H) in POS/NEG emotional intensity were defined. Fig. 13.5 shows the findings for the EIS-R-POS groups. It can be seen that the group with "high" scores on the EIS-R-POS scale had the largest "emotional footprint." Considering that the contour of the emotional profile was similar across the three ESI-R-POS groups, it appeared that

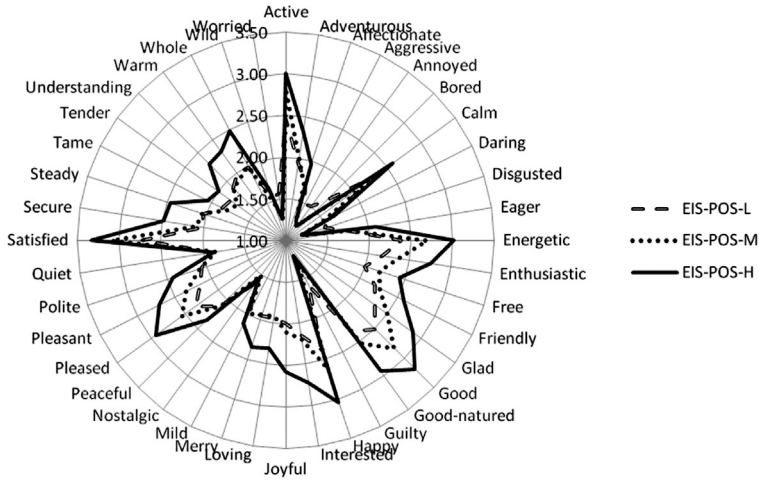


Figure 13.5 EsSense Profile for snack bar concepts (Study 1) by participants segmented according to responses on the positive subscale of the Emotion Intensity inventory (EIS-R-POS). EIS-R-POS-L is the segment defined by participants ($n = 222$) with the 33% lowest average scores on the EIS-R-POS scale. EIS-R-POS-H is the segment defined by participants ($n = 222$) with the 33% highest average scores on the EIS-R-POS scale. EIS-R-POS-M the segment ($n = 261$) defined by the 33% of participants with intermediate scores. Scores are anchored at 1 = "not at all" and 5 = "extremely." The middle anchor is 3 = "moderately."

differences in how participants expected to feel after eating the snack bars were linked to the magnitude of the emotional response, as opposed to the particular emotions that were elicited. For negative emotions (eg, *annoyed*, *bored*, *disgusted*, *guilty*, *worried*) this pattern also held, but in reverse. The "high" EIS-R-POS group had lower emotion scores on the two groups with lower scores on the EIS-R-POS scale.

More recently, Piqueras-Fiszman and Jaeger (2015b) extended the explorations of individual differences in emotional experiences to mealtime eating situations. Their findings mirrored those reported by Jaeger and Hedderley (2013). Significant differences in emotional responding between groups of participants classified as belonging to the "low," "medium," or "high" tertiles of EIS-R-POS and PBC scores were established (for 18 and 14 of 40 emotion words, respectively). The pattern of differences was also consistent with the previous findings, in that more intense responses were reported for positive emotions in the "high" scoring group. The reverse was found for negative emotions, where participants with "high" EIS-R-POS and "high" PBC scores rated negative emotions less intense. It was also found that variation in the EIS-R-NEG subscale did not influence emotional responding. In situations where negative emotions are more strongly associated with products, this trait may be more relevant.

In summary, based on existing data, it is uncertain how important it is to account for the influences of these two trait characteristics in applied consumer product emotion research. If the goal is to match a product to a certain emotional profile in terms of specific intensities of certain emotions, then factors that can influence

responses should ideally be controlled for. However, it is unclear that benchmark values are being used in a similar way to hedonic scaling where average scores of 7 or greater on a 9-point scale may be required prior to product launch. Such practices could be developed in the future.

4.3.1 Other psychosocial variables

The relative recency of research linked to consumer product emotions means that many gaps exist in terms of understanding the factors that moderate the elicited responses. One psychosocial variable that may be interesting to consider in product testing situations is the participant's ability to "perform" the emotion task. Lesschaeve and Issanchou (1996) reported that trained sensory panellists with poorer ability to concentrate yielded data that were less reliable (ie, more inconsistent). This in turn could negatively impact the ability to discriminate between samples. Trait scales exist that capture individual differences in ability/difficulty of describing experienced emotions. For example, Gohm and Clore (2000) captured this tendency with items such as: "It is difficult for me to find the right words for my feelings" and "I am able to describe my feelings easily." It is possible that people who experience difficulty in describing experienced emotions are less suitable participants for consumer product emotion research. Jaeger, Cardello, and Schutz (2013c) reported on task difficulties experienced by some respondents who are asked to evaluate products using a lengthy list of emotion words. It was found that some individuals were unclear on why some words would even be considered for use in describing the emotions evoked by foods (other results found in this study appear in Section 6.1). A better understanding of the nature of respondents in terms of their differential ability or comprehension of emotion-related tasks may be worthwhile.

Another, related variable that comes from the general emotion literature is the trust that individuals place in their feelings. Research by Salovey, Mayer, Goldman, Turvey, and Palfai (1995) has shown that some people pay more attention to their internal feelings as a source of information from which to make decisions, while Epstein, Pacini, Denes-Raj, and Heier (1996) have shown stable individual differences in people's tendency to trust "gut feelings" when making decisions. In a recent study, Avnet, Pham, and Stephen (2012) demonstrated that those individuals who had a higher trust in their own feelings had a more positive attitude toward a target behavior (reading) in the presence of an advertisement with a pleasant soundtrack than people with a lower trust in their feelings, suggesting that the people with a higher trust in their own feelings were more influenced by those feelings, as evoked in the advertisement. Similarly, Kergoat et al. (2010), in a product test of seat car fabrics, showed that a cluster of consumers who were characterized by a preference for velvet fabric experienced positive emotions more intensely than did those who did not like velvet, and that the non-likers relied more heavily on their feelings (emotions) than did the likers.

It would seem logical that individuals who rely more heavily on their feelings or who have a greater trust in their own emotions would respond differently to an emotion-laden product than would people who place less trust in their emotions as a guide to making product decisions. A more detailed analysis of this potential effect on product decision-making, based on experienced emotions and one's trust in these emotional experiences, would seem to be a valuable future contribution.

5 Effect of other experimental design elements

5.1 Asking emotion questions before or after hedonic and/or sensory attribute tasks

Since many product tests involve the elicitation of hedonic data, and product emotion ratings were introduced in order to obtain additional product insight that goes beyond hedonic responses, the two types of responses are often co-elicited in the same test. For this reason, the interaction of scale type for the emotion data with the hedonic rating is of interest.

The literature regarding this interaction is inconclusive in the case of responses which characterize products in terms of their sensory properties (ie, appearance, smell, flavor, taste, texture, aftertaste). For intensity ratings of sensory attributes, some researchers have found a bias on hedonic ratings (Earthy, MacFie, & Hedderley, 1997; Popper, Rosenstock, Schraidt, & Kroll, 2004; Prescott, Lee, & Kim, 2011). This has been attributed to the intensity data requiring an analytic mind set, which interferes with the synthetic mind-set required by an overall hedonic evaluation (Prescott et al. 2011). However, others have found no such effects (Gacula, Mohan, Faller, Pollack, & Moskowitz, 2008; Vickers, Christensen, Fahrenholtz, & Gengler, 1993). For CATA scaling of sensory data, no major biases have been observed (Adams, Williams, Lancaster, & Foley, 2007; Ares & Jaeger, 2015; Jaeger & Ares, 2014; Jaeger et al., 2013a, 2013b). Similarly, in an examination of the effect of RATA sensory data on hedonic ratings, across a wide range of studies, Jaeger and Ares (2015) found no evidence that RATA questions influenced hedonic ratings. Interestingly, though, when RATA data were collected simultaneously with hedonic data, hedonic discrimination was found to increase, perhaps due to the RATA data focusing greater attention on the task.

For emotion data, King et al. (2013) found emotion rating data to be more sensitive to ballot formatting relative to the hedonic question and that overall liking was rated differently when accompanied by emotion ratings. This effect could be due to the analytic versus synthetic nature of the two tasks, as Prescott et al. (2011) suggested. Alternatively, as Köster and Mojet (2015) suggested, it may be due to the fact that the rating of 39 emotions, as in the EsSense Profile Method, some of which consumers may struggle to connect to foods and beverages (see Jaeger et al., 2013c) may somehow interfere with the hedonic task.

For CATA scaling of emotions, unpublished data on apples from a study reported by Jaeger and Hedderley (2013) bear on this issue. In this study, hedonic data were collected before and after CATA responses to the 39 EsSense Profile words. Using a between-subjects experimental design, consumers ($n \sim 50$ in each group) completed the different ballot versions and across the two tasted apples it was found that average liking scores were the same, that is, 6.7 (SD = 1.5) when liking was obtained immediately before emotion responses and 6.7 (SD = 2.2) when liking was obtained subsequent to emotion responses. These data are consistent with the findings on sensory CATA data and its variants, as reported above, and suggest that for emotion tasks, rating versus CATA scaling may not be equal in terms of the potential to bias hedonic responses. There may be a number of reasons for this, but it may well be due to the

characteristics of the CATA question format which does not require deep cognitive processing (Rasinski et al. 1994; Strack, 1992; Sudman & Bradburn, 1982).

On the basis of the overall data, we conclude that CATA or RATA sensory and emotion responses are less likely to bias hedonic scores than are ratings, and that they are less likely to interact with relative positioning of the emotion and hedonic questions than are rating data. However, this is not to say that such biases will never occur (Jaeger et al., 2013b). Rather, investigators must carefully assess the potential interaction for their own specific application, and consideration should be given to forfeiting the collection of both types of data together, if it is not essential to the study objectives to collect both. An alternative perspective for practical applications is to always use the same questionnaire format, to enable comparison across tests. Hereby, the use of rating scales for emotion words of co-elicitation with hedonic responses would be acceptable, as long as consistency between tests is retained.

Meiselman (2015) has further extended the question of when it is best to test emotions to also consider if it is better to test immediately after product consumption or well after product consumption. He argues that if the purpose is to characterize products, then data collection during product consumption or immediately thereafter makes most sense. This recommendation is also based on the definition of emotions as being immediate/short-term responses. It should also be considered a possibility that the number of samples being evaluated has an impact on whether or not hedonic bias due to concurrent emotion elicitation is likely to occur. Tentatively, when only a few samples are being evaluated, as in the data by Jaeger (unpublished) described above, overall liking scores are less likely to be affected.

5.2 *Effect of number of samples being assessed in emotion research*

In their research on important elements of questionnaire and test design for emotion research, King et al. (2013) conclude that two samples may be the optimal number to test. The intensity of rated emotions tended to decrease with an increase in the number of samples tested. Much published sensory and consumer research involves more samples than this in each test, but in more applied settings two samples may be more common place.

Considering that the question of number of samples to test has not been thoroughly investigated empirically, it seems prudent to limit the number of samples in a test. However, as noted by others (eg, Hein, Jaeger, Carr, & Delahunty, 2008; Meilgaard, Carr, & Civille, 2006), the appropriate number of samples in a given test will depend on the product category, the other responses collected, and how much time is available for the test. It may also depend on the scaling method being used. Tentatively, CATA questions are less demanding for respondents and hence allow more samples to be assessed. Yet, sensory fatigue and disengagement with the task may increase as the number of samples increases. These effects are likely to be product-specific, population-specific, test-specific, and so on, so if protocols for routine testing are being developed, it may be prudent to obtain some task perception measures or feedback from test participants. Examples of such approaches can be found in Jaeger et al. (2013c) and King and Jaeger (2014).

It is also relevant to note with regard to this topic that Moskowitz, as part of his MindGenomics approach (Moskowitz & Gofman, 2007), obtains emotion responses to a large number of stimuli (typically written product concepts), sometimes 50+, and are able to estimate good-fitting models with face validity. Product tasting is unlikely to be involved in this approach, which could be a contributing factor. Also, typically respondents are presented with a short list of emotions (5–8) of which they have to select the one that best fits how they feel. If this explanation is given credence, it suggests a possible trade-off between the number of stimuli to assess and the scaling method. Ratings of a large number of emotions may be best suited for a few samples, relative to a large number of stimuli or concepts to be tasted or evaluated.

This begins to address another empirical decision that researchers need to make, and which we suggest should not be made in isolation of other factors. For product development applications, the rating of emotions tends to be favored, since interval data give more precision and discriminatory ability (all else being equal), especially if the data are "high quality," in the sense of being elicited by consumers who are attentive and engaged in the task. Yet, if the task is perceived as too cumbersome and tedious, then data quality may decline. This could be associated with decreased discriminatory ability and, hence, less practical relevance. It would be desirable with empirical research to address such matters and the comparisons between the use of trained assessors (with rating scales) and consumers (with CATA questions) for sensory product characterization could be a template. In such work it has been shown that product spaces are stable from both sets of assessors (eg, Ares et al., 2015b).

5.3 Number of subjects required for emotion testing

The question of how many participants should be used in product emotion research, to our knowledge, has not explicitly been subject to empirical research. Likely there are several explanations for this, including the recency of the emotion research area. More pragmatically, it is also likely to be due to the co-elicitation of emotion responses with hedonic and sensory product information. For these response types, there have been many past investigations into the number of required participants (eg, Gacula & Rutenbeck, 2006; Heymann, Machado, Torri, & Robinson, 2012; Mammasse & Schlich, 2014; Moskowitz, 1997). Hence, published research sample sizes with consumers now almost always exceed 100–120 people. This may be an acceptable sample size if participants share core common features of relevance to the product category. However, if segmentation is intended by age, gender or other characteristics, then sample sizes should perhaps also exceed 100 in each segment. A push toward larger sample sizes in sensory and consumer research has been advocated by Meiselman (2013), not only to facilitate segmentation, but to progress beyond the convenience samples that characterize published research. Who takes part in product testing is another key empirical consideration, and if the data generated are to have validity beyond the group of respondents from which it was elicited, it must fulfill the characteristics associated with probability samples or carefully defined quota samples. Simply put, it is not meaningful to use student or incidental product users, for example, to become informed about the emotional responses of regular users of the product category. Carefully defining the consumer segment for emotion research

will gain importance, as will demonstrating that appropriate screening criteria have been used to recruit consumers into these segments. In this sense, emotion research is no different to other types of consumer product research.

On the topic of segmentation, it is also possible that segmentation by product emotional profile rather than person characteristics may attract attention (Köster & Mojet, 2015). That is, emotion data can be analyzed for evidence of distinct response patterns. Behind this proposition lies the notion that a given product may give rise to different responses in people and different product emotion profiles can exist for each product. In such instances, as with other forms of segmentation, it is necessary that the initial population is sufficient to support such types of data-mining efforts.

Concerning the sample size needed for product-focused emotion research it is also probable that consideration be given in the future to the stability of the elicited responses. This is an emerging development in consumer-driven product characterization based on sensory characteristics. For example, Ares, Tarrega, Izquierdo, and Jaeger (2014d) reported that 60–80 consumers appear to be sufficient in many cases to obtain stable product and attribute spaces. That is to say that if the study were to be replicated, it would yield the same insights regarding similarities and differences in product spaces and regarding which sensory characteristics are associated (or not) with each product. In product-focused emotion research, instead of sensory characteristics, products are being described in terms of the emotional associations they elicit. The question of interest becomes: are the product spaces generated from emotional responses stable, and are the emotional profiles derived for each product stable? Meaning, if the study was repeated with an "identical" consumer population under "identical" testing conditions would the same emotion characteristics of the products be uncovered?

If the elicited data are to have practical relevance and predictive validity, the above is an important consideration. The procedures used by Ares and colleagues can equally well be applied to sensory data as to emotion data. Tentatively, it may be the case that differences between products can be obtained with fewer data points than required for stability in terms of usage. For sensory attributes it has been found that complex words are used less reliably by consumers, possibly due to heterogeneity in understanding of their meaning (Ares et al., 2014a). This could also be the case for emotion words where some emotions are more familiar/common that others (eg, *unfulfilled* vs *sad* or *warm hearted* vs *happy*).

Published studies that directly address these issues with emotion data are not available. However, extrapolating from the WellSense Profile, a questionnaire developed to measure consumer wellness associated with foods across five dimensions, of which one is emotional (King et al., 2015), consistency in responses may be expected. When testing the same products with consumer groups who were very similar, the data were stable. King and colleagues from McCormick & Company (unpublished data) have also found that responses to the EsSense Profile are repeatable. In a CLT with 112 consumers (who were product users), the same snack food product was presented three times under blind conditions in a single study. Mean rating scores were not significantly different for 38 of 39 emotion words. Only for *free* was significance reached ($P = 0.04$), but the difference was 0.2 (on a 5-piont scale), which would not be considered to have practical relevance.

6 Consumer perceptions of product emotion research

The current section promotes a participant-centric perspective to our consideration of methodological issues in questionnaire-based approaches to elicitation of product emotions. Herein we seek to address the question of what it is like to be a participant in such research.

6.1 Self-reported task perceptions

6.1.1 Qualitative insights regarding consumers' task perceptions

Jaeger et al. (2013c) used a combination of protocol analysis (Ericsson & Simon, 1993; Kuusela & Paul, 2000) and think-aloud methods (Darker & French, 2009) to qualitatively gain a participants' perspective of emotion questionnaire research. Their empirical strategy was implemented with the EsSense Profile (due to its greater popularity) and encompassed multiple studies, multiple products, and a total of ~300 adult New Zealand consumers. Following qualitative analysis of content, a number of themes pertaining to participants' task perceptions were identified. It appeared that completing the emotion questionnaire was an easy and even fun process for some participants. There were also comments suggesting that the task was intuitive and did not require much thought, either because it was easy for participants to decide how they felt and/or that they responded based on their gut feeling.

However, these positive aspects were tempered by several other facts. At times, participants struggled to see a connection between the emotion words contained in the questionnaire and the food samples that they were eating. For example, "I'm not sure that [potato] chips give me emotions," "Nostalgic… I'm not sure you could be nostalgic about chocolate or [potato] chips," and "How do I feel—adventurous, active—I don't think it applies to food but that's just me…." It was also clear that participants sometimes perceived the emotion words as being too similar. Examples included: *carefree* and *free*; *pleased* and *happy*; *merry* and *happy*; *timid* and *calm*; *tense* and *timid*; and *happy* and *free*. Negative comments on the large number of EsSense Profile words (39 emotions) and comments pointing to this being perceived as too lengthy and too repetitive, especially if many samples were assessed, were encountered. Examples from Experiment 1A include: "The list is really long and quite intimidating … and I'm going to have to fill in every single one" and "Quite a long list … I am overwhelmed."

As described above, participants mostly found the EsSense Profile task easy and intuitive, but some also have some misgivings about the task, describing it as odd/weird/unusual. Conversely, such discourse was almost non-existent in think-aloud data from hedonic scaling and sensory product description using CATA questions. In Experiment 1A by Jaeger et al. (2013c), none of the participants experienced difficulty in rating their degree of liking/disliking and many were able to talk about the sample and how it influenced acceptability. Similarly, participants very rarely experienced difficulty in completing the CATA question. Although there was some evidence that sensory terms were sometimes unknown/misunderstood (eg, "What does fibrous flesh mean?"), participants described the task as "…pretty normal" and "It was really quite simple."

In conclusion, Jaeger et al. (2013c) advocated that researchers be mindful of participants' perceptions of the task and consider the possibility that the responses elicited with the EsSense Profile are moderated by such effects. Aware that their conclusions were based on qualitative analyses from a limited number of studies, and a single emotion questionnaire, they encouraged independent replication and extension of their findings. Acknowledging response artifacts associated with collecting concurrent verbal protocols, independence of research methods was also encouraged in future research.

6.1.2 Questions measuring perceived ease-of-task and tediousness-of-task

It is a limitation that the data by Jaeger et al. (2013c) were qualitative such that frequency of the reported consumer perceptions cannot be estimated. Such an additional step is needed to confirm that the concerns identified by these authors in relation to product emotion research using questionnaires is sound. Again, it is pertinent to consider consumer-elicited sensory product characterization as a template for future research in emotion research. Questions measuring perceived ease-of-task and tediousness-of-task are used on a routine basis by Ares, Jaeger, and colleagues when collecting task perception responses from consumers performing sensory characterization using CATA questions. Typically, two questions are administered immediately following completion of a product task: (1) It was easy to answer the questions about these samples and (2) It was tedious to answer the questions about these samples (7-point scale: 1 = "disagree extremely," 7 = "agree extremely"). Across a broad range of product categories (fresh fruit, bread/crackers, confectionary, nuts, cake, cheese, vegetables, wine, soft drinks) the average responses for the ease of task question are 5–6 ("agree" and "agree strongly"), while the average ratings for the task tediousness question are 2–3 ("disagree strongly" and "disagree") (eg, Ares et al., 2014a, 2014b; Jaeger & Ares, 2014; Jaeger et al., 2014, 2015a, 2015b). Thus, consumers do not find the tasks difficult or tedious. These results appear to be independent of CATA question variant, such as whether CATA responses were elicited subsequent to hedonic responses, using a forced choice Yes-No format, using terms in randomized presentation order, or using a RATA format (ie, rate-all-that-apply).

In consumer product emotion research, similar questions regarding consumers' tasks could be used, for example to establish how widespread and strongly experienced the "Ok, but a bit weird" task perception uncovered by Jaeger et al. (2013c). In a CLT with ~ 250 NZ adult consumers, Jaeger, Piqueras-Fiszman, and colleagues (unpublished data) used the same two questions as Jaeger, Ares, and colleagues implement in sensory CATA research for a test involving three samples of cream cheese (plain and flavored). Under an evoked consumption context, a Yes/No CATA question with 15 emotions was used. For the ease-of-task question, the average rating was "agree strongly" (M = 6.0, SD = 1.1). Less than 4% of participants indicated "disagree" to "disagree extremely" with the statement. For the question pertaining to perceived tediousness, the average rating was between "disagree" and "disagree strongly" (M = 2.5, SD = 1.3) and less than 9% of participants indicated "agree" to "agree extremely" with the statement.

These preliminary data suggest that a test with three samples, evaluated using a CATA-style question for a short list of emotion words tailored to the product category/evoked consumption, is not perceived as difficult or tedious. The extent to which such data replicate and extend to other testing situations is partially addressed in the following section.

6.2 Differences between task perceptions of CATA and rating emotion questionnaires

Contributing further to the debate begun by Jaeger et al. (2013c) regarding how consumers respond to the task of completing an emotion questionnaire, King and Jaeger (2014) investigated perceptions of emotion questions in a CLT. Six statements (three positively worded; three negatively worded) were rated on 7-point Likert scales ("disagree strongly" to "agree strongly"), for example, "The questions about how I feel when I eat food were odd" and "The emotion terms in the questionnaire were relevant to how I feel when I eat food." Implementing a between-subjects experimental design, some participants were given task perception questions that did not explicitly refer to the emotion task (eg, "The questions in the questionnaire were odd" and "The questions were relevant to the samples").

The EsSense Profile was completed in the rating or CATA format, and as a control condition a hedonic-only ballot with no emotion words was also used. Across data from 300+ consumers in the USA and New Zealand, self-reported responses to questions about task perceptions were strongly influenced by the question wording. When emotions were referenced in the wording of the task perception questions, the average responses were significantly less positive than when emotions were not referenced in the question wording. Furthermore, task perceptions depended on whether the product emotion questionnaire utilized rating scales or a CATA question format. Of particular note, it was found that the EsSense Profile administered in the CATA variant was perceived similarly to a questionnaire with only a hedonic question. Compared to the CATA variant, the reaction to rating emotions in the questionnaire resulted in a 44% overall decrease in the positive questions and a 37% increase in the negative questions.

Despite rating of product emotion delivering interval data, which contain greater precision than the binary responses obtained from CATA questions, the data by King and Jaeger (2014) suggest that emotion rating is perceived by a proportion of consumers as a task that is somewhat more odd, less relevant, more difficult to relate to, more silly, and less sensical. For example, when asked about the extent to which they agreed/disagreed with the statement "Most of the terms in the questionnaire had nothing to do with the feelings I experience when I eat food," 47% of participants agreed when completing the emotion task using ratings, while 37% agreed when doing the emotion task as CATA. When asked whether it was easy to relate the emotion words in the questionnaire to how they feel when eating food, more participants agreed in response to the CATA task than in response to the rating task (61% vs 47%). Practitioners may wish to consider these differences in task perceptions when considering choice of scale formats in emotion questionnaires, and balance these considerations against other factors influencing test implementation.

7 Conclusions

Product emotion research is a rapidly growing area of research within academia and industry. The rapid expansion in the number and types of emotion questionnaires and lexicons, the growing variety of methods for scaling emotions, the multitude of combinations of emotion data collection procedures, the interactions of these methods and procedures with other product test variables, and the sheer number of new applications for product emotion research has created a situation in which it is necessary to know and understand the methodological issues and problems in product emotion research if one is to become an active and productive researcher in the field.

In this chapter, we have sought to identify and bring to light many of these methodological issues, in order to provide guidance and direction to new investigators coming into this area of research, as well as to stimulate thought and ideas for new avenues of emotion research among established researchers in the area.

As authors, we are aware that it is impossible to cover all methodological issues within a single chapter. Nevertheless, we hope that we have brought to light the majority of important issues and have presented the most relevant research that addresses those issues. The main conclusion we seek readers to take from this chapter is that there is no single "measurement formula" that will be optimal for all the different situations where consumer-driven product-elicited emotions are of interest. There is no panacea—each new testing situation required consideration of the advantages/disadvantages of different measurement decisions.

Lastly, we look forward to the development of new and creative methods in this important area of consumer research, in order to further our understanding of the important role of emotions in product acceptance, choice, and consumption.

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Emotions in Clinical Practice

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Ueli Kramer[1,2]
[1]University of Lausanne, Lausanne, Switzerland [2]University of Windsor, Windsor, ON, Canada

1 Introduction

Emotions are central features of human life. They inform us about our goals, preferences, values, wishes, needs, and meanings (Frijda, 1986). Humans tend to repeat what they find pleasurable, tend to avoid what provides tension, tend to engage in action that is in accordance with their innermost goals and standards and enjoy being in a romantic relationship. Sometimes, emotions are overwhelming experiences which take centerstage, sometimes an almost invisible sign that something goes wrong; in both cases, they govern our decisions, actions, and thoughts (Ekman & Davidson, 1994; Ekman & Friesen, 1975; Frijda, 1986; Greenberg, 2002).

In clinical practice, when treating patients presenting with psychological (or medical) problems, emotions are central. There is hardly any therapeutic approach which does not give explanations for emotional phenomena (Ehrenreich, Fairholme, Buzzella, Ellard, & Barlow, 2007; Greenberg & Safran, 1987). Given this, centrality of emotion, assessment of emotion, and of emotional change, in clinical practice is therefore a central task. In what follows, we will demonstrate how important it is to use evidence-based assessment procedures of emotion in clinical practice.

Firstly, we will present clinical tools et conceptualizations developed by clinical researchers and practitioners working with emotions in psychotherapy (Greenberg, 2002; Greenberg & Elliott, 1997; Greenberg & Paivio, 1997). Secondly, we will turn to two more classical categories of instruments which may be used by clinicians for assessing emotion: self-report questionnaires and observer-rated methods, in addition to physiological approaches to measurement. These tools will be classified according to the main components of emotion: emotion arousal, awareness, expression, regulation, along with the assessment of emotion types (Sloan & Kring, 2007).

The choice of the best assessment strategy will basically depend on two aspects: (1) the underlying theoretical conception the assessor adopts with regard to emotion and emotional experience and (2) contextual factors, such as the aim of the assessment, the available time and resources. Irrespective of the theory adopted, it is central for clinical practice to understand emotion as multifaceted (or multicomponent) phenomena, with several levels of response (or activations; Leventhal & Scherer, 1987; Scherer, 1984). In addition, it is important to assume that emotion has a temporal unfolding (eg, Sander, 2013), with some components of emotion being rather stable over time, and some others fluctuating possibly from one second or minute to the next (Kramer, Pascual-Leone, Despland, & de Roten, 2015; Sloan & Kring, 2007).

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Why is it that emotion is so central in clinical practice? In order to answer this question, we will first define the context. Clinical practice denotes a treatment context in which two parties, at least, mutually define each other as patient (ie, treatment-seeker) and therapist (ie, treatment-provider). In this context, the patient presents with a clinical disorder, or a problem, for which he/she asks for help. In the present chapter, we will mostly focus on mental disorders, or psychological problems, but many conclusions may apply to somatic disorders as well.

Emotion is central in this context: as soon as two human beings interact, there may be some kind of emotional experience. There may be emotions in the patient related to the simple fact of asking for help, for example shame, embarrassment, and anxiety; conversely, the therapist may feel concern, gravity, and genuine interest when encountering a patient. The contents of the dialogue form into a narrative which is usually co-constructed by the patient and the therapist. This dialogue evokes additional emotions in both interaction partners, on the actual fact of collaborating, on the—shared or not—observation of difficulty in this collaboration and on specific other contents. Among these, grieving might be an important emotional process when the initial goals of the intervention are not possible to be met, or when the therapy ends. So, irrespective of the type of intervention, there are a host of emotions in the therapy room, from the very first to the very last moments of contact. Emotion may not only result from the actual patient–therapist interaction, but from the psychological disorder, or problem, itself. A patient with depression may feel numb or helpless in the session; this depressive state may be related to underlying unresolved feelings of suppressed anger at the face of a past violation, or to underlying self-contempt, feelings of worthlessness, or fear of being all alone in life. A differentiated assessment, taking into account both surface characteristics of emotion (the presenting emotion in the here and now) and underlying unresolved characteristics of emotion (the core emotion), is therefore important.

Assessment of these emotions is important, as emotions guide the patient's (and the therapist's) decisions, plans, thoughts, and actions, which might have an impact on the course of the treatment. A patient who presents with strong anger and blames the therapist for his/her problems in the beginning of therapy might provoke a defensive emotional reaction in the therapist. The latter might want to end therapy before providing the central intervention. Therefore, accurate description and assessment of emotions in the clinical process is important and will help clinicians remain on track and focused in their task of healing and helping.

Such an accurate assessment is difficult to obtain, due to the fluctuating nature of some emotion components, such as arousal or regulation. The latter might change in the interaction between patient and therapist and without actual (video-)recording, it is difficult to correctly recall what really happened. It is also questionable to what extent the person him-/herself may be capable of accurately describing his/her emotional experience. Whereas accurate description is not even a given in healthy—nonclinical—populations (Nabi, 2002), accurate descriptions are probably the exception in the case of severe mental disorder (eg, personality disorders; Ogrodniczuk, Piper, & Joyce, 2011). Difficulties in accurately describing emotional experiences have also been called alexithymia, a trait feature of many patients consulting in medical or psychological therapy rooms. In addition, there are a number of general

methodological problems when using self-report measures of psychological variables (Nisbett & Wilson, 1977; Shedler, Mayman, & Manis, 1993). Therefore, the sole use of self-report questionnaires for assessing emotion in clinical practice is inherently limited.

Another problem arises in the clinical context. Patients enrolled in clinical assessment of emotion might (self-)report only superficial emotions in an assessment session and might not (1) have experiential access to the actual central emotion and/or (2) do not feel sufficiently confident in this context to share central experiences.

In what follows, we will describe how assessment of emotion may be adjusted to these specificities of the clinical context.

2 Clinical tools for the assessment of emotion

We differentiate two fundamental developments as tools for the assessment of emotion in clinical practice. Both take into account the complexity of the task as outlined above. For clinical practice, it is important to underscore that some part of the intervention is based on sound intuition of the clinician; at the same time, clinicians need clear signposts they may use for assessment. Fundamentally, we present two tools representing assessment of the progressively central emotion process: this means that assessment is not completed after a specific amount of sessions—nor limited to a particular moment in time—but an ongoing process starting with the very first contact and ending with the very last.

We will elaborate on the different forms of therapist empathy (Greenberg & Elliott, 1997), then develop a differentiated perspective on emotion assessment, as defined by researchers and clinicians from the emotion-focused therapy approach (Greenberg & Paivio, 1997; Pascual-Leone & Greenberg, 2007).

2.1 Forms of therapist empathy

An empathic stance means the understanding by taking the patient's frame of reference, an understanding "from within." Rogers (1957) described that the clinician needs to attempt to fundamentally try to put him-/herself in the "client's shoes," so he/she can better understand the patient's experience. Applying this stance to emotions in the clinical context (Greenberg & Elliott, 1997), the clinician works "as if" he/she enters into the patient's emotional experience, in a particular moment, speaks from this experience, and renders it poignant. Empathy is therefore not only an assessment tool, but also a powerful intervention which contributes to the patient's emotion regulation and encourages further emotion exploration and transformation. From an observational perspective, empathic attitudes and interventions are marked by adjusted vocal qualities, for example a fragile voice facing expressed vulnerability or shame, or a strong voice aiming at mirroring the energy in anger. Empathic interactions may also be characterized by a therapist who shows genuine interest in what the patient has to say, by moving his/her upper body toward the patient. There might also be a tear at the edge of the clinician's eye. Finally, empathic clinicians

avoid interrupting the patient too much and adapt intervention speed to the patient's needs (Paivio & Laurent, 2001). In order to validate such statements, it seems necessary to adopt an observer-rated approach to empathy, where these behaviors may actually be observed to a certain extent in the patient–therapist interaction. In what follows, we will privilege this descriptive approach over the self-reported approach to measure empathy.

This fundamental principle of therapist empathy, drawn from classical client-centered psychotherapy, has today spread into a great variety of therapy approaches, for example short-term psychodynamic psychotherapy for affect phobia (McCullough et al., 2003), motivational interviewing aiming at the reduction of addictions (Miller & Rollnick, 1991) and, in a more differentiated manner, emotion-focused therapy (Elliott, Watson, Goldman, & Greenberg, 2004; Greenberg, 2002; Watson & Greenberg, 2011). In a recent meta-analysis, Elliott, Bohart, Watson, and Greenberg (2011) showed that empathy was consistently related with symptom change at the end of psychological treatment and becomes thus one of the most solid markers of evidence-based relationship interventions in clinical practice (Norcross & Wampold, 2011). As discussed above, these findings are mostly based on observational data gathered from psychological treatment contexts via valid observer-rated measures of empathy.

We may differentiate between seven different interventions describing aspects of empathy, all focused on emotions in clinical practice (Greenberg & Elliott, 1997). They all aim at a deeper emotion experience in the patient and assessment of the central emotion components, rather than staying on the surface of the phenomena.

1. Empathic understanding

   Empathic understanding conveys to the patient that the therapist has understood explicit and implicit aspects of the patient's experience. The therapist does not add any new information to what was previously said by the patient, but renders explicit what was described more implicitly. For example, a patient who experiences an existential issue, that is, death of a close family member, with a sense of loss, but also some guilt in relation with the loved one, the therapist can say "I see your sense of loss, and you also seem to ask yourself whether you have done things right with this person…."
2. Empathic affirmation

   Empathic affirmation offers validation of the current stressful situation experienced by the patient. The patient experiences in the sessions distress, vulnerability, a sense of weakness, and a fundamental pain. The patient may turn his/her gaze toward the floor, and breathe more quickly, or sigh in the middle of a sentence. This sense of vulnerability is acknowledged in an affirmative way immediately by the therapist. The latter can say something like: "I see, this experience is very difficult for you."
3. Empathic evocation

   Empathic evocation is a reflection by the therapist, which aims at the poignancy of the experienced emotion, by adding expressive words, metaphors, or evoking images. It should help the patient to clearly represent the emotional implications of an experience. As such, no new information is added here, but the intensity of the elements presented is increased and condensed. Facing a patient who suffers from being left by his intimate partner, the therapist may respond in an empathically evocative manner by saying: "It's almost as if now, there is nobody else there for you."

4. Empathic exploration

   Empathic exploration fosters in the patient an exploratory stance to understand his/her experience "at the edge" of awareness. The therapist may offer guidance toward unexplored aspects, unclear implications and emotions that were underreported so far. As such, the therapist explores implicit aspects which were alluded to before by the patient, but were not explicitly part of the description. Facing a patient who suddenly feels very weak in session, the therapist could propose: "Inside you, right now, you feel so vulnerable, so unseen, so…." The open ending of the sentence fosters the patient's exploration; the latter may add how he/she feels in the moment.

5. Empathic conjecture

   Empathic conjecture describes, a bit differently than the other forms of empathy, therapist responses which encompass new information. Here, the therapist describes what he/she understands and integrates this understanding with the formulation of new information. This information is supposed to be central, which the patient has not accessed before. For example, facing a patient who has described a feeling of being rejected in interpersonal relationships, in a hypothetical manner, consistent with an empathic conjecture, the therapist may say: "It may be that you fundamentally feel that you are not interesting at all." Note that such profound interventions need a particular therapeutic relationship which generally is only achieved in the context of psychotherapy, so this form of empathy might not be useful in all contexts of clinical practice.

6. Empathic refocusing

   Finally, empathic refocusing describes a therapist intervention which aims at conveying empathy for the patient's difficulty in staying with the central theme. In this sense, the intervention encompasses both the central theme and the momentary importance for the patient to go astray and avoid confrontation with the central issues. The therapist may for example say: "It is difficult for you, I see, to stay with this fundamental sense of weakness."

In conclusion, assessment of emotion in clinical practice may start with the awareness of the therapist (or the assessor) that the patient's central emotional experiences may only be accessed when an appropriate empathic stance is proposed. Generally, patients do not report right away their central emotional concerns; they may start with peripheral and minor aspects, so there is time to decide whether the current relationship is trustworthy. It is therefore central for assessors and therapists alike to use these forms of empathy in clinical practice from the very first contact on and in a differentiated fashion. Only then, is a detailed assessment of the patient's emotional experience feasible in a way which reflects reliably the patient's innermost emotional concerns. It remains an open question for research which type of empathy relates to which therapeutic and patient's processes and outcomes.

2.2 A differentiated perspective on emotion in clinical practice

Whereas emotion in general is considered as an adaptive source of information informing about central concerns, goals, needs, and preferences (Frijda, 1986), there are clinical situations which warrant a more differentiated perspective on emotion (Greenberg, 2002; Sloan & Kring, 2007). A specific emotion expressed by an individual might represent a reaction to an external event, or might be a reaction to an internal process. For example, a person might feel angry because her husband keeps

imposing demands on her she feels are too much (external), or a person might feel helpless about her incapacity to control her anger (internal). According to Greenberg and Paivio (1997), there are fundamentally three different emotion types: primary, secondary, and instrumental. Primary emotions are direct and immediate reactions to external events (or stimuli), secondary emotions are to be found sequentially after such primary reactions. Secondary emotions are also socially mediated and influenced. Instrumental emotions have an interpersonal component to the expression of a particular emotion. Then, primary emotions may be further differentiated into adaptive (as part of the biologically anchored system of adaptation) and maladaptive (as a result of learning history). Because this differentiated conception is generally not included in theories of emotion and because of its high relevance for all clinicians working with patients presenting with a great number of psychological problems, we will describe them more in detail.

1. Primary adaptive emotions

   Primary adaptive emotions are reactions which demonstrate an adaptive value on the moment of the experience, for example, sadness at a loss, fear facing a danger, or anger facing a transgression. The contents of these emotions are generally clear: the therapist knows clearly what the patient is angry about or why he/she is sad. Primary adaptive emotions are freshly experienced, marked by immediacy, novelty, and discovery. Even if their content may be quite negative (ie, sadness at a loss), a patient who accesses this kind of emotion will generally describe a sense of relief and other kinds of positive feelings (Fosha, 2000; Greenberg, 2002). If they are completely accessed, fundamental needs might be unpacked, as well as adaptive (and hitherto unknown) action tendencies. These emotions are usually hidden initially in clinical situations; these emotions may have been interrupted by other internal processes (see below).
2. Primary maladaptive emotions

   Primary maladaptive emotions are primary reactions to external events, which were adaptive at one point in time of the individual's history, but which are not adaptive anymore. Generally, they may be linked with the person's attachment history, his/her links with the primary caretaker, and the latter's emotional reaction to the person's initial emotional expression. For example, a patient has experienced in her childhood that close relationships may be dangerous, the source of control and violence, as part of a traumatic history of abuse. This person has developed a primary emotion of fear of intimacy, coupled with an action tendency to be angry when someone expresses a warm support. Whereas this fear of intimacy was adaptive at one point, currently, such fear does not seem to correspond to any adaptive value anymore. Another person might have an old familiar feeling of being insufficient, without any value; a feeling part of shame-based emotions. Finally, a person might have a familiar feeling of being vulnerable, dependent, and weak; a feeling part of the fear-based emotions. These types of emotions are immediate reactions to external events, but they are not freshly experienced, but represent a "same old feeling" kind of experience, which becomes a central focus of exploration, as these primary maladaptive emotions may contribute to a number of psychological problems.
3. Secondary emotions

   Secondary emotions are reactions to inner emotional (or cognitive) experiences. They are secondary in terms of the sequence and the function. For example, a patient experiences a primary maladaptive emotion, as described above, with the fear-based idea of not being seen and does not support exploring this feeling further and, instead, switches into a more

secondary (here defensive) emotional state of anger. As such, this patient might blame another person for being responsible for her problems. Another patient might feel depressed and helpless (secondary emotion) when he thinks about his repetitive failures. This patient might say in an assessment interview for further psychotherapy: "It doesn't matter what I do, I will not change. I have done so many therapies before and nothing seems to help me." It becomes clear that this patient feels that he is "trapped" and has lost all perspective for change. Empathic exploration (see above) helps this patient to gain awareness about an old familiar feeling of being inappropriate, related to shame-based emotions (a primary maladaptive emotion here). The patient accesses a rather superficial fear when he says: "If I re-start work, if I make an effort, I will fall again, like before, so I better stay at home and do nothing." The fear to "fall again" is related with underlying experiences of shame in this patient, which need to be part of an accurate emotional assessment. Whereas emotion theory generally underlines the immediacy and short-term nature of emotion, secondary emotions are not different on this level of expression. Secondary emotions are also expressed immediately in the context, but it is assumed that an underlying issue—generally related to a primary maladaptive emotion—orients unwillingly the expression of a secondary emotion. Therefore, the assessment on all these levels is important.

4. Instrumental emotions

   Instrumental emotions are expressed in an interpersonal context, where the individual anticipates that this expression has a specific effect on the interaction partner. The latter may also be the therapist or the assessor. So this emotion type is defined by the fact that it is oriented toward a particular goal, that is, by having an effect on the other person, rather than by the origin of the emotion. For example, the expression of sadness may produce sympathy for the self, or the expression of anxiety may help to ensure support from the significant other. This type of emotion may have a dramatic character, but not necessarily.

In conclusion, there are a number of different experientially distinct emotions. It remains an open question how they may be assessed in a reliable fashion. The next section will describe the most common assessment strategies, including a possible observer-rated approach for assessing emotion types.

3 Common assessment procedures in clinical practice

Emotions in clinical practice may be assessed from a number of perspectives, which will be discussed in this section. We also need to differentiate a number of components that emotion researchers have identified which are relevant for clinical practice. The main components of assessment are emotion arousal, emotion awareness, emotion expression, emotion regulation and, finally, emotion types (Sloan & Kring, 2007).

3.1 Assessment of arousal

Emotional arousal denotes the intensity of a momentary emotional experience. One of two classical measures is generally used, the Subjective Units of Distress Scale (SUDS, Wolpe, 1958) and the Self-Assessment Manikin (SAM; Bradley & Lang,

1994). The SUDS involves one item rated from 0 to 100 (or from 0 to 10) with regard to the intensity of distress (ie, anxiety), assessing both arousal and intensity of negative valence within one item. It is frequently used in assessment of behavioral exposure therapy for anxiety disorders (Wolpe, 1958) where a decrease, over the course of therapy, of the emotional arousal will be expected. Its simplicity is compelling for clinical use; however, it remains only one specific window into the complex emotional experience of the patient. The SAM has a similar function, with assessment on three items (ie, arousal, valence, and dominance), but the first item is the one that is most frequently used by clinicians and clinical researchers. This arousal item is rated on a Likert-type scale ranging from 1 (very calm) to 9 (very aroused), by using a series of pictograms (ie, manikin figures) representing the levels of momentary arousal. The individuals are asked to describe their momentary level of arousal with regard to a specific stimulus. Because of the graphical representation of the concept to be measured, it is particularly user-friendly and applicable across clinical populations, including children. It has the advantage over the SUDS in that it differentiates between arousal and valence, allowing for combinations between the two subscales, that is, in particular the assessment of a positively valenced and highly arousal state becomes feasible. Unlike for the SUDS, the SAM has supporting psychometric evidence in the context of data of effects of behavior therapy and its correlation with a number of psychophysiological measures (Bradley, Greenwald, Petry, & Lang, 1992; Lang, Greenwald, Bradley, & Hamm, 1993). Its particular relevance for the context of behavioral exposure-based therapy for anxiety disorders was demonstrated (Sloan & Marx, 2006), but this measure may be used in a more broad fashion, across clinical contexts and patient populations.

We note that self-reported assessment of arousal might be biased, in particular in patients presenting with repressive personality features, or with lack of emotional (and body) awareness. In this case, evolving technology has allowed clinicians to rely increasingly on psychophysiological measures of skin conductance, heart and respiratory rates, reflecting sympathetic activation in the body (see chapter: The Psychophysiology of Emotions). In particular in the context of in vivo exposure behavioral techniques (the direct confrontation with a feared stimuli, for example with a snake for a patient presenting with snake phobia), it might be important to closely monitor breathing activity—and feed this information back into the therapy process. In these clinical situations, the activity of self-report might interfere with the therapeutic arousal (Alpers, Wilhelm, & Roth, 2005).

3.2 Assessment of awareness

Awareness is a central component of emotion. Lack of emotional awareness was summarized by the term alexithymia. There are several self-report questionnaires assessing alexithymia, however, the Toronto Alexithymia Scale-20 (TAS-20; Bagby, Parker, & Taylor, 1994) is the most commonly used. The TAS-20 encompasses 20 items assessing the inability to correctly label emotions, scored on a 5-point Likert-scale ranging from 1 (strongly agree) to 5 (strongly disagree). An item example is "I am often confused about what emotion I am feeling." Research has shown

acceptable reliability and internal consistency coefficients for a student sample (alphas ranging between 0.70 and 0.81; Bagby et al., 1994; Parker, Taylor, & Bagby, 2003). Alexithymia was shown to be related to a number of clinical problems, such as anxiety disorders, somatoform disorders, depression, and personality disorders (Grabe, Spitzer, & Freyberger, 2004; Lipanen, Saarjarvi, & Lauerma, 2004). Alexithymia was demonstrated to influence the course and outcome of psychotherapy across clinical populations (eg, depression and personality disorders; Ogrodniczuk et al., 2011; Rufer et al., 2004). It can also be used as measure of change in emotional awareness across therapy (Ogrodniczuk, Joyce, & Piper, 2013). The major concern is its self-reported nature: it was argued that it is difficult for a patient to accurately rate his/her own lack of emotion awareness, however, it was demonstrated that this measure had good agreement with observer-rated methods of alexithymia (Bagby et al., 1994).

In order to respond to this criticism, the Level of Emotional Awareness Scale (LEAS; Lane, Quinlan, Schwartz, Walker, & Zeitlin, 1990), an observer-rated scale, was created. A number of hypothetical scenes—each should evoke a particular emotion—are presented to the patient who then comments on how he/she is feeling in response. The scenes are designed to evoke four emotion types: anger, sadness, fear, and happiness. This open-ended answer is then coded on a scale of emotional awareness and differentiation, ranging from level 1 (nonemotional response) to level 5 (emotional response from self can be differentiated from that of the other). This measure has been demonstrated to relate to measures of openness to experience, emotion perception, and emotional range (Lane, Sechrest, Riedel, Shapiro, & Kasniak, 2000; Lane et al., 1990). Excellent inter-rater reliability and internal consistency were reported by Lane et al. (1990). Lower scores on the LEAS were shown in clinical populations, such as patients with eating disorders and psychosomatic disorders (eg, Bydlowski et al., 2005), compared to healthy controls. Women seem to score higher on this instrument (Barrett, Lane, Sechrest, & Schwartz, 2000). Change in emotional awareness may also be assessed by using the LEAS; so far, this has not been demonstrated in studies. Whereas this instrument optimally measures emotional awareness, it remains a quite complex, although still feasible, test to administer in clinical practice.

3.3 Assessment of expression

The quality of emotional expression—the display of emotion toward the outer world—may be measured by one of two self-reported questionnaires, the Berkeley Expressivity Questionnaire (BEQ; Gross & John, 1997) and the Emotional Expressivity Questionnaire (EEQ; Kring, Smith, & Neale, 1994). Although based on slightly different conceptions of emotional expressions, both measures present links with different psychological disorders, for example generalized anxiety disorder. However, for both questionnaires, it was noted that the self-reported assessment of emotional expression might not be valid. Therefore, there are a number of observer-rated instruments measuring emotion expression.

Among these, the Facial Action Coding System (FACS; Ekman & Friesen, 1978, along with the emotional FACS; see chapter: Measuring Emotions in the Face) and the Facial Expression Coding System (FACES; Kring & Sloan, 1991) need to be

mentioned. FACS measures the differential muscle movements on the face, whereas the FACES assesses the valence of an emotional expression on the face. Both systems have strong validation data and several studies have demonstrated that emotion expression is different in specific clinical populations (ie, persons with borderline personality disorder, schizophrenia, depression, and childhood sexual abuse, among others; see Aghevli, Blanchard, & Horan, 2003; Ekman, Matsumoto, & Friesen, 1997; Rennenberg, Heyn, Gebhard, & Bachmann, 2005; Sloan, Strauss, & Wisner, 2001). Despite the importance of these rating systems, it needs to be noted that rater training, as for most observer-rated scales, is rather time-consuming. This needs to be considered for the assessment of only one emotion component. Nevertheless, these instruments remain important tools in the assessment of emotion in clinical practice.

3.4 Assessment of regulation

Emotion regulation—denoting all influences the individual has on his/her emotions—is one of most intensively studied components of emotion. Therefore, it is not surprising that a great number of self-reported questionnaires exist, based on quite different definitions and conceptions of emotion regulation. We will only focus on two central questionnaires, the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) and the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). The ERQ is based on the conception of emotion regulation according to Gross (2001), where antecedent-focused regulation (reappraisal) is differentiated from response-focused regulation (suppression), the former being assumed to be more effective than the latter. Unfortunately, this scale has only rarely been used in clinical populations. However, the DERS is a comprehensive scale assessing a number of emotion regulation strategies and has been used in a sample of patients with borderline personality disorder undergoing group therapy (Gratz & Gunderson, 2006). The authors showed a decrease of problematic strategies in the patients attending the therapy. Thus, the DERS might be a viable self-report measure for emotion regulation in clinical practice. This is particularly relevant, as the concept of emotion regulation is central in several clinical models (Greenberg, 2002; Linehan, Bohus, & Lynch, 2007). Emotion regulation is understood as a core capacity leading to change across different forms of treatment (McMain, Pos, & Iwakabe, 2010). For assessment, it needs to be noted that the patient is generally not aware of some of his/her emotion regulation strategies used, therefore, a complementary observer-rated approach might be necessary.

The Coping Action Patterns (CAP) rating system (Perry, Drapeau, & Dunkley, 2005) is an observer-rated instrument assessing coping strategies, as means of emotion regulation. It assesses in total 36 categories, nested within 12 overall categories, which are in their turn nested within three clusters (based on the hierarchical structure of coping; see Skinner, Edge, Altman, & Sherwood, 2003) and enables to describe coping in the therapy hour. The CAP differentiates between coping facing stress perceived as challenge (ie, productive strategies), as opposed to coping facing stress perceived as threat (Skinner et al., 2003). Inter-rater reliability was reported to range between 0.70 and 0.91 (eg, Kramer, de Roten, Drapeau, & Despland, 2013), which is excellent. It was shown that problematic coping with emotion, such as opposition and submission coping, relate to clinical phenomena, such as depression and borderline

personality disorder (eg, Kramer, 2010, 2014). Change of overall coping was shown across samples, for different patient populations and different therapy approaches (see Kramer, de Roten, Drapeau, et al., 2013; Kramer, de Roten, Perry, & Despland, 2013). As discussed above for the LEAS, rater training is time-consuming for this observer-rated scale. In order to increase feasibility in a specific clinical context, the scale may be applied after a shortened clinic-focused training.

3.5 Assessment of emotion types

A more advanced assessment strategy, as close as possible to the experiential nature of emotions, is the measurement in terms of specific emotion categories. Most emotional experiences may be subjectively lived as part of categories: we like to comment that "I'm sad." or "I'm devastated." There is a self-report questionnaire, the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) which may be used. The intensities of specific emotion adjectives are rated; positive and negative emotions are differentiated. The timeframe for assessment may be variable, between at the present moment and in general. The scale was extensively studied in clinical populations presenting with anxiety and depressive disorders (Watson, 2005). Again, it might be difficult for patients lacking emotional awareness to accurately rate their different emotions. Observer-rated measures can help here.

Ambulatory assessment of specific emotion categories is a different avenue of emotion measurement which has excellent ecological validity (Reisch, Ebner-Priemer, Tschacher, Bohus, & Linehan, 2008). The principle is that the patient receives a mobile device which asks him/her at several timepoints during the day about the momentary emotions. Whereas this methodology may help in gaining insight about real-life emotional fluctuations, for example in patients with borderline personality disorder (Reisch et al., 2008), it suffers from limitations related to self-reporting of emotional states (see above).

Observer-rated assessment of distinct emotional categories may be achieved using the Classification of Affective Meaning States (CAMS; Pascual-Leone & Greenberg, 2005). This scale was developed based on the fundamental distinction between primary and secondary emotions outlined above and is therefore fundamentally anchored in emotion-focused clinical practice. It assesses a dozen main categories of emotions, which are understood to be experientially distinct. For example, global distress—a general (secondary) form of sadness, sometimes blended with some anger—can be differentiated from the experience of primary grief (over a specific loss; Kramer, Pascual-Leone, Despland, et al., 2015). Similarly, anger may be differentiated between (primary) assertive anger (ie, entailing standing up for one's need) and (secondary) rejecting anger (ie, entailing complaining and accusing the other person). The CAMS has extensively been used in clinical populations, encompassing depression, interpersonal injuries, trauma, general anxiety disorder, and personality disorders (see Choi, Pos, & Magnusson, in press; Kramer, Pascual-Leone, Rohde, & Sachse, 2015; Kramer et al., in press; Pascual-Leone & Greenberg, 2007). Whereas the rater training is rather time-consuming, we need to note that for clinical practice, again, the concepts encompassed in this rating scale may be used in a more simplified way, to make them accessible to everyday clinical practice.

4 Conclusions and perspectives

Emotion assessment in clinical practice is an important task, when one wants to understand the central components of a clinical disorder presented by a patient. However, the fluctuating nature of emotion, different types of emotion and the observation that patients, like many healthy controls, generally fail to accurately self-identify and self-report their emotions (eg, Nabi, 2002), render this task daunting.

We argue that in addition to the discussed self-report measures, it should be the clinician's central concern to assess emotions in the unfolding interaction. In order to make this interaction focusing on central components, different forms of therapist empathy may be used, for example understanding, affirmation, evocation, and exploration. Such a differentiated stance toward emotion fosters trust in the patient who may open up more and access more central and core emotional contents and components, as part of an assessment. We presented a heuristic which may help to differentiate different types of emotions, as a function of their centrality for the clinical concern and the experience of the patient in the here and now. Different emotion types, as subjectively experienced by the patient in the session, seem to be a particularly promising way of assessing emotions in clinical practice.

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Emotions Studied in Context: The Role of the Eating Environment

15

John S.A. Edwards[1], Heather J. Hartwell[1] and Agnes Giboreau[2]
[1]Food Service and Applied Nutrition Research Group, Bournemouth University, Poole, United Kingdom [2]The Center for Food and Hospitality Research, Institut Paul Bocuse, Ecully, France

1 Introduction, rationale, and overview of the chapter

Food and meals are seldom, but not exclusively, eaten in isolation and are, therefore, influenced by a myriad of factors as diverse as with whom the meal is consumed to the surrounding or prevailing conditions under which the meal is eaten; that is the environment. At a fundamental level, environment can be defined (Oxford English Dictionary, 2015) as:

> *The surroundings or conditions in which a person, animal, or plant lives or operates.*

However, in the context of the eating environment, a number of other definitions have been offered. Numerous references are made in the literature to the social and physical environments. Lin and Liang (2011), for example, investigating customer emotions and service encounters, refer to the social environment (including factors, such as employee displayed emotions) and the physical environment (including factors, such as design). Other terms in general use include the soft environment and the built or concrete environment; tangible and intangible environment. Furthermore, terms such as ambience and atmosphere are also used interchangeably, where in the latter case, work has been undertaken, not least of all on the terminology itself. Kotler (1973–1974) uses terms such as spatial aesthetics and atmospherics; Bitner (1992) uses the built environment and servicescapes; Hutton and Richardson (1995) healthscapes; whilst Sobal and Wansink (2007) explode the taxonomy completely with, *kitchenscapes, tablescapes, platescapes*, and *foodscapes.*

It could be argued that the term environment is more inclusive than the various "scapes"; notwithstanding, this chapter takes the broadest definition to investigate the role the eating environment has and might have on the range of emotions, how emotions might influence the eating environment and how any changes which occur might be measured. The term environment is used synonymously with the other *servicescape* terminology.

Other semantics also provide a challenge when studying research undertaken in an environment in which food is consumed. It is field research, but hardly an appropriate term for anything consumed in a restaurant or at home; live research and real(istic) environments

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offer little clarification of the situation. The term "*typical*" environment (typical of the environment where that consumption might take place) has therefore been chosen to represent research undertaken in a "working setting" as opposed to a laboratory setting.

The chapter commences by providing an overview of eating scenarios and considers the changes to eating habits, food and meal consumption patterns which have taken place in recent years when eating both at and away from home. It identifies the contextual factors illustrating the importance/effects of the environment, in particular the part played by emotions, before the main thrust of the chapter which considers the issues and challenges of measuring and assessing emotions in a typical eating environment; then draws conclusions.

1.1 Eating scenarios, both at home and away from home

According to Maslow's Hierarchy of Needs (Maslow, 1943), physiological needs, including food and water, are the primary physical requirements for human survival, without which the human body cannot function and survive. In developed societies, this basic need is rather more complex, when eating both in and out of the home.

The general changes which have taken place, particularly in recent years, could not have gone unnoticed; and if estimates are to be believed, that pace of change is likely to continue. Planet Earth is becoming increasing crowded and, worldwide, it is estimated that the population will increase from 7 billion today to over 9 billion by 2050 (OECD, 2014). This is likely to place tremendous pressure on all facets of everyday life, including the availability of natural resources, such as energy and water, and the availability and price of food. A rising number of families in OECD countries have less money to spend on food, with a growing number of families and children suffering from hunger or food insecurity in economically distressed countries (OECD, 2014).

At the same time the population is getting older, with the number of over-65-year-olds increasing from 15% today to 25% by 2050 (OECD, 2014). Developing nations are becoming more demanding of food and other available resources, hence food shortages in many countries will exacerbate political upheaval, famine, and the spread of disease. On the other hand, globally in 2014, more than 1.9 billion adults (13%) of 18 years and older, were overweight; of these over 600 million were obese (WHO, 2015). This situation is unlikely to improve where currently 42 million children under the age of 5 years are overweight or obese (WHO, 2015). These and other environmental factors, including lifestyle and technology, have and will continue to affect the environment, eating habits, and food consumption patterns, both at home and outside the home, well into the future.

1.2 Changes in eating habits, food, and meal consumption patterns

Individual dietary habits and practices are socially and culturally embedded in a person's domestic routine and in the rhythms of their everyday lives (Jackson & Pickering, 2009). Hence, a knowledge of meals will provide a better understanding of the eating environment. This section briefly identifies and considers different eating scenarios, when eating both at and away from home.

1.2.1 Family meal structure

"Because they spend so much time out of the house earning money, many young women in cities … have never learned to cook. Sometimes their households scratch along, ill-fed. At other times their husbands are condemned to take over domestic duties" wrote the industrialist and economist Frederick Engels in 1845 (Anon, 2013). It could be argued that little has changed, but, over the centuries, family meals have taken a variety of formats. They are determined by factors as diverse as nationality, ethnic background, religious affiliation, social class, finance, and domestic arrangements, with a consequence that, both nationally and internationally, there is really no uniform family meal pattern.

The research on how family meals have changed is mixed. The demise of the family meal has been reported in the popular press where it is claimed that the family meal is now down to 67 minutes a day, whereas eating while doing other things now takes 78 minutes per person per day. Astoundingly, it has been claimed that 20% of food intake in America is now eaten in the car (Pollan, 2013). On the other hand, the academic literature has reported an increase between 2005 and 2010 in the number of family meals and the number of those meals that were home-cooked (Todd, 2014). The reasons for the change in family dining are as diverse as: working parents, availability of ready meals and microwaves, and a more active lifestyle. Other factors must also be considered as in one study, about half of the adults ate family dinners at restaurants, fast food outlets, takeout food at home, and at the homes of friends and relatives (Sobal & Hanson, 2014). Hence it is unclear whether there is a demise in family meals or simply a changing family meal structure.

What seems to be the case is that a number of benefits have been attributed to family meals. The findings of a systematic review (Harrison et al., 2015) indicate that frequent family meals are associated with better psychosocial outcomes for children and adolescents. In general, frequent family meals are inversely associated with eating disorders, alcohol and substance abuse, violent behavior, and feelings of depression or thoughts of suicide. There is also a positive relationship between frequent family meals, increased self-esteem, and commitment to learning or a higher grade point average; with females seemingly gaining more protective effects from frequent family meals than males.

Other benefits attributed to the children of families who frequently have family meals together include enhanced vocabulary, academic success, healthy food selections, demonstration of positive values, and avoidance of high-risk behaviors (such as substance abuse, school problems, and eating disorders) (Fruh, Fulkerson, Mulekar, Kendrick, & Clanton, 2011). For instance, adolescents from families with a more positive emotional atmosphere at mealtimes reportedly eat meals together more frequently and have healthier diets (Berge & Neumark-Sztainer, 2011).

1.2.2 Meal patterns and meal times

Over the centuries, not only has the pattern of meals changed but so have the timings. Around the 16th century, the day would probably have started with foods such as bread and beer with only two "formal" meals per day; one around 10:00 am in the summer (9:00 am in the winter) and one around 5:00 pm (4:00 pm in the winter).

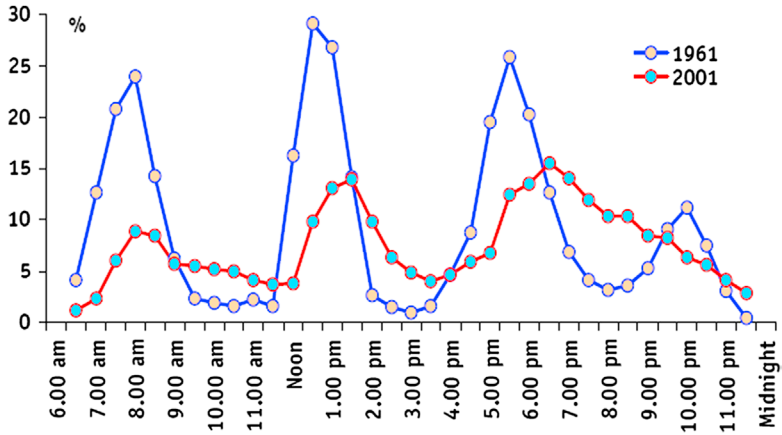


Figure 15.1 Changes in meal times 1961–2001.
Source: Cabinet Office (2008).

Meals then generally became later and later, necessitating the introduction of breakfast giving a three meal per day structure; and in some cases with the addition of a supper meal.

More recently meal timings have become much less formal as demonstrated in Fig. 15.1, where it can be seen that the rigid timing of meals has, to a great extent, given way to an increased frequency of meals, consumed throughout the day.

What is also apparent is that dietary quality is often poorer at the weekends, characterized by higher fat intakes, higher alcohol intakes, and consequently higher energy intakes, which are not necessarily offset by an increase in activity; rather an increase in sedentary behaviors (McCarthy, 2014). In the United States, watching TV during mealtimes, reported by 34% of boys and 31% of girls during family meal times, has been associated with poorer dietary quality among adolescents (Feldman, Eisenberg, Neumark-Sztainer, & Story, 2007). Where the TV was not on during family meals, children are more likely to eat fruit and vegetables and less likely to consume soda and chips (Andaya, Arredondo, Alcaraz, Lindsay, & Elder, 2011).

1.2.3 Snacks versus meals

Notwithstanding the definition and composition of snacks, but defined here as anything consumed between the three main meals, the frequency of consumption and their contribution toward the diet, overweight, and obesity is not entirely clear. Research suggests that in certain age groups the prevalence of snacking over the years has increased, whilst in other groups it has remained fairly static. Whether snacks have replaced the pattern of meals is also far from clear (Bellise, 2014; Kant & Graubard, 2015).

Commercial research has shown that, adjusted for inflation, total annual worldwide sales of snack items up to March 2014 was worth US$374 billion, a rise of 2%

over the previous year, although in Europe sales remain fairly static at US$167 billion. Globally, women consume more snacks than men, for example, 68% versus 61% for chocolate and 68% versus 57% for fresh fruit. What type of snack is consumed varies worldwide. Confectionery, sugary sweets, and chocolate comprise the largest sales in Europe (US$46.5 billion) and the Middle East/Africa (US$1.9 billion). In North America, salty snacks contribute more than one-fifth of sales (US$27.7 billion), refrigerated snacks make up one-third of sales in the Asia-Pacific region (US$13.7 billion), whereas cookies (biscuits) and cakes make up more than one-quarter of total sales in Latin America (US$8.6 billion) (Nielsen, 2014).

The reasons for snacking are many and varied, for example, globally, 76% of consumers often or sometimes eat snacks between meals for reasons of hunger or to satisfy a craving, and 45% as a meal replacement; consumers in the Middle East/Africa (58%) and Latin America (55%) eat snacks as a meal replacement. Nutrition is also a consideration with 61% consuming snacks as an energy boost, whereas other reasons are attributed to "purely emotional," where globally, 64% consume snacks for their mood and 44% because they are stressed (Nielsen, 2014).

1.2.4 Eating out versus at home

People have always eaten out of the home; from the Ancient Greeks and Romans, and in the Middle Ages, where a fear of burning down the dwelling, and lack of cooking resources and skills were the encouragement to have food cooked or baked centrally. What has changed today is the frequency with which people eat out. In the United States of America, for example, the restaurants' share of the "food dollar" has risen from 25% in 1955 to 47% at present. It is forecast to be worth US$709.2 billion in 2015 or 4% of the US gross domestic product (NRA, 2015). It has also increased the proportion of food and nutrients coming from outside the home. The exact effects vary depending, for example, on which meals are consumed, but on average, breakfast away from home decreases the number of servings of whole grains and dairy consumed, and increases the percent of calories from saturated and solid fat, alcohol, and added sugar. Dinner away from home reduces the number of servings of vegetables consumed (Todd, Mancino, & Lin, 2010).

Globally, the foodservice industry grew 2% in 2014 with annual sales of US$2.7 trillion; with further rises expected in 2015. The Asia-Pacific region provided the strongest growth, 41% of total spending, more than double the next largest region, which is perhaps not surprising as the region has more than half of the global population. At the same time, the developed markets had particularly sluggish growth, although Latin America and the Middle East saw double-digit growth, but from a very low baseline. "Non-traditional" outlets, such as home delivery, takeaway, and drive-through also grew in 2014 as consumers sought to maximize convenience and save time. What is perhaps interesting is that more and more lower-income consumers from the emerging markets are eating out on a regular basis, and in doing so, driving down the average sale per transaction. What is also interesting is that "standalone" outlets, rather than chains, dominate the foodservice industry with 76% of sales by value (Euromonitor International, 2015).

2 Contextual factors: the environment

Food and meals are not consumed in isolation but within the environment in which we live. Eating is seldom a case of matching food and consumer, a refueling process, and tends to be a pleasurable experience with a growing, if not conclusive, body of evidence showing that the entirety of the eating episode around the meal, that is, the food, the consumer, and the situation or circumstances (environment), in which consumption takes place, need to be considered. This section considers the role and relevance of the eating environment.

The influence the environment has on food was demonstrated as long ago as 1945, where the acceptability of the same food consumed on the ground was rated differently when served on an aircraft flight (Green & Butts, 1945). Since then, other recent studies have sought to demonstrate how the acceptability of identically prepared foods, differs when served in a variety of different styles of restaurant, for example:

- using US army combat rations, the Meal Ready to Eat, taken out of its packaging and offered as part of the menu in both a cafeteria and restaurant (Meiselman, Johnson, Reeve, & Crouch, 2000);
- a creamy chicken dish with rice, served in a variety of locations including a 4-star hotel restaurant, military dining room, boarding school, and a residential home, where the dish could be freely chosen from the menu (Edwards, Meiselman, Edwards, & Lesher, 2003);
- similar dishes served in a laboratory, a central location, and an outlet of a national restaurant chain (King, Meiselman, Hottenstein, Work, & Cronk, 2007).

In each of these studies, identically prepared meals were served in the customary style of the operation and diners were able to freely choose their own meals; acceptability was rated using a 9-point hedonic scale. The only factor which differed was the situation under which consumption took place, that is, the environment, but the results (see Table 15.1 for results of the second study) clearly illustrate that the environment affected the acceptability of a dish. As a general rule, identical food items were rated

Table 15.1 Acceptability of an identically prepared chicken dish served in various locations

Dining location	Mean	*n*
Army training camp	6.6[a]	43
University staff refectory	6.6[a]	36
Private boarding school	6.7[a]	88
Freshman's buffet	6.7[a]	83
Private party	7.0[ab]	77
Residential home (elderly)	7.1[ab]	43
Student refectory	7.1[ab]	33
Day care center (elderly)	7.1[ab]	33
University 4-star restaurant	7.6[ab]	19
Hotel 4-star restaurant	7.6[ab]	32

Source: Adapted from Edwards et al. (2003).
Notes: 1, Dislike Extremely; 5, Neutral; 9, Like Extremely. Means with different superscript letters are significantly different ($P \leq 0.05$).

differently in different environmental locations; the "better" the dining facility, the higher the food acceptability ratings. In addition, and as discussed later, the influence of environment reinforces the notion that in order to gain a true or fuller understanding of relationships between emotions and the environment, empirical studies need to be conducted in a typical environment rather than, or in addition to, a laboratory.

A similar scenario applies when studying meals and testing products in the home and in the laboratory (Boutrolle & Delarue, 2009). The authors, in considering the relative merits of testing products in a central location versus the home, note that testing food products under controlled test conditions may well modify consumers' perception and liking, leading them to conclude that product uses need to be taken into account not only in the study design but also in the interpretation of the results.

2.1 The importance of the environment and emotions

A number of studies demonstrating the importance of the environment on emotions have been undertaken in a typical environment.

Perceptions of the physical environment have been shown to directly influence customers' emotions, which in turn affect their behavioral intentions, producing pleasure-feeling emotions. The dominant factor associated with pleasure-feeling is facility aesthetics (Kim & Moon, 2009; using a questionnaire administered to tourists visiting a theme park in Canada). Jang and Namkung (2009) using self-administered questionnaires in four mid- to upscale restaurants have shown that the environment (atmospherics and service) function as stimuli that enhance positive emotions, while product attributes such as food quality act to relieve negative emotional responses. Ali and Amin (2014; using a self-administered questionnaire in various resort hotels) found that customers who have higher perceptions of the physical environment are more likely to have positive emotions, which in turn increase customer satisfaction and behavioral intentions toward the experience. This was further illustrated by Slåtten, Mehmetoglu, Svensson and Sværi, (2009; using a structured questionnaire in a Norwegian winter park), who demonstrated that design and construction are linked to customers' feelings of joy; design had the strongest impact on emotions, which were highly related to the influence on customer loyalty.

Emotional treatment has been shown to be effective in situations to resolve service failures, that is, when the service provided does not meet expectations (Ha & Jang, 2009). It has also been shown that older consumers have more positive emotions after service recovery efforts than younger customers. The authors suggest that restaurant managers should focus on a sincere emotional approach to enhance post-recovery satisfaction because consumers may expect and appreciate an apology and empathy more than money; also being more effective in customer retention (Kim & Jang, 2015; using a questionnaire in a casual restaurant).

In a student cafeteria, Edwards, Hartwell, and Brown (2013) investigated how emotions affected meal choice and meal acceptability. Diners ($n = 408$) completed a pre-meal emotional status questionnaire, chose and paid for their meal before finding a table/seat where it could be consumed. When finished they returned with their plate and completed a similar emotional status questionnaire. Results show that emotions, as described by 47 words (expressions), tended to be flattened after consuming the

meal. Gender, eating alone or with others, age and year of study, were important, pre- to post-meal. Males appear to be more positively disposed than females; the negative emotions, less clear by gender; eating alone heightened positive emotions; older subjects are more heightened negatively before a meal, which is flattened post-meal consumption; first-year students' emotions are heightened positively both pre- and post-meal. Emotions had no influence on which meal was selected, although there was a weak association between the meals eaten and subsequent emotion. In general, positive emotions induced higher meal acceptability; negative emotions lowered acceptability scores; the variables, gender, eating alone or with others, and age had no influence on meal acceptability, although year of study did.

2.2 The appropriateness of the eating environment

Also to be considered is the appropriateness of the food in relation to the eating environment (Cardello, Schutz, Snow, & Lesher, 2000). Many foods could be considered appropriate to different situations, for example, some foods might be more appropriate served at a breakfast meal, and others at an evening meal. Similarly, different foods might be more appropriate in one environment, but not another. A burger would be served in a fast food restaurant but perhaps would not be so appropriate in an up-market restaurant.

This belief has been supported in a number of studies where it has been demonstrated that environmental cues steer people's decisions concerning food intake and food choice (Prinsen, de Ridder, & de Vet, 2013). It has also been shown that consumers consistently show the effects of appropriateness on their emotions toward food products and eating occasions. The frequency and intensity of positive emotions are generally higher in more appropriate contexts, supporting the idea that emotional responses are subject to a large number of contextual influences, hence appropriateness measures should be considered for inclusion in any research on emotions (Piqueras-Fiszman & Jaeger, 2015).

2.3 The environment influences

Kotler (1973–1974) suggests that the dimensions of the environment should be considered through the senses, hence the contributing factors are: *visual dimensions, aural dimensions, olfactory dimensions,* and *tactile dimensions*. Turley and Milliman (2000) use variables thus:

External variables, such as the entrance, signs, and size of the building.
General interior variables, such as flooring, music, color, smell, and temperature.
Layout and design variables, such as space, waiting areas, furniture layout, and traffic flows.
Point of purchase and decoration variables, such as signs, cards, and product displays.
Human variables, such as employee and customer characteristics, crowding, and privacy.

Whichever classification is used, what is clear is that numerous environmental variables contribute to and influence eating meals. It involves factors where, in some cases, little academic research has been conducted. By way of example, three areas of environmental interest, where research has been undertaken, are summarized below. Clearly though, space precludes the consideration of all factors, but they have been highlighted and summarized in Fig. 15.2 so that the reader, who might be unfamiliar with the topic, can appreciate the breadth and depth of the issues involved.

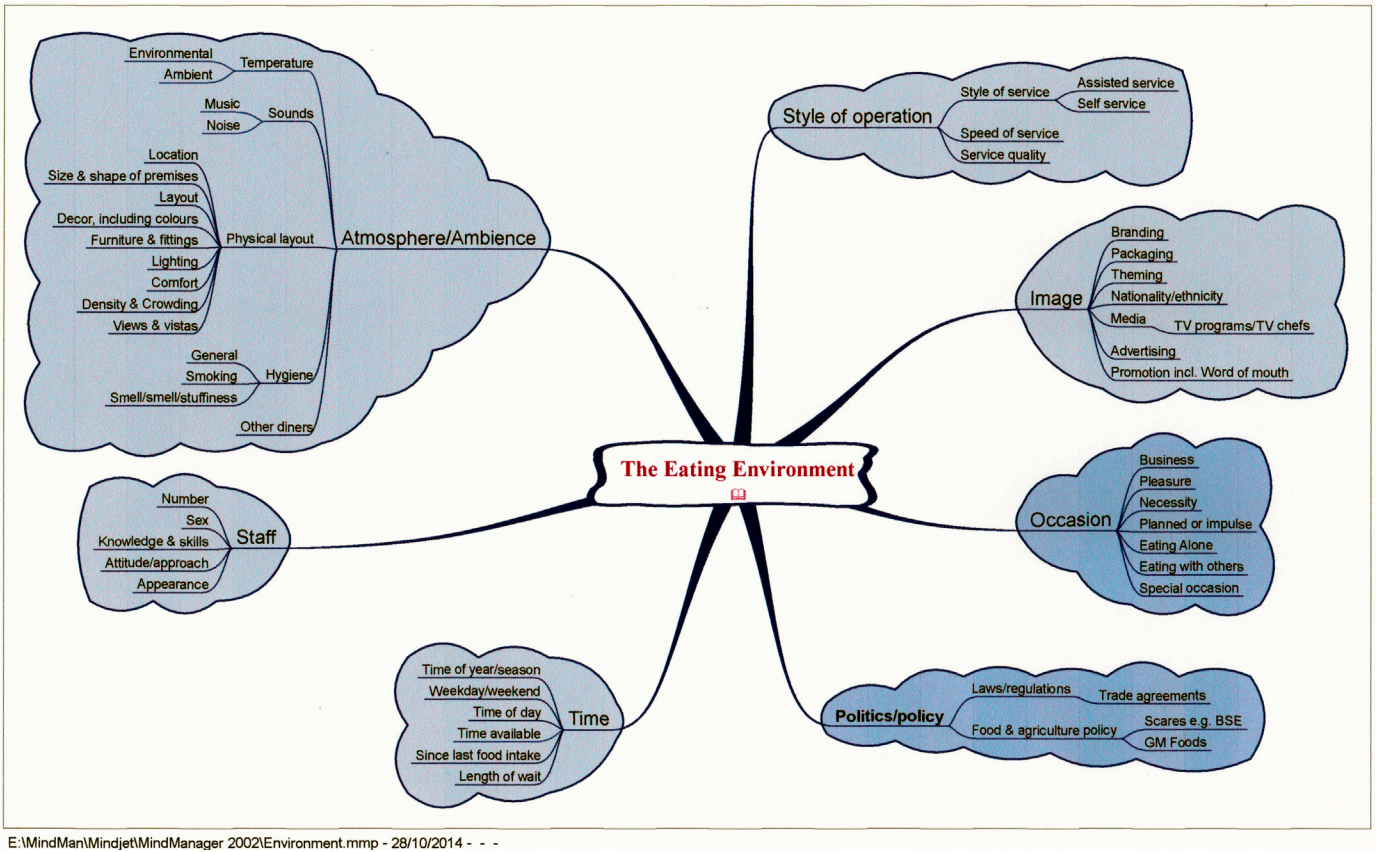


Figure 15.2 Primary factors influencing emotions in the eating environment.

2.3.1 Décor/ethnicity

In an up-market restaurant, an Italian menu was offered over a number of days (control) and diners asked to state, amongst other things, which country, either Britain, Italy, France, or simply foreign, they thought the food came from. Over subsequent days (experimental) an identical menu was offered with the exception that the restaurant was decorated with an Italian theme, to include aspects such as Italian flags and bunting and ethic names added to the dishes. Results (Table 15.2) show that in the control phase diners were unsure which country the food came from, but when an Italian theme was added, they immediately recognized that the food was Italian. The only variable that had been changed was the addition of flags and bunting; manipulating the environment, in this case the décor, provided, inter alia, a different perspective of the food to diners (Bell, Meiselman, Pierson & Reeve, 1994).

2.3.2 Odor

Diners were invited to a cafeteria for an all-day breakfast, where they could freely choose their food and return for more if they wanted. On some days there was no odor in the cafeteria, on other days a pleasant smell (grilled bacon), and on other days an odor which was disliked (boiled cabbage). Results (Table 15.3) show that on the days when exposed to an odor, which was liked rather than no or a disliked odor, the total amount of food consumed increased. The environment, in this case the pleasantness of the odor, had a positive influence on the amount consumed (Blackwell, 1997).

Table 15.2 Ethnic classification of meals served

	Control (%)	Experimental (%)
British	23.8	10.2
Italian	36.5	76.0
French	11.1	0
Foreign	28.6	13.3

Source: Adapted from Bell et al. (1994).

Table 15.3 Amount consumed when exposed to an odor which is liked

Amount consumed (g)		
Food	**Not exposed**	**When exposed**
Sausage	168	210
Bacon	75	120
Beefburger	232	232

Source: Adapted from Blackwell (1997).

Table 15.4 Average spending according to type of music played

Variable	Expenditure (£)		
	Classical music	Pop music	No music
Starters	4.92[ab]	4.04[a]	4.26[b]
Main course	14.72	14.52	14.49
Dessert	3.42	2.56	2.75
Coffee	1.07[a]	0.80	0.54[a]
Bar	3.51	3.06	2.98
Wine	4.88	4.49	5.05
Total drink	8.39	7.55	8.04
Total food	24.13[ab]	21.91[a]	21.70[b]
Total spend	32.52[ab]	29.46[a]	29.73[b]

Source: Adapted from North et al. (2003).
Note: Totals do not sum due to rounding. Letters denote significant differences.

2.3.3 Music

The influence of music has been studied in various styles of restaurants, over a number of years. For example, Milliman (1986) and North, Shilcock, and Hargreaves (2003) have shown how different genres and speed of music can influence perceptions and other aspects of the meal. Slower music, for example, encourages diners to spend longer at the table and spend more on their purchases; and music, particularly "classical" music is better than no music (Table 15.4). The results are not necessarily indicative of what type of music should be played, but rather how the eating environment, in this case music, might be used to manipulate and influence various aspects of the meal experience.

3 Measuring emotions in the environment

The commonest way in which food can affect behavior is through changes in mood and arousal that occur from before, to after eating a meal (Gibson, 2006). Individuals tend to consider and evaluate the environment holistically as opposed to one or two specific clues. However, what is unclear and remains unresolved in that evaluation is whether cognition or emotion comes first (Lin, 2004). When a person enters a dining room, do they think or feel first?

Despite this and until recently, few studies have investigated the role of measuring emotions when eating in a typical environment, how emotions might influence or change what is chosen, and what effects that choice might have on aspects such as food acceptance and consumption. The purpose of this section is not to provide a detailed textbook replacement for those planning research in a typical environment setting; an internet search will reveal many scholarly tomes. The aim is more to

highlight some of the issues judged to be important and which need to be taken into consideration, based primarily on emotions-related research, which has already been conducted on human subjects. It then provides three illustrative case studies where research has recently been conducted in a typical environment.

Numerous authors have commented on and debated the rationale, advantages, and disadvantages of collecting data in a typical environment versus laboratory studies (Boutrolle & Delarue, 2009, provide a useful summary and overview). As long ago as 1992, Meiselman (1992) advocated greater research on "real foods in real environments" as one strategy for the better prediction of food-related behaviors. That is not to say there is no place for laboratory work, as demonstrated by the responses (see Appetite 1992; 19(1); eg, Kissileff, 1992). What in essence it suggests is that typical environments can also be a laboratory, but one where people live and eat, and therefore research needs to be studied in that context.

As seen in earlier chapters, just as there is no firm consensus on the definition of emotions; there is also no "gold standard," even within disciplines, as to exactly how emotions might be measured in a typical environment. Furthermore, most eating-related studies have tended to concentrate on measuring and assessing changes in emotions using a single food; invariably in a controlled laboratory environment, and often using subjects with eating disorders (dieting and/or obesity) or psychology students (see, eg, review by Macht, 2008). Until relatively recently, no studies have sought to measure emotions in a typical environment where complete meals are consumed.

3.1 Choice of techniques in typical environment settings

Deciding on the choice of technique is one topic that is likely to occupy a considerable amount of time in the planning of any research project to be undertaken in a realistic environment. There is no "ideal," although the choice currently is likely to be between interviews, being the most common qualitative technique, and questionnaires, with or without observation, being the most common quantitative technique. Newer techniques, such as detailed observation of behavior (gestures, durations, and interactions), which are not as yet commonly used, are coming on-stream and are thought likely to play a greater role in the future.

3.1.1 Interviews

Interviews have, until recently, been a little-used technique in emotion research, but one that can be used as either a standalone tool, in addition to quantitative techniques (Brown, Edwards, & Hartwell, 2013), or as a precursor to help establish a valid tool to be used in any quantitative study.

Interviews enable subjects to fully articulate any changes in emotions that may not be apparent from words used in a questionnaire. Questionnaires can capture changes in emotions in numerical terms; they cannot explain in any depth why those changes may have taken place. Indeed, "probing" that is normally associated with in-depth interviews can be used to maximum effect by encouraging participants to reflect on

the feelings elicited by the consumption of the meal concerned. In this context, the amounts of each food consumed can be weighed and the reasons for consumption, or otherwise, explored.

Unstructured, and to some extent structured interviews, need to be conducted in a "neutral environment," that is, in a quiet, nonthreatening setting, probably away from where food consumption takes place and where the participants' story is paramount and takes primacy, thereby permitting the interviewee to express his or her views in a nonthreatening climate, and for the interview to flow as freely as possible. This is particularly important in a study where there is a research vacuum (Holloway & Wheeler, 2010), such as, in the study of emotions.

One approach during the interview is to ask diners to articulate how they feel before, during, and after the meal. The interviewer then probes the responses, being careful to avoid asking leading questions and again introducing any bias. As a result, each interview can take over 60 minutes, and although each is unique, common threads and patterns begin to emerge (content-thematic) until "saturation" is reached.

Interviews tend to be digitally recorded, and then transcribed before being analyzed. This latter process can be undertaken either manually or using one of the many computer programs that are available.[1] It is important, though, to become fully immersed in the data by repeatedly reading or going through the transcripts and listening to the recordings, thereby providing a holistic view of what has been said. The data are then broken down into manageable "chunks" and labeled or coded according to their content. This content is then sorted and grouped into broad overarching categories, although there will, of course, be some overlapping content and themes. Once this has been achieved the results can be reviewed allowing interpretation and meaning to be brought to the data.

3.1.2 Laddering interviews and means–end chain analysis

Two inter-related techniques, which have existed for many years are laddering interviews which in turn provide means–end chain data (also termed means–end laddering) and have been commonly used in areas such as market research where it is claimed they provide a better understanding of consumer behavior (Reynolds & Olson (Eds.), 2001). More recently, the techniques have become popular as a way of understanding consumers' motivations for food product choice (Costa, Schoolmeester, Dekker, & Jongen, 2007; Russell et al., 2004), but as yet they are relatively uncommon in emotions research.

Means–end laddering is an in-depth, probing interview technique which "forces" the respondent up a ladder of abstraction, linking relatively concrete meanings with abstract meanings, which may be more important (Mostovicz & Kakabadse, 2009).

Different laddering techniques, soft and hard (Russell et al., 2004), can be used but two stages are generally involved: firstly the attributes relevant to the research issue are identified from, for example, the literature and subject experts. These then

[1] See, for example, "Computer Assisted Qualitative Data Analysis (CAQDAS)," an information, advice, training, and ongoing support service in the use of a range of CAQDAS applications. http://www.surrey.ac.uk/sociology/research/researchcentres/caqdas/.

provide the structuring for the interviews which are conducted on a one-to-one basis. Subsequent analysis provides a means–end chain demonstrating how consumers link product attributes to their own aims and circumstances.

3.1.3 Questionnaires

The most popular quantitative technique for measuring emotions in a typical environment is questionnaires, where various instruments and techniques have been developed, tested, and validated. Early attempts have included: van Strien et al. (1986); Arnow, Kenardy, and Agras (1995); Ozier et al. (2007); and Tanofsky-Kraff et al. (2007). The development of these instruments invariably started with a large number of words (eg, 585; Clore, Ortony, & Foss, 1987) which were narrowed down, through a process of elimination and validation, then truncated into a more manageable number. The temptation to make the instrument more user-friendly is to reduce the total number of words to as few as possible making it much easier to administer and be completed. For example, Ladhari, Brun, and Morales (2008) narrowed the terms down to 12 words; Paquet, St-Amaud-McKenzie, Kergoat, Ferland, and Dubé (2003) 10 words; or 3 (fear, happiness, and disgust) McNamara, Hay, Katsikitis, and Chur-Hansen (2008). However, Laros and Steenkamp (2005), amongst others, counsel against collapsing the words too far, as important nuances can be lost.

The question then arises as to what is the "ideal" length, that is, how many words should be used. Richins (1997) developed and tested an instrument with 47 variables (expressions), clustered into 17 emotional descriptors. Laros and Steenkamp (2005) subsequently took this work further by developing and testing a hierarchy of three levels that emotions might fall into: the super-ordinate level with positive and negative effects; the basic level with four positive and four negative emotions; and the subordinate level with the specific emotions identified and used by Richins (1997). Recently, King and Meiselman (2010), in developing their emotional assessment tool for use primarily in product development, narrowed theirs down to 39 words. Edwards et al. (2013) used a 47-word scale initially based on the work of Richins (1997) and King and Meiselman (2010), grouping the words according to the work of Laros and Steenkamp (2005). Subsequent testing and validation ($n = 32$) gave a Cronbach's alpha value (a measure of the internal consistency or reliability) of 0.922.

When considering terminology, the importance of other "emotional dimensions," such as "spiritual" should not be overlooked. Tama and Voonb (2014) incorporated nine such dimensions in their questionnaire survey of customer emotional experiences in halal food establishments. The findings indicated that the spiritual dimension and customer acceptance have a strong influence on the customers' emotional experience.

In the development process, Richins (1997) noted that their tool was not intended to be a definitive assessment instrument but more the starting point in determining the proper assessment of consumption-related emotions. Similarly, the authors suggest that the proposed scale may not necessarily be used in its entirety but adapted to suit the particular circumstances being investigated.

When considering the length of scale to be adopted, Richins (1997) used a four-point scale, because of the lengthy number of descriptors, although it was

acknowledged that other scales have been equally as successful. King and Meiselman (2010), for example, used a five-point scale (not at all; slightly; moderately; very; extremely); Carley, Forrester, and Maute (1994) a seven-point scale (not at all = 1, very strong = 7); Dubé, LeBel, and Lu (2005) a seven-point scale (1 = not at all, 7 = very intensely). Others (Arnow et al., 1995; Tanofsky-Kraff et al., 2007) used an entirely different scale; no desire to eat; a small desire to eat; a moderate desire to eat; a strong desire to eat; an overwhelming (very strong) desire to eat.

Another area to consider, and reported in studies, is the systematic or memory order effects (Richins, 1997). Where instruments are administer on a number of occasions then the question order could become familiar to the subject. This is obviously unimportant in the studies where questionnaires are only administered once but needs to be considered in multiapplications. Edwards et al. (2013) addressed this, where the questionnaire was administered twice, pre- and post-meal, by reverse-ordering the questions to help reduce, if not eliminate, any memory recall effects. Randomizing pre- to post-meal questions was considered unworkable for the analysis stage.

3.2 Sample and sample size in relation to the chosen technique

Sample size, that is, the number of subjects, replicates, or observations required to be able to make statistically valid inferences about a population, is an important feature of any empirical research, more so perhaps in a study taking place in a typical environment. Too small a sample, the less likely the results are to be valid and meaningful; too large may or may not provide greater accuracy but uses additional resources which could be wasted if the sample is unnecessarily over-large.

The approach to sample size will depend on numerous factors, not least on whether the research is quantitative or qualitative, but perhaps equally as important are more practical considerations. These include the availability of resources, including trained personnel, finance, and time, and of course, the availability and willingness of subjects to take part, and an establishment where the research can be conducted. The sample size in qualitative research is likely to be smaller than quantitative, often tends to be more subjective, but in turn will depend on additional factors, such as, the nature and complexity of the research problem and depth of analysis required.

Several approaches to help decide upon the sample size could be adopted, such as power calculation in quantitative research and a similar tool in qualitative research, where thematic analysis is contemplated (Fugard & Potts, 2015). However, the purpose here is not to review the approaches to sample size calculation. When calculating sample size it should be remembered that no one method is ideal and in practical terms more than one technique, including common sense, will need to be applied. Other approaches use terminology such as:

> Opportunistic—where potential subjects are approached as and when they become available;
> Saturation—where data are collected until "saturation" is reached, that is additional respondents are repeating or reinforcing what has already been established and no new or relevant information emerges (Given, 2008).

3.3 Practicalities in measuring emotions

Sample size has already been addressed, but research in a typical environment requires other factors, which are no less important, but need to be taken into consideration, prior to the commencement of the study.

3.3.1 Difficulties in isolating and controlling the variables to be studied

Isolating the variables to be studied is one of the most difficult tasks to be overcome in typical environments. Unlike a laboratory, extraneous factors that have the potential to affect the results are more difficult to exclude from or control in the typical study. They have been called a nuisance by Rozin and Tuorila (1993) because they complicate the situation and call into question the validity of the research.

Many of these variables can be identified but can they really be eliminated? Similarly, how might these other variables react synergistically? Clearly there is no one complete answer and the most that can be done is to identify and recognize the variables that have the potential to influence (Fig. 15.2), then to consider how they might be eliminated or controlled, if at all possible. The downside here, of course, if variables are eliminated, for example music, is whether the environment is then typical of where consumption takes place. This aspect might be considered as one of the downsides to typical research. What is lost by not being able to control the variables is made up for by the fact that the research is undertaken in a setting that best replicates and represents a typical environment, hence the results are more likely to reflect that environment. It also adds credence to the argument that in some instances, research should firstly be conducted in a controlled laboratory environment before being taken into the "field."

3.3.2 Choice of location

Identifying and selecting a realistic location can in itself be a challenge. Commercial enterprises are unlikely to assist, unless they perceive clear business advantages. Similarly, in many other locations, such as hospitals, ethical approval will need to be sought. If a positive business or other outcomes can be clearly demonstrated and then shared, often businesses are more willing to cooperate.

The choice concerning the type of foodservice outlet is broad, ranging from Michelin starred restaurants, to cafés, fast-food restaurants, military dining rooms, senior living, hospitals, etc. Each has a number of advantages and disadvantages, the choice depending partly on the ease of access and the willingness of the establishment to participate, and the overall purpose of the research.

3.3.3 Subjects

Identifying subjects who meet the selection criteria is part of the training needed for the data collectors; along with the "charm" and ability to convince them to take part.

How subjects are physically selected must also be considered. It may not be feasible, desirable or necessary to recruit all diners and in order that data collectors do not become overwhelmed, subjects could be selected randomly, for example, every third male and every third female. However, when selecting subjects, care needs to be taken to ensure those selected, particularly if they sit at tables with others who have not been selected, do not feel "different" or "privileged." Similarly, if they do sit with others, that they are not influenced by the other diners; both scenarios having the potential to influence subjects' emotional ratings. One possible solution, if questionnaires are being used, is to give questionnaires to every diner, but only use and process those which have been selected randomly.

A further issue is that care is needed when meals have been prepaid or are "free" and whether these situations might give subjects and emotions ratings a positive bias. It is difficult to avoid or overcome these scenarios, other than to consider the circumstances when interpreting the results.

3.3.4 Reward

A reward, either as money, a voucher, or "gift," is sometimes necessary to secure the participation of willing participants. How much and the format of the reward, for example, cash, a voucher, or something "in kind," will depend on the amount of work the subjects need to do, and how big the budget might be. It should be "appropriate" to the group or study, sufficient to attract enough subjects, but not so much as to introduce any bias; hence probably given after the subjects have completed their tasks.

4 Case studies

The following three case studies are illustrative of research which has been undertaken in a typical environment. The first and second studies involve the administering of questionnaires; the third study involves the conduct of interviews.

Case study 1 Questionnaires

The relationship between emotions, food consumption, and meal acceptability when eating out of the home

Source: Adapted from: Edwards et al. (2013) and Hartwell et al. (2013).

Introduction

Food and meals consumed outside the home, for both pleasure and in the workplace, are now common and, as a result, the nutritional contribution that these meals make has become extremely important. Yet no studies have investigated how emotions might influence or change when eating a self-selected meal and what affects these might have on aspects such as emotions, food acceptance, and consumption.

Purpose

The purpose of this study was to evaluate how emotions affect dietary choice and how choice affects emotions and acceptability in a typical eating environment.

Methods

Diners ($n = 408$), who entered a university cafeteria, were recruited using both posters and word of mouth. Once suitable subjects were recruited, they completed a pre-meal emotional status questionnaire, then chose and paid for their hot mid-day, main meal (traditional, or pizza, or pasta or jacket potato with filling) from a self-selected cafeteria, before finding a table/seat where it could be consumed. Once finished, they returned with their plate and completed the post-meal emotional status questionnaire and supplementary questionnaire.

The questionnaire (47 expressions with a 5-point scale; 1 = not at all, 5 = extremely) was developed from the work of Richins (1997); King and Meiselman (2010) and grouped according to the work of Laros and Steenkamp (2005). Piloting ($n = 32$) provided a Cronbach's alpha value of 0.922. Questions were reverse-ordered, pre- to post-test, to alleviate any "memory recall effects."

Results

Results, pre- to post-meal are summarized in Fig. 15.3.

In general, the results demonstrate a greater propensity of positive over negative emotions which were altered by eating a hot main meal, which in the main

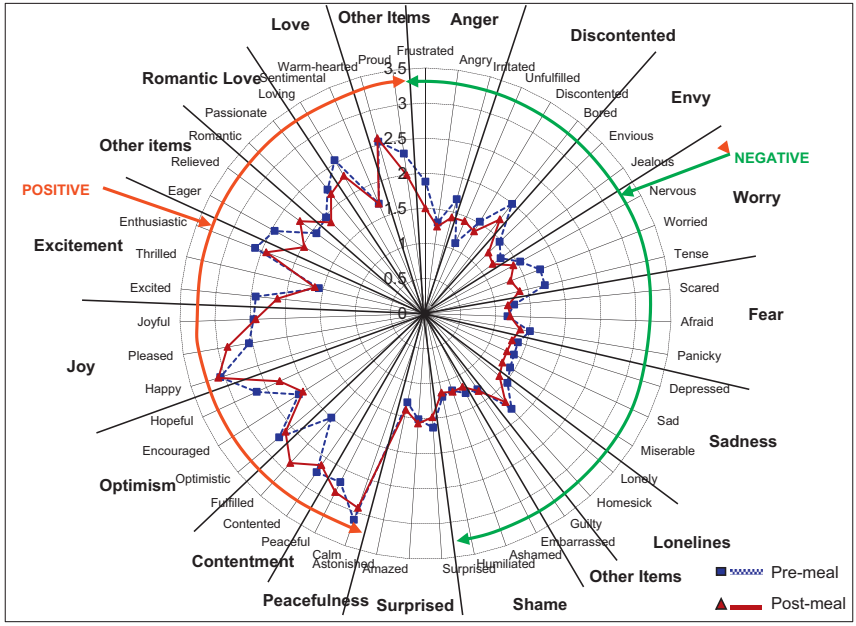


Figure 15.3 Pre- to post-results.
Source: Hartwell, H.J., Edwards, J.S.A. and Brown, L. (2013).

tended to be flattened. Gender, eating alone or with others, age and year of study, were found to be important, pre- to post-meal. Males appear to be more positively disposed to the food than females; the negative emotions are less clear by gender. Eating alone heightens positive and negative emotions. Older subjects are more heightened negatively before a meal, which is flattened post-meal consumption.

Conclusion

Overall, emotions had no influence on which meal was selected, although there was a weak association between the meals eaten and subsequent emotion. Positive emotions induced higher meal acceptability, negative emotions lower acceptability scores.

Case study 2 Questionnaire

The effect of five colored eating context environments on the emotional states of restaurant guests

Source: Giboreau, A, Jacquier, C., & Rouby, C. Unpublished data from Institut Paul Bocuse, Lyon, France.

Introduction

Colors can affect consumers' perceptions and food choice (Magoulas, 2009; Piqueras-Fiszman, Giboreau, & Spence, 2013; Sester et al., 2013). Singh (2006) considers color as a factor stimulating appetite or affecting behavior, such as, staying longer or buying more wine, dessert, or coffee in a soothing environment. However, colors are also potential brakes to eating certain foods and diminishing the desire to eat (Downham & Collins, 1999).

Purpose

The purpose of this study was to assess the effects of five colored eating environments on customers' emotional states and on food liking.

Methods/approach

Five colored environments (red, blue, white, green, and a gray control) were defined through the change of tableware, dishes, furniture, decor, and lighting. Regular customers ($n = 416$; mean age = 42.5 years, 45.5% men) (booked and paid for their meals) came to eat in the experimental restaurant, as usual, taking approximately one and a half hours.

Participants completed two emotional state and food appreciation questionnaires, one before and one after the meal. The first questionnaire evaluated the acceptability of a standard predinner drink and the whole meal before and after the meal, using a 9-point scale (from 1 = I don't like at all to 9 = I like very much). The second, an emotional state questionnaire evaluated participants' responses to the question "*How do you feel right now?*" using a 5-point scale

(from 1 = not at all to 5 = extremely). Twenty emotional terms comprising 10 positive words (admiring, amused, excited, happy, pleasantly surprised, reassured, relaxed, serene, sleepy, well) and 10 negative words (disappointed, disgusted, irritated, nostalgic, sad, stimulated, stressed, tense, uncomfortable, unpleasantly surprised), were selected from previous studies (Chrea et al., 2009; Desmet & Schifferstein, 2008; King & Meiselman, 2010; Richins, 1997). The scale demonstrated good sensitivity in measuring emotional differences in the experimental restaurant setting (Porcherot, Petit, Giboreau, Gaudreau, & Cayeux, 2015).

Results

No significant differences ($P > 0.05$) in emotional states were found between the five colored environments before the meal. However, some emotional items changed in the environments over the course of the meal. Fig. 15.4 shows significant ($P < 0.05$) environmental effects for four positive emotional states after the meal: pleasantly surprised, well, reassured, and stimulated.

More specifically, customers were significantly more pleasantly surprised in the white environment than in the blue and the green, and they were more reassured in the white environment compared to the blue. Customers felt less stimulated in the red and blue environments than in the gray control and in the red environment compared to the white one. In addition, results show a general improvement of customers' mood when comparing before and after meal responses, whatever the

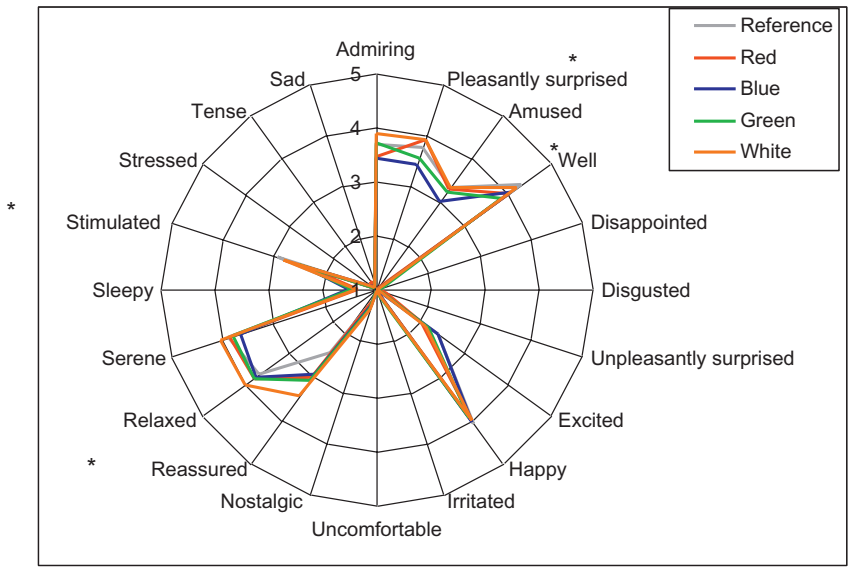


Figure 15.4. Means of customers' emotional scores after the meal in five colored environments (1–5 point scale; ANOVA-LSD post hoc, $*P < 0.05$).

environmental color. No differences were measured related to the diverse food items of the gastronomical menu served during this experiment.

Conclusion

This work confirms the eating environment, in particular the color of the dining room, has an impact on customers' emotions. Our results are in accordance with previous research showing an effect of the color on the mood (Vogels, 2008) and a more specific impact of colored indoor spaces on people, that is, warm colors are associated with excitation and cool colors with relaxation (Küller, Mikellides, & Janssens, 2009). Moreover, whatever the colored environment, positive emotions are reinforced after the meal, suggesting an interesting overall well-being value of meals.

Acknowledgment: US Natick RDCOM for the grant supporting this research.

Case study 3 Interviews

Eating and emotion: The lunchtime meal

Source: Adapted from Brown et al. (2013).

Introduction

The role of emotions is important in the study of eating out and the foodservice industry. Both positive and negative emotions, along with perceived service quality, are the three most important dimensions in customer satisfaction (Ladhari et al., 2008).

Purpose

The purpose of this study was to investigate the changes in emotions brought about by eating a midday meal.

Methods/approach

Students ($n = 10$) using a cafeteria for their midday meal, chose and paid for their meal as usual. Interviewees were recruited in the cafeteria through posters asking for volunteers, and offering a small remuneration for their time (£10).

Unstructured interviews were conducted so that the participants' "story" took primacy and the interview was as free as possible from any interviewer bias. Interviewees were asked to articulate how they felt before they ate their meal and how they felt afterwards. The responses offered by participants were probed, and care taken to avoid asking leading questions. Thus each interview was unique, although common patterns emerged. Each interview lasted between 60 and 75 minutes and was digitally recorded.

Digital recordings were transcribed and analyzed through thematic analysis. Immersion in the data took place through the repeated reading of transcripts and listening to the recordings. This allowed a holistic view of the data before the text was broken up through analysis. This process involved separating data into

discrete manageable chunks and labeling them according to content. Thereafter, codes were sorted into overarching research categories, although some overlapped. The final stage involved interpretation, bringing meaning to the data, and where a dialog with the literature related to emergent themes.

Results
There was a clear relationship between emotions and eating a meal, with increases noted in levels of concentration, energy, and happiness. The quality of the food eaten was an issue of concern to participants; access to a healthy meal was seen to be important, given the perceived benefits for emotional and physical health. Eating was deemed to be both a physical and social activity. Eating in company enhanced the emotional experience of dining, as it offered the opportunity to bond with friends.

Conclusion
This study identifies a link between subjects' emotional states and the overall meal experience with improvements noted in concentration, energy levels, and happiness; and demonstrates the importance of meal provision in an education environment.

5 Summary and conclusions

Eating is a natural physiological activity which takes place both inside and outside the home; in the environment. The eating environment is a complex phenomenon involving a number of factors which, either individually or synergistically, have the ability to influence the meal experience; emotions are one such set of contributing factors.

The study of emotions is an important consideration as, for example, emotions have the ability to influence behavioral intentions, which in turn influence overall satisfaction and can be effective in the event of service failure; all important business considerations.

Measuring emotions can be undertaken in a controlled laboratory environment, prior to being taken into the "field" or in a "typical" setting. Alternatively, the study may go straight to a typical setting. Considerable controversy and discussion have taken place in the literature and elsewhere as to the validity of each approach, but what is clear is that there is no one solution or technique which fits all situations. Much will depend on the aim, circumstances, and resources of the study. However, there is a strong argument that although a laboratory study will provide initial answers, it is only once it has been taken into the field in a typical environment, particularly when meals, rather than individual foods, are consumed and using actual customers, that the true nature of emotions and changes in emotional status can be captured. Perceived weakness in a typical study, over a strictly controlled laboratory study are invariably more than made up for by the realism of a typical environment.

The techniques used to date to measure emotions in a typical environment tend to be restricted to questionnaires, which remain the most common; and more recently,

interviews, although other techniques continue to be developed. The choice and nuances of a questionnaire require careful deliberation, as again no single instrument represents the ideal, and they may need to be adapted to fit the circumstances. Similar considerations also apply with interviews along with the sample size. Thereafter, the practicalities of the actual data collection are not something which should be left to chance and each aspect needs to be carefully thought through.

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Emotion-Driven Product Design

16

Pieter M.A. Desmet, Steven F. Fokkinga, Deger Ozkaramanli and JungKyoon Yoon
Department of Industrial Design, Delft University of Technology, Delft, The Netherlands

1 Introduction

From everyday commodities to exclusive luxuries, emotions are elementary for *all* design that is acquired and consumed by people. Emotions embody the essence of relevance (Gilbert, 2006): We are emotional only about things and events that matter to us, which includes seeing, buying, using and owning consumer goods (Desmet, 2002). Designers are both inspired and challenged by the diverse, holistic, and elusive qualities of consumer emotions (for an overview, see Desmet & Hekkert, 2009). There are no one-to-one relationships between certain types of stimuli and certain types of emotions: Different people have different emotions towards the same event, and one person may be delighted by a consumer good that offends another. A product that rouses a person today, may leave her cold tomorrow, and the same person may have different emotions towards different features of one single product design. Moreover, the emotions of consumers are influenced by the context in which they are experienced, which changes over time. Consequently, the increasing interest in consumer emotions in design practice, commonly referred to as "design for emotion" or "emotion-driven design," has stimulated a need for theory and methodology that support a structured design process.

This chapter focuses on this practice of emotion-driven design: The activity of designing products and services with the deliberate intention to evoke predefined target emotions. Although consumer emotions are taken into consideration in any given design project, in emotion-driven design these emotions take a central role: The design goal typically includes a statement about the intended emotional user effect or "target emotion." Since the late 1990s, the challenges of emotion-driven design have been addressed with a steady growth in design research that focuses on understanding consumer emotions, and on the development of tools and techniques that facilitate emotion-driven design processes. This chapter focuses on a key achievement of this body of research, which is the progress of design-relevant *emotion knowledge*. Emotion knowledge is an explicit understanding of the phenomenon emotion, including the conditions that elicit emotions and their behavioral and experiential manifestations. It embodies universal principles of emotions that are widely applicable because they are not restricted to particular types of stimuli, consumers, or emotions. This

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means that this kind of knowledge is applicable to all kinds of design that is created for consumers, including food and nonfood design, durable and nondurable product design, graphic and package design, and service design.

In this chapter, design is addressed as an activity, which represents the overall innovation cycle until implementation, including gathering relevant insights, formulating propositions, developing concepts, materializing shape and color, and testing the results. Emotion knowledge can serve various functions depending on the place in the design process, such as helping in formulating the design goal, facilitating creativity, and supporting communication within design teams, with clients, and with consumers. In addition, explicit emotion knowledge can feed and enhance implicit design knowledge and skills. Six key insights from emotion knowledge will be introduced that have proven useful in emotion-driven design practice and are supported by published empirical data. Each insight has been developed and matured over several years of design research and application in industry projects. We will explore how and where these insights (and some of the tools and methods that have been developed on the basis of these insights) can contribute to design activities. The first three focus on the emotion itself and explain what emotions are, and which emotions can be evoked by consumer goods. The last three insights focus on the causes of emotions and explain how consumer goods evoke emotions. The insights are introduced in the following six sections, each of which discusses the theoretical basis, the contribution to emotion-driven design, related design tools, and examples of design cases.

2 Shades of pleasure

The first insight is that positive emotions are *highly diverse*. Most consumer products[1] can evoke a wide palette of different pleasant emotions. For example, when first using a new device to measure our blood pressure, we can be inspired by the innovative technology, fascinated by the design, proud of our usage skills, relieved for the security it will provide us with, and so forth. The range of positive emotions that people can experience in response to consumer goods is a lot more diverse than is typically recognized in emotion-driven design projects. Consumers can experience at least 25 different positive emotions when using products (Desmet, 2012), such as pride, hope, joy, and love, see Fig. 16.1.

Although all positive emotions are pleasurable by nature, each represents a different kind of pleasure, and an understanding of these differences has at least two advantages for product innovation. The first is that different emotions have different influences on people's perceptions, thoughts, and behavior (Frijda, 2007). For instance, hope stimulates an urge to commit to the activity at hand (Lazarus, 1991), amusement stimulates an urge to share the joviality (Gervais & Wilson, 2005), and contentment stimulates an urge to savor life circumstances and recent successes

[1] In this chapter, "consumer products" is used to represent all types of design, including food and nonfood, durable and nondurable design, graphic, package, and service design.



Figure 16.1 Typology of 25 positive emotions.
Source: Adapted from Desmet (2012).

(Fredrickson, 1998). Understanding these differences can be put to use by influencing the consumer's behavior in a favorable way. Yoon, Desmet, and Van der Helm (2012), for example, showed that fascination stimulates product users to invest more time in exploring the product's features and discover more functions. A product that evokes surprise draws a person's attention and makes it more likely that he later recalls and recognizes it (Ludden, Schifferstein, & Hekkert, 2008). Lastly, a product that evokes inspiration infuses a user with new and creative thoughts, facilitating a shift in perspective (Desmet, 2008). The second advantage is that selecting distinct target emotions offers possibilities for product differentiation. Several design cases have been published that illustrate that targeting a positive emotion that is unconventional for the product category can stimulate design innovation. Desmet and Schifferstein (2012), for example, described how a unique experience in the category of fabric care was created by selecting *inspiration* as the target emotion for fragrance and package development. Likewise, Owusu (2012) designed a social game that evokes pride in

dementia patients, an emotion that these patients rarely experience in their daily life, which resulted in a game that stands out in the category of social games.

Because positive emotions are highly diverse, designers can benefit from having a broad repertoire of positive emotions and an understanding of the nuances between them. In a recent study, we found that having a nuanced understanding of positive emotions can contribute to design activities in at least four ways (Yoon, Pohlmeyer, & Desmet, 2014a). The ability to recognize emotions with precision and specificity positively influences empathy (Mayer & Salovey, 1993), and an increased level of empathy facilitates a deep understanding of consumers' emotions, which can help to uncover relevant consumer insights. Secondly, being aware of nuances of emotions supports a precise determination of the intended emotional impact, which increases the effectiveness of emotion-driven design activities. Thirdly, considering a wider diversity of positive emotions stimulates creativity and innovative thinking. Fourthly, articulating emotional states with fine-grained emotion terms provides innovation teams with a shared language of emotions that facilitates collaboration and communication about the subjective qualities of the design.

These advantages have stimulated the introduction of tools and techniques that support design teams in developing a nuanced understanding of positive emotions. An example is the "Positive Emotional Granularity" card set (PEG cards) developed by Yoon, Desmet, and Pohlmeyer (2013) (Fig. 16.2). The set consists of 25 cards that depict definitions of emotions, underlying causes, and visuals of expressive manifestations. The set can be used for communication (eg, to enable design teams to determine and communicate target emotions to design for, and to enable consumers to report their emotions in the context of product testing) and as a source of inspiration (eg, to facilitate lateral thinking in design conceptualization).

Yoon, Pohlmeyer, and Desmet (2014b) describe a design project for an international airline company in which various positive emotions served as target emotions.

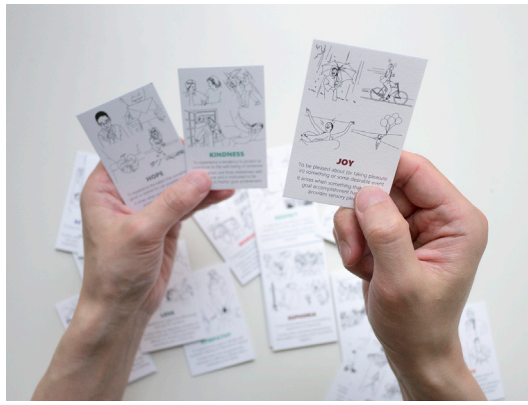


Figure 16.2 Positive emotional granularity cards.

The company wanted to introduce products and services in the crew center that evoke positive emotions to improve the mood of flight attendants just before boarding the airplane. At the beginning of the project, the PEG cards were used in the communication with the client to select which emotions should be experienced by the cabin crew. This resulted in a selection of 10 positive emotions that guided the design process: anticipation, confidence, energized, inspiration, joy, kindness, pride, relaxation, respect, and sympathy. For each emotion, separate ideas were generated. Because the emotions differ in terms of causes and behavioral effects, with interviews, observations, and creative workshops, the designers explored when and why flight attendants experienced each of the 10 emotions, and how these emotions contributed to their professional activities. The gained insights were translated to a collection of 30 designed interventions, 3 for each emotion. Two examples are "Good Night" and "The Curtain" (Fig. 16.3), which were designed to evoke kindness and anticipation, respectively.

Good Night is a smartphone application that enables team members to help each other to be on time when they have early flights. The application is aware of the schedule of a flight attendant and automatically sets the desired wake-up time for each team member. At wake-up time, the application gently reminds the team members to check who might still be asleep by showing each member's state, and, if necessary, signaling to give them a friendly wake-up call. In this way, the flight attendants kindly look after each other, and feel connected even before they meet. The Curtain intends to stimulate positive anticipation for the upcoming flight. As the flight attendants walk from the crew center towards the airport gate, the closed curtain slowly opens and lights around the curtain frame glow, one by one. When all the lights are on, the curtain is completely open. This moment builds up a feeling of expectancy and signals that they are ready and prepared to go "on-stage."

Summarizing, in this section we discussed that positive consumer emotions are highly diverse, and that having an awareness of this variety can facilitate creative innovation and design differentiation. In addition, design that targets specific positive emotions can be used do incite different types of consumer behavior. Tools that broaden the repertoire of positive emotions can be used to facilitate communication with clients and between members of the design team.

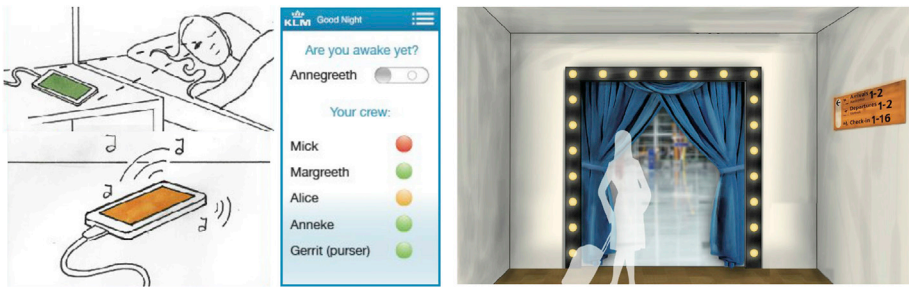


Figure 16.3 Emotion intervention designs.

3 Delights of distress

The second insight of design-relevant emotion knowledge is that people often *enjoy experiencing negative emotions*. This idea contrasts with common sense, which dictates that negative emotions are caused by bad or unfavorable events. Different negative emotions like fear, anger, sadness, frustration, and shame signal that a situation or event is a threat to a person's well-being and typically leads him to avoid, oppose, or reject the object of emotion (Frijda, 1986). It therefore makes sense that companies spend a lot of effort to ensure that their products do not evoke negative emotions: A food package should not be frustratingly difficult to open, the lifespan of a washing machine should not be disappointingly short, and plane travel should arouse as little anxiety as possible. Consequently, most research in the domain of product development and testing has focused on interventions that increase positive emotions and decrease negative emotions (Schifferstein & Desmet, 2010; see chapters: Emotions Elicited by Foods and Emotion in Beverages).

However, when digging deeper in the nuances of emotional experiences, we can identify many enjoyable activities that are characterized by negative emotions. For example, people enjoy spending effort on frustratingly difficult puzzles, they watch tearjerker movies to wallow in sadness, and they ride rollercoasters that literally sway them between anxiety and terror. Not only do people enjoy these activities, they actively seek them out and spend money on them. Yet, consumer products are rarely designed to evoke such experiences, and therefore enjoyable negative emotions are typically restricted to the domain of art and entertainment.

The reluctance to target negative emotions with consumer goods can be partly attributed to a lack of understanding about the differences between negative emotions that are plainly unpleasant and those that are enjoyable. Why do we enjoy solving a frustrating puzzle, but find a frustratingly difficult-to-open package plainly unpleasant? The answer is that people can enjoy negative emotions when they are able to experience the negative stimulus while knowing that they are *protected* from its adverse consequences (Andrade & Cohen, 2007; Apter, 2007, pp. 50–53; Fokkinga & Desmet, 2012). This "protective frame" makes the difference between a negative emotion and an enjoyable "rich" experience. For example, people in a rollercoaster experience all the physical sensations of being part of a spectacular accident, but simultaneously know that they are actually safe from harm. People can deeply pity the misfortunes of a movie character, but can also enjoy these feelings because they know that they are not feeling sorry for a real person. Lastly, the difficult puzzle is "enjoyably frustrating" because the user knows that it can be put aside without any repercussions. Compare this experience to the frustration that is evoked by a food tin that is impossible to open: This frustration is genuinely unpleasant because not having access to its contents has actual unwanted consequences.

There are several reasons why it is beneficial to include negative emotions in the designer's repertoire (Fokkinga & Desmet, 2013). The first is that negative emotions can provide an edginess and engagement to product experiences that can surpass that of positive emotions. Secondly, negative emotions are typically easier to evoke

in high intensity than purely positive emotions: The intensity of a rollercoaster ride can only be matched with events that are highly favorable and uncommon, such as winning the lottery or getting married. Lastly, like positive emotions, each negative emotion has a unique effect on people's perception, thought, and behavior. These effects can be put to functional use by influencing the product user in a favorable way. For example, Fokkinga and Desmet (2013) reported the "Direct Dietitian" (Fig. 16.4), a smartphone application that informs people about nutrition, keeps track of the food items that supermarket customers put in their shopping carts and represents the consequences of their choices in the body shape of a cartoon character. When the customer only picks up foods that are high in saturated fat, the character will start looking obese, and when the customer mostly picks up food that is high in protein and fiber, the character will become very muscular. By exaggerating the consequences of the food choice, the cartoon character takes on grotesque body shapes that can evoke mild embarrassment and disgust. Because people are wired to pay attention to stimuli that evoke these emotions, they will consult nutritional information more frequently than in its traditional numerical format.

While disgusting stimuli draw people's attention, other negative emotions have completely different effects. For example, sadness slows people down and makes them reflect on things (Rucker & Petty, 2004). Conversely, anger can make people more assertive and confident (Tamir, Mitchell, & Gross, 2008). Thus, it is crucial to consider which emotions should be part of the product experience. Fokkinga and Desmet (2013) introduced a three-step approach that design teams can use to arrive at a specific emotionally rich product experience (Fig. 16.5). The first step is selecting the most suitable negative emotion, the second step is finding a way to evoke this emotion through the product or service, and the third step is making the experience enjoyable by ensuring the consumer is protected from possible negative consequences.

For each step, it is paramount to have a thorough understanding of the characteristics of specific negative emotions. Evoking the wrong negative emotion, or evoking the right negative emotion in the wrong way could lead to adverse product experiences. For this purpose, an online database was set up that explains in great detail

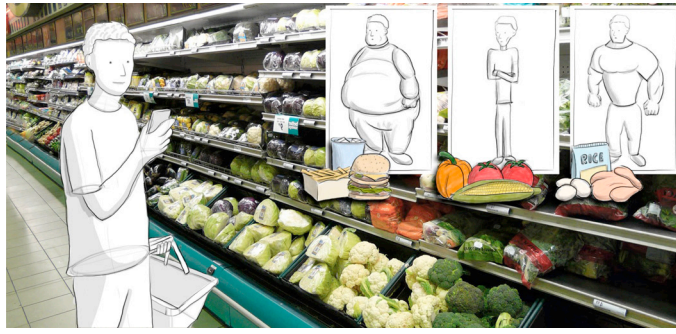


Figure 16.4 Design for rich experiences: The "Direct Dietitian."

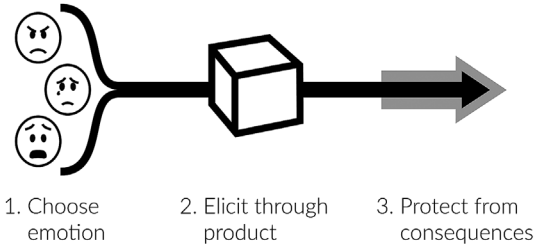


Figure 16.5 An approach to create emotionally rich experiences.



Figure 16.6 Artist's rendering of "Run for your life," a wristband that evokes enjoyable fear in recreational runners.

the characteristics of 36 negative emotions (Fokkinga & Desmet, n.d.), which serves as the counterpart to the typology of 25 positive emotions discussed in the previous section. This database was designed as an informative yet engaging tool that provides both analytical understanding and intuitive familiarity with a large number of emotions through detailed texts, movie clips, comic strips, and a quiz to test current emotion knowledge.

The design approach and database were used to develop a wristband that aims to engage and motivate recreational runners, called "Run for your life" (Fig. 16.6). Through visual, auditory, and tactile feedback, the product evokes fear emotions by giving the runner the impression of being chased by something. For example, in one scenario the runner wears headphones through which she periodically hears dogs coming after her, inciting her to go faster and outrun them. If successful, the dogs will fall back, if not, she will feel a (harmless) sting. This product was prototyped and tested in several versions that varied the type of feedback, the behavior of the pursuer, and the targeted fear emotion. For the latter, the negative emotion database was

instrumental, as it differentiates between eight fear emotions, such as anxiety, startle, worry, and nervousness. The prototype was tested with 11 participants in a total of 26 runs (Fokkinga & Desmet, 2014). Four runners did not find the wristband enjoyable or motivating, either because they did not enjoy the presence of audiovisual stimuli while running or because they did not like the idea of something manipulating their emotions. For seven runners the wristband did have the intended effect. Four of those mainly commented that the product made the experience of running more enjoyable, while the three others found that it was an effective way to increase their performance. Interestingly, during the development of this product, a smartphone app with a similar idea was released by studio Six, entitled "Zombies, run!" With this app, runners listen to a scenario that includes running away from zombies. This app was one of the best-selling nonfree apps in the iOS and Android app stores, generating over 2 million downloads in 4 years (Six to start, n.d.).

Summarizing, in this section we proposed that it is profitable to include negative emotions in the designer's repertoire because they can create unique and powerful consumer experiences that stimulate engagement and desirable consumer behavior. A three-step approach to design for "rich experiences" enables design teams to make use of negative emotions while creating positive consumer experiences.

4 Landscape of emotions

The third insight is that most consumer emotions are *nuanced and mixed*. On the one hand, product emotions are not a particular type or subset of emotions. Any positive or negative emotion that a person experiences in social interactions or other situations can also be experienced when seeing or using a product. Products may evoke some emotions (eg, fascination or irritation) more often than others (eg, euphoria or fear), but essentially all emotions can be evoked by consumer products. There is nothing unique or special about these emotions, and they can only be distinguished from "regular" emotions in terms of the stimuli that elicit them. On the other hand, product emotions are *atypical* in two ways (Desmet, 2002). Firstly, the emotions evoked by consumer goods are typically subtle and low in intensity. Even though products can evoke strong emotions, for example, when you buy your first car or when your computer gives a "fatal error," these moments are best considered rare and isolated peaks in a wide landscape of mild experiences. While we remember these peaks as emotions, we often do not remember the subtle hills that surround them. Consequently, many people believe that they are "not so emotional" about products. In reality, we are very emotional about products, but most these emotions are too subtle to be remembered after the episode (Laurans, 2011). The second atypicality is that product emotions are often mixed or diverse. Products are complex stimuli (see also Section 7) and therefore evoke multiple responses at the same time. Moreover, the human–product interaction that unfolds over time generates a constant stream of emotional stimuli. For example, a consumer can first be delighted by the design of her new smart phone, then anxious that she will damage the fragile cover, disappointed about the sound quality, and finally inspired by its ease of use.

Emotion research that is intended to support design processes should be sensitive to this subtle and mixed nature of product emotions and to the designer "frame of thought." Designers focus on integrated possibilities of various future worlds, "in which values like originality and creativity overshadow the typical scientific values like validity and reliability." Hence, creativity is supported when data are represented in a descriptive and holistic fashion and communicated with visual data representations (Desmet & Schifferstein, 2012, p. 172). When using emotion questionnaires, an important question is how many emotions to include. The ambition to obtain rich insights into nuanced variations in emotional experiences encourages the inclusion of a high number of emotions. On the other hand, the disadvantage is that longer questionnaires take more time to fill out and are more demanding for the respondent, which can reduce the validity of measurement and increase study costs. Moreover, the optimal number of emotions to be measured depends on additional considerations, like the number of products to be measured, the difference between products, context of measurement, and the respondents (for discussions, see chapters: Emotion in Beverages and Methodological Issues in Consumer Product Emotion Research Using Questionnaires). For each study, an optimum balance has to be determined, and various lists are available, ranging between 3 up to 72 emotion adjectives (for an overview, see Desmet, Vastenburg, & Romero, in press), including the often-used lists of 39 emotions by King and Meiselman (2010) and 47 emotions by Richins (1997).

Although there is no single "best" instrument to obtain design-relevant emotion insights, self-report methods are particularly useful because they can measure low-intensity emotions and enable an efficient integration of qualitative and quantitative research (for an overview, see chapter: Methodological Issues in Consumer Product Emotion Research Using Questionnaires). In addition, they can be administered in real-life situations and are easy to administer, they can be customized to match research needs, and analyzing resulting data does not require specialist knowledge or equipment. A limitation is that self-report cannot be used for continuous measurement, because respondents have to interrupt their activities to record their responses (for a discussion, see chapter: Short-term Time Structure of Food-Related Emotions: Measuring Dynamics of Responses). Moreover, compared to physiological and behavioral measures, they are more demanding for the respondent, which can affect validity.

Pictorial self-report measures have the advantage of requiring relatively little effort from the respondent and, when carefully developed, they enable the measurement of low-intensity emotions, and can be used with a variety of respondent populations, including children and respondents with different languages (Laurans & Desmet, 2008). An example is PrEmo2 (Laurans & Desmet, 2012), which features an animated character that expresses 14 emotions.[2] The questionnaire is administered through a web interface. When a participant clicks on a character, it plays a 1-second animation of the emotion expression with body movement and sound (Fig. 16.7).

[2] PrEmo2 is an updated version of PrEmo1, which measures 14 emotions that are often evoked by product design, see Desmet, Hekkert, and Jacobs (2000).

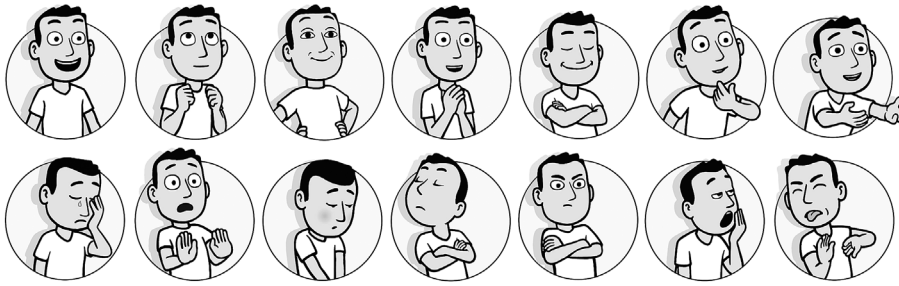


Figure 16.7 PrEmo2 character stills. (Top row: joy, hope, pride, admiration, satisfaction, fascination, and attraction. Bottom row: sadness, fear, shame, contempt, dissatisfaction, boredom, and aversion.)

PrEmo2 measures seven positive and seven negative emotions that were based on the work of Ortony, Clore, and Collins (1990) and represents four relevant emotional domains: general well-being emotions (joy, hope, sadness, fear); expectation-based emotions (satisfaction, dissatisfaction); social context emotions (pride, admiration, shame, contempt); material context emotions (fascination, attraction, boredom, disgust). Respondents are asked to consider the emotions represented by the animated cartoon and, for each emotion, to indicate the extent to which it corresponds to their current experience, using a 5-point scale. PrEmo2 can be used to measure emotions evoked by separate aspects of products, like appearance or fragrance, but also by product usage.

Several additional methods are available that depict distinct emotions using cartoon-like illustrations. Examples are the "Gaston Lagaffe" scale, which measures 8 basic emotions (GLS; Johnstone, Van Reekum, Hird, Kirsner, & Scherer, 2005), LEM, which measures 8 interaction-relevant emotions (Huisman & Van Hout, 2010), Russkam, a set of emoticons that express 29 emotions (Sánchez, Hernández, Penagos, & Ostróvskaya, 2006), and MAAC, developed for young children, which measures 16 emotions with animated characters (Manassis et al., 2009). Unique among visually oriented self-report methods is the "Sensorial Evaluation Approach" (Isbister, Höök, Sharp, & Laaksolahti, 2006), which uses eight abstract three-dimensional objects as a projective technique for qualitative affect measurement. A disadvantage of pictorial scales is that emotion sets are not easily customized because the development and validation of pictorial representations requires a substantial investment of time and effort. A main advantage however, is the sensitivity: Several studies have shown that methods that use pictorial or multisensorial representations of emotions can be more sensitive to nuanced variations in emotions between products than those that use verbal representations (Desmet, 2002; Isbister et al., 2006; Manassis et al., 2009). This sensitivity is promising for design research that aims to pick up on the subtle variations in experiences evoked by consumer products.

Summarizing, in this section we proposed that emotion research in a design context should be sensitive to the subtle and mixed nature of product emotions. Rather than focusing on emotional peaks, design intentions can focus on the landscape of

mild consumer experiences. Emotion measurement tools that address this landscape can be used to formulate emotion profiles that guide emotionally innovative product development.

5 Gateways to value

The fourth key insight is that emotions are *gateways to what people really care for*. Whereas the first three insights addressed the emotional experience evoked by products, this fourth insight focuses on the causes that underlie these emotions. It echoes the "law of concern" that was formulated by Frijda (1986, p. 351), stating that "every emotion hides a concern, that is, a more or less enduring disposition to prefer particular states of the world." In other words, the occurrence of an emotion *always* points to the presence of a personal concern.[3] This explains why different people can have a different emotion in reaction to the same stimulus: Because their concerns are different. For example, the informal demeanor of a waiter may delight one restaurant guest and irritate another: The first guest has a concern for "friendly service," while the second values "polite service."

When designers want to obtain an overview of the relevant concerns of a target group, they typically use methods like interviewing, focus groups, or questionnaires to ask people what they want, need, and expect. A drawback is that people often find it difficult to retrieve and formulate concerns that are not immediately relevant to the current situation (Sanders & Stappers, 2008). Moreover, they are not always aware of all their concerns that can be relevant for the design brief at hand. In those cases, emotions, when probed, can be a valuable gateway to these concerns. Desmet and Roeser (2015) argued that because emotions are a prime source of knowledge and understanding of values, it follows that emotions can play an important role in understanding concerns involved in design. This means that, because emotions and concerns are so intrinsically linked to each other, emotional experiences are reliable entry points to uncover underlying concerns.

All the positive and negative emotions that are experienced in the context of using a product are viable entry points to understand what people really want, need, and expect in that situation. Because these real-life consumer concerns can serve as input in emotion-driven design processes, emotion measurement can generate insights that are useful for emotion-driven design when used to probe for consumer concerns (for a discussion on emotions studied in context, see chapter: Emotions Studied in Context: The Role of the Eating Environment). Ozkaramanli, Fokkinga, Desmet, Balkan, and George (2013) developed a guided self-report procedure that uses this insight to find relevant consumer concerns: the Emotion Capture Card (ECC) procedure, see Fig. 16.8. In the two-staged procedure, the participant is first asked about a specific experienced emotion, which is then taken as the starting point to probe for the underlying concern

[3]We follow the convention in emotion psychology to use the word "concern" as the umbrella term for everything an individual wants or cares about, comprising goals, needs, standards, and values.

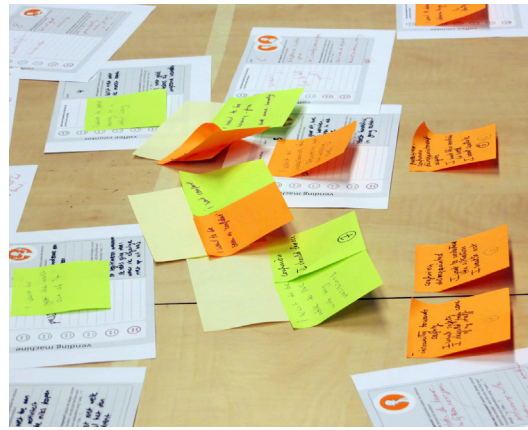


Figure 16.8 Emotion Capture Cards.

using a laddering-type interview technique (see Reynolds & Gutman, 1988). The researcher notes each emotion and corresponding concern on a separate card as input for further interviewing.

In the first stage, the research team immerses in a predetermined real-life consumer situation (eg, having breakfast, watching a movie) in a relatively unobtrusive way. The main goal is to "capture" all emotions experienced in that situation; subtle and intense, positive and negative. Participants report their emotions as they arise, and the researchers can occasionally prompt for emotions when they observe emotional events. All emotions are noted on separate paper cards, the ECCs. In the second stage, the results are the basis for an interview that aims to uncover the concerns that underlie the captured emotional experiences. For each card, three types of questions are asked: *what* questions to determine what happened (eg, "I bought a bag of nuts that was expired"), *how* questions to determine how the participant felt about this event (eg, "I was angry"), and *why* questions to understand why this event was important to the participant (eg, "shops should pay attention to what they are selling"). An ECC procedure can yield anywhere between a few dozen to hundreds of capture cards, depending on the number and length of the research sessions. In the analysis, typically one concern is distilled from each capture card, which are then aggregated to a set of relevant concern clusters.

In a case study, Ozkaramanli et al. (2013) found that using emotions as a means to access consumers' concerns can combine qualities of customer journey mapping (see, eg, Norton & Pine, 2013) with those of experience sampling (Larson & Csikszentmihalyi, 1983): It helps uncovering a precise and rich profile of consumer concerns that is anchored in the dynamic usage episode. The design case was the development of new tea snack concepts. The designs were based on an overview of tea ritual concerns that were uncovered with an ECC study. Sixteen Turkish consumers from a target group were visited for 3–6 hours during their afternoon tea ritual with friends or family. These home visits yielded 210 ECCs, which were clustered in

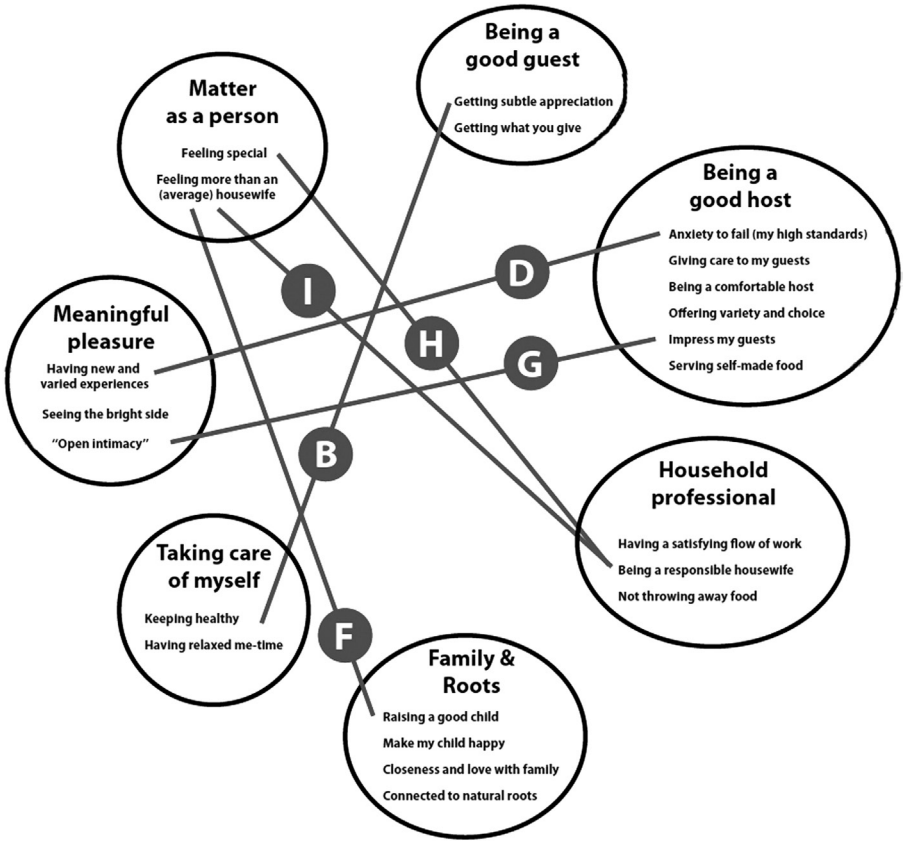


Figure 16.9. Seven clusters of consumer concerns for the tea ritual. *Lines* denote relationships that were used to formulate six design directions.

seven main concern categories including "being a good host," "taking care of myself," and "being a responsible housewife," see Fig. 16.9.

The three concerns statements "I want to enjoy a satisfying flow of work," "I want to be a responsible housewife," and "I don't want to throw away food," were clustered in the theme of "being a household professional." These three represent important nuances and add richness to the overall theme. Having such a comprehensive yet compact overview of concern themes enables identifying important relationships (denoted by lines and letters in Fig. 16.9), which were subsequently used as input for emotion-driven design directions.

Summarizing, in this section we proposed that emotions are reliable entry points to understand what people care about in the context of consuming goods and services. A guided self-report approach was discussed that combines observation, emotion measurement, and interview techniques to obtain a design-relevant set of consumer concerns.

6 Desires and dilemmas

The fifth key insight is that consumer emotions are often driven by *conflicting concerns*. Half the time people are awake they experience a desire and half of these desires conflict with other goals (Hofmann, Baumeister, Förster, & Vohs, 2011). As a result, people experience mixed emotions, in many everyday events, including those in which they consume products and services (eg, Otnes, Lowrey, & Shrum, 1997). For example, a person having dinner in a restaurant can feel delighted by the prospect of having a chocolate dessert, but also anticipate the regret of this choice and feel better off with a fruit salad. While the dessert is more satisfying in the moment (concern for enjoyment), the fruit salad contributes more to a slim waistline in the long run (concern for positive self-image). Such conflicts of concerns create emotional dilemmas: When faced with two mutually exclusive choices of action, people experience positive and negative emotions towards both choices, because either one violates one concern while fulfilling the other.

One approach in dealing with conflicting concerns is to design different consumer goods to target the different concerns represented by the conflict, which require the consumer to make a choice. For example, indulgence-focused desserts can be developed for those who want to give into the concern for enjoyment, and health-conscious desserts for those who want to respect the concern for long-term positive self-image. The fifth insight, however, implies that consumers often have both concerns represented by the concern conflict at the same time. As a consequence, products that fulfill one of these concerns will always be emotionally satisfying in some aspects, while dissatisfying in others. Ozkaramanli, Desmet, and Ozcan (in press) proposed that products that solve the concern conflict instead of "choosing sides" for one of the two concerns, can stimulate positive consumer emotions. Such products can tackle the emotional duality that is created by products that do not address the concern conflict. For instance, a fruit salad that is designed to be experienced as a luxurious treat can simultaneously fulfill the concern for indulgence *and* the concern for positive self-image.

Designing with dilemmas, with its focus on conflicting consumer concerns, can be a source of design creativity. Contradictions stimulate problem solvers to search for solutions that can eliminate the tension to restore consistency (Glover, Ronning, & Reynolds, 2013). Recognizing the value of dilemmas, design approaches such as Theory of Inventive Problem Solving (TRIZ) and lateral thinking encourage design practitioners to seek and utilize conflicting requirements or opinions in a design brief (De Bono, 1995; Mann, 2001). Being related to important psychological processes such as decision-making and self-actualization, dilemmas can have a negative influence on the satisfaction derived from daily choices (a phenomenon called paradox of choice; Schwartz, 2004) and on general subjective wellbeing (Emmons & King, 1988). Therefore, products and services that support people in dealing with their dilemmas can contribute to consumers' overall wellbeing. For instance, recognizing the prevalence of self-control dilemmas in everyday life, a large body of work in consumer research has focused on factors that influence decisions between virtue products (ie, products that promise future benefits but carry immediate usage costs,

such as condoms or dental floss) and vice products (eg, products that promise immediate benefits, but carry future costs, such as cigarettes or fast food) (eg, Ein-Gar, Goldenberg, & Sagiv, 2012).

A dilemma-driven design approach requires an overview of concerns that are relevant for the consumer and inspiring for design innovation. The previous section demonstrated that the ECC procedure is a useful tool to obtain clear concern statements. When making sense of the (typically) hundreds of concern statements that the capture card procedure yields, it can be useful to consult general goal taxonomies that provide compact and comprehensive overviews of universal human goals, like the one developed by Ford (1992). Once concern themes are identified, juxtaposing them can reveal consumer dilemmas that are relevant in the domain of the design brief. In order to best inspire design creativity, the formulated dilemmas should create a "positive solution space." Such a positive space is generated when the formulations of the concerns is open-ended (eg, "I want to eat healthy," instead of "I want to eat a banana") and positive (eg, "I want to eat healthy," instead of "I don't want to eat unhealthy").

The dilemma-driven design approach was used to develop three concepts for a multinational food company, see Fig. 16.10. The brief was to develop energizing breakfast cereal concepts for young professionals. The designers first identified relevant and inspiring dilemmas experienced in the context of having breakfast. These dilemmas, which were formulated to include concerns that are both open-ended and positive, were used as the basis for their design concepts.

The first design concept, "Dare and Share," was based on the dilemma of "I want to nurture relationships," but also "I want to enjoy my personal time." This dilemma was experienced by couples who wake up at different times. The person who has to get up first enjoys the private moment of having breakfast before rushing off to work, but she would also like to use the breakfast moment to express her love for her partner. The design goal was to enable consumers to nurture their relationship *while* they are having a moment of personal time. The concept is a cereal box that includes a large bag and seven separately packed spoon-sized pockets. Users can leave a small pocket on the kitchen table for their partner as a little expression of their intimacy. "Break on the Go" was based on the dilemma between the concerns "I want to have my breakfast in peace" and "I want to be on time for work." The design goal for this concept was to create an on-the-go breakfast that feels more like having a breakfast at home.



Figure 16.10 Design with dilemmas: Breakfast cereal concepts for young professionals.

The design is a breakfast box that allows users to pack their cereal, yoghurt and fruit combinations, to eat on-the-go. When opened, the lid of the box forms a barrier between the user and his environment, which enables a "private and cozy" breakfast experience. The third concept in Fig. 16.10, "One-bite Crunch," was based on the dilemma between "I want to add surprising ingredients to my breakfast," and "I want to manage my time in the morning." The design goal for this concept was to create "convenient surprises." The design is a box with bite-size cereal balls that surprise consumers with different flavors, while also allowing them to enjoy their breakfast in an efficient way.

Summarizing, in this section we proposed that concern conflicts are valuable input for design because they offer opportunities for creating products and services that are both innovative and highly relevant to the consumer. Dilemma-driven design is a potent approach to design for emotion because human emotions are often driven by concern conflicts instead of by single concerns. By targeting these conflicts, emotion-driven design can enable consumers to manage or solve their personal dilemmas.

7 Context for emotion

The sixth and final insight is that consumer emotions are *often not evoked by the product*. Consumer goods can evoke a wide pallet of emotions, as was illustrated with several cases in the previous sections. The majority of research on the emotional impact of design focuses on situations in which the product is the emotional stimulus. For example, one may be fascinated by a novel smartphone, disappointed by its slow interface and delighted by its colorful interface. In real life, however, most emotions that consumers experience when using products are not about these products—implying that the product is not the stimulus that evokes the emotion (Desmet, 2012). Take the smartphone example: one may be upset with her friend for not calling her back, relieved that her online agenda alerts her that the meeting has been canceled before she got into her car, and delighted to see that her weather app predicts that it will stop raining this afternoon. In these cases, the emotions are clearly not directly evoked by the smartphone. The phone, however, does play a role by facilitating the activities and interactions that evoke the emotions. Hence, if this person would not have owned and used the phone, she may not have experienced these emotions. In these cases, the role of the product is indirect: It is not causing emotions but it is a resource that facilitates and influences activities and interactions that, in turn, evoke emotions.

The sixth insight implies that emotion-driven design can benefit from a holistic view on consumer emotions that not only takes into account the emotions that are evoked by the product design but also those that are experienced in the context of usage. The context in which a product is used influences the emotional impact of the product (for a discussion, see chapter: Emotions Studied in Context: The Role of the Eating Environment), and likewise the product can influence the emotions that are experienced in the context of use. These "contextual emotions" are less direct than the "product emotions" and therefore more difficult to conceive or influence with design. At the same time, they offer additional opportunities for emotion-driven design



Figure 16.11 Airplane breakfast: morning tapas.

innovation. For instance, a straightforward approach is to identify and solve negative emotions in the context of use. This approach starts with capturing all emotions that consumers experience in the context of a particular activity (eg, having breakfast) or situation (eg, at the train station). The results can be used to inspire new goods and services that reduce negative emotions that are experienced in this activity or context. Likewise, new goods and services can be conceived that capitalize on positive emotions experienced in the context of an activity.

The airplane breakfast in Fig. 16.11 is an example of an emotion-driven product design that was based on insights into the emotions of people in the context of usage. This design (as presented by Desmet & Schifferstein, 2012) was created for an international airline company. Passenger emotions were measured on board during the context of a flight. The study indicated that passengers experienced two strong negative emotions: *boredom* due to a lack of stimulation, and *frustration* due to a lack of control. Hence, the two key concerns the designers focused on, were those of "being stimulated" and "having control." Although these emotions and related concerns had nothing to do with the meal, they were relevant in the context of consuming the meal. The intention was to reduce the overall passenger boredom and frustration by using the meal to fulfill these two concerns.

The resulting design was named morning tapas because it was a breakfast that consists of several main elements (warm and hot, savory, and sweet), and some condiments in the middle, like nuts and honey. These elements can be combined in many different ways, allowing the passengers to "play with their food," which addresses both the concerns for control and for stimulation. An evaluation study found that boredom and frustration had decreased significantly, and the overall passenger satisfaction had increased after introducing the new breakfast type (Desmet & Schifferstein, 2012).

Summarizing, in this section we proposed that many consumer emotions are not "about" the product but about activities and situations in which the product is consumed. This implies that opportunities for emotion-driven design increase when acknowledging that consumer goods are not only emotional stimuli (direct emotions), but as part of the "context for experience" (indirect emotions). This approach

to emotion-driven design requires researchers and designers to look beyond direct product emotions and also capture and design for emotions in the context of use.

8 Conclusion

This chapter introduced six insights that represent design-relevant emotion knowledge. In our experience, a profound emotion knowledge can serve several purposes in innovation processes. It helps to organize the research in service of the emotion-driven design process, that is, which research questions to pose, which methods to use, and what insights to obtain. In addition, it is useful to structure design thinking, stimulate creativity, and facilitate communication with clients and within design teams. To be relevant to design research and practice, emotion knowledge should be implemented in tools that help design teams to measure, represent, and interpret user emotions.

In the first three sections, we proposed that design can evoke a broad pallet of positive and negative emotions, and that an understanding of the differences between emotions can be beneficial when aiming to design goods and services that evoke unique experiences. Moreover, because different emotions stimulate different behaviors, emotion-driven design can be used to influence consumer behavior in a favorable way. The opportunities to do so increase when also including negative emotions in the design repertoire. When applied with the inclusion of a mental protective frame, negative emotions can contribute to a rich and unique consumer experience. The first three insights illustrate that consumer emotions are nuanced, subtle, and multidimensional, and that emotion-driven design requires research and design methods that accept and adopt this richness. In the second part of the chapter we discussed the implications of the direct relationship between emotions and personal significance. Because emotions always point to the presence of a consumer concern, measuring emotions is an effective approach to understanding what people really care for. Moreover, because emotions are often driven by concern conflicts, dilemma-driven design is a powerful approach to design emotionally relevant products and services. Lastly, the opportunities for emotion-driven design increase substantially when not only considering emotions that are evoked by products and services (ie, direct emotions) but also those that are experienced in the context of consuming products and services (ie, indirect emotions).

Acknowledgments

Direct Dietitian (Fig. 16.4) and Run for your Life (Fig. 16.6; illustration by Jort Nijhuis) were designed by Steven Fokkinga and Morning Tapas (Fig. 16.11) by Rick Porcelijn and Pieter Desmet. All other product examples in this chapter were designed by students of Delft University of Technology: Good Night (Fig. 16.3) by Inge van der Lee, Amanda Lee Jakobsen, Suwen Shen, and Maik de Rooij. The Curtain (Fig. 16.3) by Inge van der Lee, Amanda Lee Jakobsen, Suwen Shen, and Maik de Rooij; Dare and Share (Fig. 16.10) by Arjen Oenema; Break to Go (Fig. 16.10) by Jenny Tsay; One-Bite Crunch (Fig. 16.10) by Shannon Chang.

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Emotions of Odors and Personal and Home Care Products

17

C. Porcherot[1,], S. Delplanque[2,*], C. Ferdenzi[3], N. Gaudreau[1] and I. Cayeux[1]*
[1]Firmenich SA, Geneva, Switzerland [2]Swiss Center for Affective Sciences, University of Geneva, Geneva, Switzerland [3]Lyon Neuroscience Research Center, CNRS UMR5292, University of Lyon, Lyon, France

1 Relations between olfaction and emotional processing and importance of associative learning during life experiences

Scents have always been considered a powerful elicitor of emotions in several cultures. Scientific evidence has shown the impact of olfaction on emotional processing and its effects on mood, physiology, and behavior, with the link between odors and emotion being advantaged over other senses (Ehrlichman & Bastone, 1992; Ferdenzi, Delplanque, et al., 2013, Ferdenzi, Roberts, et al., 2013; Herz, 2002; Kadohisa, 2013). Numerous studies have shown that the hedonic tone of odors—also called hedonicity, pleasantness, or valence—influences mood such that pleasant odors tend to induce positive moods, whereas unpleasant odors tend to induce negative moods, or to reduce self-confidence (Knasko, 1992, 1995; Lehrner, Marwinski, Lehr, Johren, & Deecke, 2005; Rétiveau, Chambers, & Milliken, 2004; Roberts et al., 2009; Schiffman, Miller, Suggs, & Graham, 1995). In addition, behavioral and physiological investigations have revealed that odors can induce states of relaxation or excitation, reduce anxiety and stress arousal, influence performance in cognitive tasks, and provoke changes in physiological parameters, such as heart rate or skin conductance (eg, Alaoui-Ismaili, Robin, Rada, Dittmar, & Vernet-Maury, 1997; Alaoui-Ismaili, Vernet-Maury, Dittmar, Delhomme, & Chanel, 1997; Bensafi et al., 2002a, 2002b; Delplanque et al., 2008, 2009; Ehrlichman & Bastone, 1992; Goel, Kim, & Lao, 2005; Herz, 2009; Heuberger, Redhammer, & Buchbauer, 2004; Torii et al., 1988). Results from numerous experiments suggest that odors can affect cognition and behavior in a similar fashion to that of emotional stimuli in other perceptual modalities (Chebat & Michon, 2003; Degel & Köster, 1999; Epple & Herz, 1999; Ilmberger et al., 2001; Ludvigson & Rottman, 1989; Millot & Brand, 2001; Millot, Brand, & Morand, 2002). Different essential oils have therefore been tested

*These authors contributed equally to this work.

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to investigate their potential use as stress releasers in various stressful situations (Heuberger & Ilmberger 2010; Lehrner et al., 2005).

To explain olfactory effects on moods or emotions, pharmacological and psychological mechanisms have been postulated. A pharmacological influence implies that the odorant molecules interact directly and affect the nervous or endocrine system, being absorbed at the respiratory tract level (or the skin), reaching the blood circulation, and passing through the blood–brain barrier. In contrast, a psychological action implies that odors exert their effects through learning, conscious perception, and belief/expectation after being processed by the olfactory systems (ie, principal and trigeminal). Experimental data are often not conclusive about which mechanism is at stake. For instance, Lorig and Roberts (1990), observed that contingent negative variation values (ie, the amplitude of an event-related electrical component extracted from electroencephalography) changed not only as a function of the stimulatory or sedative properties of essential oils, but also with the beliefs and expectations about odors, independently of which odor was presented. This observation was confirmed by Campenni, Crawley, and Meier (2004) with the suggestion of odor effects (ie, relaxing or stimulating) on heart rate and skin conductance levels, demonstrating that belief and expectation may have significant influences on emotional responses to odors. To date, critical examination of the literature strongly favors the psychological hypothesis (see Herz, 2009, for a discussion on this topic). More particularly, Herz (2009) stated that "responses to odors are learned through association with emotional experiences, and that odors consequently take on the properties of the associated emotions and exert the concordant emotional, cognitive, behavioral, and physiological effects themselves." Thus, olfaction is strongly tied to everyday life experiences and memory. This kind of learning explains why odors can evoke intense autobiographical memories (Chu & Downes, 2000) and why odor effects on moods and behaviors are mediated by prior experiences and expectations. These effects are usually interpreted as an interdependence of olfaction and emotion in overlapping neural systems of the amygdala and hippocampus, areas of the brain responsible for associative learning and memory (Herz, Eliassen, Beland, & Souza, 2004; Phillips & Heining, 2002). Thus, according to Herz (2009), "Associative learning, perceptual experience, and expectation can account for the emotional, behavioral, and physiological effects produced by odor inhalation." This claim strongly favors mediating factors, such as culture, gender, individual differences, and personality (Campenni et al., 2004).

2 What is measured? Emotion or feelings?

Scherer (2009) defined an emotion as a series of synchronized, interconnected changes in an individual's thoughts and body state (unconscious and conscious) in response to a stimulus event (real or imaginary), which prepares the individual by affecting how he or she feels, behaves, and appears. These changes occur in light of what a situation means to the person from past experiences, social context, goals, and desires. On the basis of this definition, several emotion components have been traditionally investigated to measure unconscious and conscious emotional responses,

physiological activation, action tendency, motor expression, cognitive processing, and feelings. In practice, however, it is difficult, if not impossible, to investigate all of these components, together with specific measures to assert that a product or a situation has elicited a true emotion. Using questionnaires developed to measure feelings, one can assert only that "potential emotions" have been identified or measured, as the feeling reported would need to be confirmed by measures on a cognitive, behavioral, or physiological level to be fully considered as defining true emotion (for a discussion on this topic, see Delplanque et al., 2012; Zentner, Grandjean, & Scherer, 2008). This requirement implies the need to carefully use the appropriate terms to define what is currently being measured and not to use emotion and feelings as interchangeable terms (see Scherer, 2009).

In this chapter, we focus on the feeling component of the emotion. Feelings have a special status, as they integrate all of the other components, provide access to consciousness, and allow interpersonal communication of emotional experiences. In the literature on emotion, it is generally assumed that feelings are conscious phenomena measured via verbal report (see Scherer, 2009, for a discussion on this topic). We consequently acknowledge that the methodology we describe hereafter, that is, the verbal report of olfactory-elicited feelings, does not capture the entire emotional phenomenon.

3 Development of a methodology for measuring feelings in response to odors through verbal reports: a cross-cultural approach

3.1 Methods from the literature and rationale of the approach

Different emotional scales and emotional lexicons have been developed because emotional responses can depend highly on the product of interest, and more importantly, on the context of use. These tools are available in the literature and are related to food-specific domains (eg, EsSense Profile from Bhumiratana, Adhikari, & Chambers, 2014; Chaya et al., 2015; Ferrarini et al., 2010; King & Meiselman, 2010; Laros & Steenkamp, 2005; Ng, Chaya, & Hort, 2013a, 2013b; Pineau, Rytz, Hudry, Maier, & Alexander, 2010; Rousset, Deiss, Juillard, Schlich, & Droit-Volet, 2005; Spinelli, Masi, Dinnella, Zoboli, & Monteleone, 2014; Thomson & Crocker, 2013) or to odors and fragrances (eg, Berezina, 2014; Churchill & Behan, 2010; Desmet & Schifferstein, 2008; Rétiveau et al., 2004; Warrenburg, 2005; Geneva Emotion and Odor Scale (GEOS) from Chrea et al., 2009; UniEOS from Ferdenzi, Delplanque, et al., 2013; ScentMove scale from Porcherot et al., 2010). A more systematic comparison between existing food- and odor-related emotional lexicons was recently made by Gmuer, Guth, Runte, and Siegrist (2015).

Many of the scales developed to investigate how people report their feelings associated with odor perception were mainly derived from two classic theoretical approaches: (1) the discrete emotion theory from Ekman (1984), postulating the existence of six basic emotions (fear, anger, sadness, surprise, joy or happiness, and disgust) or

(2) the bidimensional theory from Russell (1980), which positions emotions in a bidimensional space: valence (positive vs negative) by arousal (activating vs calming). In the sensory science literature, different emotional lexicons or feeling scales were designed in accordance with the product, including extended sets of basic emotions or feeling terms taken from preexisting bidimensional feeling scales. The theoretical grounding in which emotional processing associated with odor perception is restricted to one or two dimensions can be questioned, as well as the use of basic emotion terms to categorize odor-related feelings. The theoretical and practical limitations of using terms derived from the classic approach to investigate odor-elicited feelings has been described extensively elsewhere (eg, Chrea et al., 2009; Delplanque et al., 2012; Porcherot et al., 2010). While keeping in mind that odor-affective values are mainly attributed through associative learning processes, however, we postulated the existence of additional affective facets across different types of odors and across different cultures and languages. Our team therefore initiated long-term studies to characterize feelings elicited by odors across cultures. The objective was to determine whether subjective affective responses to smells vary across cultures and whether the terminology and organization of the affective terms vary. We conducted studies in six countries to develop and compare verbalization models from six cultures: the French-speaking part of Switzerland (Chrea et al., 2009), the United Kingdom and Singapore (Ferdenzi et al., 2011), the United States, China, and Brazil (Ferdenzi, Delplanque, et al., 2013).

3.2 Creation of the GEOS

The originality of these studies lies in the selection of terms, based on respondents' opinions, whereby consumers had to choose the most relevant terms to express their feelings in the context of olfaction. We provided respondents with odors, or asked them to consider their own olfactive experiences. A high number of consumers selected terms from an initial list of 480. This list was obtained from a literature research on emotion and odor perception that included the terms used in different versions of dimensional theories, as well as an exhaustive list of terms derived from the basic emotions approach as applied to olfaction. The 480 terms were then translated into French and a back-translation process was applied. It was important that consumers select affective terms in the language of their culture in order to avoid translation bias. Term selection is a crucial step in lexicon development (see Gmuer et al., 2015, for a discussion on this topic). The composition of the resulting scale dramatically depends on the initial number of terms, their restriction to emotions or extension to moods or traits, and the theoretical framework adopted (eg, basic emotion or bidimensional approaches).

In the methodology we present here, the selection of terms was based on a three-step approach developed by Chrea et al. (2009) and conducted to create the GEOS as a first experiment in the Swiss culture. In the first study, 210 consumers rated the appropriateness of the 480 affective terms to describe their feelings by referring to their own smelling experiences, with no odorant provided. Terms were retained when ratings were above 50% on a 10-cm linear scale (ie, from mid to high appropriateness) for at least 66% of the subjects, reducing the list to 73 terms. These criteria do

not, however, constitute "gold standards": They were adopted because they provided a reasonable compromise between the number of terms being understood and their use by the respondents. Consumer samples can also dramatically influence the choice and use of terms, especially if the lexicon is built on the basis of an expert population.

In the second step conducted to develop GEOS, 38 consumers rated the intensity of their feelings for each of 73 affective terms while smelling 24 odorants from everyday life. The odorants covered a large range of everyday odors that tend to reflect different odor-related contexts from pleasant to unpleasant, from familiar to unfamiliar, and from edible (sweet, savory, fruits, spices, drinks, and vegetables) to nonedible (cosmetic, household, woody, plants, animal, floral, and medicine). An exploratory factor analysis with varimax rotation was performed on the data to retain terms that had both high loading on the dimensions and high interrater agreement, that is, 36 terms. Finally, the third study tested the robustness of the scale structure with a wider set of odorants (56 odorants) and a larger sample of participants from the general public (317 consumers). A confirmatory factor analysis validated the selected 36 terms and their organization into six feeling categories in this French-speaking population. The scale development process was therefore based on participants' affective responses to a wide range of odors that well represented our industry needs, from fragrances to flavors. Recollection of odor-related feelings (step 1) and actual experience of feelings through odor presentations (steps 2 and 3) were both at the basis of the GEOS design. Presenting an odor or a food-related product, or working with consumers' recollection of past experiences, also constitutes a crucial choice in the setup of a scale. Whereas recollection assumes that consumers possess a clear representation of their feelings in memory, elicitation of feelings with the actual presentation of odors (or food-related products) highly depends on the odor choices; their quality, intensity, and presentation mode; and the context in which they are presented. This step is also crucial to determine whether the objective is to obtain a lexicon specific to a class of products (eg, fabric softeners, fine fragrance) or to a broader domain (eg, food, odor; see also Gmuer et al., 2015, for a discussion of this topic).

The resulting GEOS model is presented in Fig. 17.1. This model, with six emotional categories, was statistically more powerful (ie, explained more variance and benefited from higher interrater agreements) than alternative tested models (eg, bidimensional; see Chrea et al., 2009, for more details). The scale is characterized by five positive emotional categories and only one negative category. The importance of the positive emotions was observed earlier in a food context by Desmet and Schifferstein (2008), who found that, in general, consumers have positive predispositions toward past food experiences. It was also underlined by Gmuer et al. (2015), who found that up to 70% of the food-associated emotional terms were positive from a systematic, linguistic-based approach. This asymmetry reflects that most feelings experienced with food or odors are positive and rich, depending on the context of the experience.

A direct comparison of the existing sets of terms (GEOS, tridimensional, and basic emotion, as presented in Table 17.1) was also performed in an independent study (Delplanque et al., 2012), with the argument that a new set of terms is worth using only if it truly provides advantages over other existing sets. The comparative validity

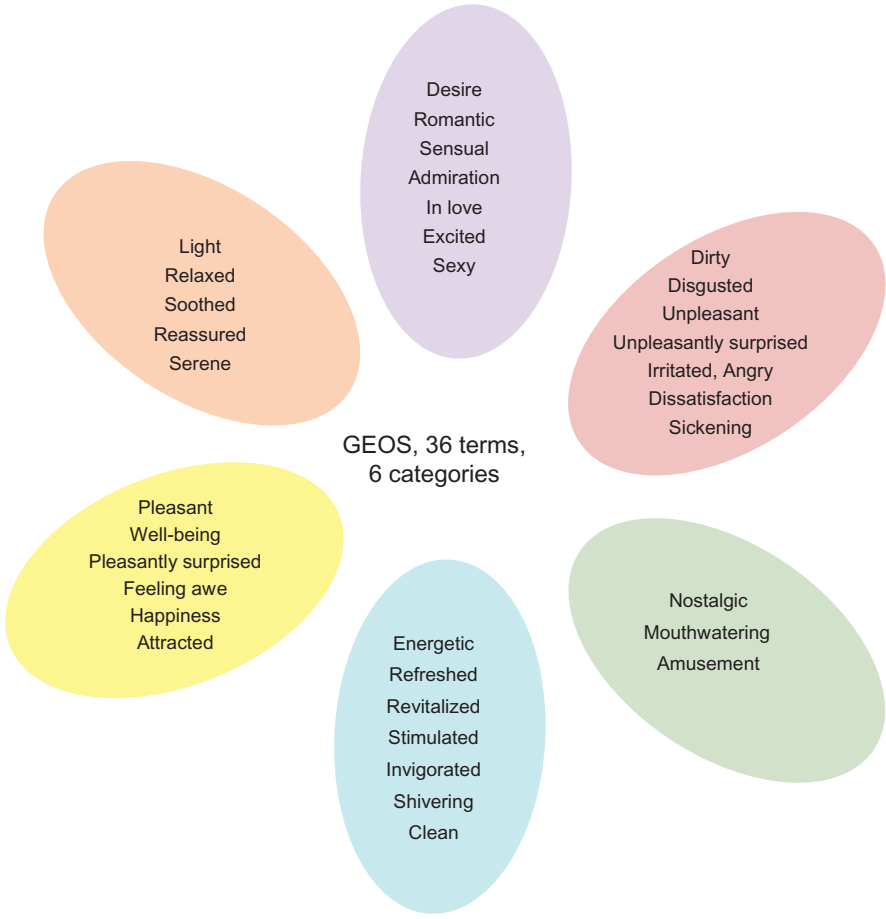


Figure 17.1 GEOS, or Geneva Emotion and Odor Scale, which consists of 36 emotional terms grouped into 6 emotional categories by factorial analyses.

of the models was based on three criteria: (1) the intensity of the reported feelings, (2) the interrater agreement in using the different sets of terms, and (3) the ability of the three sets of terms to discriminate the feelings related to different olfactory stimuli. The results of this study indicated that GEOS outperformed the other two proposed sets, showing higher intensity ratings than the basic emotions set and higher interrater agreement and better ability to discriminate among the feelings related to olfactory stimuli than the other two tested sets (ie, tridimensional and basic emotion terms). The psychometric space described by GEOS is shaped by affective terms gathered in six classes of feelings that were named pleasant feeling, unpleasant feeling,

Table 17.1 Main feeling terms and three subheading representative terms for each emotion model

Model	Main feeling term	Representative terms
GEOS	Relaxation	Relaxed_serene_soothed
	Unpleasant feeling	Disgusted_irritated_unpleasantly surprised
	Sensuality	In love_desire_romantic
	Refreshment	Revitalized_invigorated_clean
	Sensory pleasure	Nostalgic_amusement_salivating
	Pleasant feeling	Happiness_well-being_pleasantly surprised
Basic	Surprise	Surprised_amazed_stunned
	Anger	Angry_furious_outraged
	Sadness	Downcast_sad_discouraged
	Disgust	Gutted_disgusted_repelled
	Joy	Delighted_cheerful_happy
	Fear	Terrified_frightened_scared
Tridimensional	Activation	Excited_alert_stimulated
	Dominance	Dominant_powerful_under control
	Pleasure	Happy_delighted_glad
	Submissiveness	Submissive_without control_without power
	Unpleasant	Unhappy_displeased_discontented
	Deactivation	Calm_rested_asleep

relaxation, refreshment, sensuality, and sensory pleasure. As further developed in this chapter, we argue that those terms are deeply emotional in the sense that the feelings they depict motivate the individual to adjust or to solve olfactory-linked survival-relevant problems, a key function of emotion.

3.3 Extension to other cultures

Since GEOS was developed in a French-speaking, developed Western country, the next question was whether feelings regarding odors were universal or dependent on an individual's experiential and cultural background. Strong support for the latter possibility came from already-existing major cross-cultural studies on the hedonic perception of odors (Pangborn, Guinard, & Davis, 1988; Wysocki, Pierce, & Gilbert, 1991). We thus launched the development of several scales, with a different set of 350 to 540 consumers participating in each country. Of importance is that the odorants presented to build the scales included a common set to assess cultural diversity in eliciting feelings from identical odorants, as well as culture-specific odorants so as not to miss those feelings born of culture-specific odors (eg, pandan and tea odor for China, banana and coconut for Brazil). The three-step study process (presented in Fig. 17.2), as used for the Swiss culture, was systematically reproduced in five other cultures and resulted in the development of culture-specific emotion and odor scales (EOSs).

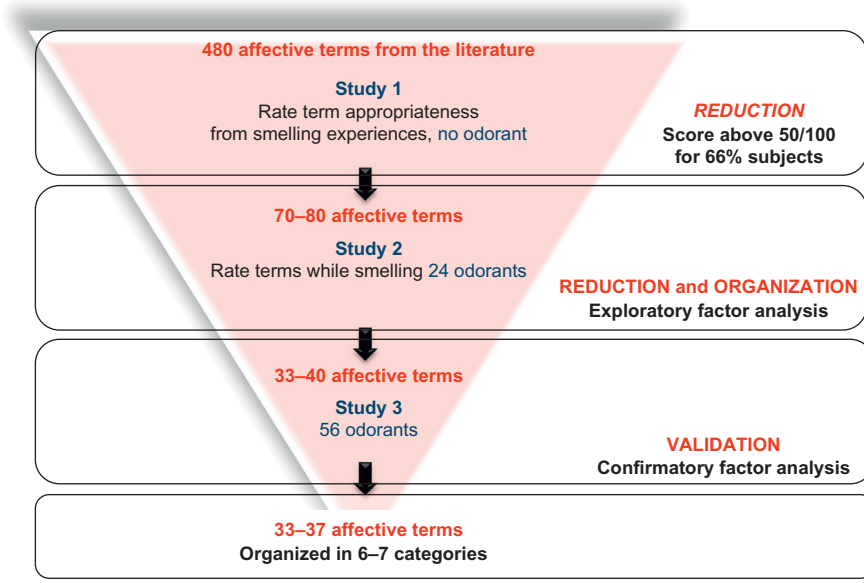


Figure 17.2 Three-step process in the selection of affective terms.

The 480 terms were kept in English for the studies conducted in the United Kingdom, the United States (two cities, one in Arkansas and one in California), and Singapore; translated into Chinese for China; and translated into Portuguese for Brazil by applying a back-translation process. The number of affective terms was reduced from 480 to 33 to 37, which were organized into six to seven emotional categories, depending on the culture. Emotional categories were named according to the affective terms that were grouped by factor analyses. The first fundamental result obtained was that five of these emotional categories were common to all cultures: (1) Happiness/Delight, (2) Sensuality/Desire, (3) Energy, (4) Soothing/Peacefulness, and (5) Unpleasant feelings. In addition, four emotional categories were more culture-specific: (1) Hunger/Thirst (the United Kingdom, the United States, Brazil), (2) Interest/Amusement (China, Singapore), (3) Nostalgia (the United Kingdom, Brazil, China, Singapore), and (4) Spirituality (Singapore). These specific affective categories reflect the influence of culture on odor-elicited feelings and highlight the relevance of the cross-cultural approach. We found with multidimensional scaling analyses that the organization of the emotional categories was mainly influenced by the geographic proximity of the countries: the closer the countries, the more similar the feelings elicited by a set of odors and the resulting organization of the affective terms (Fig. 17.3). Exceptions to this pattern were Singapore and China, with affective responses of Singaporeans being closer to those of Europeans (Ferdenzi, Delplanque, et al., 2013). This result might be explained by the choice of using the English language in Singapore; a study conducted in Mandarin could have given different results. Although some of the affective terms in the emotional categories were culturally shared (ie, happy, energetic,

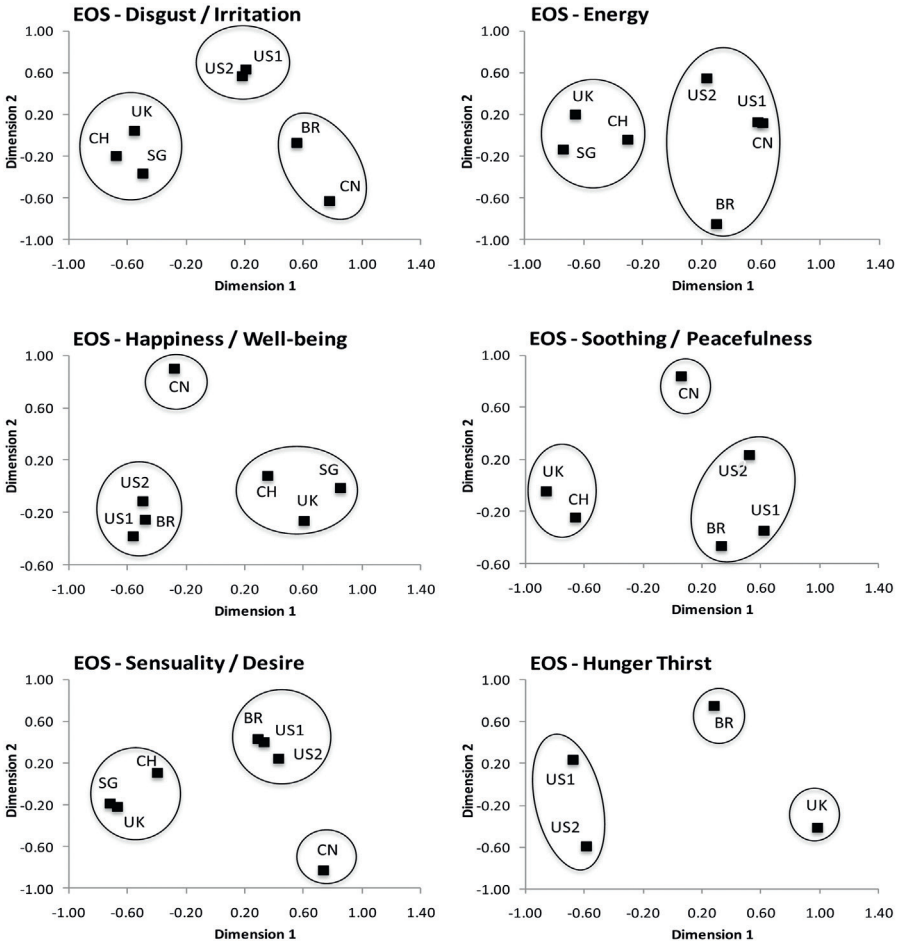


Figure 17.3 Representation of the seven geographic areas on the first two dimensions of the multidimensional scaling analyses for the EOS categories: familiarity, liking, and correct identification. *Black circles* represent the groups obtained with cluster analyses (Ward's method on city-block Manhattan distances). BR, Brazil; CH, Switzerland; CN, China; SG, Singapore; UK, United Kingdom; US1, United States (Arkansas); US2, United States (California).

refreshed, sensual, romantic, relaxed, disgusted, irritated), several culture-specific affective terms also appeared (ie, for the Happiness/Delight emotional category: "attracted, feeling awe" in Switzerland; "in a good mood" in the United Kingdom; "likeable, satisfaction, smiling, delighted, bliss, fantastic" in the United States; "feeling of plenitude, euphoric, jovial, titillated, beaming" in China; "joyful" in Brazil); see Table 17.2 for more details. The studies conducted in different cultures therefore showed that feelings elicited by odors vary across cultures, more so regarding affective terms, which varied considerably more from one culture to another (see Tables

Table 17.2 Selection of terms by culture for the Happiness/Well-being emotional category

Agreeable	CN
Amusement	BR
Attracted	CH
Beaming	CN
Bliss	USA1, USA2
Cheerful	CN
Comforted	SG, BR
Delighted	USA1, USA2, CN
Euphoric	CN
Fantastic	USA1, USA2
Feeling awe	CH
Feeling of plenitude	CN
Happiness	CH, SG
Happy	USA1, USA2, CN, BR
In a good mood	UK, CN
Joyful	CH, USA1, BR
Jovial	CN
Likeable	USA2
Pleasant	SG, CH
Pleasantly surprised	CH,CN, UK, USA1, SG
Pleasure	USA1, USA2
Relaxed	SG
Satisfaction	USA1
Smiling	USA2
Titillated	CN
Well-being	CH, SG, BR

Note: BR, Brazil; CH, Switzerland; CN, China; SG, Singapore; UK, United Kingdom; USA1, United States (Arkansas); USA2, United States (California).

3a and 3b in Ferdenzi, Delplanque, et al., 2013) than did their organization and emotional categories (most of which were common to all cultures). The latter result reinforced the interpretation that, from a functional point of view, these common feelings motivate the individual to adjust or to solve culturally common and perhaps universal olfactory-linked, survival-relevant problems.

In considering cultural invariants and cultural specificities among the seven EOSs, our question was as follows: To what extent do culture specificities need to be taken into account in the verbal measures of feelings? We therefore conducted studies on 12 shampoo fragrances with Swiss consumers, who rated their feelings with their culture-specific scale (GEOS) and with the scales developed for the United States and China, the terms of the latter scales being translated into French. Results showed more appropriateness and discrimination when the Swiss consumers rated their feelings with the GEOS scale than with the other scales (Porcherot, Delplanque, Gaudreau, DeLaura, & Cayeux, 2012). These results emphasized the biases related

to one culture using a scale obtained from another culture. These biases are not only related to translation bias, but also to the fact that some of the affective terms from one culture may not be well understood by another culture (eg, "feeling of plenitude" and "psychologically affected" feelings from the Chinese scale were not understood by Swiss participants), may have a different meaning (eg, "delighted" from the American scale), or may not be relevant in the context of odor-elicited emotion (eg, "impressed" and "depressed" from the Chinese scale were not used by Swiss participants).

Our cross-cultural approach had taken cultural differences into account and had shown the importance and impact of these differences. This approach is probably not specific to odors; Part IV of this book is dedicated to cross-cultural studies of emotions. However, from the perspective of an international company, a global scale needed to be envisaged to use in studies that test and compare products in different countries. Moreover, a global scale could be used to help develop a global database of consumer research performed in many different countries, which might be used in the selection of fragrances and ingredients to broadly fulfill emotional benefits or to target a specific population. For the creation of a global scale, we decided to keep all nine emotional categories found in the six cultures in order to take all culture specificities into account (ie, the five common emotional categories in the six cultures and the four culture-specific emotional categories). We reasoned as follows: The only risk was if a culture did not use an emotional category because it was not relevant (eg, the emotional category related to spirituality and found only in the Singaporean culture might not be relevant in other cultures; as a result, it was not used). For the affective terms, a good understanding of the terms was favored and three of the terms most common to the six cultures were kept per emotional category (except for the emotional category related to spirituality from the Singaporean culture, for which only one of the two terms "spiritual feelings" and "religious feelings" was selected). A total of 25 terms were selected: 10 were consistently selected by the six cultures (ie, relaxed, happy, disgusted, irritated, unpleasantly surprised, sensual, romantic, desire, energetic, and refreshed); four additional terms were used by at least five cultures; and three, from culture-specific emotional categories, were used by only one culture (ie, impressed, melancholic, and spiritual feeling). The resulting scale, Universal Emotion and Odor Scale (UniGEOS; Ferdenzi, Delplanque, et al., 2013), encompasses 25 emotional terms available in four languages (English, French, Portuguese, and Chinese), grouped into nine emotional categories (Table 17.3). This structured lexicon for feelings is designed to be used for multicountry consumer research.

3.4 Functional significance of EOS feeling categories

Most of the feeling categories extracted by using this data-driven approach are consistent with the putative function of odor-related emotions. Indeed, emotions are thought to allow adjustment or to solve survival-relevant problems, such as forming attachments, maintaining cooperative relations, or avoiding physical threats (for a review about the functions of emotions, see Keltner & Gross, 1999). Emotions motivate organisms to adapt their behaviors to changing situations (Frijda & Scherer, 2009). The feeling categories (Disgust/Irritation, Happiness/Well-being, Sensuality/

Table 17.3 Proposed Universal Emotion and Odor Scale (UniGEOS) with 9 affective categories and 25 affective terms in 4 languages

English	French	Chinese	Portuguese
1. UNPLEASANT FEELINGS			
disgusted (N = 7)	dégoûté	厌恶的	enojado
irritated (N = 6)	irrité	恼怒的	irritado
unpleasantly surprised (N = 6)	désagréablement surpris	不愉快的意外惊喜	desagradavelmente surpreso
2. HAPPINESS/DELIGHT			
happy (N = 6)	heureux	幸福的	feliz
pleasantly surprised (N = 5)	agréablement surpris	惊喜的	agradavelmente surpreso
well-being (N = 3)	bien-être	安宁	bem-estar
3. SENSUALITY/DESIRE			
desire (N = 7)	désir	渴望	desejo
romantic (N = 7)	romantique	浪漫的	romântico
sensual (N = 6)	sensuel	肉欲的	sensual
4. ENERGY			
refreshed (N = 7)	rafraîchi	恢复精神的	refrescado
energetic (N = 6)	énergique	精力充沛的	energético
revitalized (N = 5)	revitalisé	恢复生机的	revitalizado
5. SOOTHING/ PEACEFULNESS			
relaxed (N = 7)	relaxé	得到安宁的	relaxado
comforted (N = 5)	réconforté	宽慰的	confortado
soothed (N = 4)	apaisé	受安慰的	sossegado
6. HUNGER/THIRST			
mouth-watering (N = 5)	salivant	令人垂涎欲滴的	com água na boca
thirsty (N = 3)	assoiffé	口渴的	sedento
famished (N = 2)	affamé	极饥饿的	faminto
7. INTEREST			
amusement (N = 3)	amusement	娱乐	diversão
interesting (N = 2)	captivant	有趣的	interessante
impressed (N = 1)	impressionné	印象深刻的	impressionado
8. NOSTALGIA			
sad (N = 3)	triste	伤心的	triste
melancholic (N = 1)	mélancolique	忧郁的	melancólico
nostalgic (N = 3)	nostalgique	怀旧的	nostálgico
9. SPIRITUALITY			
spiritual feeling (N = 1)	sentiment spirituel	精神感觉	sentimento espiritual

N is the number of geographic areas (out of the seven studied) in which the term appears.

Desire, Energy, Soothing/Peacefulness) depicted by the EOSs may represent the way that respondents' feelings are related to the different functions of olfaction. Experiencing these feelings could motivate the individual to adopt the optimally suited reaction to an odor's perception. In a recent review on the functions of human olfaction, Stevenson (2010) defined three major classes of functions related to "Ingestion (Detection/identification prior to ingestion; Detection of expectancy violations; Appetite regulation; Breast orientation and feeding), Avoiding environmental hazards (Fear related; Disgust related), and Social Communication (Reproductive [Inbreeding avoidance, fitness detection in prospective mates]; Emotional contagion [fear contagion, stress buffering])" (p. 3). In this respect, most of the terms gathered under the EOS category "Disgust-Irritation" may reflect the unpleasant subjective affective experience associated with the detection of "expectancy violation" or "environmental hazards," described as key functions of olfaction. These unpleasant feelings might, for instance, motivate withdrawal behavior. The terms from the "Well-being-Happiness" category may reflect the feeling associated with the fulfillment of "expectancies" or "food intake." The terms under "Sensuality" may reflect the feelings associated with many situations of "social communication" and those in the "Energizing-Refreshing" and "Soothing-Peacefulness" categories may depict the feelings that motivate responses in relation to many functions of olfaction, such as being energized prior to ingestion in order to enhance the search for food, or feeling relaxed after smelling the known odor of a partner. In summary, although adopting a valence by arousal space as a representation of feelings does not fully account for many odor-elicited action tendencies, more complex representations of feelings such as that proposed by EOS constitute a better picture of the way individuals adjust in order to solve olfactory-linked, survival-relevant problems, a key function of emotion (Chrea et al., 2009; Delplanque et al., 2012; Ferdenzi, Delplanque, et al., 2013). Several terms would not have been intuitively or a priori associated with feelings as defined here, such as "thirsty" or "hungry." These terms are of less importance in terms of explained variance in the model and they could not have been kept if more conservative statistical criteria had been chosen. Apart from that, it is worth noting that they correspond to the verbal report of highly motivational states that remain related to the olfactory world.

4 Different strategies for measuring odor-related feelings in sensory settings

We used the global scale, UniGEOS, in sensory booth sessions or central location tests by asking a reasonable number of consumers (ie, 60—120) how they feel while smelling an odor, or a fragranced product, for each of the 25 affective terms presented in a balanced order. Linear continuous or categorical scales were used by participants, who rated the intensity of their feelings from "not at all" to "very intense" (answers scored from 0 to 10). Different fragranced products were presented in the same sensory booth session. Feelings occurring during emotional responses are short-term

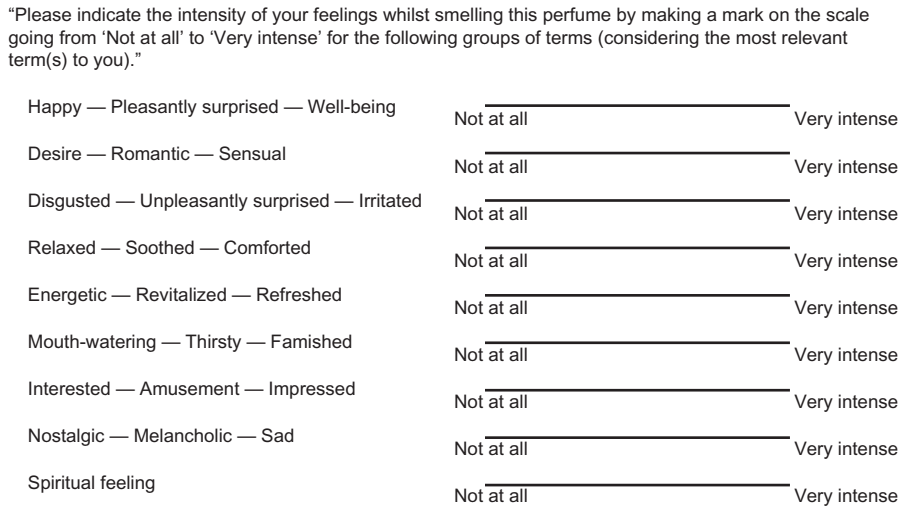


Figure 17.4 ScentMove questionnaire.

responses to actual or imaginary events; they are therefore measured during or just after smelling the odors and fragrances. It takes approximately 15–30 minutes to complete such a test. The length of the experiment might, however, be critical when the participants are asked to compare a high number of fragrances, and so sensory fatigue, habituation, and cross-adaptation phenomena should be considered.

To tackle this important issue, one can adopt several strategies. The questionnaires can be further simplified by reducing the number of scales to be rated. In the resulting ScentMove questionnaire (Fig. 17.4), only one scale was kept for each feeling category obtained from the exploratory and confirmatory factorial analyses, which grouped terms according to their similarities. This process led to six scales for GEOS, or nine scales for UniGEOS, and each scale was illustrated by the three terms depicting the feeling category. With the ScentMove questionnaire, participants are asked to rate the intensity of their feelings for each series of terms, considering which term(s) is most relevant to them. Other authors (Spinelli et al., 2014) recognized that this approach could help the respondent to better understand the task by clarifying the emotional category. In addition, a study conducted on 12 shampoo fragrances showed that the original GEOS and the simplified ScentMove questionnaires yielded comparable results (Porcherot et al., 2010). The two-dimensional coordinates obtained for the shampoo evaluation with the two different questionnaires were similar (Fig. 17.5), and the calculated RV coefficient (RV $= 0.731$) confirmed the similarity of the two matrices.

Another strategy to reduce the length of the experiments was to consider the check-all-that-apply (CATA) method. The 25 emotional attributes of UniGEOS were presented following a balanced order of presentation. Consumers were requested to select, or check, as many emotional attributes as needed to qualify their feelings while smelling fragrances. We compared the CATA method with a 5-point scale rating

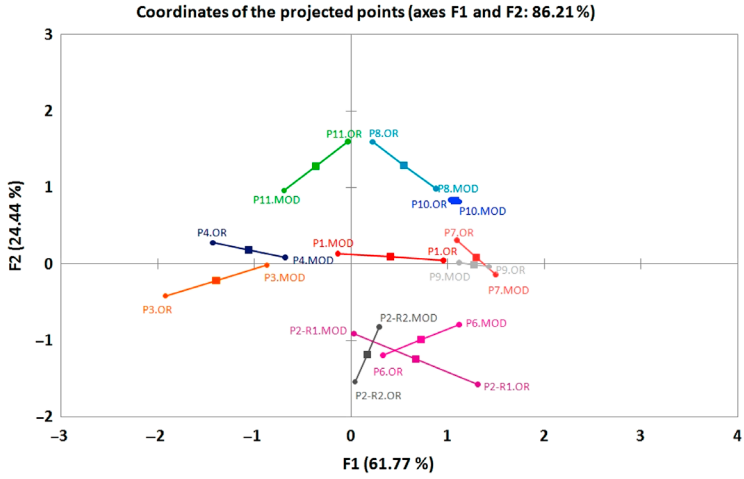


Figure 17.5 Two-dimensional mapping resulting from the multidimensional factor analyses performed on the original and the modified questionnaires; representation of the 11 products (product 2 being repeated).

method, using five shampoo fragrances evaluated in six different tests (Porcherot et al., 2014). Multidimensional factor analyses and RV coefficients indicated similar fragrance descriptions among the six tests and different emotional responses among the five shampoo fragrances. Results showed that the CATA method could be applied by using the terms provided by UniGEOS with more discrimination, especially when the within-subject randomization of terms was applied (by product and by subject randomization). We therefore suggest applying the CATA approach instead of an intensity scale for product ranges with narrow differences. The CATA approach may also have the advantage of eliciting more spontaneous answers, as compared with a scaling approach. This approach has been applied by other authors (Jaeger, Cardello, & Schutz, 2013; Jiang, King, & Prinyawiwatkul, 2014; King, Meiselman, & Carr, 2013; Ng et al., 2013a; Warrenburg, 2005). King et al. (2013) found that the CATA approach provided more differentiation at the higher levels of emotional frequency for a few select emotions, and the rating scale provided differentiation for more attributes at lower levels of emotional response. Warrenburg (2005) suggested another approach consisting of picking only one of the emotional categories that best matches the feelings related to the fragrance and found more discrimination than by asking the consumers to rate each of the eight categories. This approach might, however, be too restrictive, as products may elicit multiple (mixed) emotions simultaneously rather than eliciting one single emotion (Desmet, 2003; Porcherot et al., 2010). Finally, Crocker and Thomson (2014) suggested best–worst scaling, in which respondents are presented with the object to be profiled and asked to choose the words most and least associated with the object from successive sets of four or five words. However, we found that best–worst scaling was considerably more time-consuming and may thus take too long to catch the transient immediate emotions evoked during smelling.

Concerning the setup of the consumer tests, they could be conducted in sensory booths or in central location tests, where different perfumes or flavors are presented to consumers. Consumers fill in the UniGEOS or ScentMove questionnaire in addition to other questions that are traditionally asked by our consumer insight teams (eg, purchase intent or other relevant attributes). These laboratory settings may, however, overestimate differences of self-reported feelings as compared with more natural settings (Porcherot, Petit, Giboreau, Gaudreau, & Cayeux, 2015). It is therefore important to consider consumer home use testing, in which consumers receive only one fragranced product (eg, shampoo or detergent) in their home to evaluate over consecutive days to capture feelings associated with the use of the product. The questionnaire procedure remains the same, but the feeling response could be captured at different times of the product experience. We conducted a study to investigate the emotional responses to softeners according to four different laundry moments (ie, when opening the bottle and pouring the product, when opening the machine and removing the wet laundry from the machine, when the laundry is drying in a tumble dryer or on the line, or while ironing or when folding, or scrubbing the laundry once it is dry). Different emotional responses were observed at these different laundry moments. Emotional responses were highest when the laundry was presented wet, or when it was scrubbed by the respondents, and lowest when the laundry was presented dry (Fig. 17.6). This line of study is similar to that conducted by Schifferstein, Fenko, Desmet, Labbe, and Martin (2013), who explored consumers' feelings at different stages of the consumption sequence, from shopping to preparation to consumption. They found that different feelings were elicited during the various stages of user–product interactions.

In summary, these psychometrically validated EOSs (GEOS, UniGEOS, and ScentMove) have proven to be practical tools and are routinely used in our industry for commercial fragrances, commercial flavors, ingredient screening, and comparisons based on elicited feelings. We demonstrated that these questionnaires were adapted to the measurement of feelings for different fragranced and flavored products

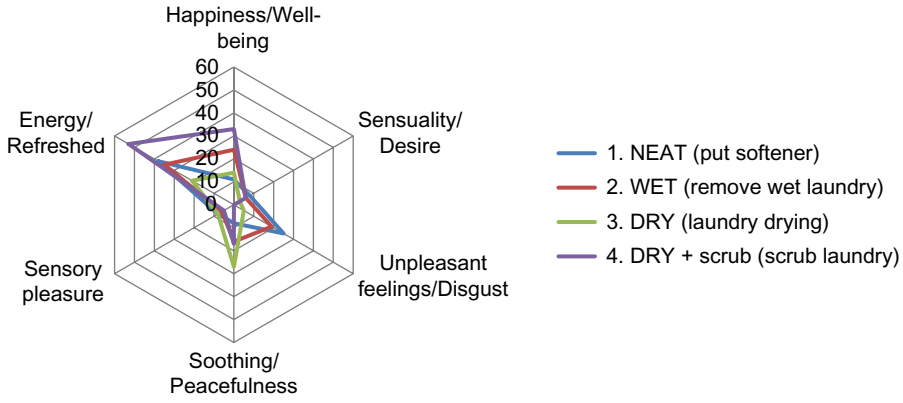


Figure 17.6 Mean of intensities by emotional category for one fragranced softener at laundry moments.

(eg, fragrances: fine fragrances, shampoos, softeners; flavors: dairy products, teas, cookies) by providing reproducible, discriminating, and consensual results (Porcherot et al., 2010). An internal program has been initiated to proactively collect feelings related to our products in a database. Creative teams are using this database to develop emotion-laden fragrances and flavors in harmony with the positioning of the emotional benefits of the product. They create an "olfactive link" with ScentMove feeling categories expressed by consumers. For example, comfort-relaxing perception was related to milky notes, violet, and linden, as demonstrated in a study conducted on shampoos with French consumers. Thomson, Crocker, and Marketo (2010) also worked on the link between feelings and chocolate description and found that: "cocoa (sensory characteristic) is associated with powerful and energetic (conceptualisations); bitter with confident, adventurous and masculine; smoky/burnt with arrogant, serious, traditional and pretentious; vanilla, brown and initial bite with sensual, fun and luxurious; and creamy and sweet with fun, comforting and easygoing." (p. 1124).

We also developed a global survey aimed at uncovering specific links between feelings, personal/functional products, colors, and ingredients (flowers, fruits, spices, foods/drinks, woods) in several countries around the world, with a minimum of 300 respondents per country (65% female/35% male, unpublished data). These associations were provided by the consumers on the basis of their experience and expectations without smelling any odor. This approach is already rich in information and underlines, for instance, the fact that "comforted" in China is related to carnation, lily, and jasmine, whereas it is more related to rose and lotus flower in India and to rose and lavender in Brazil (Table 17.4). This information could proactively be used by perfumers when they are asked to develop appropriate perfumes in accordance

Table 17.4 Percentage of associations between flower ingredients (top 15) and "comforted" feeling in China, India, and Brazil

Flower ingredient	China (%)	India (%)	Brazil (%)
Carnation	28	16	14
Lily	24	27	22
Jasmine	23	34	29
Narcissus	19	16	5
Lotus flower	19	41	17
Peony	18	12	5
Osmanthus	18	10	9
Lilac	18	12	17
Rose	17	53	33
Lavender	17	35	31
Orchid	17	22	29
Violet	16	19	29
Cherry blossom	16	16	17
Water lily	15	19	5
Gardenia	15	11	15

with the requested emotional benefits in these countries. A similar exercise was conducted by Parente (2010) for different cosmetic products. Functional hygiene products (toothpaste and deodorant) were associated with well-being, efficacy, simplicity, essential, trust, care, routine, and peaceful. Face treatment products (shampoo and cream rinse) were associated with terms such as care, essential, well-being, and pleasant. This result emphasizes that emotional expectations depend on the product categories. The development of scales for specific product categories and context of use is needed. Emotional expectations may also depend on other factors such as brand and packaging, which would need to be considered as well.

5 Different approaches for measuring expectations and contextual modulations of fragrance-elicited emotions

Fragrance is a decisive factor, along with functionality and price, when consumers shop for personal and home care products. Perfumes offer a wide range of choice to meet diversified consumer needs and preferences. At the key moment of choice, the fragrance needs to trigger appropriate feelings in this context. This feeling also depends on consumers' expectations about the fragrance from the product label, advertising, positioning, color, or packaging. Shoppers, for example, may check the fragrance pleasantness and try to verify the information from the label and packaging information by smelling the product in the supermarket. Overall evaluation and choice is not only a result of sensory input from the smell, or bottom-up processing, but also a result of top-down modulation when the consumer compares the smelling experience to expectations. The incorporation of the right fragrance in a product is crucial because it can enhance the consumer's perception of the product by supporting product positioning. Perfumes may therefore strongly affect why shoppers purchase a product, how they use it, and why they return for repeat purchases. Products that appropriately fulfill consumers' emotional expectations have a higher probability of success in the market, and the fragrance strongly contributes to this success if it is consistent with the product (Seo, Roid, Müller, & Negoias, 2010). We therefore wanted to investigate the extent to which the feelings response to odor is influenced by expectation.

In a first study, we examined the influence of food odorant names on self-reported feelings (Porcherot, Delplanque, Planchais, et al., 2012). This exercise was possible because food names may elicit memories of an emotional experience with the food. In addition, the odor name may drive strong expectations when it is mentioned on the product packaging because consumers expect to recognize the named odor. In this context, we sought to quantify the discrepancy between the emotional expectations raised by the odor name and the emotional experiences provided by the smell of the odor. Consumers reported their feelings while smelling an odorant, which was presented blind or in association with its name (ie, a mint odor with a "mint" name). In a third condition, consumers reported how they would expect to feel if they smelled a given odorant, with the name of the odorant being presented to them (ie, "mint"). Results indicated that the information about the odorant name influences the reported feelings, as previously observed by several authors (review from Deliza & MacFie,

1996) regarding traditional liking assessments, with differences among feeling categories and odorants. First, expected feelings were in line with experienced feelings, with no significant difference among all emotional categories for eight odorants (eg, caramel, citrus, exotic, mint). Second, experienced feeling intensities were lower than those of expected feelings, depending on the odorants and the feeling categories. Results for mint and honey odorants are provided in Fig. 17.7. The quality of the

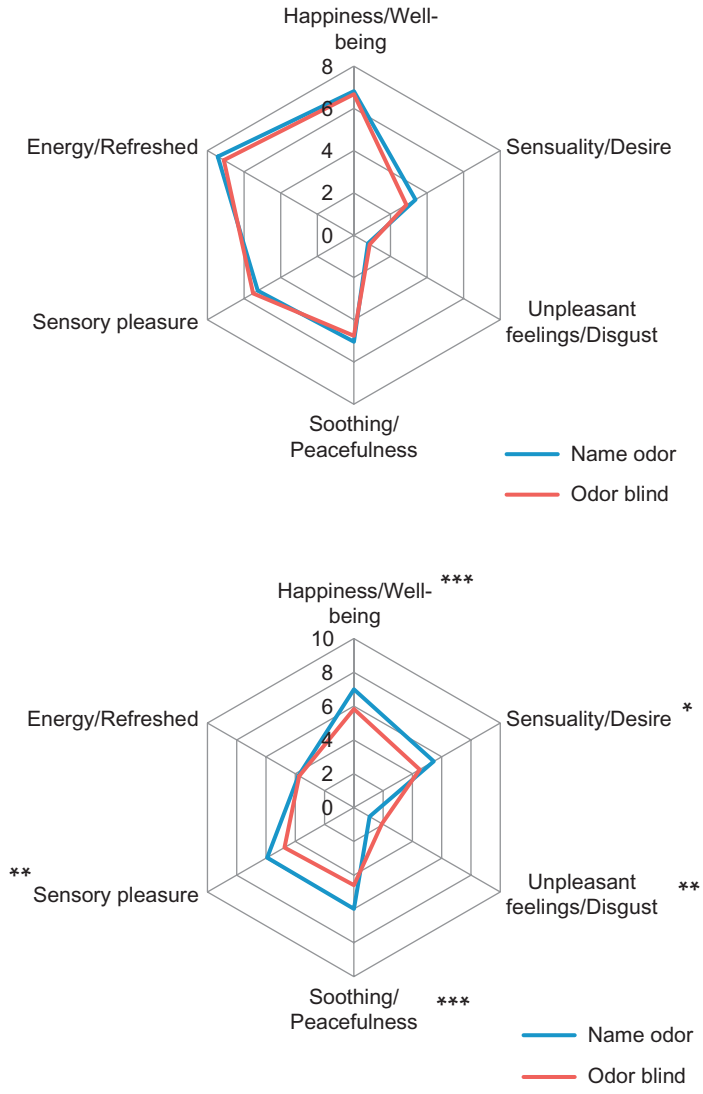


Figure 17.7 Mean of intensities by emotional category for two odorants (mint, then honey) in two conditions: blind presentation of the odorant, or expectation from the odorant name. * indicates a significant difference at the 95% confidence level, ** at the 99% confidence level, and *** at the 99.9% confidence level.

odor was of crucial importance, when, for instance, the intensity of feelings during the actual experience was below expectations. The information about the name was sometimes sufficient to decrease this discrepancy. A similar approach was conducted on food names and tasted foods by Cardello et al. (2012) in order to compare how one expects to feel to how one actually feels. Highly emotion-laden food items (eg, chocolate) elicited a more intense emotional response to the name than to the tasted product, suggesting that food names may elicit memories of an idealized emotional experience with the food (see also Thomson et al., 2010). This observation was confirmed by Spinelli, Masi, Zoboli, Prescott, and Monteleone (2015) on hazelnut and cocoa spreads, which were presented blind and with their packaging. These influences are probably much weaker than those based on experiences in earlier eating situations (Köster, Møller, & Mojet, 2014). The context used to evaluate a product also has a strong influence (eg, study conducted on spices; King et al., 2013).

Comparisons between experienced and expected feeling profiles may provide valuable recommendations to perfumers in terms of odorant composition adjustments and reformulations. We compared emotional expectations associated with shampoo packaging and emotional experiences elicited by the experience of the shampoo fragrance presented blind (unpublished data). Emotional expectations were mostly associated with what was claimed by the packaging. One fragrance did not elicit the feelings that were expected on the basis of what was claimed by the product's packaging (ie, relaxing; Fig. 17.8). This result helped guide adjustments in product composition so that the fragrance could be reformulated to best fit consumer expectations in order to deliver more relaxing feelings.

Contextual information may deeply influence product experience and feelings. Ng et al. (2013b) found that "intrinsic sensory characteristics have a stronger association with emotions, whereas extrinsic product characteristics seem to have a stronger association with abstract/functional conceptualisations." Packaging design characteristics are also critical, as they can suggest a certain identity that may enhance or interfere with the identification and evaluation of the content (Schifferstein et al., 2013). Colors may also better suit some fragrances than others and thus be more congruent (Schifferstein & Tanudjaja, 2004). Olfactory perceptions are known to be affected by the visual system, even if a question focuses on perfume perception (Dalton, 2002). We investigated the influence of color on feeling responses for perfumed fabric softeners with the hypothesis that color–perfume congruent pairs will induce enhanced positive emotional experiences (Porcherot, Delplanque, Gaudreau, & Cayeux, 2013). Participants were asked to report their feelings for nine perfumed fabric softeners, composed of one of three perfume variants and presented as one of three color variants (white, pink, and blue). Subjective affective responses varied as a function of perfumes and were slightly influenced by colors. White and pink colors increased the reported happiness, romantic, nostalgic, and relaxed feeling categories, whereas the pink color increasing the desire feeling. However, influences of color on feelings seemed global because they were the same for all perfumes. The influence of colors may, however, depend on the product. Some data show that color is more important than odor for an individual to determine the freshness of soft drinks and dishwashing liquids, whereas both color and odor are of equivalent importance in the reported freshness of scented

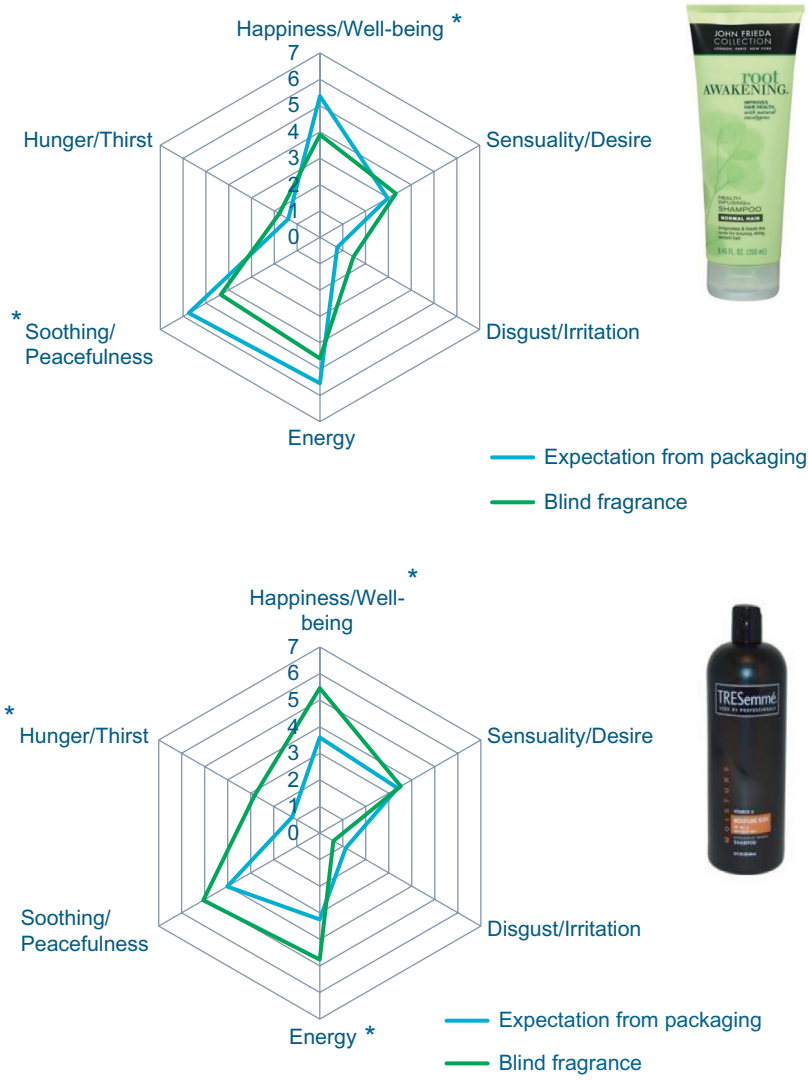


Figure 17.8 Mean of intensities by emotional category for two fragranced shampoos in two conditions: blind presentation of the fragrance, or expectation from the packaging. * indicates a significant difference at the 95% confidence level.

candles (Fenko, Schifferstein, Huang, & Hekkert, 2009). Product experience and feelings are influenced by both the actual perception of the sensory product properties and by preexisting attitudes and beliefs about a product (Schifferstein et al., 2013). Nonetheless, the relative influence of each factor remains difficult, if not impossible, to predict. From the same perspective, Thomson et al. (2010) mentioned that "when someone tells us that a product makes them feel 'happy', 'passionate', etc. it is more

likely that they are reflecting what the product is communicating to them (emotional conceptualisations) rather than doing to them (emotional consequences)." According to Thomson and Crocker (2013): "more research needs to be conducted to develop practical procedures that allow researchers to capture the prevailing feelings of individuals and to track the transitions induced by products, brands, advertising, etc."

6 Final recommendations for measuring feelings elicited by odors

In this chapter, we have shown that feelings elicited by odors can be measured in sensory laboratories or in home conditions by asking a reasonable number of consumers how they feel while smelling an odor or a fragranced product. To that end, we have developed different tools: culture-specific scales (eg, GEOS when the test is conducted in Switzerland), the more universal scale in its complete form (ie, UniGEOS) for a limited number of fragrances, or the universal scale in its reduced form (ie, ScentMove) to compare a higher number of fragrances. Consumer responses can be provided on a 10-cm linear or structured scale, or by applying the CATA method when the product range is narrow. Odors can be provided by sniffing pens, or by asking the consumer to directly smell shampoos or softener bases (neat format) or to smell products on wet hair or wet laundry. It is important to avoid smell contamination when several odors need to be evaluated in the same session. The emotional response should be captured during or just after the smelling experience because our questionnaires (GEOS, UniGEOS, or ScentMove) were developed to capture odor-elicited subjective reports of emotion (ie, feelings), not to measure changes of longer-lasting mood states over time. However, other authors captured the effect of perfumes on mood states before and after the fragrance experience for 12 days (Schiffman et al., 1995).

Feeling measures can be used as a relevant source of information in fragrance development projects (Meiselman, 2015). Gmuer et al. (2015) emphasized that the "advantage of using extensive emotion lists is seen in the additional information gained compared to a smaller number or higher-level, less specific descriptors, traditional hedonic measurement methods or whether solely positive and negative affect would be considered." A growing number of studies report the usefulness of measuring differentiations of feelings for products that did not differ in liking (King & Meiselman, 2010; King et al., 2013; Laros & Steenkamp, 2005; Ng et al., 2013a; Porcherot et al., 2010; Warrenburg, 2005).

We believe that these questionnaires can be used either for smelling fragranced products, or for tasting flavored products. However, we are aware that a scale developed solely on the basis of odors may be limited by the lack of terms related to specific fragranced and flavored product categories for specific contexts of use (the need for a specific category lexicon was also observed by Spinelli et al., 2014). This brings us to another limitation of several approaches: Emotional lexicons were generated in response to physical stimuli outside of any context of use (Schifferstein et al., 2013). Piqueras-Fiszman and Jaeger (2014a, 2014b, 2014c) conducted a series of

experiments that showed how the imagined context and appropriateness of different eating situations influenced emotional responses, emphasizing that emotions are more related to the eating situations than to the food itself. For Köster and Mojet (2015), "there is ample evidence that we do not remember the food we ate earlier with precision, but are immediately reminded of the earlier situation in which we ate it (its ambiance or the company we ate it with) or we note deviations from it as a surprise and warning." Finally, we are strongly in favor of a cross-cultural approach instead of translating a scale obtained in only one culture. This was confirmed by Spinelli et al. (2014) in an Italian adaptation of EsSense, supporting the idea that Italian consumers find the adjective "nostalgic" inappropriate.

Other types of measures of emotional responses can also be envisaged in order to bring complementary information to verbal reports. For example, Churchill and Behan (2010) used mood portraits, which measure the emotional response to fragrances by using visuals, or a series of photographs evoking an emotional response; respondents selected the pictures that evoked the same mood as the fragrance. This method may have the advantage of involving less cognitive interpretation because the task is not directly link to the fragrances. Other authors tried psychophysiological measures, which are detailed in chapter 4 "The Psychophysiology of Emotions" Although psychophysiological techniques have the advantage of not demanding the user's attention or depending on the user's language skills, physiological responses are generally not sensitive enough to distinguish between different types of positive emotions (eg, Ludden, Schifferstein, & Hekkert, 2009; Warrenburg, 2002). Moreover, these measures are generally difficult to implement, they are conducted out of context, and they are invasive, limiting consumer movements, and spontaneity. As a result, it is difficult to take cultural differences into account unless different laboratories are set up in different cultures. More than classic measures therefore need to be investigated to measure physiological emotional responses.

7 Conclusion

Odors and fragrances are strong drivers of emotions and may strongly influence consumer behaviors. In that sense, it is crucial for our industry to better understand how fragrances elicit emotions and how to measure these emotions. We used an original cross-cultural approach to develop a self-reporting model of different feelings and odor scales: GEOS, UniGEOS, and ScentMove. These scales have proven to be practical tools and are routinely used in our industry for commercial fragrances, commercial flavors, ingredient screening, and comparisons based on elicited feelings. Our long-term research program will continue to investigate context and expectations in the modulation of fragrance-elicited feelings, as well as to identify discriminant physiological markers and to explore new behavioral measures. For personal care and home care products, which are similar in terms of performance and valence, consideration of feelings has become a valuable asset in product differentiation (Cardello et al., 2012; Desmet, 2002; Thomson, 2008).

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Emotions Elicited by Foods

18

Silvia C. King[1,2]

[1]McCormick & Co., Inc., Hunt Valley, MD, United States [2]Silvia C. King Consulting LLC, Cincinnati, OH, United States

1 Introduction

The idea of measuring consumer emotions in response to food and food practices sparked in the marketing field but the abundance of approaches used to measure emotions lead to Richins' (1997) review to identify limitations to these approaches. Richins' paper proposed a list of terms that consumers experienced in consumption situations within the realm of marketing. Laros and Steenkamp (2005) further developed a hierarchical model to standardize the lists of emotions. Richins' paper clustered emotions into 16 groups (8 positive and 8 negative); Laros and Steenkamp clustered emotions into eight categories, four positive and four negative, suggesting similarities among some of the emotion terms.

A series of publications in the sensory and consumer field exploded in the late 2000s (Churchill & Behan, 2010; Desmet & Schifferstein, 2008; King & Meiselman, 2010; Porcherot et al., 2010; Thomson, Crocker, & Marketo, 2010). The research focused on developing approaches to measure emotions in response to food and aromatics.

But why measure emotions in response to food? Because food *nourishes the body and soul*. While food delivers nutrients to our bodies, the vast culinary literature might suggest that there are other elements, such as enjoyment and pleasure associated with food. Macht (2008) uncovered a relationship between eating and emotions, suggesting, as an example, that emotions regulate eating, and eating regulates emotions.

Food can elicit a wide range of emotions that can be associated with the food itself, as well as components of the food experience, such as the context in which it is consumed or the memories associated with a particular food (Schifferstein, 2015). This chapter will focus on those emotions associated with foods and the food experience, from purchase to post-consumption, as well as explore commercial applications connecting food-elicited emotions to the brand.

2 Measuring emotions across the food experience

Schifferstein (2010) promotes the idea of incorporating all aspects of the food experience including sensory, product esthetics, product meaning, and emotions to provide a more complete understanding of the consumer experience. In addition to incorporating all aspects of the product, it is important to include the different stages where a consumer might interact with food. Consumer interaction with the food starts at the point of purchase, followed by food preparation, consumption, and post-consumption.

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Emotion research has been conducted at all of these stages (Chang, Lv, Chou, He, & Song, 2014; Muller, Tse, & Venkatasubramaniam, 1991; Schifferstein, Fenko, Desmet, Labbe, & Martin, 2013). While some foods may be experienced through advertisement prior to purchase, the vast majority of food is not advertised; therefore this aspect is not discussed in this chapter.

2.1 Food purchase

While food purchase is an important aspect of the experience, little information has been published in the sensory and consumer field. This area has been studied by the psychology field and put into practice by the marketing field. Emotions experienced in response to food will likely determine which foods are selected at the purchase point. One of the more publicized cases where emotions were used to measure emotional response during purchasing is the soup study. Campbell's Soup (US) conducted a research study to improve soup purchase. This study focused on identifying emotional responses to the package, and subsequently, modifying the package to elicit the appropriate response resulting in increased purchase of the product (The Emotional Quotient of Soup Shopping (2010). *The Wall Street Journal*). Campbell's assumption that their soup elicited "warm feelings" were disproved at the point of purchase, after testing consumers during purchasing and learning that the package was not delivering on those feelings. A key point in this study was the importance of the package imagery and its connection with consumer expectations of the product. Thomson and Crocker's (2015) research emphasized the importance of measuring emotions associated with the product, packaging, and brand. While images were important, so were the messages included in the packaging, impacting consumer's preference for a product (Thomas & Allchurch, 2014). Liao, Corsi, Chrysochou, and Lockshin's (2015) research on emotional response to food packaging compared self-reported emotional response and physiological measures associated with emotions of packaging images, colors, and typeface of the printed message. He concluded that self-reports could be used to measure response to all three aspects of the package, while physiological measures could be used to measure emotions associated with imagery. Liao (2015) proposed a combination of both approaches to gain a more comprehensive understanding of the consumer response to packaging. Schifferstein et al. (2013) measured feelings associated with all aspects of the food experience, including purchase. This research identified visual properties of the food package as the primary driver of the consumer emotional response to the food package, followed by taste (or expected taste), validating some of the findings in the Campbell's study.

2.2 Food preparation

Most foods require some form of preparation, or interaction, prior to consumption. The elicited emotions during this product interaction provide great insights into the consumer experience with the product. Think about a meal prepared at home … think about all the steps required to get that meal to the table. The preparation, for many consumers, is an anticipated part of the food experience. Some foods may require minimal preparation, while others require significant involvement resulting in a sense of pride or frustration.

Food preparation may elicit different emotions depending on the type of preparation, the ingredients involved, and even the occasion for which the food is being prepared. Osdoba, Mann, Redden, and Vickers (2015) studied whether choosing meal components and/or preparing a meal could help reduce individuals' stress and improve mood. Their findings suggested that food preparation versus no food preparation elicited similar responses after a stress-induced situation.

In a different study, McCormick & Co., Inc. (2008, unpublished) tested three levels of food involvement. Consumers prepared one of three variants at home, through a Home Use Test (HUT); a HUT (or home placement test) is a type of consumer test where participants evaluate the product under its normal conditions of use (Meilgaard et al., 2006). Consumers evaluated one of three variants, consisting of different forms of flavor delivery, requiring different levels of interaction with the food. The variants will be described as low, medium and high levels of interaction with the food. Consumers were asked to describe their emotions during the preparation of the food using the EsSense Profile modified for this product category. Comparison of the three variants resulted in differences in emotional response. In the food preparation requiring low interaction, consumers felt more calm, and less worried; when requiring high interaction during preparation, consumers described feeling more adventurous and excited; with the intermediate level of interaction, consumers described feeling more comforted, relaxed and satisfied (Table 18.1).

In a different study, Schifferstein et al. (2013) evaluated the food preparation of a dehydrated product, identifying the sense of smell as the most important contributor with a strong emotional response described as satisfied and pleasantly surprised. Capturing emotional response during food preparation may provide a better understanding of the consumer experience with the product as well as direction on how to improve not only the product characteristics but optimize the preparation to deliver an overall optimal experience for the consumer.

Table 18.1 This table presents the results from HUTs where consumers tested one of three products at home

Preparation	Low interaction	Medium interaction	High interaction
Strongest	Calm	Comforted	Adventurous
	Casual	Indulgent	Excited
	Interested	Pleasure	Interested
	Trustworthy	Relaxed	
	Worry free	Satisfied	
Weakest	Adventurous	Casual	Calm
	Comforted	Excited	Comforted
	Indulgent	Interested	Indulgent
	Pleasure		Relaxed
			Worry free

The products were described as low, medium and high interaction based on the level of preparation required for each product. The emotions are categorized as strongest or weakest, based on the intensity of each emotion in relation to other emotions rated for the same product.

2.3 Consumption

While purchase and preparation/interaction are important to the food experience, food consumption and/or sensory characteristics of the food have been the primary area of focus for the food industry (Cardello et al., 2012; Desmet & Schifferstein, 2008; Jaeger & Hedderley, 2013; King & Meiselman, 2010; Ng & Hort, 2013a; Spinelli, Masi, Dinnella, Zoboli, & Monteleone, 2014). Central location tests (CLTs) have been used most often when measuring emotions with food; CLTs are consumer tests usually conducted in an area where consumers congregate or can be assembled (Meilgaard et al., 2006). However, HUTs, where consumers evaluate products at home, are also used. A key difference in the execution of CLTs and HUTs is that in a CLT format, consumers of the product typically evaluate small portions of one or more foods and rate the emotional response in relation to each food, while in a HUT, consumers typically consume full portions of the product in combination with other foods/beverages, if applicable, under close to normal consumption conditions. This difference, in itself, may have a profound impact on the emotional response to the food.

Desmet and Schifferstein (2008) proposed five sources of emotions associated with food consumption: sensory attributes (amused, pleasant, bored, disgusted), experienced consequences (relieved, stimulated, disappointed, dissatisfied), anticipated consequences (hope, afraid, desire, unpleasant), personal or cultural meaning (love, amused, hope, bored), and actions of associated agents (angry, contempt, ashamed, proud).

King and Meiselman (2010) described the approach taken to develop an emotion questionnaire for foods. This questionnaire, the EsSense Profile, contains a list of 39 emotions. This questionnaire was applied to different testing approaches (CLTs, HUTs, and Internet surveys) and different foods and food categories to evaluate the ability of the questionnaire to capture product differences, within and between food categories.

Cardello et al. (2012) and Jaeger and Hedderley (2013) used EsSense Profile to compare responses to food names versus actual consumption of the same food. Both research studies resulted in a stronger emotional response to the name of the food, however, the emotion profile pattern comparing the name of the food versus consuming the food was similar.

Ng, Chaya, and Hort (2013a) identified a two-dimensional structure in response to foods: pleasantness versus engagement/activation (Fig. 18.1); these dimensions were consistent whether consumers rated the foods using the EsSense Profile or consumer-generated emotion terms; these dimensions can also be described as positive affect and sensation-seeking dimensions based on the Multiple Affect Adjective Check List-Revised (MAACL-R by Zuckerman & Lubin, 1985). Ng, Chaya, and Hort (2013b) also found that emotion differentiated the various formulations of fruit squash better than hedonic scores (overall acceptability).

Furthermore, by combining preparation and consumption emotion data, we can gain a deeper level of understanding of the food experience as shown in the next example. Results from the McCormick study presented in Section 2.2 were combined with consumption results for the same three variants. Results of these studies indicated that the overall emotional response was significantly higher during consumption versus preparation; 20 emotion terms scored significantly higher during consumption

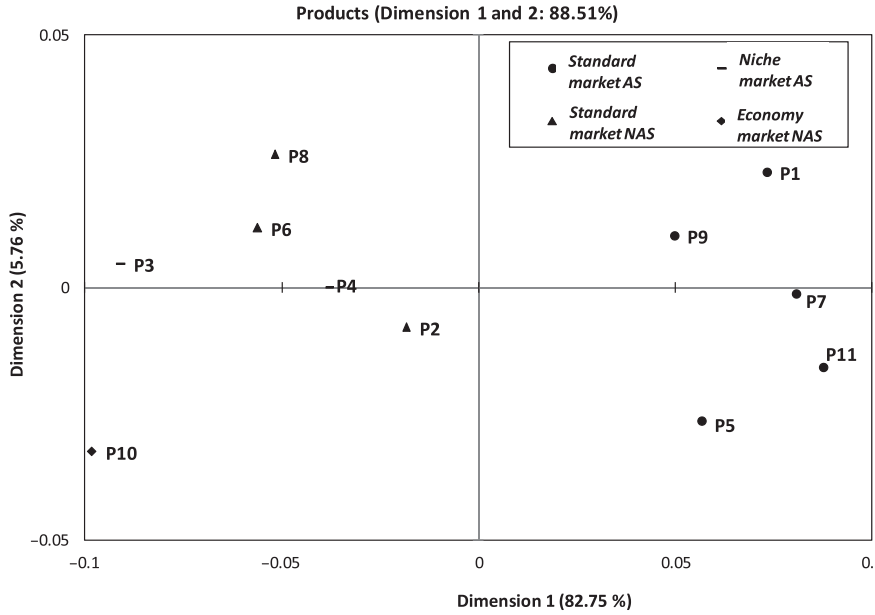


Figure 18.1 PCA analysis product plot (PC1 vs PC2) obtained from EsSense Profile PCA based on the evaluation of 11 samples. PCA1 describes emotions associated with pleasantness or positive affect; PCA2 describes emotions associated with engagement/activation or sensation seeking.
Source: Ng et al. (2013a).

versus food preparation; the differences included terms like adventurous, calm, comforted, relaxed, and satisfied. These data might suggest that food consumption may elicit a stronger emotional response than food preparation, at least for these types of products. In addition, there were some similarities between the two stages, preparation and consumption. These similarities included terms like confident, enthusiastic, and sociable; these results are important in that they help identify those core emotions that are consistent to the consumer experience with this product and may be used to better define or strengthen the product image. In addition, many of the emotions that differentiated the three variants during preparation, also differentiated the products during consumption, suggesting these emotions are key differentiators of the variants and should be further compared to the brand image to determine which emotions better resonate with the category/brand.

2.4 Post-consumption

The psychology field in relation to eating disorders has more extensively studied the emotions associated by post-consumption.

Dubé, LeBel, and Lu (2005) compared the emotional triggers for comfort foods and uncovered an affect asymmetry driven by three demographics (gender, age, and

Table 18.2 This table presents immediate (1/2 hour) and delayed (24 hour) emotion responses after consuming biscuits with varying levels of hedonic and utilitarian benefits

Products	Emotions	Correlation between arousal and emotions	Immediate mean (SD)	Half-hour delay mean (SD)	24-hour delay mean (SD)	F
SH	Excitement	0.70[b]	5.47 (1.01)	6.00 (0.74)	6.53 (0.63)	13.04[c]
	Cheerfulness	0.64[b]	5.30 (0.88)	5.93 (0.78)	6.43 (0.68)	15.73[c]
SU	Security	−0.13[a]	5.50 (1.17)	4.77 (1.25)	4.03 (1.07)	11.91[c]
	Confidence	−0.11[a]	5.37 (0.93)	4.63 (1.21)	3.97 (1.00)	13.21[c]
IH	Dissatisfaction	−0.35[b]	5.43 (1.14)	4.43 (0.90)	3.83 (0.83)	21.08[c]
IU	Anger	−0.23[b]	5.27 (0.78)	5.80 (0.85)	6.33 (0.84)	12.51[c]

[a] $P < 0.05$.
[b] $P < 0.01$.
[c] $P < 0.001$.
Source: Chang et al. (2014).

culture). For example, males associated positive emotions with comfort foods while females associated negative emotions with these foods. Food consumption alleviated the negative emotions in females, however, females felt guilty post-consumption.

Chang et al. (2014) compared immediate and post-consumption emotions in association with cell phones as well as food. Food measures were taken during consumption and 24 hour after consumption. The authors' findings suggested that emotions, combined with hedonic responses (product acceptability) may be used as an indicator of product success and product loyalty (Table 18.2). Additional research is merited as a way to predict changes in the food experience over time but more importantly, the impact emotions might have on repeat purchase.

3 Commercial applications of emotion testing

If we use the definition that an emotion is a direct response to a stimulus, we can then measure emotional response to all aspects of the food experience, from purchase to post-consumption as already described. Additionally, we can use emotion methodology to capture responses to the food that have commercial applications.

3.1 Food name

Emotions can be studied in response to a food name, which is a reflection of the consumer's memory of the food, past experience and/or expected experience with the food (Cardello et al., 2012; Jaeger & Hedderley, 2013; King & Meiselman, 2010).

Cardello et al. (2012) noted that the intensity of the emotions was stronger when reporting about the food name than when eating the food (Fig. 18.2). An interesting

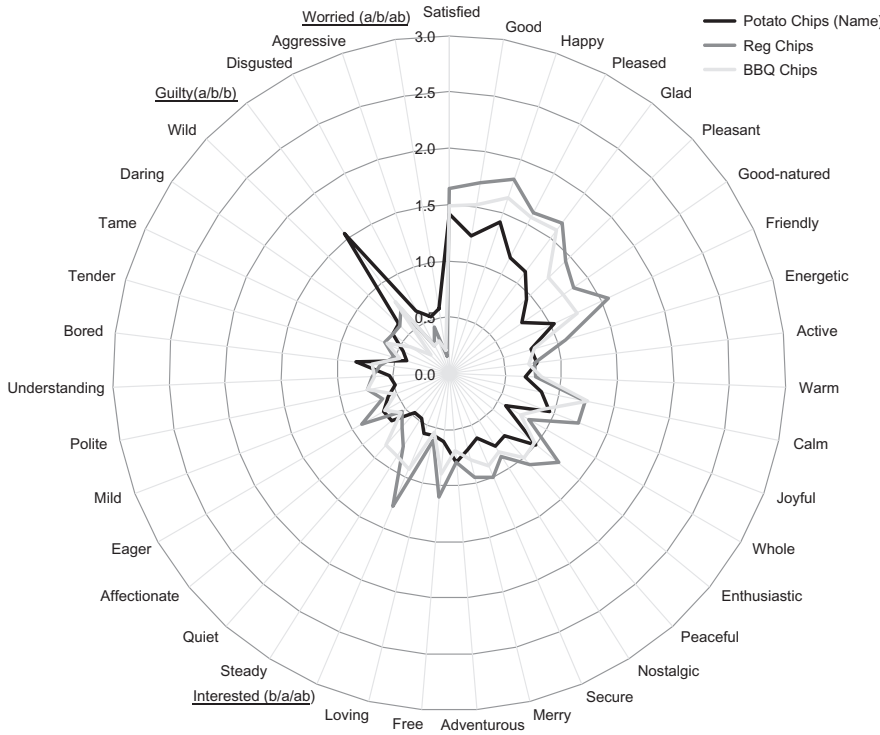


Figure 18.2 This spider chart presents the emotion's average intensity for each product, either based on name of the product, that is, potato chips, or taste of the product, that is, regular potato chips and BBQ chips. The average intensity is the distance from the center of the chart to each intercepted point in the line scale represented by the distance from the center to each emotion term.
Source: Cardello et al. (2012).

finding in the case of the product name (potato chips) is the increased feeling of guilt when rating the name of the product, which was lower when eating the product. These results imply that the emotions associated with the food name include other aspects of the imagined eating experience, while emotions when eating the product may focus primarily on the food.

Another study by King, Meiselman, and Carr (2010) compared two approaches for collecting emotion data: evaluating a product name (internet survey) versus tasting the food (CLT). Compared to the internet survey of the product's name, the CLT tasting the food elicited stronger emotions like bored, peaceful, pleased, and satisfied; it was hypothesized that the term bored may have been a reflection of the test format and waiting period between product tastings, rather than an emotion elicited by the product; peaceful, pleased, and satisfied were elicited by the product itself and specifically by the act of consuming the products. These results were consistent with Desmet and Schifferstein's (2013) work on emotional response to the food. The results of the Internet survey resulted in a stronger *loving* response for the products, probably due

to the consumer's idealized image of the food product. Testing product names may be used as a way to understand product image and consumer expectations of the food, while tasting the food can be used to understand the food composition and its impact on the consumer response.

3.2 Food category

Products within a food category, like different types of desserts, may elicit different emotional responses. Understanding the emotional landscape of a product category can be used to: (1) identify new product opportunities, (2) differentiate brands within category, and/or (3) guide product development efforts.

Spinelli et al. (2014) differentiated the emotions elicited by different commercial hazelnut spreads available in the Italian market (Fig. 18.3). In this study product G elicited the strongest positive emotional response with terms like curious, energetic, and satisfied. Product E elicited stronger negative emotions with terms like indifferent, bored, and disappointed. The information collected helped understand the

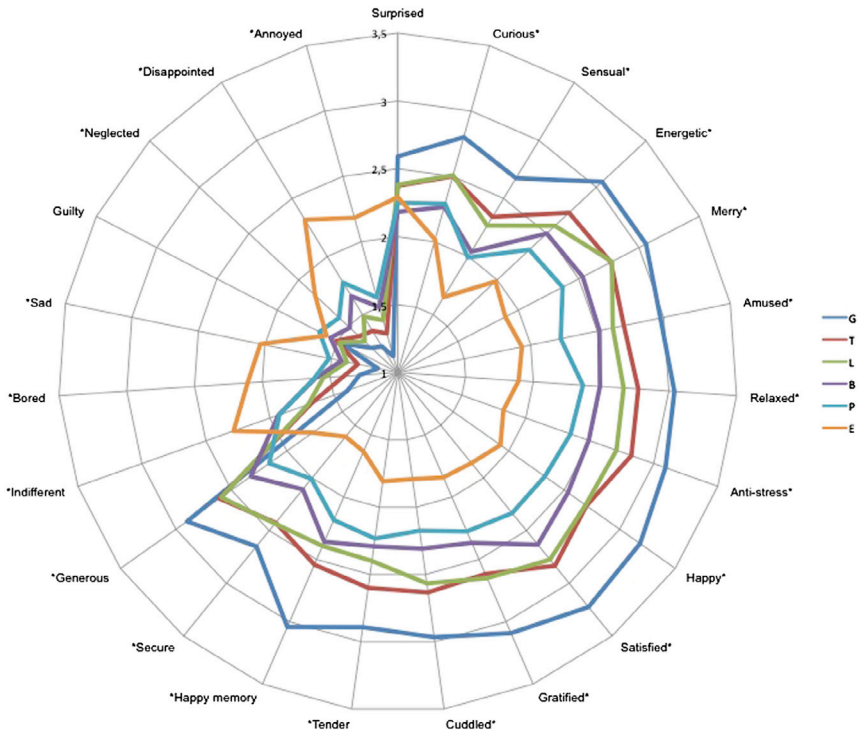


Figure 18.3 This spider chart compares the mean emotional responses to six products using the EmoSemio emotion questionnaire. The average intensity is the distance from the center of the chart to each intercepted point in the line scale represented by the distance from the center to each emotion term.
Source: Spinelli et al. (2014).

differences across brands and formulations within the category landscape. These data in combination with hedonic ratings (overall acceptability) were used to identify the consumers' preferred emotion profile.

A similar study was conducted by McCormick & Co., Inc. and presented by King (2011). The study compared consumer emotions toward products within a cooking sauce category. The sauces were evaluated using two approaches: (1) Internet survey, used to measure the emotions elicited by the name of the different sauces; the name consisted of the brand name and flavor description for each sauce and (2) CLT, used to measure the emotions elicited by the various sauces during consumption; the sauces were prepared according to package directions; the samples were identified using the flavor description only. The sauces were differentiated based on the emotions elicited by the name as well as the emotions elicited by tasting the sauces. The results of both the Internet study and the CLT study provided an understanding of the impact the sensory characteristics of each product had on the emotional response. It also demonstrated the impact the brand name had on consumer's emotional expectations of the products (Fig. 18.4).

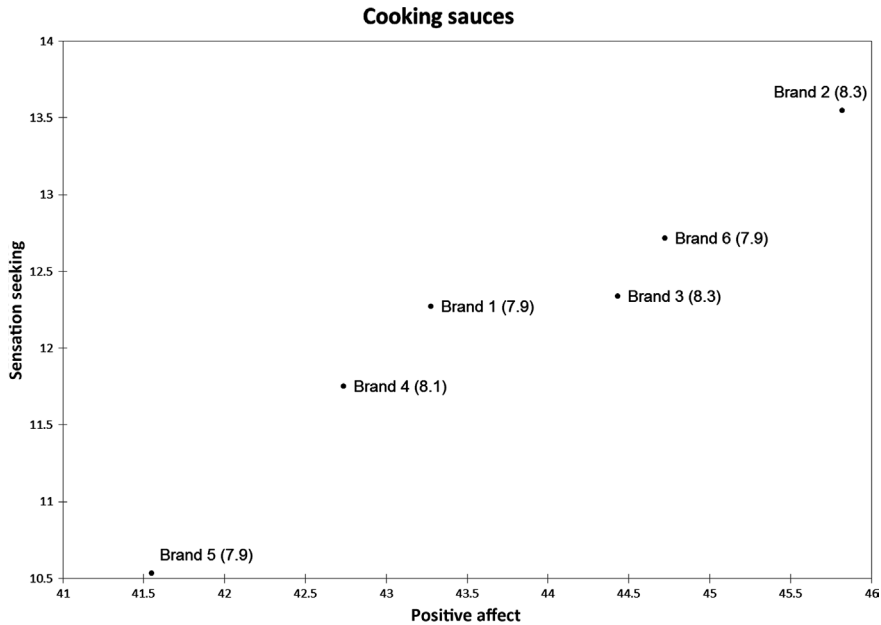


Figure 18.4 This chart presents a two-dimensional plot obtained from data collected using the EsSense Profile emotion questionnaire. Emotions were grouped using the criteria presented in the revised version of the Multiple Affect Adjective Check List developed by Zuccherman and Lubin in 1965 (MACCL-R): Positive affect and sensation-seeking emotions. The data displayed are composed of the total positive affect score (*X* axis) and total sensation seeking score (*Y* axis) for each of the cooking sauces. Average acceptability for each sauce is presented in parentheses next to each product label.

Fig. 18.4 grouped the two primary dimensions of emotions included in the EsSense Profile (King & Meiselman, 2010): positive affect/valence and sensation-seeking/arousal dimensions. The acceptability of the products (number next to product name) tended to increase with the increase of both emotion dimensions. The results of this study would suggest that both emotion dimensions (positive affect and sensation-seeking) are important to the success of this product.

3.3 Product formulation

One of the most practical applications of emotion testing in the food industry is in its application throughout the product development cycle. Emotion testing may be applied to product improvement projects (ie, the improved product is better than the current product) and cost-optimization (associated with cost reduction of ingredients or overall formula). Emotion tests may be used to detect small ingredient changes in formulation as shown by King and Meiselman (2010); in combination with hedonic response, emotions can help identify whether the changes result in a positive or negative outcome for the product under formulation.

The literature is limited in this area of application since most companies might use this information internally to provide technical insulation or a technical advantage against other competitors in the market. Understanding the relationship between product formulations and emotions can be a pivotal application for the food industry.

King and Carr (2010) presented a commercial application where product similarity was the desired outcome. Twenty-nine consumer test evaluations were conducted to identify potential product formulations resulting in similarity when compared to the current market formula. Product similarity was defined by similar hedonic response (overall acceptability) and key diagnostic questions, such as just-about-right (JAR) scales measuring specific sensory attributes like flavor, texture, or appearance associated with the product. Results from this study indicated that 17 tests resulted in similar overall acceptability response; of those tests, only 3 resulted in similar emotional responses. This is a case where emotions provided incremental information about the products and helped make business decisions with a lower risk of consumer rejection.

Emotion testing on food may also be applied to the development and/or maintenance of market leaders. Market leaders in a food category tend to be copied by competitors over time, with the intent of taking a portion of the market share. In some cases, market leaders may be optimized to ensure continued market leadership. In this type of application, emotions provide incremental understanding of the product itself and versus the competition. This continued improvement approach can be used to create market dominance based on overall product acceptability as well as emotional consumer response.

Food product improvements vary across companies but are generally driven by a significant increase in overall acceptability and/or preference. Emotion data can be used in combination with these data to provide a more complete analysis of the products, resulting in better product understanding and better business decisions; for example, if a product is well liked but the emotions associated with the product are

not consistent with consumer's expectation for the same product, the business may decide to modify the product characteristics to better deliver on those consumer emotional expectations.

3.4 Emotional response to the brand

There are different elements of the food to be considered during a consumer test, such as whether the food is presented branded or unbranded; for example, samples in a CLT may be presented using the product and brand name, that is, *My brand beverage XXX*, or presented unbranded, that is, *beverage XXX*.

We need to consider that most foods are sold branded, from produce to prepared food items. The brand name provides a strong identity or connection with the consumer, facilitating product recognition.

Strong brands are intimately associated with the emotional identity of the product (Thomson & Crocker, 2015). A study by Spinelli et al. (2015) compared the differences in emotional response to branded (informed condition), and unbranded (blind condition) products (Fig. 18.5). This study recommends using both approaches, collecting data branded and unbranded, to gain better understanding of the emotional drivers for the product; the blind condition uncovers emotional response to the product formulation, while the informed condition uncovers the impact (or bias) the brand has on the overall product.

A caveat on these types of studies is that, while some products may lend themselves to be tested without a brand name, some products have a strong brand loyalty and are quickly recognized by their consumer, either based on packaging, shape, flavor, etc. The assumption that consumers do not recognize their favorite brand in an unbranded test situation may be misleading; these results could contain both brand and product emotional response, when only product response data are expected. While testing unbranded and branded products, testing branded products ultimately results in a more holistic emotional response to the product, which is closer to a real-life situation.

3.5 Emotional response to the context or situation

Food is consumed under a variety of contexts or situations. The impact of contextual situations on emotional response has been investigated by testing the product in actual situations. Porcherot, Petit, Giboreau, Gaudreau, and Cayeux (2015) conducted a study in a restaurant where different aperitifs were evaluated in the context of a meal situation. This study resulted in differences between the flavored aperitifs based on familiarity and appropriateness for the situation.

The work by Piqueras-Fiszman and Jaeger (2014) demonstrated the impact that food-appropriate situations have on emotional response to food.

While eliciting specific situations or appropriate occasions can provide additional information on the products tested, a simpler, more generic approach for eliciting situations/contexts can provide increased sensitivity in consumer response to the products, specifically, on the emotional response to the product.

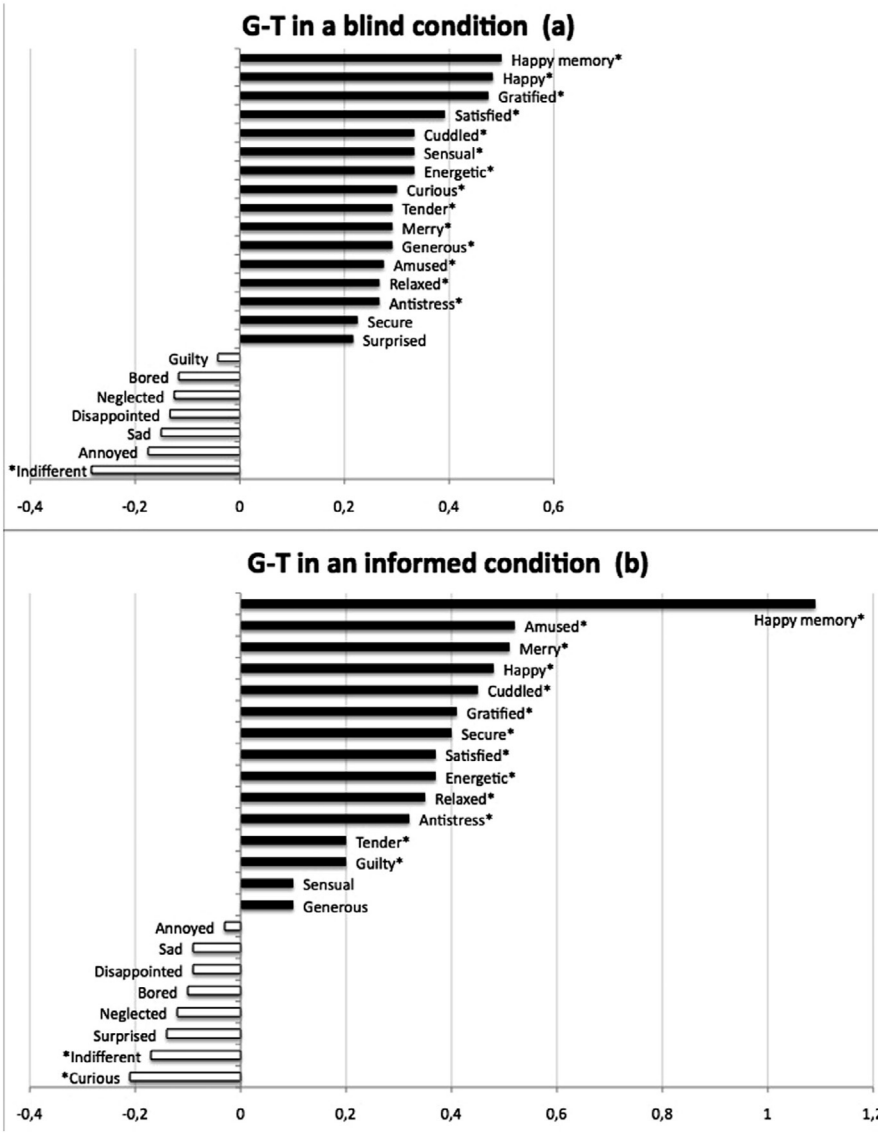


Figure 18.5 Differences in emotions between two products labeled G and T tested using two approaches. In the blind condition where samples were presented unbranded, and informed condition, where samples were presented branded. Significant differences for *P* values equal to or less than 0.05.
Source: Spinelli et al. (2015).

A consumer study (unpublished study by McCormick & Co., Inc.) was conducted using a generic context where consumers were asked to "*think of the last time they consumed the product*" under evaluation. The product consisted of a traditional US sauce used to accompany foods. Consumers evaluated two variants of the product using a questionnaire that included hedonic questions, such as overall liking, emotions, using the EsSense Profile and JAR scale questions of various sensory characteristics of the product. Two separate CLTs were conducted with different consumers. In the first test consumers completed the questionnaire without any elicited context (no context); in the second test consumers completed the same questionnaire, but prior to evaluating each product, they were instructed to think about the last time they ate the product (context). The emotion results observed when comparing both tests suggested a stronger emotional response and greater differentiation between the variants when the generic context was included in the test; specifically, only two emotions differentiated the products with no context, while six emotions were used to differentiate the products when a context was described. The use of context in a CLT situation appears to provide a common ground for consumers to evaluate the product, resulting in greater differences and better consistency in the results. Additional research is still needed to fully understand how eliciting context in consumer test situations like CLTs impacts emotional response.

4 Caveats of measuring emotions elicited by foods and food experience

4.1 Negative emotions associated with food

Richins (1997), Laros and Steenkamp (2005), Desmet and Schifferstein (2008), King and Meiselman (2010), and Manzocco (2013), concluded that foods typically elicit positive emotions. Even when evaluating products that are not well liked, consumers tend to use negative emotions sparingly (King & Meiselman, 2010; Fig. 18.6a). The use of negative emotions may vary by culture, gender, etc., as demonstrated by Manzocco, Rumignani, and Lagazio (2013); least favorite foods tended to be rated more negatively by Italians (Fig. 18.6b) compared to the US study (Fig. 18.6a).

Current questionnaires vary in their use of negative emotions; while some prefer to use a balanced number of positive and negative emotions (Desmet & Schifferstein, 2008); some limit the use of negative terms to just a few (King & Meiselman, 2010). The number of negative emotions in a questionnaire may depend on the purpose of the research; traditional consumer tests with consumers of a product may not benefit from the use of many negative terms since consumers typically rate any negative emotions very low ("not at all" in a 5-point rating scale—King & Meiselman, 2010). However, there are opportunities to increase the number of negative emotions in a questionnaire when the products being tested are new to the respondent or vary widely from the current market product.

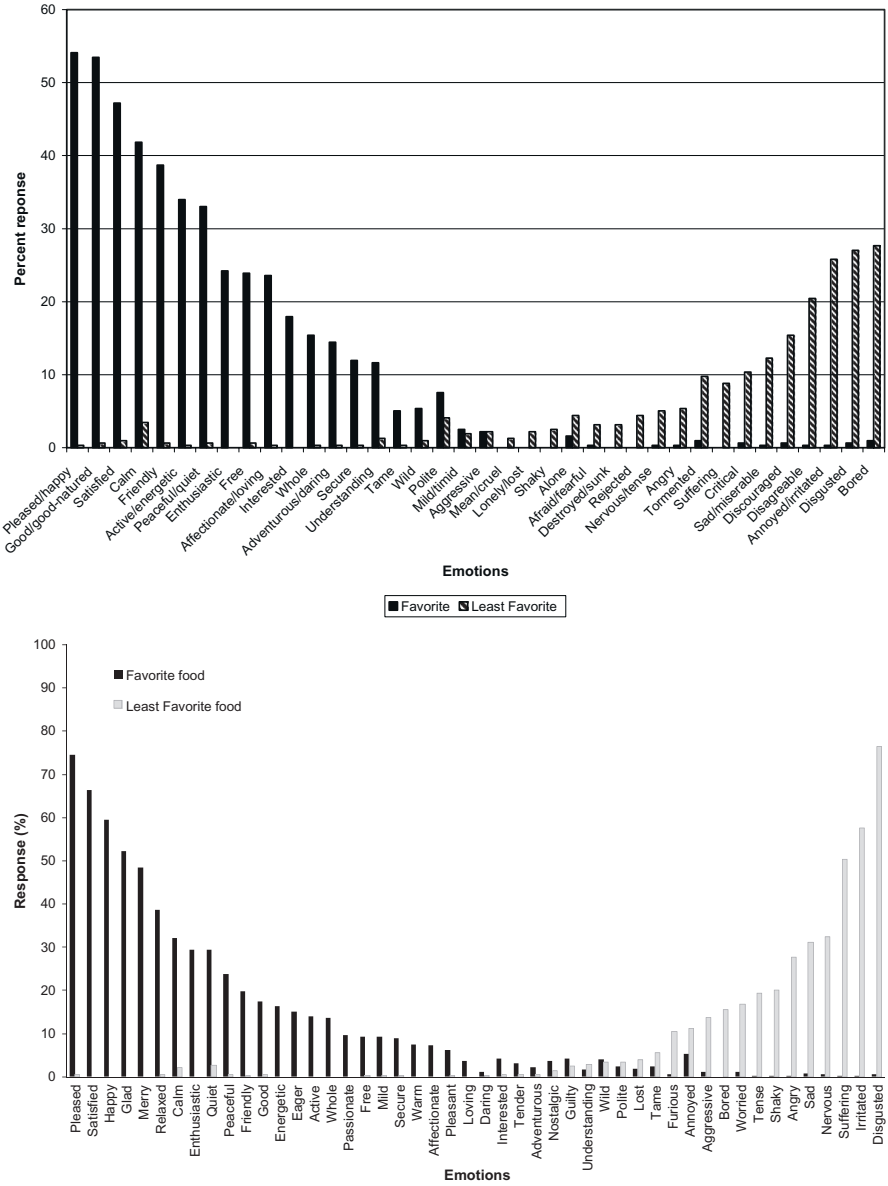


Figure 18.6 (a) Mean frequency of emotion terms describing individual favorite and least favorite foods collected with US participants ($n = 105$). *Source:* King and Meiselman (2010). (b) Mean frequency of emotion terms describing individual favorite and least favorite foods collected with Italian participants ($n = 400$).
Source: Manzocco et al. (2013).

While the use of negative emotions may be somewhat limited, at least for the US market, it may still offer valuable information on how consumers feel about the products, by capturing the absence of negative response to a product.

4.2 New market category or new product testing

Foods elicit emotions based on prior exposure or familiarity with the food. What happens when we want to test a new product category or food? Respondents' ability to associate emotions with a new product will be limited, based primarily on past knowledge and experience; therefore, initial emotion response may be weak at best. It is important to provide respondents with as much information as possible about the product and context associated with a product to provide some emotional connection and possibly elicit emotions associated with the product.

Kuenzel et al. (2010) evaluated familiar flavors and novel flavors of fruit drinks while viewing films associated with joy, contentment, or no emotion. This study found that familiar flavors elicited consistent responses regardless of the type of film viewed during consumption, while the emotional response to the novel flavors was biased with the type of film shown. These results further suggest that novel products/flavors do not have an emotional profile attached to them. In order to generate emotional response to these novel products, additional elements need to be incorporated, such as providing consumers with product concepts that describe the context or situation and any key elements associated with the product to aid in the emotional evaluation and connection with such product.

4.3 Demographics

Consumers are typically recruited based on specific demographic requirements associated with the product. The emotional response can vary across the demographic groups included in the test. For example, different genders or age groups may respond differently to the products. These differences provide additional understanding on how the experience with the product varies across demographic groups. For example, a product marketed for mass appeal, should be equally engaging emotionally to both genders. King et al. (2010) identified key differences in the relationship between acceptability and emotions when comparing gender response; males associated overall acceptability with two emotions, satisfied and a lack of disgusted, while females associated acceptability with 25 positive emotions, including joyful, good, happy, pleasant and a lack of disgusted; the remaining 14 emotions expressed other aspects of the food experience.

A key factor in consumer testing is the frequency of product consumption, typically categorized into heavy users and light users as well as non-users in some cases. King and Meiselman (2010) uncovered differences in emotional response based on how frequently consumers use the product under evaluation; frequency of consumption was directly correlated to intensity of emotional response, that is, heavy users of a product rated the intensity of the many of the positive emotions higher while light users rated the intensity lower (Fig. 18.7). It should be noted that very low frequencies

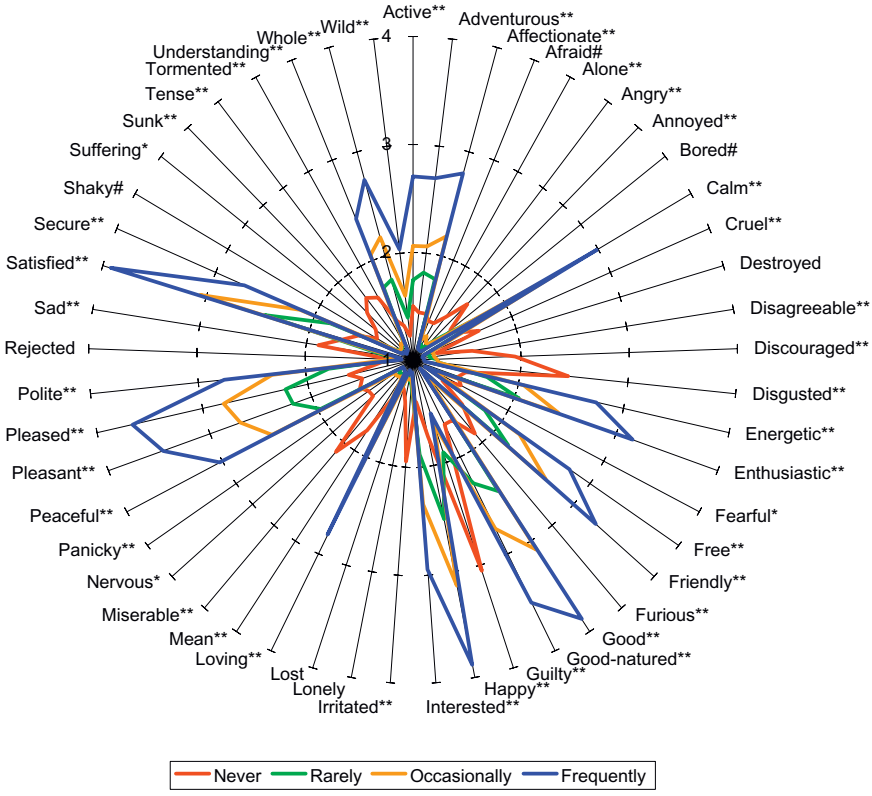


Figure 18.7 This spider chart presents the effect of frequency of use on emotion response. Consumer profiles averaged over five different products (pizza, mashed potatoes and gravy, vanilla ice cream, fried chicken, and chocolate). Non-users (shown in red) have a different and more negative emotional profile than users. Frequent users (blue) have the strongest positive emotions. Emotions were measured using the full list of emotions prior to the EsSense Profile. #, *, ** Indicate a significant difference at $P \leq 0.10, 0.05, 0.01$, respectively.
Source: King and Meiselman (2010).

otherwise described as non-product users, typically rated emotions very low, but had a tendency to rate negative emotions, such as bored and disgusted, higher compared to product users.

5 Summary

This chapter discussed the application that emotion data have in understanding the consumer food experience. It presented studies that help assess consumer emotions at different stages of the food experience, from purchase to post-consumption. It is clear that the consumer food experience is complex and it encompasses many aspects

in addition to overall acceptability and emotions. Schifferstein (2015) offered a more encompassing approach where emotions are only a part of the total experience being measured, suggesting than other components are necessary to create a successful product. This section offered a different approached to collect consumer emotion data elicited by food and their applications in the commercial sector.

Emotion research may be applied in the academic and commercial fields to better understand the drivers of food consumption and create better, healthier foods for consumers. The field of emotion research with food is a relatively new area of consumer research and more work is needed to understand the relationship of food and emotions, but more importantly, to understand the role that emotion data plays in food consumption and ultimately market success.

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Emotion in Beverages

19

Hannelize van Zyl
Heineken, Zoeterwoude, The Netherlands

1 Introduction

The emotional benefit derived from beverages finds one of its best examples in the relationship that the British—or those of strong British heritage—have with tea. In these cultures there are few emotional upheavals that are not swiftly followed by: "Let me make you a cup of tea." Indeed, the comforting effect of tea is sought after on a daily basis by many from these cultures and at any moment in the day. Twinings captured this emotional benefit perfectly in their slogan "Gets you back to you" for their 2013–14 advertising campaign (Fig. 19.1). The full versions of the campaign can be viewed at the following links: https://youtu.be/lvQp4G_x7ig and https://youtu.be/ChxzFDi2nWg. This also captures an important aspect of the dual concept of refreshment. It is all too easy to confuse the physical benefit of thirst quenching with the emotional benefit of refreshment which can be achieved equally well by tea, whisky, beer, or water, depending not only on the beverage itself, but on the person consuming it, the events preceding it, and the context in which it is consumed. In beverages, perhaps more than in other products, we find that negative emotions are important to investigate, not because we study products that are disliked, but because beverages have the benefit of reducing negative feelings or emotions and making people feel better. However, this effect seems not to be universal, and differences between cultures can be observed. While the word emotion is used throughout this chapter due to references to previous work by other researchers, it is the feeling component of emotion as described in the chapter "Emotions of Odors and Personal and HomeCare Products" in this book which is most relevant in the context of studying beverages.

This chapter will explore several aspects of emotions related to beverages. It starts with a look at the reasons to study such emotions, with a section particularly dedicated to negative emotions. The next section describes how cultural differences influence those reasons, followed by a section on the importance of the context in which emotions and beverages are studied. The next part of the chapter deals with the practical aspects of studying emotions in beverages, including how the size of the difference between products determines the choice of method. Three types of methods (facial recognition, physiological response and verbal methods) are discussed in subsections. The chapter concludes with thoughts on practical aspects for studying emotions related to beverages.

Throughout the chapter, reference is made to many researchers' work in this area. In some cases individual studies are discussed in more detail in order to illustrate a particular point.

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Figure 19.1 Twinings' 2013 and 2014 "Gets you back to you" campaign.

2 Why study emotions related to beverages

Wine has long been thought to have an effect on emotions. In "Laws" Plato wrote that wine makes people cheerful and hopeful, that it intensifies emotion, and results in a lack of fear. He wrote that wine rejuvenates older people by softening and cheering them, making them less ashamed and bolder (Belfiore, 1986). Both the reasons why people consume beverages and the way they are advertised give us an insight into why it is important to study emotions related to beverages and how that information can be used in product development and marketing.

Charters and Pettigrew (2008) summarize other researchers' findings regarding why people drink alcoholic beverages as mainly related to taste and food pairing, being sociable, and the combined reasons of relaxation and mood alteration. In their own qualitative study on why Australian consumers drink wine, they found that the main reason was enjoyment of the taste and respondents' feelings as a result. They also found that the sensory pleasure was linked to relaxation and thus to unwinding and increased calmness.

Many beverage advertisements invest in emotional content to sell their product. Coca Cola has good examples in both their "Open Happiness" campaign and in the video advertisement for Coca Cola Life: https://www.youtube.com/watch?v=4sNlcwAh83Y. In studying the emotions associated with a wine purchasing or consumption experience by way of narrative texts from 140 respondents, Mora and Mascarola (2010) concluded that advertising messages for wine should center round the emotions consumers are likely to experience as a result of the product and brand rather than the brand's personality.

In a world of numerous highly liked products, emotions provide additional differentiation between products (Desmet & Schifferstein, 2008; Dorado, Picard,

Pérez-Hugalde, & Chaya, 2015; King & Meiselman, 2010; Köster, 2009; Ng, Chaya, & Hort, 2013a). This insight can be leveraged to win in an increasingly competitive market (Ferrarini et al., 2010).

The benefit of studying emotions or affective terms as part of the product development process lies in how it lends itself to creating a product which best fits the emotional benefit that it is expected to have based on its advertising, brand and packaging. If it is possible to ensure congruence, expectations are confirmed and repeat purchase is more likely. Chaya, Pacoud, Ng, Fenton, and Hort (2015a) concluded that evaluating both the beverage and the packaging was necessary to aid the development process as impacted by the emotional signature of beer, while Ng, Chaya, and Hort (2013b) found that emotions were related to the flavor of blackcurrant squash itself and conceptual attributes to the packaging of blackcurrant squash. Slater (2014) wrote in the UC Davis Graduate School of Management blog feature that packaging is about creating an emotional experience with the consumer in order to tell a story, rather than only about form and function, while Thomson and Crocker (2013) focus on the importance of evaluating the emotional and conceptual impact of product, packaging, brand, and advertising together.

Chaya et al. (2015a) gave a good example of this. They studied the emotional response of 90 respondents to 10 lager beers, some of which were familiar to consumers and some of which were unfamiliar. Respondents were asked to score their hedonic response (overall liking) followed by their emotional response related to 39 terms according to the EsSense Profile methodology (King & Meiselman, 2010). The evaluations were completed in three separate sessions; first for the unbranded products, then for the packaging alone, and finally for the product with the packaging (informed condition). While for some beers the sensory attributes were the most influential in driving emotional response, packaging cues were in general more important in determining where a product fell within the emotional space. They showed that the position of the product in the informed condition, which is how consumers normally consume products, is closer to that of the packaging alone, compared to that of the product in blind condition. This result is contrary to the findings of Ng et al. (2013b), where the sensory characteristics of blackcurrant squashes affected the emotional response more than the extrinsic characteristics of the product, which in turn affected functional conceptualizations. This difference in findings might suggest that beer packaging has a higher emotional impact than blackcurrant squash packaging and that one cannot assume that what is true for one beverage type also follows for another. Chaya et al. (2015a) suggest that, in order to optimize products in the beer industry, it would make sense for the sensory properties of the product to be congruent with the emotional response evoked by the packaging.

2.1 Negative emotions

One of the emotional benefits of beverages is the amelioration of negative emotions. In a study by van Zyl and Meiselman (2015), and a subsequent follow-up study, respondents from most of the eight countries studied (UK, USA, Australia, New Zealand, Spain, Mexico, Portugal, and Brazil) indicated that their favorite beverage "makes me feel less like that" for a list of negative emotions. Fewer respondents from

Table 19.1 Percentage of respondents from each country who indicated that their favorite beverage made them feel less like each of the negative emotions

	Afraid	Disappointed	Irritated	Stressed	Troubled
Favorite beverages with alcohol					
UK	54	56	56	63	55
USA	52	53	57	59	54
Australia	51	54	54	60	55
New Zealand	50	52	52	59	52
Brazil	36	33	40	43	32
Portugal	36	36	43	54	36
Mexico	43	39	48	58	44
Spain	25	27	26	28	26
Favorite beverages without alcohol					
UK	31	34	38	40	38
USA	31	36	36	43	38
Australia	39	45	48	56	47
New Zealand	37	37	43	51	42
Brazil	19	18	20	27	17
Portugal	18	25	34	42	26
Mexico	27	29	35	45	38
Spain	12	11	11	17	13

Spain reported such an effect. Some examples of negative emotions and the differences between countries are summarized in Table 19.1. At the end of a busy and stressful day consumers may choose a beverage that reduces their feelings of stress and frustration and makes them feel more relaxed. The choice of beverage might be different at the end of a week when a higher level of de-stressing is expected. This presents us with a unique challenge in the discipline of measuring emotions as it is even more difficult to measure the disappearance of an emotion than one that arrives or increases as a result of a product a respondent is consuming. The most obvious solution is of course to measure emotions both before and after the product experience and then to calculate the difference, as reported by Hartwell, Edwards, and Brown (2013).

One relatively recent development is the use of the Temporal Dominance of Emotions method (Jager et al., 2014). While it was not designed with negative emotions in mind, it seems like a feasible solution for measuring changes in emotions without having to complete two questionnaires. The study was successful in indicating the sensory drivers of emotions for different types of chocolate. The limiting factor here, as is the case with TDS, is that one has to limit the number of emotions to 8 or 10. This implies at least some advance work to study which emotions are the most pertinent. However, this can also be seen as beneficial as a shorter list of emotions is presumed by some to make the task easier for respondents.

3 Cultural differences

Just as the type of product determines the emotion list used to evaluate the product, so culture is also an important consideration. For more detail on how culture affects the study of emotions, please see the chapter "Different Ways of Measuring Emotions Cross-Culturally." The use of emotion words and dimensions and their meanings differ by language and culture, which allows the sharing of subjective feelings (Ferrarini et al., 2010). This is further explained in the chapter "Translatability of Emotions." Our cultural heritage does not only determine the type of products we are familiar with and learn to like but also the emotional connection that we have with those products. Wine is an example of one such product. In France, Italy, Spain, and Portugal, wine is part of everyday life and an inherent part of the cultural heritage. Consumers from these countries expect wine to be part of the meal and an integral part of conviviality. In some other countries on the other hand, wine might be seen as a way of reducing stress or inducing a positive emotion.

Mouret, Lo Monaco, Urdapiletta, and Parr (2013) found differences between French and New Zealand respondents in terms of their social representations of wine. French respondents associated wine with vines and terroir, and thereby its origin and identity, but also with consumption in a meal context and as a result conviviality and sharing with friends. New Zealand respondents on the other hand characterized wine in terms of work and passion, enjoyment, fun and relaxation, also with friends.

This difference between cultures can also be seen in a study by van Zyl and Meiselman (2015) which studied respondents' emotional reactions to their favorite beverage, including all beverages. Respondents from Spain showed less emotional involvement with all beverage types (beer, wine, spirits, cold beverages without alcohol, and hot beverages without alcohol) than respondents from English-speaking countries or Mexico. In a large quantitative study respondents were asked to imagine having their favorite beverage and to indicate whether a list of emotion terms were applicable to that beverage, either by making them feel more like that or less like that or whether the terms were not applicable. Respondents from Spain chose the "not applicable" option more often than respondents from English-speaking countries or Mexico. The study was repeated in Portugal and Brazil and it became clear that respondents from Portugal showed a similar reduced emotional involvement with wine to respondents from Spain, while those from Brazil were similar in their emotional reactions to respondents from Mexico. However, while respondents from Spain showed very little emotional involvement with any beverages, respondents from Portugal did show more emotional reaction to beverages, such as beer and spirits, than for wine (Fig. 19.2). This might also explain why the research of Ferrarini et al. (2010) resulted in a relatively short list of emotions when studying the emotions of Italian consumers related to wine. While most researchers find a list of about 25 (Ferdenzi et al., 2013) to 44 (Chaya et al., 2015b) affective terms when designing a list for a specific product, Ferrarini et al. (2010) found only 16 affective terms relevant to wine. In their study there was no reference to wine decreasing negative emotions, but rather a strong focus on pleasant emotions. It therefore seems that, while wine is

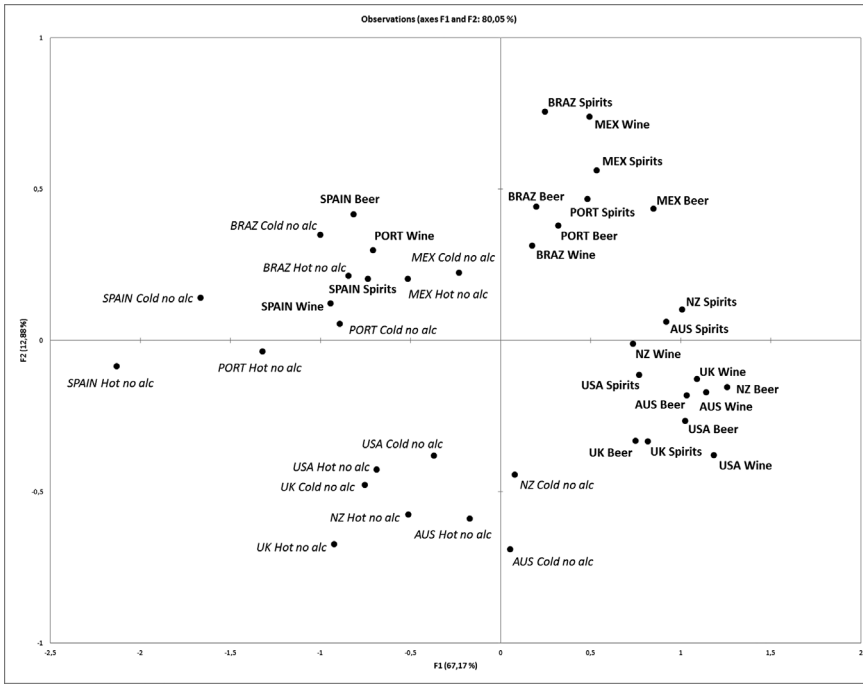


Figure 19.2 Observations plot of covariance PCA on the percentage of respondents who indicated that their favorite beverage made them feel "more like this" for all positive emotions and "less like this" for all negative emotions, analyzed by beverage type (van Zyl & Meiselman, submitted manuscript).

an important aspect of the Spanish, Portuguese, French and Italian cultures, the reasons for enjoying it may have more to do with enjoying everyday occasions and the company of friends than improving one's emotional state or feelings.

4 Context

The effect of the environment on consumers' emotions should not be neglected. According to Lin (2004), customers continuously interact with their physical environment and while the individual evaluation of that environment can be very specific, understanding the emotional effect of the environment can aid in making it more pleasant and effective.

Many of the situations in which beverages are consumed are social occasions. Apart from the beverage itself, the company, the location, and the reason for the consumption may all have an effect on the emotions of consumers. It is not clear how much of the emotional experience is due to the beverage and how much of it is due to the many contextual aspects or indeed, whether they can be untangled.

Porcherot, Petit, Giboreau, Gaudreau, and Cayeuw (2015) studied both emotions and moods in a restaurant setting, specifically the affective feelings related to an aperitif. Respondents were guests at an experimental restaurant at the Institute Paul Bocuse and, as they booked the tables themselves, arrived in usual dinner companion groups and had a choice of starter and main course, they were in conditions that would normally be expected in a restaurant. Three flavors of Kir (white wine with fruit liquor) served as welcome drinks were compared. A control group did not receive Kir. Once respondents were seated at their table they completed a Visual Analog Mood Scale (VAMS) after which they were presented with the aperitif. A ScentMove questionnaire was completed by respondents who received the aperitif once they have had at least half of it and this was followed by another VAMS questionnaire. At the end of the dinner respondents were asked to complete the final VAMS questionnaire. Respondents in the control group did not complete the ScentMove questionnaire and only completed two VAMS questionnaires: before the dinner and after the dinner. While there were no significant differences in affective feelings of the ScentMove questionnaire or overall liking between the apricot, raspberry and grapefruit variants, all three variants were highly liked and associated with well-being and relaxation. Of the three variants, only the raspberry variant resulted in a significant difference in mood states before and after the aperitif, with a reduction in the moods tense and anxious. The raspberry variant was also the most familiar in flavor (as scored by respondents) which may explain why this flavor alone achieved the reduction in tense and anxious mood states.

Burgess, Gilbert, and Thomas (2012) found that evoking a context within a CLT condition had an effect on the emotion responses of consumers when evaluating four samples of hot chocolate, using a shortened version of the EsSense Profile. In the control group, where no context was evoked, samples were differentiated based on only 1 of 22 emotions (bored). However, when respondents first wrote their own narrative about a situation in which they would want to have something comforting to drink before evaluating the four hot chocolate samples, the products were differentiated on 19 of the 22 emotion terms. It therefore seems that an appropriate situational context, even when imagined, increases the emotional relevance of the product and, as a result, the discrimination between samples. This is confirmed by the findings of Picqueras-Fiszman and Jaeger (2014) that the way in which a context is evoked affects the perceived appropriateness of a product, which in turn affects the emotional responses.

5 Product differences and choice of method

The reason for studying products often indicates the size of differences we might expect between samples and that, in turn, dictates the type of method we use to evaluate the products of interest. Academic researchers may be interested in studying relatively large differences, such as comparing fruit juice to vegetable juice, or fresh juice compared to sirups or squash, where both the sensory and hedonic properties might have a wide range. Alternatively, the interest may lie in studying products

which vary widely in sensory characteristics but can be expected to be quite similar in acceptability, such as different types of cocktails, whisky, beer, or fruit juice. Commercial interest in understanding emotions related to beverages is often centered around products that are more similar in nature, for example different types of fresh orange juice, different lagers that are of similar acceptability or deciding on a new soft drink recipe to fit a specific concept and for which various prototypes have been developed.

In a commercial setting the product development process and its related phases follow a similar principle. In the first phase several prototypes with different sensory characteristics should be screened to identify those which may be taken forward to further development. During this development phase it is conceivable that we should use methods which can distinguish between products that are liked and disliked and to understand the positive and negative emotional drivers for each. In this instance, methods such as PrEmo, facial recognition of emotions, or physiological methods might be relevant as a screening tool to separate several products into those which may have potential and those which are not suitable.

Further along the product development process we may want to evaluate two or three potential products to determine their suitability and how well they fit a concept. In this instance products may be quite similar and equally liked. The method we choose to use here therefore has to be more sensitive and able to discriminate between products with smaller differences. Furthermore, what is of value in this development and evaluation phase is the identification of how the emotions elicited by the product fit those elicited by the concept. Here we are interested in more subtle feelings rather than strong, basic emotions. It might, for instance, be of interest to know whether a product conveys the feelings of calm and peacefulness, of refreshment and relaxation or whether it is comforting. In order to study such subtle differences we need a method which is sensitive and includes the feelings that are relevant to the product and the concept. Examples of such methods are the EsSense Profile (King & Meiselman, 2010) and emotion/feeling lists developed for specific beverages such as for wine (Danner et al., 2015; Ferrarini et al., 2010; van Zyl and Meiselman, unpublished), coffee (Bhumiratana, Adhikari, & Chambers, 2014; van Zyl and Meiselman, unpublished), beer (Chaya et al., 2015b; Eaton, Chaya, Smart, & Hort, 2014), blackcurrant squash (Ng et al., 2013a), and soft drinks/sodas (van Zyl and Meiselman, unpublished) all of which are summarized in Tables 19.3a to d.

5.1 Facial expression of emotions

While facial expression might be a very useful tool to measure the reaction of respondents to advertisements and other visual stimuli, as well as fragrances and aromas, its uses regarding food products are limited as a result of chewing, for example, which possibly has a bigger effect on the facial displacement of respondents than the feelings experienced during consumption. In studying beverages this method is further hampered by the fact that at the moment of most interest, that is the moment at which the flavor is first experienced, the mouth is at least partly obscured by the container from which the respondent is drinking.

As this method measures basic emotions (angry, disgusted, happy, sad, scared, and surprised) and in the case of the Noldus Information Technology solution also the neutral facial expression (He, Boesveldt, de Graaf, & de Wijk, 2014), it is suitable to evaluate products with large differences in acceptability where we can expect products to be differentiated in terms of emotions such as disgust, surprise, and happiness. As such it could be a suitable option for screening purposes.

Danner, Haindl, Joech, and Duerrschmid (2014a) found significant differences in facial expressions between salted sauerkraut juice, grapefruit juice, and mixed vegetable juice compared to orange juice and banana nectar. The juices were selected specifically for their differences in sensory characteristics and to span a hedonic range, while being similar in familiarity to respondents. Respondents evaluated 2cl of each sample in a semimonadic design. After consuming the sample, respondents had to wait 20 seconds to consider how much they liked the sample before answering on a 9-point scale. During this waiting time implicit emotion measurements were taken using Noldus FaceReader. This measurement started immediately after swallowing. Of the 99 respondents, the data from 10 were excluded because they wore glasses and this interfered with collecting facial expression data. Analysis of the implicit facial responses showed that samples that were disliked (salted sauerkraut, mixed vegetable, and grapefruit juices) resulted in more intense negative emotions and less neutral expressions than liked samples (orange and banana juices) and liked samples resulted in only minor changes in spontaneous facial expressions with no differentiation between banana and orange juice. Interestingly, it was found that the emotion "happy" was expressed for the disliked salted sauerkraut juice. The researchers reported that upon asking respondents why they smiled after tasting this sample they were informed that respondents were surprised or did not expect the sample to taste like that. However, surprise was not identified as a differentiating emotion between samples in this study. Respondents' liking scores differentiated between three groups of products. Banana juice was significantly more liked than orange juice, and both banana and orange juice were significantly more liked than the vegetable, salted sauerkraut and grapefruit juices. In this study, 9-point hedonic scores differentiated more between products than facial expression.

A study conducted with 495 UK respondents and six lager beers showed no significant difference in product differentiation in terms of facial expression (van Zyl, 2015). Respondents evaluated six products in a randomized design. In order to capture the emotions experienced as a result of the beverages, respondents had to follow a very specific procedure to avoid the obstruction of their facial expressions by the glass from which they tasted the product. This involved taking a sip of the beverage, keeping it in the mouth, putting down the glass, looking straight into the camera and then swallowing. Data were analyzed in two ways. First the facial point displacements were grouped into facial action clusters (Table 19.2) and a score between 0 and 1 assigned to each respondent for each cluster. The score is a measure of how clearly a respondent showed the facial expression related to the cluster. The data were then analyzed to determine whether there were differences between the products in terms of these clusters. The differences between the first three clusters were mostly related to head movement and cluster 4 consisted entirely of no movement at all. In the

Table 19.2 Facial action clusters from a study with different lager beers

Facial action cluster	Label
Cluster 1	Lip suck, small head movement
Cluster 2	Lip suck, no head movement
Cluster 3	Lip suck, big head movement
Cluster 4	Still (no movements)
Cluster 5	Lip tight
Cluster 6	Lip corner depress
Cluster 7	Eyebrows raise

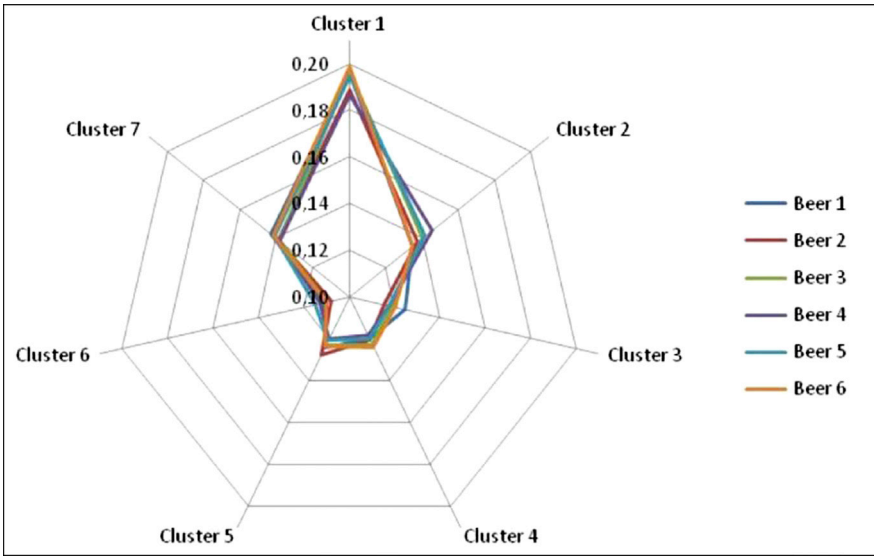


Figure 19.3 Facial Action Cluster scores for six lager beers. Scores are assigned on a scale from 0 to 1 (van Zyl, 2015).

second analysis, the intensity of nine specific Facial Action Units, which were found to be relevant to this study, was estimated and data were again analyzed to determine whether there were differences between the products in terms of the action units. Of the 495 respondents only 30 were found to show significant facial expression upon consumption of the beers and neither of the analyses resulted in significant differences between products (Fig. 19.3).

For products which are expected to be very different in acceptability it is reasonable to expect to find differences in disgust. However, as indicated by the study of Danner et al. (2014), it is likely to find significant differences in hedonic scores between such products. If we are therefore working with respondents who are able to verbalize whether or not they like a product, studying facial expression of emotion

does not necessarily add value. Danner, Sidorkina, Joechl, and Duerrschmid (2014b) also found that in studying various types of orange juices, facial expression was only able to discriminate the least-liked sample (diluted orange sirup) from the orange juice samples. Basic emotions, while sufficient to distinguish between liked and disliked products, are not enough to distinguish in greater detail between products that are equally liked (Danner et al., 2014; Wendin, Allesen-Holm, & Bredie, 2011; Zeinstra, Koelen, Colindres, Kok, & de Graaf, 2009) and unpleasant tastes evoke more facial displays than pleasant tastes (Greimel, Macht, Krumhuber, & Ellring, 2006). To discriminate between products that are highly liked, combinations of hedonic ratings, feelings or affective terms and conceptual attributes are needed.

If we consider some of the feelings that we are interested in (such as relaxed and relieved) it is clear that they are not expressed in easy-to-recognize facial expressions. While the basic emotions of fear and anger result in facial expressions, we do not expect beverages to elicit these types of emotions.

However, if facial expression methods can be used to study how negative emotions, such as feeling stressed and frustrated, are reduced by beverages to result in a more positive emotional state, it would be of greater benefit in understanding the dynamics of emotions related to beverages.

5.2 Physiological response

Physiological response measures have been suggested as an alternative to facial expression to obtain an objective measure of emotional response, which is not modulated by the cognitive process of response to a questionnaire (He et al., 2014). Different research groups use different measures, such as skin conductivity, heart rate, electrocardiogram (ECG), and others.

Inoue, Kuoda, Sugimoto, Kakuda, and Fushiki (2014) studied emotional responses of respondents who either had an affinity or antipathy for jasmine tea by measuring the autonomic nervous response by way of ECG and by way of a profile of mood states (POMS) both before and after ECG. Respondents were also asked to report on their mood using the Profile of Mood States questionnaire translated into Japanese. They found that respondents who liked jasmine tea showed a decrease in heart rate and an increase in parasympathetic nervous activity after inhaling high-intensity jasmine tea aroma. Respondents also reported a decrease in almost all negative mood states. This suggests both a psychological as well as a physical sedative effect. Respondents who did not like jasmine tea aroma reported an increase in negative mood states along with an increase in sympathetic nervous activity, suggesting an excitatory effect. They concluded that the emotions experienced by consumers are not only linked to the aroma or flavor of the product but also depend on whether or not respondents like the product and, the stronger the aroma, the stronger the emotional effect.

In a pilot study Beyts et al. (2015) studied the effect of four beer aromas and a control without added aroma on heart rate, skin temperature, and the activity of facial muscles (corrugator supercilli and zygomatic major). Respondents were also asked to rate their response in terms of emotional valence and activation as well as the intensity and familiarity of the aromas. Of the physiological measures, heart rate was the only

variable that showed a significant effect and then for only one of the four aromas (isoamyl acetate which is perceived as banana). However, subjects' responses to the questionnaire were more discriminating, allowing differentiation between aromas based on their relative emotional activation and valence, as well as familiarity of the aromas.

From both these studies it appears that while physiological responses allow for some differentiation between aromas of jasmine tea and beer, these were not more discriminating than respondents' report of their own emotions or mood states.

5.3 Verbal emotion/affective feeling lists

In studying beverages that are highly liked and similar in acceptability the interest is often in more subtle feelings, rather than in basic emotions. It is here that verbal affective feeling lists become useful in distinguishing more subtle differences between products. We might, for example, want to know whether different hop flavors make respondents feel joyful and energized or peaceful and relaxed.

As reported by Jaeger, Cardello, and Schutz (2013) the list of words presented to respondents may lead to some confusion if the words are not relevant to the category being studied. In their research, New Zealand respondents evaluated different emotion measurement scales, but predominantly the EsSense Profile method, for different product categories and for food names as well as actual samples. Some respondents found the task to be strange and did not understand why the specific stimuli would elicit the emotions on the list. When respondents were asked to list the emotions they did consider relevant to the products, there were far fewer words than on the EsSense Profile list and there was only partial overlap. This may be because the EsSense Profile list was developed specifically for savory snack foods and is therefore less relevant to other product categories. Emotion terms used in a verbal emotion measurement method should be understandable and clear to consumers and relevant to the category to be evaluated.

In designing emotion lists for any product category and therefore also for beverages, it is important to ensure that the right words are used for the product category being studied (beverages in this instance) and then specifically for the type of beverage being studied. The words used have to make sense to the respondents who will be using the lists. To find the more subtle feelings differentiating beverages it might therefore be necessary to do sufficient prework to ensure the correct list of emotions. For example, the list of emotions relevant to Italian consumers of wine as developed by Ferrarini et al. (2010) is different from the list of emotions developed for studying the feelings relevant to coffee by Bhumiratana et al. (2014). Pineau et al. (2010) developed a list of emotions to study the differences in emotions related to flavored water and van Zyl and Meiselman (2015) used both quantitative and qualitative methods to identify emotion terms relevant to various types of beverages.

Several authors (Bhumiratana et al., 2014; Chaya et al., 2015b; Ferrarini et al., 2010; Ng et al., 2013a, 2013b) found that when respondents were given the opportunity to specify the emotions related to specific beverages, there was only partial overlap with the EsSense Profile list of emotions. Bhumiratana et al. (2014) identified

44 emotions related to the coffee-drinking experience. Of these terms, 27 were related specifically to coffee, while the other 17 were more universal and overlapped with the EsSense Profile. As was the case with other studies (Chaya et al., 2015a; Ng et al., 2013a, 2013b), principal component analysis divided the emotions into two dimensions, namely positive and negative on one hand, and low to high energy on the other hand. From this study it was possible to identify that consumers sought different emotional reasons for the consumption of coffee. Some respondents chose a specific coffee for the resulting high-energy positive emotions, while others sought a low-energy positive emotional state.

Chaya et al. (2015a) used the EsSense Profile to study the emotions elicited by beer, packaging, and a combination of beer and packaging. While the study showed significant differences between products not all emotion terms discriminated between products or did not discriminate very well. As a result they concluded that it might be more relevant to develop a product-specific list of terms which they then did in another study (Chaya et al., 2015b).

In Tables 19.3a to d word lists created for specific beverages and the EsSense Profile list are compared. It seems that there are some terms which might be relevant to foods and beverages in general (good and happy) and others which are specific to each beverage type, such as clear-minded for coffee Bhumiratana et al. (2014) and conscious and responsible for non-alcoholic beer (Silva et al., 2016). As we endeavor to differentiate between products that are equal in liking and guide consumers towards the best beverage for the occasion and related emotional benefit, it becomes increasingly important to ensure that we use the terms that will allow us to find that differentiation and that convey the specific feelings and emotions that are elicited by the sensory characteristics of specific products for specific consumers.

In studying the emotions related to coffee, Bhumiratana et al. (2014) found a set of affective terms which were specific to coffee and which were not previously found to be relevant to products. This group of terms indicated the importance to consumers to stay mentally alert and focused (motivated, in control, productive, clear-minded). They also found that different terms were important for different clusters of coffee drinkers, highlighting the importance of developing a list of emotion terms specifically with users of the product to be studied. Silva et al. (2016) also identified affective terms related to being in control and alert when studying non-alcoholic beer. It seems therefore that, as our understanding of consumers' interactions with products increase, what consumers themselves consider important and differentiating terms may be more important than making sure we study only strictly defined emotions.

5.3.1 Generating lists

The terms emotions and feelings are sometimes used interchangeably, even though they have different meanings. In consumer-generated emotion lists one often sees words that are neither emotions nor feelings but conceptual attributes or, in some instances, adjectives describing the product or even nouns. In studying emotions, affective feelings or conceptual attributes there is merit in clearly identifying terms that are classified as such in constructing relevant lists.

Table 19.3a Comparison of the EsSense Profile™ list to lists developed specifically for beer

EsSense Profile™ [a]	Beer (UK)[b]	Beer (Spain)[c]	Beer (Netherlands and Portugal)[d]
Active			
Adventurous			Adventurous
Affectionate			
Aggressive			
		Agreeable	
	Alarmed		
			Amused
		Annoyed	
		Appetised	
		Authentic	
		Bad	
Bored	Bored	Bored	
Calm	Calm		Calm
		Cheated	
	Cheated		
		Classic	
	Comfortable		
	Comforted		Comforted
	Confused		
	Content		
	Curious	Curious	Curious
Daring			
	Desirous		
		Different	
	Disappointed	Disappointed	Disappointed
Disgusted	Disgusted	Disgusted	
		Disillusioned/disenchanted	
	Dissatisfied	Dissatisfied	
Eager		Eager	
Energetic			Energetic
	Enjoyment	Enjoyment	
Enthusiastic	Enthusiastic		
	Excited	Excited	Excited
			Exuberant
		Festive	
Free			Free
		Fresh	
Friendly		Friendly	Friendly
	Fulfilled		
	Fun		
Glad			
Good	Good		Good
Good-natured			
			Grumpy
Guilty			

(*Continued*)

Table 19.3a (Continued)

EsSense Profile™ [a]	Beer (UK)[b]	Beer (Spain)[c]	Beer (Netherlands and Portugal)[d]
Happy	Happy	Happy (cheerful)	Happy
	Horrible		
	Impressed		
		Indifferent	
		Intense	
Interested	Interested		
Joyful			Joyful
		Lacking in appetite	
		Lively	
Loving			
Merry			
Mild		Mild	
		Natural	
		Negative	
	Nice	Nice	
		Normal	
Nostalgic	Nostalgic	Nostalgic	
		Objectionable	
	Optimistic		
	Overwhelmed		
Peaceful			
Pleasant	Pleasant	Pleasant	
Pleased	Pleased		Pleased
Polite			
		Positive	
Quiet			
	Relaxed	Relaxed	Relaxed
	Relieved		
	Repulsed	Repulsed	
			Restless
			Sad
	Safe		
Satisfied	Satisfied	Satisfied	
Secure			
	Shocked	Shocked	
Steady			
	Strange		
		Strong (powerful)	
	Surprise (pleasant)		
	Surprise (unpleasant)		
Tame	Tame		
Tender			
		Traditional	
		Uncomfortable	

(*Continued*)

Table 19.3a (Continued)

EsSense Profile™ [a]	Beer (UK)[b]	Beer (Spain)[c]	Beer (Netherlands and Portugal)[d]
Understanding			
	Underwhelmed		
		Unmotivated	
	Unpleasant	Unpleasant	
		Unusual	
	Want		
Warm	Warm		
Whole			
Wild			
Worried			

[a]King and Meiselman (2010).
[b]Eaton et al. (2014).
[c]Chaya et al. (2015b).
[d]Silva et al. (2016).

Table 19.3b Comparison of the EsSense Profile™ list to lists developed specifically for coffee

EsSense Profile™ [a]	Coffee (USA)[b]	Coffee (UK, USA, Australia, New Zealand, Spain, Mexico, Portugal, Brazil)[c]
Active	Active	
Adventurous		
Affectionate		
Aggressive		
	Annoyed	
	Awake	
	Balanced	
	Boosted	
Bored	Bored	
Calm		Calm
		Cheerful
	Clear minded	
	Comfortable	
		Comforted
	Content	Contented
	Curious	
Daring		
	Disappointed	
Disgusted	Disgusted	
Eager		
	Educated	
	Empowering	
Energetic	Energetic	Energized
Enthusiastic		
Free	Free	

(*Continued*)

Table 19.3b (Continued)

EsSense Profile™ [a]	Coffee (USA)[b]	Coffee (UK, USA, Australia, New Zealand, Spain, Mexico, Portugal, Brazil)[c]
Friendly		
	Fulfilling	
	Fun	
Glad		
Good	Good	Good
Good-natured		
	Grouchy	
Guilty	Guilty	
Happy		Happy
Interested		
	In control	
	Jolted	
Joyful	Joyful	
	Jump start	
Loving		
Merry	Merry	
Mild		
	Motivated	
	Nervous	
Nostalgic		
	Off-balance	
Peaceful	Peaceful	Peaceful
Pleasant	Pleasant	
Pleased	Pleased	
Polite		
	Productive	
Quiet		
		Refreshed
	Relaxed	Relaxed
	Rested	
	Rewarded	
Satisfied	Satisfied	Satisfied
Secure		
	Social	
	Soothing	
	Special	
Steady		
Tame		
Tender		
Understanding	Understanding	
Warm	Warm	Warm
Whole		
Wild	Wild	
Worried	Worried	

[a]King and Meiselman (2010).
[b]Bhumiratana et al. (2014).
[c]van Zyl and Meiselman (unpublished).

Table 19.3c Comparison of the EsSense Profile™ list to lists developed specifically for Spirits and Wine

EsSense Profile™ [a]	Spirits (UK, USA, Australia, New Zealand, Spain, Mexico, Portugal, Brazil)[b]	Wine (Italy)[c]	Wine (UK, USA, Australia, New Zealand, Spain, Mexico, Portugal, Brazil)[b]	Wine (Australia)[d]	Wine (Netherlands and Portugal)[e]
Active					
Adventurous	Adventurous		Adventurous	Adventurous	
Affectionate	Affectionate		Affectionate		
Aggressive		Aggressive			
	Amused	Amusing	Amused		Amused
		Bland			
Bored					
	Blissful				
Calm	Calm		Calm	Calm	Calm
	Cheerful		Cheerful		
	Comforted		Comforted		Comforted
	Contented		Contented	Contented	
		Curious			Curious
Daring					
	Delighted		Delighted		
		Desirable			
					Disappointed
Disgusted		Disgusting			
Eager					
		Elegant			
				Embarrassed	
Energetic	Energized		Energized		
Enthusiastic	Enthusiastic		Enthusiastic	Enthusiastic	
				Envious	
		Euphoric			

	Excited		Excited		Excited
					Exuberant
Free	Free		Free		Free
Friendly	Friendly		Friendly		
					Fulfilled
Glad					
Good	Good		Good		Good
Good-natured					
Guilty					
Happy	Happy	Happy	Happy	Happy	Happy
Interested		Interesting			
				Irritated	
Joyful	Joyful	Joyful	Joyful		Joyful
		Keen			
				Lonely	
Loving	Loving		Loving		Loving
Merry	Merry		Merry		
Mild					
	Naughty				
			Nervous (less)		
Nostalgic				Nostalgic	
	Optimistic		Optimistic	Optimistic	
		Overwhelming			
				Panicky	
		Passionate		Passionate	
		Peacable			
Peaceful	Peaceful		Peaceful		
	Playful		Playful		
Pleasant		Pleasant			
Pleased					Pleased
Polite					

(*Continued*)

Table 19.3c (Continued)

EsSense Profile™ [a]	Spirits (UK, USA, Australia, New Zealand, Spain, Mexico, Portugal, Brazil)[b]	Wine (Italy)[c]	Wine (UK, USA, Australia, New Zealand, Spain, Mexico, Portugal, Brazil)[b]	Wine (Australia)[d]	Wine (Netherlands and Portugal)[e]
Quiet					
	Refreshed		Refreshed		
	Relaxed		Relaxed	Relaxed	Relaxed
					Restless
			Sad (less)	Sad	Sad
Satisfied	Satisfied		Satisfied		
Secure					
			Serene		
	Sexy				
Steady					
	Stressed (less)		Stressed (less)		
				Surprised	
Tame					
Tender					
	Tense (less)		Tense (less)	Tense	
Understanding					
				Unfulfilled	
Warm	Warm		Warm	Warm hearted	
Whole					
Wild					
Worried	Worried (less)		Worried (less)		

[a]King and Meiselman (2010).
[b]van Zyl and Meiselman (unpublished).
[c]Ferrarini et al. (2010).
[d]Danner et al. (2015).
[e]Silva et al. (2016).

Table 19.3d Comparison of the EsSense Profile™ list to lists developed specifically for different types of cold non-alcoholic beverages

EsSense Profile™ [a]	Alcohol Free Beer (Netherlands and Portugal)[b]	Blackcurrant squash (UK)[c]	Soft Drinks/Soda (UK, USA, Australia, New Zealand, Spain, Mexico, Portugal, Brazil)[d]
Active			
Adventurous			
Affectionate			
Aggressive			
		Angry	
		Annoyed	
		Approval	
		At ease	
		Attentive	
Bored		Bored	
Calm	Calm		Calm
		Cautious	
			Cheerful
	Conscious		
		Comforted	Comforted
		Confused	
			Contented
	Curious	Curious	
Daring			
		Desire	
	Disappointed	Disappointed	
		Discontented	
Disgusted		Disgusted	
		Displeasure	
Eager			
Energetic			Energized
Enthusiastic			
Free	Free		
Friendly	Friendly		
Glad			
Good	Good	Good	Good
Good-natured			
	Grumpy		
Guilty		Guilty pleasure	
Happy	Happy	Happy	Happy
		Unhappy	
Interested		Interested	
Joyful			
Loving			

(*Continued*)

Table 19.3d (Continued)

EsSense Profile™ [a]	Alcohol Free Beer (Netherlands and Portugal)[b]	Blackcurrant squash (UK)[c]	Soft Drinks/Soda (UK, USA, Australia, New Zealand, Spain, Mexico, Portugal, Brazil)[d]
Merry			Merry
Mild			
Nostalgic			
Peaceful			Peaceful
Pleasant			
Pleased	Pleased	Pleased	
Polite			
Quiet			
		Refreshed	Refreshed
		Not refreshed	
	Relaxed		Relaxed
		Regret	
		Reminisence	
		Resentment	
	Responsible		
	Safe		
Satisfied		Satisfaction	Satisfied
		Sceptical	
Secure			
		Shocked	
		Sickly	
Steady			
		Surprise (pleasant)	
		Surprise (unpleasant)	
Tame			
Tender			
		Trust	
		Uncomfortable	
Understanding			
Warm		Warm	
Whole			
Wild			
Worried		Worried	

[a]King and Meiselman (2010).
[b]Silva et al. (2016).
[c]Ng et al. (2013).
[d]van Zyl and Meiselman (unpublished).

Lists can either be developed as part of individual studies Ng et al. (2013a) or by embarking on a combination of qualitative research followed by quantitative validation as done by several other researchers (Bhumiratana et al., 2014; Pineau et al., 2010; van Zyl & Meiselman, 2015). The first method is limiting in the sense that the developed list is relevant only to those consumers taking part in the study and therefore might be of limited future use. On the other hand, doing a large qualitative study followed by quantitative validation is time-consuming. However, if the list of words is to be used in many subsequent studies it may well be worth the effort. It will however require that the researcher considers all the cultural and other demographic aspects of their research population to ensure that the list of emotions is relevant, not only to the product itself but also to the countries and cultures where research is to be conducted. One suggestion is to use existing lists from which to compile a long list of emotion words that might be relevant to the product to be studied. Following this, qualitative and/or quantitative tasks can be used to narrow down the list to terms relevant to the specific product under investigation and finally the list can be reduced further by removing synonyms (Pineau et al., 2010; van Zyl and Meiselman, 2015).

Before generating lists with consumers it is well worth the time spent to first discuss what emotions and feelings are, how they are related to beverages in general and specifically to the beverage(s) of interest. Van Zyl and Meiselman (2015) followed a detailed and lengthy step-wise process to generate emotion terms related to beverages. A list of 89 emotion and feeling terms compiled from literature was used as input for focus group discussions to determine which words were relevant to beverages. Thirty-four focus groups were conducted in four countries in two languages and attended by the same researcher (in person or by webcast) to ensure a common process. Before the focus groups consumers were assigned a pre-task to familiarize them with emotions and feelings and this was shared at the start of the focus group to help establish a mutual understanding of emotions and how they related to beverages. A list of terms used most commonly in each country was compiled from the focus groups and these were combined to form a list of 66 terms. These terms were then assessed on-line by 600 respondents each from eight countries in three languages to determine the terms most relevant to respondents' favorite beverages.

Emotion/affective feeling lists are sometimes criticized for their length, and shorter versions of longer lists, such as ScentMove, have been developed. Chaya et al. (2015b) used clustering to reduce a list of terms specific to beer for Spanish respondents to a shorter list. Some modifications were made to reduce overlap and confusion, resulting in a 12-item emotion category list which showed promising results for differentiating between beers.

5.3.2 Scaling method

The size of the difference between products may also dictate the type of scaling to be used. Products that are quite different can be compared using a 5-point scale, as with the EsSense Profile method, but products that are similar (such as different brands of lager) might require a line scale, such as in the case of ScentMove in order to capture the more subtle differences between products.

Ng et al. (2013a) and van Zyl, Hasted, Meiselman, and Worch (2013) have compared 5-point rating scales with CATA. Ng et al. (2013a) found that there were merits in both rating and CATA, but suggested that RATA (rating all that apply) might be a good compromise. Van Zyl et al. (2013) reported that it wasn't clear which strategies respondents used when ticking a box in a CATA list, and that CATA did not seem to be streamlined scaling. Cognitively, CATA and rating seemed to be different tasks.

6 Practical considerations in measurement

The number of products that could reasonably be evaluated in one session by respondents should be carefully assessed. King, Meiselman, and Carr (2013) suggested a maximum of four products for savory snack foods, but van Zyl et al. (2013) have evaluated six beverage products in a session and Chaya et al. (2015a) have evaluated up to 10 in one session.

Dorado, Picard, Pérez-Hugalde & Chaya (2015) found a first-order effect in studying emotions related to beer. Their hypothesis was that the sample evaluated first would result in higher positive emotion scores and lower negative emotion scores. They studied four commercial beers with 108 consumers in a balanced design. Two of the beers were served in duplicate in the first position. Respondents used the EsSense Profile to score overall liking and their emotional response to the beers. There was a significant first-order effect for 9 out of 39 emotions, namely pleasant, disgusted, glad, peaceful, interested, pleased, merry, free, and nostalgic. Positive emotions were scored higher in the first position while negative emotions were scored lower. The conclusion of this study was confirmed in a second study (Dorado et al., 2016) and the authors suggest that a warm-up or dummy sample should be added in studies to remove the first-order effect. However, if we consider the reasons why respondents might choose a beverage (eg, reducing stress or feeling more relaxed), adding a warm-up sample might remove the very thing we are attempting to study. It is conceivable that the biggest emotional benefit might be related to the first experience of the beverage. Once that first experience has passed, the subsequent emotional benefit might be decreased and we might find less differentiation between products.

In a commercial environment, it is often not feasible to generate specific emotion lists for each beverage type as it is a long and costly process. As a result companies may use existing lists, such as EsSense Profile, ScentMove or other lists of feelings previously published which may be relevant to their product (Bhumiratana et al., 2014; Chaya et al., 2015b; Ferrarini et al., 2010), or choose from a longer list of feelings those words they consider to be of interest. They may also modify these lists with words that are important from a marketing point of view (Thomson & Crocker, 2013). If it is not possible to develop a specific list it is worth investigating all published lists for the most relevant words to the product under investigation and this is often best done in a cross-functional team of sensory, market research, and commercial colleagues.

7 Conclusions

The research thus far conducted on the effect of beverages on affective feelings and emotions suggests that there are several important factors to consider. First, the size of the differences between the products studied should be understood in order to decide which method should be used. The second is the consumers taking part in the study and, if using a verbal method, the language, issues related to translation and relevant affective feelings for the beverage type as well as for the culture in which the research is conducted. The next is the context in which we decide to study the product; whether it is a real-life situation or whether it is an evoked context and if it is the latter, the most appropriate way of evoking the context. Finally, the number of samples that are presented should be carefully considered.

Although the last 5 years have seen much proliferation in the research of emotion and affective feelings related to beverages, many unanswered questions remain, not least of which being how to measure decreasing negative emotions.

More research is also needed to generate lists specific to beverages and beverage types, to understand whether measuring the emotions using those lists is repeatable and reproducible and how to account for contextual factors in consumption situations which are very often in and of themselves of high emotional impact.

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The Emotion of Happiness

20

Jaime L. Kurtz and Cheryl A. Welch
James Madison University, Harrisonburg, VA, United States

1 Introduction

Ask most anyone to name a deeply held and sought-after life goal, and happiness is likely to top the list. Although this state plays a central role in our daily and long-term motivation and decision-making, for many years, it was a topic reserved for philosophers and self-help book writers rather than psychological scientists. However, this trend shifted in the 1990s, as researchers in the burgeoning field of positive psychology began studying happiness in earnest (Seligman & Csikszentmihalyi, 2000). Since then, great strides have been made in operationally defining and developing measures to reliably tap into this construct. In this chapter we cover three areas. First, we explain how happiness is defined and assessed in the research literature. Next, we describe some of the most commonly used measures of happiness, or subjective well-being. Finally, with the goal of application in mind, we lay out the benefits and drawbacks of the most commonly used measures of happiness.

2 Happiness defined

What is happiness? This question has fascinated and perplexed philosophers, psychologists, and laypersons alike since the time of Aristotle, who remarked that "Happiness depends on ourselves." While there is much debate on what makes people happy, one widely accepted fact is that, if people declare themselves happy, that claim should be taken at face value. In other words, when making judgments regarding one's experience of happiness, renowned happiness researcher Ed Diener remarked, "The person herself or himself is the expert here: Is my life going well, according to the standards that I choose to use?" Accordingly, given its inherently subjective nature, happiness is often referred to as subjective well-being (SWB) in the literature. Keeping with convention, the terms "subjective well-being" and "happiness" will be used interchangeably here.

According to Diener, Suh, Lucas, and Smith (1999), happiness contains both affective and cognitive components; "hot" and "cold" assessments, respectively. More specifically, those high in happiness enjoy frequent positive emotions and relatively infrequent negative emotions, a concept known as affect balance. These individuals tend to be in good moods much of the time. However, being in a good mood most of the time is not sufficient for a broad sense of happiness. As they step back and think about their lives, they also tend to evaluate them positively, a cognitive assessment

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known as life satisfaction. Simply put, it is hard to envision a truly happy person who does not believe his or her life is going well.

Happiness and positive moods are related but distinct concepts, with happiness being more global and mood being more of-the-moment. Due to fluctuations in mood, many people tend to not see it as a trait. However, while mood has the propensity to fluctuate, SWB is fairly stable and trait-like, with a 0.40 heritability quotient (Lykken & Tellegen, 1996; Lyubomirsky, King, & Diener, 2005).

3 Existing happiness measures

Despite these definitional differences and the highly subjective nature of happiness, it can indeed be reliably assessed. When addressing the global happiness of a person, brief, global scales are the most commonly used method of self-assessment. However, before attempting to measure happiness, researchers need to be very clear on what they are interested in assessing; as the approach to measuring happiness depends on the research question being asked. For example, if the researcher is looking at the fluctuating levels of happiness throughout the day, or even a direct response to a particular stimulus, it is a question of one's momentary mood. One-item mood scales (eg, "How do you feel right now?"), the Positive and Negative Affectivity Scale (PANAS; Watson, Clark, & Tellegen, 1988), or the Visual Analogue Mood Scale (VAMS; van Rijsbergen, Bockting, Berking, Koeter, & Schene, 2012) are most appropriate when using this type of question. However, if the research questions being addressed are examining longer periods of momentary happiness, there are various methods for assessment that would be more appropriate then the previously mentioned measurements. When looking to assess the feeling of happiness over a period of time, such as a day or a week, the Experience Sampling Method (Csikszentmihalyi, Larson, & Prescott, 1977; Wirtz, Kruger, Napa Scollon, & Diener, 2003) or the Day Reconstruction Method (Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004) would be the best types of approaches. Unlike research questions that deal with momentary happiness, whether it be over a day or aggregated over a few months, global happiness addresses overall life happiness and satisfaction. The following section will describe the most commonly used happiness measurements and their appropriate use.

4 State-based or momentary affect scales

4.1 One-item mood scales

One commonly used mood scale, the Visual Analogue Mood Scale (VAMS), has been used in many settings including psychological clinics (van Rijsbergen et al., 2012). The scale consists of a 100-mm line labeled from 0 to 10 with "sad" located at the left corner and "happy" located at the right. Respondents are asked to place a cross on the line to represent how they currently feel, and to move it from left to right to

indicate momentary changes in mood. Convergent and discriminant validity, along with test–retest reliability have been found to be reasonably high for this measure (0.67 to 0.87, depending on the subscale; House, Arruda, Andrasik, & Grazzi, 2012). Further refinements to improve psychometric validity led to the VAMS-R (Kontou, Thomas, & Lincoln, 2012). This revision improved the convergent and discriminant validity, as well as the internal consistency of the measure ($\alpha = 0.74$). This measure has been used in a variety of settings, such as to assess psychological distress in clinical settings (Holmes, 2013).

4.2 PANAS

The PANAS, or Positive Affect and Negative Affectivity Scale (Watson et al., 1988), is a widely used self-report measure that accounts for both the valence and the arousal level of momentary emotions. The scale is made up of 10 positive affect (PA) items and 10 negative affect (NA) items. The extent to which one experiences each pleasant and unpleasant emotion is rated on 5-point Likert-type scales (1 = very slightly or not at all, 5 = extremely). Reliabilities for all items have been found to be quite high, $\alpha =$ 0.86 to 0.90 for PA, and $\alpha = 0.84$ to 0.87 for NA. Internal consistency of the measure has also been replicated in more recent studies (Lyubomirsky, Dickerhoof, Boehm, & Sheldon, 2011).

A number of studies have used PANAS to assess mood in response to various experimental manipulations (eg, Chermahini & Hommel, 2012; Renner, Schwarz, Peters, & Huibers, 2014). Chermahin and Hommel (2012) assessed the impact of cognitive processes on mood and found that creative, "big-picture" thinking improved mood, while more rigid, detail-oriented thinking lowered mood. Recently, Renner et al. (2014) used the PANAS to evaluate the effect of best-possible-self (BPS) imagery, a common technique for cultivating optimism (Sheldon & Lyubomirsky, 2006), on mood and found that while BPS had an effect on positive mood, it did not have an effect on the negative mood.

With the growth in multimedia outlets, a new version of this scale has been created. The "PANAS-t" (Gonçalves, Benevenuto, & Cha, 2013) is an adapted version to use on Twitter posts. It measures emotional attitudes from "tweets" on a variety of topics ranging from tragedies to political debates to new technology releases. The measure has been shown to effectively acquire expected emotions associated with these varying events (Gonçalves et al., 2013).

5 Facial Action Coding System

Certain methodological designs may allow researchers to examine the fine motor action of participants' facial muscles. The Facial Action Coding System (FACS; Ekman & Friesen, 1978) is an intensive coding system that allows highly trained researchers to link certain facial muscle movements with distinct emotional experiences. In the case of happiness, the relevant facial expression is, of course, the smile. FACS makes a critical distinction between the "social smile," an easy-to-fake expression in which the zygomatic major muscle is voluntarily activated to raise the corners

of one's lips, and the Duchenne smile. Those exhibiting a Duchenne smile are turning their lips up, but are also involuntarily flexing the orbicularis oculi muscle, which creates an eye-crinkle effect, commonly known as "crows' feet". This smile, which is very hard to fake, has been linked to the genuine feeling of happiness.

Because of the attention to detail it requires, FACS coding often takes place in fairly constrained laboratory situations. For instance, one study (Ekman, Davidson, & Friesen, 1990) attached electrodes to relevant facial muscles while participants watched a series of amusing film clips. Under the right conditions, assessment of the Duchenne smile can be done outside of the laboratory as well. In a highly inventive longitudinal study, Harker and Keltner (2001) obtained a college yearbook and coded female graduates' photos for the presence or absence of a Duchenne smile. Follow-ups were conducted when the women were aged 21, 27, 43, and 52. It was revealed that the positivity displayed in the yearbook photo was related to a number of desirable outcomes, including a stronger desire to affiliate with others, greater achievement-orientation, and even more satisfying marriages. Extending this even further, Abel and Kruger (2010) examined a 1952 yearbook of baseball players. They found that the presence of a Duchenne smile was significantly predictive of longevity.

6 Global measures

Because it is often defined as a big-picture assessment of one's life, researchers most often rely upon broad, global assessments, in which people evaluate their lives in a holistic way. Global assessments can be measured both through single-item measures and multi-item measures.

6.1 Single-item measures

Single-item measures, such as "Taken all things together, how would you say things are these days?" (Campbell, Converse, & Rodgers, 1976) are often used in large, multifaceted surveys such as a national census (eg, Lucas, Clark, Georgellis, & Diener, 2004). In a longitudinal study on well-being in workers, researchers were able to assess the correlation between life satisfaction and employment level (over-employed versus under-employed) by asking over 10,000 workers "How dissatisfied or satisfied are you with your life overall?" (Angrave & Charlwood, 2015). These measures show impressive reliability, especially given their brevity. For example, Fujita and Diener (2005) demonstrated test–retest reliability of 0.55 over a 17-year period. However, to allow for a more comprehensive view of happiness, slightly longer instruments tend to be preferred when studying it more intensively.

6.2 Satisfaction with life scale

Multiple-item measures are commonly used, particularly in cross-sectional and longitudinal research examining change in happiness over time (eg, Sheldon & Lyubomirsky, 2006). The five-item Satisfaction with Life Scale (SWLS; Diener,

Emmons, Larson, & Griffin, 1985) focuses on one's cognitive evaluation of his or her happiness, with questions like, "In most ways my life is close to my ideal," "The conditions of my life are excellent," "I am satisfied with life," "So far I have gotten the most important things I want in life," and "If I could live my life over again, I would change nothing." Each item is rated on a 7-point Likert-type scale (1 = strongly disagree, 7 = strongly agree). Diener et al. (1985)'s validation process showed strong reliability of the measure ($\alpha = 0.87$). High scores correlate with an array of desirable life outcomes, such as higher likelihood of college graduation, higher levels of income, better social relationships, and lower instances of anxiety and depression (Diener & Seligman, 2002; Frisch et al., 2004; Lucas et al., 2004; Myers & Diener, 1995). Conversely, more recent research with the SWLS has revealed the negative influences of today's mobile culture on health and well-being. Lepp, Barkley, and Karpinski (2014) found that high cell phone usage was correlated with lower levels of happiness, as well as lower GPA and higher rates of anxiety. With the growing culture of smartphone reliance (Kwon et al., 2013), assessing its relationship to happiness is of growing importance.

6.3 Subjective Happiness Scale

The four-item Subjective Happiness Scale (SHS; Lyubomirsky & Lepper, 1999) includes the prompt, "In general, I consider myself…," with responses ranging from 1 (*not a very happy person*) to 7 (*a very happy person*). It also asks, "Compared to my peers, I consider myself…" (1 = *less happy*, 7 = *more happy*), "Some people are generally very happy. They enjoy life regardless of what is going on, getting the most out of everything. To what extent does this characterization describe you?" (1 = *not at all*, 7 = *a great deal*), and "Some people are generally not very happy. Although they are not depressed, they never seem as happy as they might be. To what extent does this characterization describe you?" (1 = *not at all*, 7 = *a great deal*; reverse-scored). The SHS shows impressive internal consistency ($\alpha = 0.79$ to 0.94) and test–retest reliability ($r = 0.55$ to 0.90). Again, high scores correlate with desirable life outcomes, such as relationship success, income, and physical health (see Lyubomirsky et al., 2005, for a review).

This measure has been used to demonstrate changes in happiness resulting from a happiness-increasing intervention (eg, counting one's blessings, cultivating optimism; Sheldon & Lyubomirsky, 2006). Lyubomirsky and Tucker (1998) found that participants scoring high on this measure were more likely to view life events as more favorable and adaptive (ie, seeing the "silver lining" in difficult situations). They were also more likely to remember a newly met stranger in more favorable terms.

7 Brief scale critiques

These brief scales are the most widely used tools for assessing happiness, and for good reason. They are brief, inexpensive, and minimally invasive. They are also psychometrically sound and predictive of important life outcomes (Fujita & Diener,

2005; Lucas & Donnellan, 2006; Sandvik, Diener, & Seidlitz, 1993). They do, however, have their drawbacks. For one, they are crude in the sense that they do not tell us much about the discrete moments that promote or detract from happiness. When people declare themselves happy, exactly what aspects of their lives are responsible for that assessment? Also, many people are motivated to believe that they are living a good life, and a favorable happiness rating is likely to best reflect this notion.

Arguably the most prominent weakness is that the bulk of these measures are prone to reconstructive memory biases (Kahneman, 1999). They implicitly presume that raters are remembering and giving appropriate weight to all the relevant moments of their lives. However, many studies show that, instead, people rely heavily upon the information that is easy to call to mind when making their judgments. Although some have downplayed the impact of current states on global SWB ratings (Eid & Diener, 2004), current mood, recent events, social comparisons, and salient conditions like weather and dating status have been shown to affect people's global ratings of their happiness (see Schwarz & Strack, 1999, for a review). For example, when reflecting on the item, "The conditions of my life are excellent" (Diener et al., 1985), a respondent might think, "Well, it's a sunny day, vacation is coming up, and my husband took out the trash this morning…I guess my life is going well!" This is a perfectly reasonable and efficient strategy for responding to this and similar items, but it does not necessarily give an accurate rating of one's life as a whole. For these reasons and more, researchers have started proposing alternate methodologies to the brief, global assessment.

8 Combining state and trait assessments

8.1 Experience sampling method

One increasingly common technique is the experience sampling method (ESM), also known as ecological momentary assessment, which involves tracking people's momentary affective experiences, then aggregating them over a period of time. The assumption is that these measures will capture moments of happiness as they unfold in real time, minimizing memory bias. Csikszentmihalyi pioneered this methodology in the 1970s. He instructed his adolescent participants to keep careful, handwritten diaries when signaled by an electronic pager. They were asked to complete the experience-sampling form (ESF), briefly reporting where they were, what they were doing, who they were with, and how they were feeling immediately upon being signaled (Csikszentmihalyi et al., 1977).

The ESF self-report questionnaire consisted of four sections. The first section consisted of open-ended questions including: "Where were you?," "What was the main thing you were doing?," and "What other things were you doing?" The second section addressed why participants were performing the current activity using a three-item yes-or-no checklist. The next section was made up of a 10-point scale measuring the quality of the participant's interaction with the environment. The last section was a combination of 13 items assessing the participants' current mood and physical state.

The questionnaire took about 2 min to complete. Internal consistency was found to be acceptable for a measure computed from only four items, $\alpha = 0.57$ for affect and $\alpha = 0.48$ for arousal (Csikszentmihalyi & Larson, 1987). This research shed light on the day-to-day predictors of adolescent functioning and was foundational for the study of emotional experiences in everyday life.

As technology has advanced, ESM has becoming increasingly convenient and practical. In the 1990s and 2000s, personal data assistants (ie, Palm Pilots) allowed participants to move from pencil-and-paper reporting to electronic data recording (ie, Wirtz et al., 2003). Participants in a study of this nature would be signaled at random multiple times throughout the day. As soon as possible upon being signaled, they respond to inquiries into their current emotional state, energy level, degree of mind-wandering, and so on. More recently, the ubiquity of smartphone technology has led to applications that signal participants via text message, asks them relevant questions, track attrition rates, and automatically upload data (ie, Killingsworth & Gilbert, 2010).

8.2 Day reconstruction method

Despite the rich data that can be gathered from ESM, it is costly for researchers and often burdensome for participants, who may find the signals annoying and tiresome. Also, given the random timing of the signals, it may miss very important moments in one's day. Given these limitations, the Day Reconstruction Method (DRM; Kahneman et al., 2004) was developed with the goal of retaining the benefits of ESM while being inexpensive to use and less taxing on participants. In a typical DRM study, participants think back to the prior day and divide it into a series of discrete episodes (ie, driving to work, going out to lunch, checking email before bed). They then rate each episode on a series of dimensions, most notably, how happy they felt in each.

While ESM is still considered the "gold standard" of momentary assessment, DRM appears to provide data similar to that of ESM. Test–retest reliability coefficients have been found to range from 0.45 to 0.65 over a 2-week period (Krueger & Schkade, 2008), which is impressive given how experiences and emotions can vary from day to day. Moreover, negative affect reported in the DRM has been shown to relate to higher levels of resting heart rate (Daly, Delaney, Doran, Harmon, & MacLachlan, 2010). It has been used successfully in a diversity of populations, ranging from college students (Srivastava, Angelo, & Vallereux, 2008) to middle-aged working women (Kahneman et al., 2004) to both American and South Korean retirees (Oishi, Whitchurch, Miao, Kurtz, & Park, 2009). Although it provides a viable and interesting alternative to ESM, it is worth noting that it is still a bit of a burden to participants, requiring a rather intensive session of 45–75 min to complete.

Given that momentary measures such as ESM and DRM are more costly and difficult to implement than a simple, psychometrically sound scale, a reasonable question is: what do they add to our understanding of happiness? In short, quite a lot. They give detail on some of the possible momentary causes of happiness that global measures may miss. In an often-cited DRM study (Kahneman et al., 2004), socializing with friends was a happy time for working mothers, but time spent taking care of children was about as unpleasant

as commuting, a finding that inspired rich new research on the complicated relationship between parenting and happiness (Nelson et al., 2013; White & Dolan, 2009). Also, spring-break travelers revealed via ESM that their recall of their vacation was far more positive than it appeared to be as it was happening (Wirtz et al., 2003). While any vacation has its neutral or irritating moments (waiting in line, lost luggage), these moments tend to be downplayed when looking back on the experience as a whole, a phenomenon known as the "rosy view" (Mitchell, Thompson, Peterson, & Cronk, 1997). Interestingly, it was these retrospective ratings that correlated with a desire to take a similar trip in the future. Global, retrospective measures could not have detected this fascinating disconnect between momentary and recalled hedonic experience. The use of various ESM measures have also demonstrated this interesting disconnect, reminding both researchers and consumers of research to consider the multifaceted nature of SWB.

9 Conclusions and future directions

In a relatively brief period of time, happiness has shifted from an abstract concept marginalized by research psychologists (Seligman & Csikszentmihalyi, 2000) to an important, well-defined, measurable construct. Psychometrically sound measures of SWB have found meaningful links between happiness and many of the desirable things in life, including social support, happy marriages, educational attainment, professional success, and mental and physical health. Given these robust connections, researchers are making increasingly convincing arguments for the inclusion of well-being indicators in nationally representative measures such as the national census (Diener, Kesebir, & Lucas, 2008; Diener & Seligman, 2004). Several European nations have incorporated brief happiness measures in their annual censuses, and results have shed light on the emotional impact of events like marriage, divorce, widowhood, and unemployment (Diener, Lucas, & Scollon, 2006; Lucas et al., 2004).

The growing consensus in the operational definition of happiness coupled with technological advances has also allowed for the expansion of assessment modalities beyond exclusive reliance on subjective self-report measures. Researchers in social and affective neuroscience have linked happiness to certain brain structures, neurotransmitters, hormones, and reactions (Farhud, Malmir, & Khanahmadi, 2014; Lane, Reiman, Ahern, Schwartz, & Davidson, 1997). Using a PET scan, Lane et al. (1997) found happiness to be associated with stimulation in the prefrontal cortex, thalamus, hypothalamus, and parts of the temporal cortex. Farhud et al. (2014) conducted a systematic review to find the biological factors correlated with happiness. While they discussed the anatomical structures mentioned above, they also reviewed literature that focused on correlates with happiness at the neural level. Many neurotransmitters such as dopamine, serotonin, norepinephrine, and endorphin were found to be associated with happiness. In addition to these neurotransmitters, the systematic review also discussed evidence of a relationship between hormones released from the endocrine glands (ie, cortisol, adrenaline [epinephrine], and oxytocin) and happiness. These findings are providing a platform for future research on the origins, as well the influence, of happiness on a more biological level. As technology advances and becomes

more accessible to researchers, studying happiness on the biological level becomes increasingly feasible.

Outside of the laboratory, researchers study happiness as it unfolds naturally, with techniques such as the electronically activated recorder (EAR; Mehl, Vazire, Holleran, & Clark, 2010), which unobtrusively records participants' daily social interactions. With this technique, researchers can code for positive experiences such as laughter, social connection, and the degree of positivity in participants' conversations. In the last few decades, psychologists' understanding of happiness has increased tremendously, with the creation and refinement of various methodological techniques. As technology advances, we can expect both laboratory and field research to continue moving in these exciting new directions.

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Measurement of Disgust Proneness

21

Megan Viar-Paxton and Bunmi O. Olatunji
Department of Psychology, Vanderbilt University, Nashville, TN, United States

Research on the emotion of disgust has seen a considerable rise in the last few decades. Contemporary models suggest that disgust evolved largely as a defensive mechanism. As omnivores, humans will attempt to ingest nearly anything, thus disgust evolved as a food rejection system to remind us that we cannot indiscriminately consume everything that we encounter (Haidt, Rozin, McCauley, & Imada, 1997; Rozin, 1976). Accordingly, initial theories primarily focused on the function of disgust as an oral rejection of potential contaminants. Indeed, Darwin first described disgust as " … something revolting, primarily in relation to the sense of taste, as actually perceived or vividly imagined; and secondarily to anything which causes a similar feeling through the sense of smell, touch and even of eyesight" (1872/1965). However, not all stimuli that elicit disgust are food-related, including blood, mutilation, cockroaches, and incest just to name a few. Some researchers have suggested the wide range of elicitors reflects a broader protective function of disgust (Haidt, McCauley, & Rozin, 1994). Accordingly, Davey (1991) proposed the disease-avoidance model of disgust which suggests that, over time, certain stimuli (eg, small animals, blood) have acquired an association with the spread of disease or contamination. This association then leads to subsequent heightened disgust responding and avoidance. The disease-avoidance model provided an initial framework for understanding why some generally non-life-threatening objects are avoided. For example, Matchett and Davey (1991) found that a propensity to experience disgust was associated with a fear of snakes, spiders, and rats, but not with animals which are generally considered physically dangerous such as lions or sharks. This broader conceptualization of the function of disgust has served as the foundation for many contemporary models examining a variety of research questions.

The experience of disgust has been reported to be present, at least to some extent, in all individuals (Olatunji & Broman-Fulks, 2007). Disgust that is experienced at the extreme end of the spectrum may become dysfunctional in two ways. First, the threshold for what one considers disgusting may be too low, causing the individual to be easily disgusted and subsequently avoid a wide array of stimuli that may not be inherently dangerous (ie, heightened disgust propensity; Haidt et al., 1994). Second, the experience of disgust itself may be evaluated as particularly negative or dangerous (ie, heightened disgust sensitivity; van Overveld, de Jong, Peters, Cavanagh, & Davey, 2006). This tendency to evaluate the experience of disgust negatively may make even mild disgust sensations intolerable. Heightened disgust has been proposed as a potential vulnerability factor for a number of clinical disorders, particularly anxiety-related

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disorders (Olatunji, Cisler, McKay, & Phillips, 2010; Olatunji & Sawchuk, 2005; Phillips, Fahy, David, & Senior, 1998).

In addition to clinical disorders, examination of individual differences in disgust has informed current understanding of other phenomena, including cultural perceptions of beauty. For example, Tiggemann and Lewis (2004) found that individual disgust levels predicted negative attitudes about body hair on women, but not men, thereby making removal of female body hair biologically normative and more attractive. Relatedly, disgust responding may also predict mate preferences. For example, women who report greater disgust levels show stronger preferences for men with masculine faces, an evolutionary indication of health (DeBruine, Jones, Tybur, Lieberman, & Griskevicius, 2010). Similarly, Jones et al. (2013) found that individual differences in disgust were associated with women's masculinity preferences when judging the attractiveness of men's faces, bodies, and voices. Jones et al. (2013) also found that partnered women's disgust levels predicted their ratings of their actual partner's masculinity, suggesting that disgust guides not only mate preferences but actual choices as well. Disgust responding may also partially explain important biological processes during pregnancy. Indeed, it has been found that increased disgust responding in early pregnancy may serve to protect the body from disease as the immune system is compromised in order for the fetus to grow in its most vulnerable stages (Fessler, Eng, & Navarrete, 2005).

The link between individual differences in disgust and political and religious ideology has also begun to receive significant research attention. For example, Inbar, Pizaroo, and Bloom (2009) found that a propensity towards experiencing disgust was associated with more conservative political attitudes, particularly those with a "purity" focus, such as abortion and gay marriage. Similarly, Inbar, Pizarro, Iyer, and Haidt (2012) found that individual differences in disgust responding was positively correlated with measures of political conservatism and more conservative voting in the 2008 US presidential election. Furthermore, Inbar et al. (2012) replicated these findings cross-culturally in over 120 different countries. Analogous findings have been found for religious conservatism such that disgust propensity is positively associated with self-reported religiosity and social conservatism (Terrizzi, Shook, & McDaniel, 2013; Terrizzi, Shook, & Ventis, 2012). Many researchers have suggested that increased disgust responding among politically and religiously conservative individuals may represent evolutionary mechanisms of disease-avoidance by perceiving outgroup members as sources of potential contaminants (Terrizzi et al., 2013).

Recent research also suggests that individual differences in disgust may inform career preferences. These findings have been particularly salient among those in the medical profession. For example, Consedine and Windsor (2014) found that specific disgust propensities predict specialization intention among medical students above and beyond demographics and traditional determinants of career interests as determined by the Association for American Medical Colleges (ie, expectations regarding income, desire to help others, fit with personality, minimization of educational debt, etc.). More specifically, greater disgust responding towards mutilation and death predicted reduced interest in emergency medicine and greater interest in pediatrics.

Conversely, greater disgust responding towards bodily products predicted lower interest in pediatrics and obstetrics/gynecology (Consedine & Windsor, 2014). Heightened disgust sensitivity may also partially explain gender disparities in surgical careers. Consedine, Yu, Hill, and Windsor (2013) found that disgust sensitivity predicted interest in surgery above and beyond demographics and traditional career determinants (ie, AAMC career factors) such that those high in disgust responding were less likely to be interested in surgical medicine. Given that disgust research has consistently found a robust gender effect in which women are more likely to report higher levels of disgust compared to men (Arrindell, Mulkens, Kok, & Vollenbroek, 1999; Fan & Olatunji, 2013; Haidt et al., 1994; Olatunji, Ebesutani, Haidt, & Sawchuk, 2014; Olatunji, Haidt, McKay, & David, 2008; Olatunji, Sawchuk, Arrindell, & Lohr, 2005; Olatunji et al., 2009), the marked shortage of female surgeons may be at least partially be attributed to heightened disgust.

Examination of individual differences in disgust can also inform consumer decision-making. Argo, Dahl, and Morales (2006) asked participants to try on a t-shirt and rate how much they liked or disliked it. Researchers varied whether participants thought the t-shirt had not been worn or had recently been worn (ie, led participant to a dressing room that a confederate was exiting). Results showed that while participants never observed the shirt in direct contact with the confederate, the perception of physical contamination increased feelings of disgust and resulted in decreased preference of the t-shirt compared to the non-contaminated shirt. Interpersonal disgust was also examined in a study which found that consumers that were "accidently" touched by a salesperson while viewing an item, rated that item as less appealing than those individuals whose personal space was not invaded (Martin, 2012). In addition to the social transfer of disgust, consumer preferences may also be influenced by mere proximity to disgust stimuli. For example, Morales and Fitzsimon (2007) found that desirable items (eg, cookies) are rated as less desirable and are less likely to be purchased when placed next to disgust-eliciting products (eg, feminine napkins) despite the absence of actual cross-contamination. Taken together, these findings suggest that a greater understanding of disgust responding may inform more efficient and effective marketing, packaging, and product placement.

1 Measures of individual differences in disgust responding

As shown in Fig. 21.1, disgust is an emotional "hub" that extends to various phenomena (Strohminger, 2014). This broad impact of disgust highlights the importance of reliable and valid measures of the construct. A number of self-report measures have been developed to quantify individual differences in disgust responding. Although these measures were developed to assess disgust, they differ in the conceptualization of disgust, how elicitors are grouped together, and the context in which elicitors are presented. Below, we review the most widely used self-report measures of disgust, their psychometric properties, and the strengths and weaknesses of each measure.

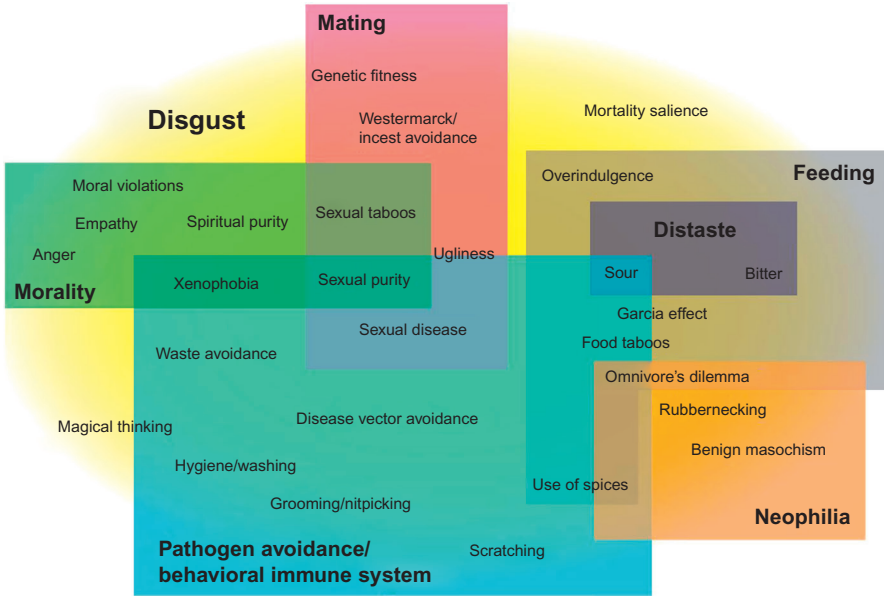


Figure 21.1 A conceptual map of disgust and related domains from Strohminger (2014).

1.1 The Disgust Scale

The first measure to appear in the literature that examined responding to a heterogeneous array of disgust elicitors (rather than exclusively looking at food rejection) was the Disgust Scale (DS; Haidt et al., 1994). The DS is a 32-item scale comprised of 16 true–false items and 16 items rated on a 3-point Likert scale (0 = *not disgusting at all*; 0.5 = *slightly disgusting*; 1 = *very disgusting*). Sample items include "It would bother me to see a rat run across my path in a park." and "I never let any part of my body touch the toilet seat in public bathrooms." The DS was developed to assess how disgusting particular experiences would be across eight domains including (1) Food, (2) Animals, (3) Body Products, (4) Body Envelope Violations, (5) Death, (6) Sex, (7) Hygiene, and (8) Sympathetic Magic. This 8-factor model has been cross-culturally replicated in a Swedish population (Björklund & Hursti, 2004). A total score is derived by summing the scores from the two sections. Scores on the DS range from 0 to 32, where larger numbers indicate a greater readiness for experiencing disgust.

The DS is perhaps the most widely used measure of individual differences in disgust responding and has been translated into several different languages including Swedish, Japanese, German, Dutch, French, Spanish, and Italian. However, a major weakness is that its subscales demonstrate low to moderate reliability (Nunnally, 1978) with αs ranging from 0.23 to 0.64 (Haidt et al., 1994; Schienle et al., 2003; Tolin, Woods, & Abramowitz, 2006). Accordingly, the Disgust Scale-Revised (DS-R; Olatunji, Williams, et al., 2007) was developed in order to address the psychometric limitations of the original DS. Using a distribution-free, exploratory factor analytic

approach, the authors removed seven items (reducing the scale from 32 items to 25) due to poor factor loading. This resulted in a three-factor model: *Core Disgust Sensitivity* (ie, disgust based on a sense of offensiveness and threat of disease), *Animal-Reminder Disgust Sensitivity* (ie, disgust that reflects the aversion to stimuli that serve as reminders of the animal origins of humans), and *Contamination-based Disgust Sensitivity* (ie, disgust reactions based on the perceived threat of transmission of contagion).

The DS is also limited by a narrow range of responses (0, 0.5, 1) which could result in ceiling effects, thereby minimizing the scale's sensitivity to detect meaningful differences. Therefore the DS-R expanded responses from a 3-point scale to a 5-point scale where 0 = *Strongly disagree* and 4 = *Strongly agree.* This allows for greater variability in disgust scores across individuals. The DS-R has demonstrated good internal consistency with non-clinical undergraduate samples and clinical (eg, OCD) samples (Olatunji, Williams, et al., 2007). The authors reported Cronbach alphas ranging from 0.84–0.88 for the total score, and 0.61–0.82 for each subscale which is substantially better than those for the DS (0.23–0.64). The DS-R correlates strongly with the original version ($r = 0.89$), but the removal of problematic items reduced the number of domains and resulted in improved model fit. This is consistent with the finding that the number of items being analyzed in a factor analysis is negatively correlated with the model's goodness of fit, which suggests that the more items a scale has, the worse the model fit (Kenny & McCoach, 2003). The improved model fit of the DS-R suggests that it is a more reliable assessment of individual differences in disgust responding compared to the DS. Indeed, this three-factor model of the DS-R has been replicated in adolescents (Kim, Ebesutani, Wall, & Olatunji, 2012) and in a number of cross-cultural samples (Kang, Kim, Namkoong, & An, 2010; Olatunji et al., 2009; van Overveld, de Jong, Peters, & Schouten, 2011).

1.2 The Disgust Emotion Scale

The Disgust Emotion Scale (DES; Walls & Kleinknecht, 1996) was also developed to address the limitations of the original DS. The DES is a 30-item measure that assesses individual differences in disgust responding across five domains: animals, injections and blood draws, mutilation and death, rotting foods, and smells. Sample items include: "The mutilated body of a dog that had been run over by a car," "A pile of rotting lettuce," and "Receiving an anesthetic injection in your mouth." Participants are asked to rate how disgusted they would be if they were exposed to each item on an expanded (compared to the original DS) 5-point Likert scale (0 = *no disgust or repugnance at all* to 4 = *extreme disgust or repugnance*). Although the DES contains many of the same elicitors as the DS (eg, urine, vomit, spoiled milk, dead body, sewer rat), the DES reduces the number of disgust domains from eight (Haidt et al., 1994) to five, with each subscale containing six items (compared to only four items per subscale with the DS). The expanded response scale coupled with fewer disgust factors allows for a much wider range (0–30) of potential responses for each subscale, thereby allowing for more sensitive detection of individual differences in disgust.

The DES has been shown to have good psychometric properties in various samples. For example, Olatunji, Williams, et al. (2007) were able to replicate the proposed five-factor structure and found that the DES total score and its subscales had good internal consistency ($\alpha s = 0.90$ total score; 0.89 foods; 0.88 blood and injections; 0.58 smells; 0.84 mutilation and death; and 0.59 small animals). The five-factor model has also been replicated in children (Muris et al., 2012). More recently, Olatunji, Ebesutani, and Reise (2015) found that a bifactor model with a general disgust propensity dimension and the five subfactors was the best fit for the data. Despite these strengths, the DES, like the DS-R, relies on disgust responding to specific elicitors. Given that these same elicitors are also generally present on measures of psychopathology (eg, measures of BII phobia, spider phobia, contamination fear), associations between disgust measures and psychopathology measures may be inflated (Thorpe & Salkovskis, 1998; Woody & Teachman, 2000). Therefore a measure that is not constrained by specific contexts or elicitors may yield more precise relations with psychopathology.

1.3 The Disgust Propensity and Sensitivity Scale

The Disgust Propensity and Sensitivity Scale (DPSS; Cavanagh & Davey, 2000) was developed to remove the contextually bound nature of disgust in previous measures and to make meaningful distinctions between individual differences in disgust *sensitivity* and disgust *propensity*. van Overveld et al. (2006) define disgust propensity as the extent to which disgust is experienced, while disgust sensitivity is defined as the extent to which the experience of disgust is interpreted as dangerous. Previous measures of disgust have examined how easily one is disgusted, but not how an individual appraises that experience. This may represent an important distinction given that how easily an individual is disgusted may be less of a risk factor for the development of psychopathology than how negatively they interpret the experience of disgust. That is, disgust propensity and disgust sensitivity may be differentially associated with the development and maintenance of psychopathology.

The DPSS is a 32-item scale designed to examine both the frequency of experiencing disgust (disgust propensity; 16 items) as well as the emotional effect of experiencing the symptoms of disgust (disgust sensitivity; 16 items). Sample items include: "I avoid disgusting things," "Disgusting things make my stomach turn," and "I become more disgusted than other people." The DPSS has been found to have good psychometric properties, including good internal consistency and test–retest reliability (Disgust Propensity: $\alpha = 0.89$; Disgust Sensitivity: $\alpha = 0.87$). van Overveld et al. (2006) examined the psychometric properties of the DPSS in relation to measures of specific phobias among a large Dutch sample. This study found the DPSS to have adequate internal consistency as well as test–retest reliability (Disgust Propensity: $\alpha = 0.78$, test–retest reliability = 0.69; Disgust Sensitivity: $\alpha = 0.77$, test–retest reliability = 0.77). Further, the two subscales were able to discriminate between specific phobias such that disgust propensity was highly associated with spider fears, while disgust sensitivity was a better predictor of fainting in BII phobia. However, correlations between disgust propensity and disgust sensitivity were high ($r = 0.59$), suggesting that the two traits may not represent distinct constructs.

Based on theory and data-driven considerations (cf. Clark & Watson, 1995), van Overveld et al. (2006) developed the DPSS-R by reducing the scale items from 32 to 16. In an investigation examining the psychometric properties of the DPSS-R, Olatunji, Cisler, Deacon, Connolly, and Lohr (2007) found that the DPSS-R demonstrated good reliability, convergent validity (eg, positive correlations with anxiety disorder symptoms and negative affect), and discriminant validity (eg, negligible relation to positive affect). Confirmatory factor analyses of the DPSS-R supported the two-factor model consisting of disgust propensity and disgust sensitivity factors (Olatunji, Cisler, et al., 2007; van Overveld et al., 2006). However, Olatunji, Cisler, et al. (2007) also found several differences in how items loaded onto the two factors, and several items failed to meet the salient factor loading of 0.40. The authors suggested possible cross-cultural inconsistencies given that the van Overveld et al. (2006) sample was Dutch and the Olatunji, Cisler, et al. (2007) sample was American.

Given the DPSS-R's weaknesses that were identified by Olatunji, Cisler, et al. (2007), Fergus and Valentiner (2009) conducted a follow-up investigation and removed four problematic items. This resulted in a 12-item DPSS-R (labeled DPSS-12). The DPSS-12 was found to provide a better fit than the 16-item DPSS-R, showed good reliability, and demonstrated meaningful correlations with disgust-relevant phobias and anxiety sensitivity. Consistent with the original DPSS (Cavanagh & Davey, 2000) and the DPSS-R (van Overveld et al., 2006), the DPSS-12 (Fergus & Valentiner, 2009) found that a two-factor model (Disgust Propensity and Disgust Sensitivity) was the best fit for the data.

Although psychometric examination of all three versions of the DPSS (ie, DPSS, DPSS-R, and DPSS-12) have consistently revealed two factors (Disgust Sensitivity and Disgust Propensity), a more recent examination of the factor structure of the DPSS-12 found support for a third factor (Goetz, Cougle, & Lee, 2013): self-focused/ruminative disgust, which included two items. Given this finding, the authors suggest two potential modifications for the DPSS-12. First, the two self-focused/ruminative disgust items can be removed to create a 10-item, two-subscale DPSS-10 measure. Indeed, the authors found that the DPSS-10 was a better fit for the data than a unidimensional, two-factor or three-factor model when all 12 items were included. Second, if all 12 items of the DPSS-12 are used, then a third factor should be taken into consideration.

While the four versions of the DPSS (ie, DPSS, DPSS-R, DPSS-12, and DPSS-10) have demonstrated acceptable reliability and meaningful associations with disgust-related phobias and other relevant traits (eg, anxiety sensitivity), the psychometric data suggest that the DPSS-12 and DPSS-10 are the most valid measures of disgust propensity and sensitivity. However, the majority of studies continue to use the 16-item DPSS-R. Indeed, a PsycInfo search reveals that since its publication in 2009 only about 18 studies have used the DPSS-12, compared to approximately 81 studies which used the DPSS-R. To date, no published studies have used the DPSS-10 since its publication in September 2013. These findings shed light on a broader issue of continuing to use less valid measures of a construct even in the face of contradictory evidence. Thus, results of studies which use the DPSS or the 16-item DPSS-R should be interpreted with caution as they contain items that have been shown to not be representative of the construct they are intended to measure.

1.4 The Three Domains of Disgust Scale

The Three Domains of Disgust Scale (TDDS; Tybur, Lieberman, & Griskevicius, 2009) was most recently developed based on an adaptationist model of disgust that suggests three functionally specialized domains of disgust have emerged through selection pressures that recurred over evolutionary history. These domains include: *pathogen disgust*, which motivates the avoidance of infectious micro-organisms; *sexual disgust*, which motivates the avoidance of sexual situations that would jeopardize one's reproductive success; and *moral disgust*, which motivates the avoidance of social norm violators. The TDDS is a 21-item self-report measure of disgust responding across three domains: *moral* disgust (eg, "deceiving a friend"), *sexual* disgust (eg, "hearing two strangers having sex"), and *pathogen* disgust (eg, "stepping on dog poop"). Items are scored on a 7-point Likert scale, where 0 = not at all disgusting and 6 = extremely disgusting. Internal consistency of the scale is adequate with Cronbach's alphas ranging from 0.83–0.89 across the three domains. The TDDS was shown to be differentially related to several personality traits, vulnerability to disease, and psychopathic tendencies.

In a follow-up psychometric evaluation, Olatunji et al. (2012) concluded that the scale had several strengths and weaknesses. The convergent and divergent validity data suggested that the three-domain structure of the TDDS is promising and indicate that the three factors are distinct from one another. However, examination of the TDDS's test-retest reliability revealed that only Pathogen Disgust and Sexual Disgust scores were found to be in the acceptable range (>0.70) of what is considered acceptable stability of score over a 12-week period (Nunnally, 1970). Although, dispositional traits are assumed to be stable over time, Moral Disgust and the TDDS total score were below the acceptable test–retest reliability range. This may suggest that some domains of disgust are inherently more stable than others. For example, disgust reactions to moral transgressions are often dictated by social norms, which are culturally defined and vary over time. However, avoidance of pathogen and sexual disgust elicitors is motivated by more biologically based systems, such that avoidance of those stimuli promotes survival either through well-being or fertility. Thus, the stability of a disgust response is likely to be reflected in the stability of the elicitor itself over time.

1.5 The Child Disgust Scale

The interest in disgust specifically as a risk factor for the development of anxiety implies that dysfunctional disgust would be present before the onset of the disorder. Given that anxiety typically develops in childhood (Kessler et al., 2005), a measure of disgust that is developmentally appropriate for young children is vital in determining whether heightened disgust sensitivity is a precursor to the development of anxiety. Previous studies have utilized downward versions of the adult disgust measures (Muris, Merchelbach, Schmidt, & Tierney, 1999; Muris, van der Heiden, & Rassin, 2008), however developmentally inappropriate elicitors and the readability of both the

items and the response scale may be too advanced for younger children. The Child Disgust Scale (CDS; Viar-Paxton et al., 2015) is a 14-item scale that was recently developed to examine disgust responding among youth. The CDS categorizes items functionally into two distinct factors: Disgust Affect (ie, the emotional experience of disgust) and Disgust Avoidance (ie, behavior towards disgusting stimuli) as well as a general disgust score. Sample items include: "If a dog licked my popsicle, I would still eat it," "I would sit next to a sweaty kid at lunch," and "I would still drink my juice box even if I saw another kid drink out of it." The CDS utilizes age-appropriate elicitors and has a low reading level that makes it easier for children to comprehend. For example, analysis of the Flesch Reading Ease (FRE) (where higher numbers indicate greater readability) and the Flesh-Kincaid reading grade level (Flesch, 1951), revealed that the CDS has the highest readability (FRE = 94.7) and the lowest grade level (2.9) compared to other disgust measures (see Table 21.1). In addition to the items themselves, the response scale is simplified to a 3-point scale (Always, Sometimes, Never) given Ollendick's (1983) suggestion that "… young children, as well as impaired clinical-child population, have difficulty understanding and discriminating responses on [a] 5-point scale."

The CDS has several notable strengths. Initial studies examining the psychometric properties of the CDS found that the CDS total score demonstrated an average Cronbach's alpha of 0.77 across four independent samples of children ages 5–13 years old. The CDS also demonstrated good convergent validity with significant correlations with measures of anxiety and fear. As evidence for known groups validity, youth with a diagnosis of a specific phobia reported greater disgust compared to a matched non-clinical sample. However, the CDS has some weaknesses including use of reverse-worded items. The reverse-worded items showed reduced internal consistency and may be confusing to children, especially younger children. Additionally, the test–retest reliability of the scale is unknown. Future research with the CDS should attempt to remove the reverse-worded items and re-examine the factor structure with new items.

2 Behavioral assessment of disgust

The development of self-report measures of disgust has allowed for rapid growth in our understanding of how individual differences in disgust relate to various phenomena. However, exclusive reliance on self-report measures of disgust can be limiting. Although self-report assessments can be useful for examining trait-like aspects of disgust, they offer limited insight presented with various stimuli in vivo. Behavioral measures of disgust may also yield individual differences in disgust responding among populations where self-report is not available or appropriate (ie, very young children, intellectually disabled, or illiterate populations). Given that disgust can be easily elicited in a laboratory setting (Rozin, Lowry, & Ebert, 1994), many studies have employed a behavioral avoidance task approach to assess disgust reactivity, or state disgust. For example, Rozin, Haidt, McCauley, Dunlop, and Ashmore (1999)

Table 21.1 **Overview of disgust sensitivity psychometric studies in chronological order**

	Sample characteristics					Questionnaire psychometrics	
Measure	**Type**	*N*	**Mean age (SD)**	**Female (%)**	**Caucasian (%)**	**FRE**	**Flesh-Kincaid**
Disgust Scale-Revised[a]	Undergraduates	655	20.31 (3.27)	75	90	75.6	4.6
	Undergraduates	993	19.01 (1.99)	75	75		
	Undergraduates	215	19.17 (3.35)	73	92		
	OCD patients	56	34.62 (11.42)	70	91		
	Non-anxious controls	14	29.00 (10.79)	71	64		
Disgust Emotion Scale[b]	Undergraduates	260	1961 (1.86)	84	NR	66.1	5.8
	Undergraduates	307[c]	20.52 (4.59)	70	NR		
Disgust Propensity and Sensitivity Scale- Revised[d]	Undergraduates	60	21.58 (2.5)	87	NR	73.4	5.0
Three Domains of Disgust Scale[e]	Undergraduates	206	19.42 (1.21)	73	77	64.0	6.5
	Undergraduates	406	19.69 (3.56)	61	88		
	Undergraduates	200	19.59 (1.44)	61	88		
	Contamination fear undergraduates	47	19.31 (1.18)	57	73		
	Undergraduates	70	19.42 (1.21)	87	70		
	Undergraduates	89	19.20 (0.96)	62	80		
	Undergraduates	89	19.42 (1.02)	62	73		

Child Disgust Scale[f]	Elementary and middle school children	1500	NA[g]	48	76	94.7	2.9
	Elementary and middle school children	574	9.07 (1.51)	54	89		
	Community child sample	50	7.62 (2.18)	48	70		
	Children with diagnosis of specific phobia	43	9.16 (1.90)	42	93		
	Non-clinical controls	43	9.16 (1.90)	42	93		

Note: *NR*, not reported; *NA*, not available; FRE, Flesch Reading Ease; *Flesch-Kincaid*, Flesch-Kincaid Grade Level.
[a]Haidt et al. (1994); Modified by Olatunji, Williams, et al. (2007). Study data presented are from Olatunji et al. (2007).
[b]Original questionnaire by Walls and Kleinknecht (1996) but psychometrics were performed by Olatunji, Sawchuk, de Jong, and Lohr (2007). Study data presented are from Olatunji et al. (2007).
[c]Demographic data unavailable for 152 participants due to a data management error.
[d]Cavanagh and Davey (2000); Modified by Van Overveld, De Jong, and Peters (2010). Study data presented are from Van Overveld et al. (2010).
[e]Olatunji et al. (2012).
[f]Viar-Paxton et al. (2015).
[g]Age was not provided for the sample only grade. The grade break-down was as follows: 186 (12%) children in 2nd grade, 198 (13%) in 3rd grade, 167 (11%) in 4th grade, 225 (15%) in 5th grade, 213 (14%) in 6th grade, 252 (17%) in 7th grade, 253 (17%) in 8th grade, and 6 (<1%) students that did not provide a grade.

exposed participants to 32 behavioral tasks that were disgust-relevant (eg, cockroaches, cremated ashes, freshly killed pig's head) and disgust-irrelevant (imitating a chicken, holding one's hand in ice water). Each task included a series of steps of increasing exposure (eg, looking at, picking up, touching, etc.). Four factors emerged from the intercorrelations of the behavioral tasks: food-related disgust; body violation- and death-related disgust; compliance motivation; and embarrassability, with only the two disgust factors being associated with self-report DS scores. This initial study suggests that a combination of self-report measures and behavioral tasks can facilitate a more comprehensive assessment of disgust.

Behavioral assessment of disgust has most often been conducted in clinical populations as a means to examine associations between self-report measures of fear or disgust and/or differences in avoidance between clinical and non-clinical samples. Using a wide array of disgust elicitors, Woody and Tolin (2002) examined disgust responding among spider fearful individuals. Disgust elicitors were categorized into four domains: foods, animals, body products, and envelope violations. Findings revealed that participants were most avoidant of the animals category with only 58% fully completing the task. Additionally, participants reported more disgust than anxiety to the task, which suggests some degree of construct validity. Examination of self-report measures of disgust revealed that the DS total score predicted avoidance only on the animals behavioral task. Similarly, Koch, O'Neil, Sawchuk, and Connolly (2002) found that blood-injection-injury (BII) fearful individuals were more avoidant of a deer leg and bloody gauze compared to non-fearful participants. Compared to non-fearful participants, BII fearful individuals reported greater fear and disgust during the behavioral tasks. However, BII fearful participants reported greater disgust than fear. Olatunji, Lohr, Sawchuk, and Tolin (2007) found that contamination fearful participants were less willing than non-fearful participants to comply when asked to approach various disgust elicitors with the exception of the envelope violation task that consisted of approaching a tray of cow eyeballs and injecting one of the eyeballs with a hypodermic needle. Additionally, they reported more fear and disgust on the behavioral tasks compared to non-fearful participants. Contamination fearful individuals also reported greater disgust compared to fear on all behavioral tasks.

Examination of facial expressions may also allow for reliable behavioral assessment of disgust. Using the Facial Action Coding System (FACS; Ekman & Friesen, 1978), Ekman, Friesen, and Hager (2002) identified two action units that are characteristic of the disgust facial expression: Action Unit (AU) 9, which indexes the wrinkling at the top of the nose, and AU10 which indexes the upper lip and wrinkles the lower part of the nose. This so-called "nose scrunch" (Pochedly, Widen, & Russell, 2012) is thought to represent the prototypical facial expression of disgust that is identifiable to most individuals (Russell, 1993). However, other research suggests that one's facial expression of disgust may be largely dependent on the type of elicitor. For example, Rozin et al. (1994) found that activation of AU9 (ie, upper nose wrinkling) was most associated with offensive smells and, to a lesser extent, distaste. Disgust elicitors that were non-food-related were more associated with activation

of AU10 (ie, raised upper lip). This variability suggests that the coding systems for facial expressions of disgust may need to vary depending on the elicitor present in the study.

Although many researchers have suggested that the disgust facial expression is universal, there is a growing body of research which finds that the disgust face is often mistaken for other negative emotions, particularly among children. Indeed, a series of studies conducted by Widen and Russell has shown that young children (ie, younger than 8 years old) often misattribute the disgust facial expression to indicate anger rather than disgust (Widen, & Russell, 2008, 2010, 2013). It has been suggested that the misattribution may be due to the "nose scrunch" that is often observed with both the disgust and the anger expression, particularly when the scowl or bared teeth are removed (Widen & Russell, 2013). These data indicate that recognition of the disgust response may be acquired rather than innate. Studies which plan to use facial expressions as an indicator of disgust reactivity should consider the age of the sample of interest.

3 Measurement of individual differences of disgust: A critique

3.1 Measurement differences

Although most measures of disgust utilize an ordinal scale (ie, numbers are ordered based on the amount of the property being measured), nearly all are analyzed as if they were interval (ie, numbers are in rank order where distances between numbers have meaning with response to the property being measured). The DPSS-R, for instance, utilizes the scale points "Never," "Rarely," "Sometimes," "Often," and "Always." While these points clearly indicate a rank order, the assumption that there is equal distance between those points is difficult to confirm. Furthermore, is the psychological meaning of this numerical value consistent across individuals? Given that each scale type has its own set of permissible statistics (Stevens, 1946), misconception regarding what type of scale is being used is an important issue. Ordinal data can only produce median or percentile results, while interval data can produce means, standard deviations, and correlations (Stevens, 1946). Stevens (1946) admits that while "outlawing" the use of means, standard deviations, and correlations of ordinal data would "serve no good purpose," computing these analyses on ordinal data is in error as they assume that the successive intervals between points are equal in size. Although this criticism applies for many self-report instruments, it is especially relevant when attempting to compare across measures of disgust which are thought to assess the same construct. Further, this issue may be particularly salient when considering comparison of different methodologies of disgust assessment. Indeed, few studies have examined how behavioral measures of disgust relate to other levels of analysis.

3.2 Content overlap

Fig. 21.1 shows that disgust may play a major role in many domains. However, research linking disgust to these various domains has largely employed self-report questionnaires that measure disgust responses to specific elicitors. This is problematic in that many of the disgust questionnaire items and disgust-related behavioral tasks are the same objects found in measures related to convergent domains of interest. For example, items related to several anxiety-related disorders (eg, small animals, insects, blood, needles) are also common disgust elicitors. Similarly, disgust items related to blood and mutilation are comparable to career-based questions regarding medical and surgical preferences. Similar content across self-report measures may yield inflated correlations between individual differences in disgust and other domains of interest (Kleinknecht & Thorndike, 1990; Thorpe & Salkovskis, 1998; Viar-Paxton, Tomarken, Pemble, & Olatunji, 2014). Thus, multimodal assessment that extends beyond self-report and behavior may be needed to rule out spurious associations related primarily to content overlap.

3.3 Cross cultural generalizability

Examination of cross-cultural differences in disgust responses may inform knowledge on the function of the emotion. Fig. 21.2 depicts global variation in disgust propensity from a web survey with 38,845 participants conducted by Curtis et al. (2004). Participants were asked to rate how disgusting they found a series of paired images that were identical except for minor alterations which made them disease-irrelevant or disease-relevant. For example, in one pair, a plate of viscous liquid is color-morphed in two ways: for the disease-irrelevant category, the liquid is dyed blue, whereas in the disease-relevant category it is made to look like bodily fluids. The results showed a high degree of variability between individuals for subjective ratings of disgust (average standard deviation = 0.83). However, differences in variability between continents were not statistically significant, varying only between 3.77 and 3.94 (SD = 0.05). These findings suggest that cultures do not significantly differ in disgust responses to images of common disease vectors. Consistent with this notion, Olatunji et al. (2009) found that scores on the DS-R significantly correlated with one another among eight countries including Australia, Brazil, Japan, Germany, Italy, Sweden, the Netherlands, and the United States. This suggests that there may be little variation in disgust elicitors *between* cultures, but considerable variability within a culture.

It is important to note that research on the cross-cultural manifestation of disgust is rather limited. For example, the countries examined in the Olatunji et al. (2009) study are all predominantly Western, and therefore some elicitors may differ in other parts of the world (ie, Africa). Although disgust is considered to be a defensive mechanism from ingesting potential contaminants, eating habits can be culturally determined. Western culture has historically viewed insects as disgusting, but insects are a main source of protein for other cultures (eg, Africa, Asia, South America) (DeFoilart, 1999). Many of the disgust questionnaires include items relating to insects (worms, cockroaches, and beetles) despite cultural variability. Curtis et al. (2004) found that

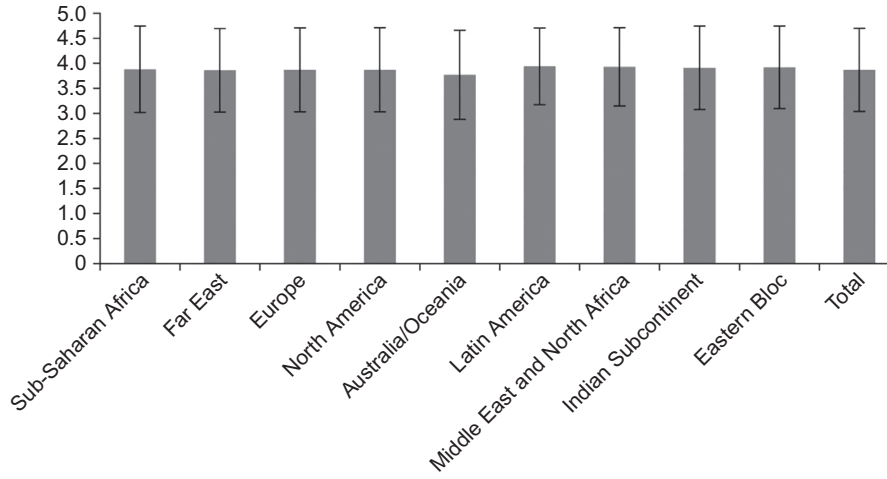


Figure 21.2 Mean and standard deviation of disgust scores for a sample of 38,845 individuals by region.

the only image pair in which the non-threatening image was rated as *more* disgusting than its disgust-relevant counterpart was the *Ascaris* (a small parasitic intestinal worm)/caterpillar pair. The *Ascaris* was found to be significantly more disgusting in Europe and North America, but the caterpillar was reported as more disgusting in the Far East, the Middle East, Latin American, and India. There were no significant differences in sub-Saharan Africa and Australia. Although the experience of disgust has been shown to serve an evolutionarily derived function, these findings suggest that culturally specific practices may yield considerable variation in predicting specific elicitors.

Important subtleties in language may also complicate cross-cultural comparisons of disgust responding. Several issues exist with translations of psychological measures including the reliance on bilingual translators, differences in back-translations (ie, translating to German then back to English) with the face-validity of the measure, and potential loss of construct. Indeed, there may be substantial cultural variance in how disgust is viewed and defined. For example, back-translation of the term disgust in Chinese cultures was more closely associated to the English term "anger" than disgust (Barger, Nabi, & Hong, 2010). Even within the United States, many participants define the term "disgust" to include conceptual features of anger, whereas the term "grossed out" is more closely akin to operational definitions of disgust (Nabi, 2002). These language considerations highlight the importance of culturally-sensitive operational definitions of disgust and in-depth translations including validation in the culture of interest.

Current measures of disgust are also limited by the lack of validation among ethnically heterogeneous populations. Table 21.1 shows that, among the studies which report ethnicity, the majority of participants in the psychometric validation studies of the scales are Caucasian. Across all the available studies reported in Table 21.1,

Caucasians account for an average of about 86% of the samples. This is a significant limitation because, although sparse, some research has shown significant ethnic differences in disgust responding. For example, compared to European Americans, African Americans report greater disgust sensitivity (Haidt et al., 1994). Similarly, Tolin et al. (2006) found that non-whites (majority African American) report greater disgust sensitivity compared to whites. However, findings which support ethnic differences in disgust sensitivity have been inconsistent (Skolnick & Dzokoto, 2013; Williams, Abramowitz, & Olatunji, 2012). Examination of ethnic differences in disgust should also be expanded beyond comparing whites to blacks. The 2010 census reports that the United States population increased by 27.3 million people (U.S. Census Report, 2010). More than half of the growth in the total US population was due to increases in the Hispanic population, which grew by 43% from 2000 to 2010 (U.S. Census Report, 2010). However, despite representing nearly 16% of the total US population, very little is known about disgust responding in the Hispanic population. A greater understanding of how disgust might vary by ethnicity can inform current understanding of a range of social and political issues that may also vary by ethnicity.

3.4 Distinct disgust domains

Although researchers agree that there are distinct disgust domains, there appears to be little agreement on the number of domains and how they should be categorized. To date, the three-factor model identified by Olatunji, Williams, et al. (2007) in their revision of the DS (core, animal-reminder, and contamination disgust) is the most widely used model. It has been replicated among adults (Olatunji et al., 2009), adolescents (Kim et al., 2012), and in different countries (Petrowski et al., 2010). However, some researchers have questioned whether core disgust, animal-reminder disgust, and contamination disgust represent conceptually distinct categories (Tybur et al., 2009) and an alternative approach that is based in the supposed function of disgust domains has been proposed. Tybur et al. (2009) highlight an adaptionist model with three functionally distinct domains: (1) pathogen disgust (motivates avoidance of infectious microorganisms), (2) sexual disgust (motivates avoidance of sexual situations that would jeopardize one's reproductive success), and (3) moral disgust (motivates avoidance of social norm violators). Although feces, mutilation, and deformed people may represent three distinct disgust constructs (ie, core, animal-reminder, and contamination, respectively) thematically, the adaptionist model states that the motivation to avoid these stimuli is the same: pathogen avoidance.

Although the adaptionist model emphasizes the functionality of disgust, Rozin and Haidt (2013) contend that such a model does not provide a complete framework for understanding disgust elicitors. They argue that culture, as opposed to biology, drives the "civilizing process" which separates humans from our animal ancestors. In addition to simply promoting pathogen avoidance, rules and practices derived from cultural evolution serve to maintain social order, prevent anarchy, and establish social hierarchies, concepts which are largely absent from primate and other mammalian societies. Rozin and Haidt also argue that the adaptionist model fails to account for a complete sampling of moral transgressions. The moral disgust domain

that Tybur et al. (2011) present only examines moral actions involving harm or fairness. Rozin and Haidt argue that actions from this domain may be more closely tied to the phenotypical anger response as opposed to disgust. The issues raised by Rozin and Haidt suggest that both culture *and* biology are likely important determinants of how disgust domains emerge. Accordingly, an integration of the two approaches may offer researchers flexibility in the self-report measures that are used. For example, consumer research focused on how interpersonal contact predicts consumer behavior may be more inclined to utilize measures which look at the function of disgust more broadly (eg, are individuals disgusted by interpersonal contact because of violation of social norms?). On the other hand, researchers examining how distinct disgust vulnerabilities may serve as risk factors for development of psychopathology, may be more inclined to use thematically grouped elicitors (eg, are individuals that are easily disgusted by blood and injections more likely to develop specific phobia?).

3.5 Distinct disgust vulnerabilities

Currently available disgust measures aim to assess individual differences in disgust responding. However, they do so without clearly differentiating, *disgust sensitivity, disgust propensity,* and *disgust reactivity.* Rozin and colleagues first utilized the term disgust sensitivity while examining disgust in the context of food rejection using the DQ (eg, Rozin, Fallon, & Augustoni-Ziskind, 1985). Rozin and colleagues defined disgust sensitivity as the degree or one's propensity to respond to stimuli with disgust. However, the use of the term "sensitivity" in this context was unfortunate given that it is often confused with other psychological constructs that are characterized by "sensitivity." Consider the construct of anxiety sensitivity (cf. Taylor, 1995) as an example. While Rozin and colleagues referred to disgust sensitivity (eg, DS, DS-R, DES) as a heightened propensity to respond with disgust, anxiety sensitivity does *not* refer to a heightened propensity to respond with anxiety. Anxiety sensitivity is conceptualized as the response of fear to the internal indicators of anxiety. However, disgust sensitivity, as it is commonly assessed in the literature, does *not* refer to the response of disgust to internal indicators of disgust. Using terms that are more in accordance with the emotion literature, *disgust propensity* can be conceptualized as the ease with which one becomes disgusted, *disgust sensitivity* refers to how negatively one interprets the experience of disgust, and *disgust reactivity* can be conceptualized as the level of disgust experienced in the presence of an elicitor. These three terms, though related, may represent separate constructs. A clearer demarcation of these terms and the measures that are used to assess them may offer much-needed clarity in the disgust assessment literature.

4 Conclusions

In 2009, Olatunji and McKay reported that citations with *disgust* and *disorder* have increased from nearly 0 in 1998 to at least 50 in 2007. A quick PsycInfo search with these same terms as keywords today reveals over 180 results, while a search with disgust as the only keyword reveals well over 1000 results. Despite the research

popularity of disgust in recent decades, much remains unknown about the emotion due to limitations of existing measures. As Crocker and Algina (1986) noted:

> *Before any measurement of a construct can be made, it is necessary to establish some rule of correspondence between the theoretical construct and observable behaviors that are legitimate indicators of the construct. This is known as 'establishing the operational definition'*
>
> *(p. 5).*

Accordingly, revisions of existing measures of disgust and development of new measures must be mindful of linking the theoretical function(s) of disgust with observable behaviors that reflect those function(s). The assessment of disgust would also be greatly improved by adapting a multimodal assessment approach. As Loevinger (1993) notes, "There are many pathways from a focal light source (ie, a construct) through a lens (ie, the assessment) to a focal point behind the lens (ie, the criterion)." In others words, each assessment modality can capture only a fraction of the construct. Incorporation of additional assessment modalities, such as behavioral outcomes may address some of the limitations that are inherent to all self-report measures of emotion. Behavioral assessment of disgust allows for the opportunity to objectively examine fluctuations in disgust reactions. Given Crocker and Algina' (1986) claim that no measure can provide a complete view of a construct, an assessment battery that includes multiple indicators will allow for the most complete view of the nature and function of disgust.

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Studying Emotions in the Elderly

22

Stefanie Kremer and Louise den Uijl
Wageningen UR Food & Biobased Research, Consumer Science & Health, Wageningen, The Netherlands

1 General introduction

Older persons are the consumers of the future since they are increasingly growing in number and form a heterogeneous part of the world's population (RIVM, 2013; United Nations, 2002). Worldwide, the number of persons aged 60 years or over is expected to almost triple by 2050. Not only is the total number of older persons rapidly growing; the older population itself is also aging. The number of *older old persons* (aged 80+ years) within the older population is expected to increase from 14% in 2013 to 19% in 2050 (United Nations, 2013). Human aging comes with various physiological and psychological changes, which in turn impact to various extents on older persons' emotional experiences, emotion regulation, emotion perception, and/or emotion-related attention and memory. Hence, the measurement of emotions in this segment of the population is becoming a topic of utmost importance–from both an academic and a commercial point of view.

This chapter aims to provide an overview of our current understanding of emotions and their measurement in older people. To this end, we first briefly reflect on several aging-related factors relevant for emotions and emotion measurement. Secondly, we review both the currently proposed theories on emotional aging, our current understanding of various facets of emotional aging, and their multidirectionality. Following-up on this, we evaluate several methods for measuring emotions in older persons. A range of widely used emotion measurement tools, their general suitability, and applications for use in the elderly population are discussed.

2 Who are "the elderly"?

The definition of seniors/the elderly and older persons varies across studies and disciplines. For example, marketers often label consumers aged at least 50 years as "old" (Weijters & Geuens, 2006), whereas others use a cut-off point of at least 60 or 65 years old (Yoon & Cole, 2008). Given the increased life expectancy and higher average age of retirement, the starting year of "old age" is becoming more and more arbitrary (Schwarz, Lentzy, & Hipp, 2008; Tempest, Barnatt, & Christine, 2008; van Rossum, 2009). In this chapter, in order to ensure a broad overview of our current understanding of elderly consumers' emotion measurements, we include studies that recruited adults of at least 55 years old. Since the vast majority of the studies conducted on this topic so far have used mainly independently living seniors aged between 60 and 75 years, both healthy seniors aged 80 and over and frail seniors of all ages are clearly understudied (Tables 22.1 and 22.2).

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Table 22.1 Overview of the reported age range, sample size, and participant characteristics of the studies referenced in Section 22.3

Reference	Age (years)	N	Participant characteristics
Carstensen (1992)	18–30–40–52	50	Participants from the longitudinal Child Guidance Study, followed over 34 years
Labouvie-Vief et al. (1989)	60–77	12	Senior volunteers selected from suburban neighborhoods in a major US mid-Western metropolitan area
Labouvie-Vief (2003)	60–77	12	Senior volunteers selected from suburban neighborhoods in a major US mid-Western metropolitan area
Smith et al. (2005)	60–71	32	Healthy seniors from the Champaign-Urbana community
Tsai et al. (2000)	70–85	48	Community sample
Carstensen et al. (2000)	Older = 60–94 Range: 18–94 (M = 55; SD = 20)	184	San Francisco Bay area residents
Mroczek and Kolarz (1998)	25–71	2727	Participants from a large, nationally representative survey of 25- to 74-year-old Americans conducted by the MacArthur Foundation Research Network on Successful Midlife Development.
Carstensen et al. (2011)	Older = 60–94 Range: 18–94 (M = 55; SD = 20)	184	San Francisco Bay area residents
English and Carstensen (2014)	60 + Range: 22–93 (M = 54; SD = 19)	135	Community-dwelling seniors
Mather and Carstensen (2003)	Experiment I: 62–94 (M = 74; SD = 6) Experiment II: 60–81 (M = 72; SD = 6)	52 42	European American or African American participants
Mikels et al. (2005)	64–80	20	Community-dwelling seniors
Kellough and Knight (2012)	64–91 (M = 76; SD = 6)	111	Volunteer seniors recruited via the USC Andrus Gerontology Center and USC Healthy Minds research
Kennedy et al. (2004)	79–100 (M = 73; SD = 10)	28	School Sisters of St. Francis (mostly in the Milwaukee, Wisconsin area)
Chipperfield et al. (2003)	72–99 (M = 80; SD = 6)	353 (172 above 80 years)	Community-dwelling seniors
Charles et al. (2003)	65–80 (M = 71; SD = 5)	48	San Francisco Bay area residents

(*Continued*)

Table 22.1 (Continued)

Reference	Age (years)	N	Participant characteristics
Piguet et al. (2008)	61–83 (M = 72; SD = 6)	36	Healthy seniors
Leigland et al. (2004)	63–81 (M = 71)	124	Community-dwelling seniors
Montepare and Dobish, 2013	60–92 (M = 71)	124	Community volunteers from local senior centers
Neiss et al. (2009)	65–85	52	Healthy seniors
Allard and Kensinger (2014)	55–85 (M = 65; SD = 9)	42	Healthy seniors
Kunzmann et al. (2005)	60–85 (M = 71)	47	Seniors recruited from local senior centers and public places
Dolcos et al. (2014)	59–84 (M = 69; SD = 8)	16	–
Riediger et al. (2014)	70–80 (M = 75; SD = 3)	52	Berlin citizens
Ruffman et al. (2009)	60–85 (M = 71)	12	Healthy seniors
Isaacowitz et al. (2007)	60–85 (M = 72; SD = 7)	78	Community-dwelling seniors
Orgeta and Phillips (2008)	61–81 (M = 70; SD = 5)	40	Community-dwelling seniors
Truong and Yang (2014)	65–87 (M = 73; SD = 6)	36	Seniors recruited from the Ryerson senior participant pool from Ryerson University

Table 22.2 **Overview of the reported age range, sample size, and participant characteristics of the studies referenced in Sections 22.4.1 and 22.4.2**

Reference	Age (years)	N	Participant characteristics
Andersen et al. (2011)	60+	12	Walking frame users living in an elderly home
Dubé et al. (2005)	55+	22	Community-dwelling seniors
den Uijl et al. (2014)	55 + (M = 65; SD = 6)	392	Vital community-dwelling seniors
den Uijl et al. (2016)	65+	154	Vital community-dwelling seniors
den Uijl et al. (under review)	65+	156	Vital community-dwelling seniors
Grühn et al. (2010)	Older = 60–78 Range: 18–78 (M = 46; SD = 18	948	Residents from Berlin (younger and older participants)
Gudmundsson et al. (2011)	60+	12	Walking frame users living in an elderly home
Isaacowitz et al. (2007)	60–85 (M = 72; SD = 7)	78	Community-dwelling seniors

(*Continued*)

Table 22.2 (Continued)

Reference	Age (years)	N	Participant characteristics
Kunz et al. (2008)	65–87 (M = 72; SD = 6)	61	Seniors from the Senior University at University of Marburg
Kunzmann et al. (2005)	60–85 (M = 71)	47	Seniors recruited from local senior centers and other public places in Berkeley, California
Kunzmann and Grühn (2005)	60–70 (M = 65; SD = 3)	48	German independently living seniors
Labouvie-Vief (2003)	60–77	12	Senior volunteers selected from suburban neighborhoods in a major US mid-Western metropolitan area
Narchi et al. (2008)	63–80	52	Seniors from a convenience sample
Neiss et al. (2009)	65–85	52	Healthy seniors
Levenson et al. (1994)	60–70 (M = 63; SD = 3)	74	San Francisco Bay area residents
Orgeta and Phillips (2008)	61–81 (M = 70; SD = 5)	40	Community-dwelling seniors
Riediger et al. (2014)	70–80 (M = 75; SD = 3)	52	Berlin citizens
Ruffman et al. (2009)	60–85 (M = 71)	12	Healthy seniors
Sheu et al. (2011)	65–96 (M = 84)	60	Hospital patients
Smith et al. (2005)	60–71	32	Healthy seniors from the Champaign-Urbana community
Tsai et al. (2000)	70–85	48	Seniors from a community sample

Generally, human aging is accompanied by age-related changes, such as declines in cognition, declines in physical strength, and/or declines in sensory perception and detection. These changes are thought not only to have a large impact on the daily functioning and perceived well-being of older persons but also to impact on how people feel and/or perceive emotions in late life.

Age-related cognitive decline is most clearly reflected in processes that require intensive resources and deliberative thinking (Craik & Salthouse, 2011). Decreasing sensory function and speed of processing have been described as underlying mechanisms. Also, deficits in processing resources, inhibitory control, or the ability to refresh recently activated information may underlie a decline in cognitive performance with increasing age. In contrast, automatic processes, not requiring extensive deliberative thinking, are thought to be relatively preserved upon aging (Craik & Salthouse, 2011).

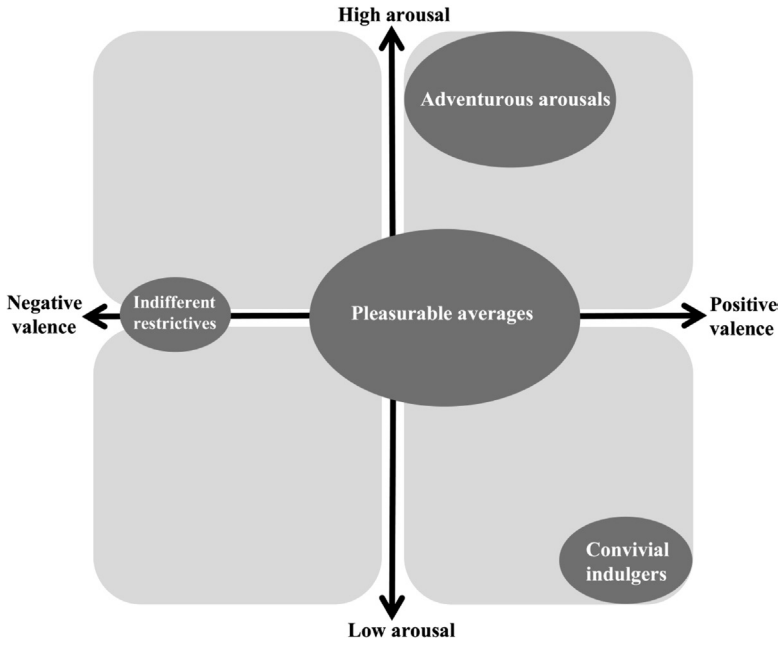


Figure 22.1 Schematic overview of the four clusters (*Pleasurable averages, Adventurous arousals, Convivial indulgers*, and *Indifferent restrictives*) in the dimensions valence and arousal. The size of the clusters schematically reflects the cluster size; that is, the larger the cluster in the scheme, the more participants belong to that cluster. Note that this figure illustrates the dimensions of the clusters schematically, hence no absolute numbers can be obtained from it.
Source: Adapted from den Uijl et al. (2014).

Another important characteristic of the senior population is its highly heterogenic nature. Rather than seeing seniors as one group with a specific set of characteristics, one needs to take into account their large interindividual differences in both physiological and psychological functioning. So far, numerous approaches to cluster older persons have been explored, often based on psychographics or gerontographics (Morgan, 1993; Moschis, 2003; Reisenwitz & Iyer, 2007). Recently, 392 vital community-dwelling seniors (mean age = 66 years old; SD = 6) were segmented on the basis of emotions associated with mealtimes. The participants used a tailored lexicon to report their emotions associated with seven mealtimes (eg, breakfast, lunch, snacks). Four consumer segments were identified: *Pleasurable averages, Adventurous arousals, Convivial indulgers*, and *Indifferent restrictives* (Fig. 22.1). Cluster members associated significantly different emotions (regarding both valence and level of emotional arousal) with their mealtimes (den Uijl, Jager, de Graaf, Waddell, & Kremer, 2014). Although the abovementioned studies provide only a brief overview of the field of senior consumer segmentation, they clearly underline the need to take heterogeneity into account in studies of emotions in senior populations.

Aging impacts the sensory functioning of older persons to various degrees. Declines in vision, hearing, gustatory, and somatosensory function are often encountered in senior populations (Doets & Kremer, 2016; Methven, Allen, Withers, & Gosney, 2012; Murray, Wallace, Zampini, & Spence, 2012; Pathai, Shiels, Lawn, Cook, & Gilbert, 2013). As described in Chapter 5 of this book, olfactory function is of special interest with regard to emotions in later life, as this modality is—anatomically—closely related to emotion perception (Shepherd, 2006). For example, Reid, Green, Wildschut, and Sedikides (2015) observed that persons reported nostalgic feelings when exposed to specific scents, such as apple pie or baby powder. Also, scent-evoked emotional memories are known to be very specific, vivid, and relatively old (Herz & Cupchik, 1992). Robust changes in older persons' olfactory function have been reported (Doty & Kamath, 2014). Around 13–25% of the older population is olfactory-impaired (Murphy et al., 2002; Vennemann, Hummel, & Berger, 2008), and around 4–6% have completely lost their ability to smell. Thus, the prevalence of olfactory impairment increases with increasing age, and the impairment is highest among men (Murphy et al., 2002). It seems, therefore, plausible that an impaired olfaction may influence older persons' behavior through modulation of their (unconscious) emotional responses to products (den Uijl, Jager, de Graaf, Zandstra, & Kremer, under review; Soudry, Lemogne, Malinvaud, Consoli, & Bonfils, 2011). However, these possible interactions have so far not received much scientific attention, offering opportunities for exciting future research.

3 Emotional ageing

In contrast to a number of cognitive functions, emotion processing seems to be relatively well preserved with increasing age (Craik & Salthouse, 2011). Over the years, various theories with regard to emotional aging have been put forward. For example, (1) Lawton (1989) proposed that, in late life, adults tend to regulate their emotions towards an optimization of affect, that is, minimizing negative affect and maximizing positive affect. These changes in emotion regulation were deemed to occur in late life as a function of positive changes in older persons' personality and social context. (2) Baltes, Baltes, and Baltes (1990) and (3) Carstensen (1992) expanded Lawton's (1989) theory and proposed, respectively, the social optimization with compensation theory (SOC) and the social selectivity theory (SST). The SOC explains that seniors focus on emotionally gratifying goals by focusing on their awareness of age-related gains and losses, whereas the SST focuses on the temporal horizon that elders face. For example, older people are thought to selectively narrow down their social networks and to focus more on emotionally close, gratifying social relationships. In this way, both theories tie emotion regulation to life-phase-specific choices (Alea, Diehl, & Bluck, 2004). (4) More recently, Charles and Piazza (2009) introduced their strength and vulnerability integration theory (SAVI), which further expands the SST. According to the SAVI, people not only change their behavior because of the temporal horizon, but also over time expand their knowledge about emotion regulation and their social lives.

This latter changed perspective and knowledge are thought to help older persons to avoid negative experiences. (5) Labouvie-Vief, DeVoe, and Bulka (1989) argued in their cognitive-affective developmental theory that emotion is qualitatively different at different points in the life span, and that emotional expression and functioning will become more sophisticated in later life. This sophistication may include increases in the complexity of experienced emotions, displays of higher emotional flexibility, and a heightened tolerance of ambiguous emotions. (6) Later, in her dynamic integration theory, Labouvie-Vief (2003) also proposed that older adults increasingly prefer positive over negative information, because of the greater cognitive demands required to process the latter. Finally, (7) Smith, Hillman, and Duley (2005) and Tsai, Levenson, and Carstensen (2000) argue that the differences in emotional processing between seniors and adults may be explained from a physiological perspective. To this end, they characterized the age groups, for example, in terms of their heart rate and skin conductance response by using the multidimensional models of valence/pleasure and activation/arousal (Larsen & Diener, 1992; Russell, 1980).

Each of the different theories on emotional aging that have been posited so far addresses some central issues of emotion and aging. However, none of the theories is able to adequately capture the sheer complexity of the phenomenon (Ebner & Fischer, 2014a)—all the more so, since the studies on emotional aging, in addition to being based on different theoretical paradigms, cover various domains that try to shed light on the phenomenon from different angles:

1. Emotional experience/expression: do older persons experience specific emotions to the same degree as younger persons?
2. Emotion regulation/control: do older persons regulate and/or control their emotions in the same way as younger persons?
3. Emotion perception/recognition: do older persons interpret and recognize emotions expressed by others to the same degree as younger persons?
4. Emotional memory/attention: do older persons differ in emotion-related memory and attention from their younger counterparts?

3.1 Emotional experience/expression

Seniors seem to differ from adults regarding their experience and expression of emotions. For example, they report more complex emotional experiences, such as co-occurrence of positive and negative affect (Carstensen, Mayr, Pasupathi, & Nesselroade, 2000). This could be explained by Labouvie-Vief et al.'s (1989) previously mentioned cognitive-affective developmental theory. In addition, seniors often experience an increase in positive affect and a decrease in (high arousal) negative affect (Chipperfield, Perry, & Weiner, 2003; Montepare & Dobish, 2013; Mroczek & Kolarz, 1998), or at least sustained levels of affective well-being (English & Carstensen, 2014; Leigland, Schulz, & Janowsky, 2004). The elderly seem to reduce or ignore negative affect or things that might induce negative emotions (Brandtstadter, Wentura, & Greve, 1993; Mather, 2012). This "positivity bias" (Carstensen, Mikels, & Mather, 2006; Mather & Carstensen, 2005) has been observed across a variety of experimental paradigms, such as visual attention and autobiographical memory, and a

variety of stimuli, such as words and pictures (Charles, Mather, & Carstensen, 2003; Chipperfield et al., 2003; Kellough & Knight, 2012; Kennedy, Mather, & Carstensen, 2004; Mather & Carstensen, 2003; Mikels, Larkin, Reuter-Lorenz, & Carstensen, 2005; Piguet, Connally, Krendl, Huot, & Corkin, 2008). For example, Chipperfield et al. (2003) reported that, during interviews, the elderly report more happiness, contentment, and gratitude, whereas they report less frustration, sadness, and anger. Also, regarding recognition of ambiguous facial affect, elders perceived more positive affect in facial expressions than younger persons (Kellough & Knight, 2012). Several explanations for the mainly positive predisposition of the elderly have been proposed, such as the previously discussed selective optimization with compensation (Baltes et al., 1990) and social selectivity theories (Carstensen, 1992). Additionally, Leigland et al. (2004) added a more anatomical explanation for the positivity bias, stating that emotion-related systems in the brain (amygdala–hippocampal system) may change and actually may become more prefrontal over time. Consequently, the relative importance of the cognitive and emotional systems in defining human behavior may actually change as people age.

3.2 Emotion regulation/control

Seniors' emotion regulation also seems to differ from that of their younger counterparts. Despite the less efficient cognitive control processing in seniors (Allard & Kensinger, 2014), they seem to have greater emotional control (Lawton, Kleban, Rajagopal, & Dean, 1992; Neiss, Leigland, Carlson, & Janowsky, 2009). Seniors seem to have lower physiological responses towards arousing stimuli, regardless of the valence of the stimuli (Kunzmann, Kupperbusch, & Levenson, 2005; Smith et al., 2005; Tsai et al., 2000). For example, Kunzmann et al. (2005) reported that seniors have a diminished cardiovascular response when they discuss emotional conflicts or when they watch films that evoke either "disgust" or "contentment." The latter could indicate a better regulated emotion state in this group, or a generally reduced emotionality. Dolcos, Katsumi, and Dixon (2014) expanded these findings from a more anatomical point of view, by reporting that during fMRI investigations in seniors they observed that certain brain regions involved in emotional control show spontaneous engagement.

3.3 Emotion perception/recognition

Besides the changes in emotion experience and regulation, changes relating to the recognition of emotional expressions may occur. For example, Riediger, Studtmann, Westphal, Rauers, and Weber (2014) showed their participants 48 videos of persons expressing positive-affect, negative-affect, and neutral smiles to a group of adults and a group of seniors. The participating seniors seemed to experience more difficulty with identifying and recognizing certain (negative) facial expressions (eg, anger, fear, sadness) than the younger persons. Interestingly, this is in line with the previously reported positivity bias. In other studies also, emotions transferred through bodily or

vocal expressions were less clearly recognized by seniors than by their younger counterparts (Isaacowitz & Stanley, 2011; Isaacowitz et al., 2007; Ruffman, Halberstadt, & Murray, 2009). Interestingly, the age-related change in affect recognition seems to depend on the quality of the expressed emotions, as for some facial emotion expressions (eg, disgust) aging did not seem to have an effect on their recognition (Orgeta & Phillips, 2008). However, it could not be completely ruled out that, rather than emotions, age-related changes in visual acuity may have influenced these findings. Unfortunately, most of the above studies did not control for age differences in visual acuity.

3.4 Emotional memory/attention

The previously mentioned positivity bias in seniors has been described for emotional memory as well, as this age group generally seems to remember positive emotional messages better than negative ones (Leigland et al., 2004; Mather, Knight, & McCaffrey, 2005). According to Mather et al. (2005), seniors tend to remember things in a—for them—emotionally gratifying way. For example, when recognizing the features of an apartment, seniors seemed to be more accurate than adults in describing the positive features (eg, a spacious kitchen) than the negative features (eg, low ceilings). In addition, Truong and Yang (2014) argued that emotional targets facilitate working memory in both younger and older adults, whereas negative emotion distracters disrupt memory performance more in older age than in younger age.

3.5 Emotional aging—deterioration, preservation, or improvement?

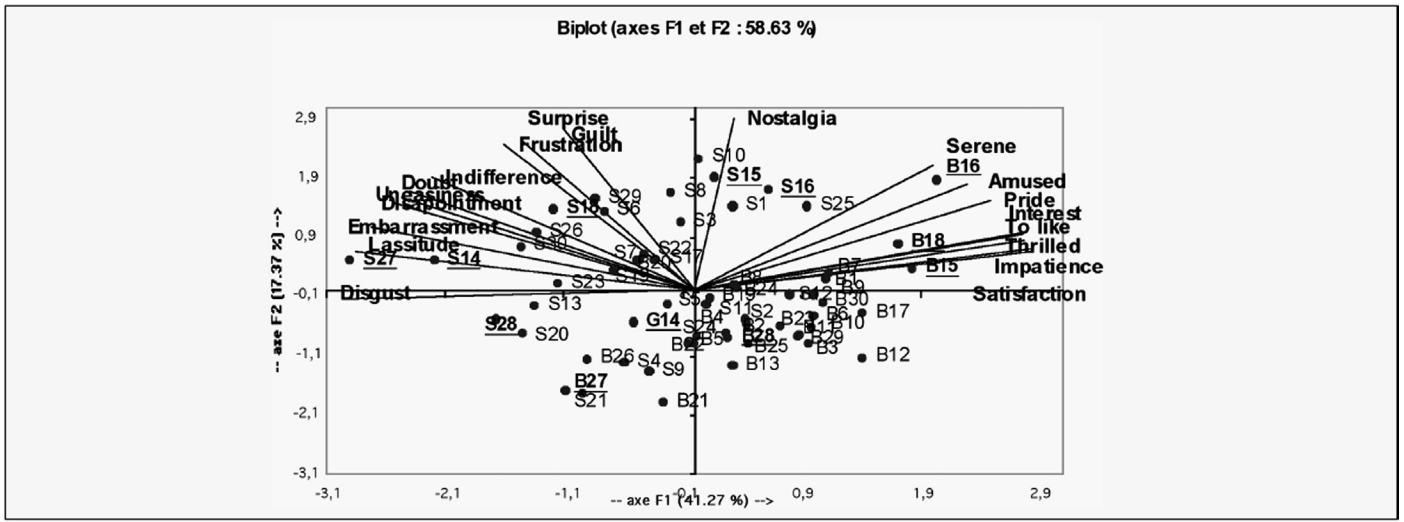
In summary, not all functional domains of emotional aging are affected in the same way (Ebner & Fischer, 2014b). The experience of emotions and the ability to regulate emotions seem to be preserved and may sometimes even improve with increasing age. In contrast, abilities related to emotion perception seem to deteriorate, as does the ability to remember (negative) emotional information. Interestingly, despite these losses in emotional functioning, most elderly people seem able to employ effective strategies that allow them to successfully navigate their environment in order to avoid many negative emotional experiences (Charles & Piazza, 2009) and consequently tend to report relatively high levels of emotional well-being. Unfortunately, the body of scientific evidence on emotional aging so far is built mainly on studies with younger elderly (mean age of the studied population ranging from 55 to 75 years old), whereas studies in older elderly populations with a mean age of 80 or above are scarce. This is unfortunate, as these older elderly persons suffer most frequently from various declines in physical and psychological health. Consequently, with an eye to the increasing number of older old persons, more systematic research into the emotional aging of the older elderly seems warranted for both younger elderly and older elderly consumers. Table 22.1 provides an overview of the studies discussed in Section 22.3.

4 Emotion measurement in the elderly

4.1 Self-reported emotion measures in the elderly population

Self-reporting of product-evoked emotions is widely used in consumer research. Some well-known examples are the EsSense® Profile (King & Meiselman, 2010), the PrEmo tool (Desmet, 2002, 2004), the Affect grid (Russell, Weiss, & Mendelsohn, 1989), the GEOS (Chrea et al., 2009), the UniGeos (Ferdenzi et al., 2013), the ScentMoveTM (Porcherot et al., 2010), the PANAS (Watson, Clark, & Tellegen, 1988), and the EmoSemio (Spinelli, Masi, Dinnella, Zoboli, & Monteleone, 2014). So far, relatively few studies have explored self-reported emotions in the senior population (for details on age range, sample size, and participant characteristics, see Table 22.2). For example, Dubé, LeBel, and Lu (2005) explored a self-composed emotion list, balanced for valence and arousal. They found that seniors reported more positive emotions prior to comfort food consumption than younger persons, but age no longer had a moderating effect post-consumption. Later, Narchi, Walrand, Boirie, and Rousset (2008) composed an emotion lexicon from existing lists of Juillard (2003) and Rousset, Deiss, Juillard, Schlich, and Droit-Volet (2005) to measure seniors' food-picture-evoked emotional associations. They observed that seniors with a low food intake reported more negative emotions (eg, "indifference," "frustration") than seniors with a high food intake (Fig. 22.2). So far, only a few studies have explored these self-reporting emotion measurement tools in the senior population, as discussed in the following paragraphs.

The EsSense® Profile (King & Meiselman, 2010) is a food-specific emotion measurement questionnaire which seems to be most widely used in the field of sensory science (Gutjar et al., 2014; King, Meiselman, & Thomas Carr, 2013; Ng, Chaya, & Hort, 2013). Recently, Nestrud, Meiselman, King, Lesher, and Cardello (2015) published the shortened version EsSense25 method, containing 25 emotions: "active," "adventurous," "aggressive," "bored," "calm," "disgusted," "enthusiastic," "free," "good," "good-natured," "guilty," "happy," "interested," "joyful," "loving," "mild," "nostalgic," "pleasant," "satisfied," "secure," "tame," "understanding," "warm," "wild," and "worried." To our knowledge, only one study has used this method in a senior population (den Uijl, Jager, de Graaf, Meiselman, & Kremer, 2016). In this study, 84 older normosmic persons (ie, with a normal sense of smell; 65 + years old), 70 older hyposmic persons (ie, with an impaired sense of smell; 65 + years old), and 80 younger adults (18–45 years old) tasted snack products. Three types of gingerbread (Peijnenburg brand: regular gingerbread, wholegrain gingerbread, and gingerbread ginger flavor) and three types of chocolate (Lindt Excellence brand: milk chocolate, dark chocolate 70% Cocoa, dark chocolate mint flavor) were evaluated using the EsSense25 method. The results (Fig. 22.3a–d) showed several differences in the emotion profiles of the three participant groups, especially between those of the older groups and the adults. They differed with regard to the type and intensity of the reported emotions. The food-evoked emotions as reported by the younger adults varied along the dimensions valence and arousal (Russell, 1980), whereas those of the older groups varied mainly along the valence dimension. Moreover, both older groups scored lower on a number



Food products assessed by the small and big eaters are labelled by S and B, respectively before the number of food. 1=Salad, 2=French beans, 3=Potatoes, 4=Cauliflower, 5=Spinach, 6=Camembert, 7=Roquefort, 8=Pears, 9=Bananas, 10=Bread, 11=Rice, 12=Pasta, 13=Pizza, 14=Pan bagnat, 15=Fruit-tart, 16=Chocolate, 17=Pound cake, 18=Cream-cake, 19=Roast-beef, 20=Minced meat, 21=Turkey, 22=Rabbit, 23=Pork chop, 24=Fish filet, 25=Seafood, 26= Tongue, 27=Kidneys, 28=Black pudding, 29=Omelette, 30=Dry sausage.

Figure 22.2 Description of average emotions intensities raised by the small and big eaters towards 30 food pictures.
Source: Adapted from Narchi et al. (2008).

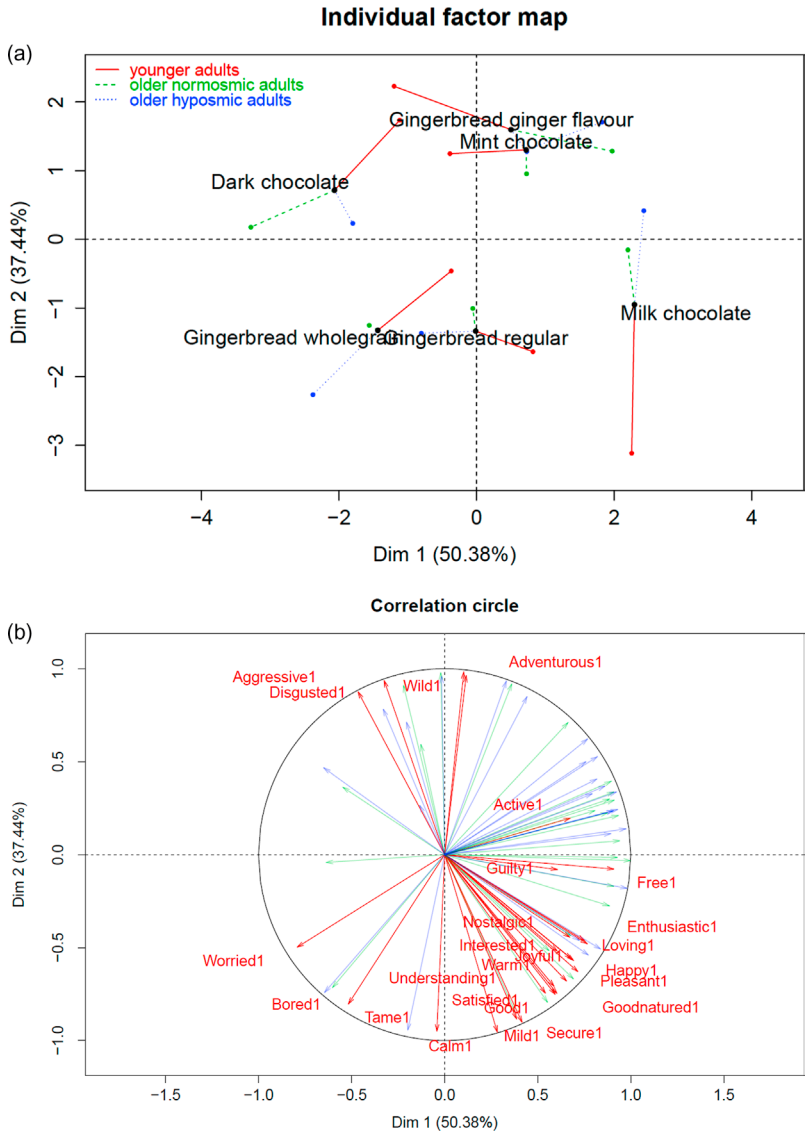


Figure 22.3 Representation of the first two dimensions of the MFA space showing (a) the six products as mean points, and the partial individuals representing the emotion configurations of the products of the three participant groups, and representations of the emotion terms in the two-dimensional space for (b) the younger adults, (c) the older normosmic adults, and (d) the older hyposmic adults.
Source: Adapted from den Uijl et al. (2016).

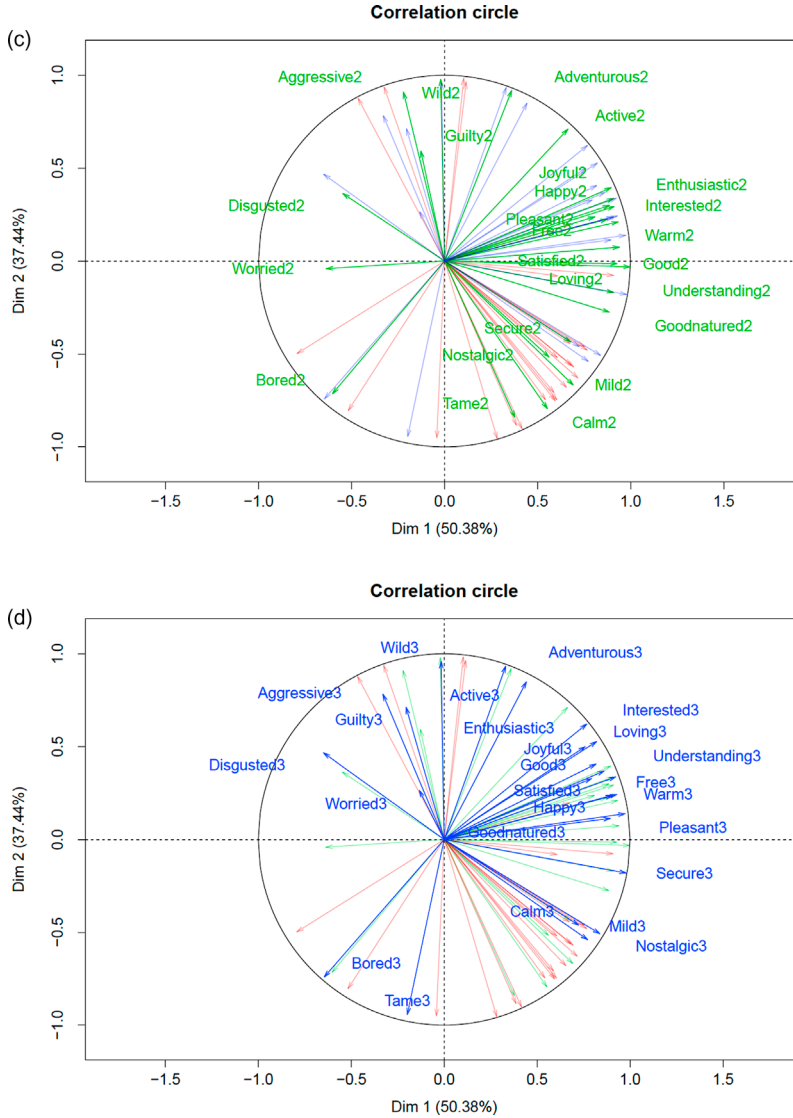


Figure 22.3 Continued

of negative emotions, such as "disgusted and bored" ($P < 0.05$). The influence of actual olfactory functioning was less pronounced and product-specific, since the normosmic older persons reported different food-evoked emotions than their hyposmic counterparts only for some products. Therefore, age and—to a lesser extent—olfactory function seem important factors to take into account when self-reported food-evoked emotions are being measured with the EsSense® Profile.

The Product Emotion Measurement Instrument (PrEmo tool; Desmet, 2002, 2004; Laurans & Desmet, 2012) is a web-based self-report tool to measure product-evoked emotions. The tool uses an animated cartoon character to express an emotion for approximately 1 second, with both movement and sound. Gudmundsson, Andersen, Achiche, and Boelskifte (2011) applied the PrEmo tool to characterize walking frame models and compared them on the basis of their emotional associations. The positive emotions associated with five walking frame models (models A, B, C, D, and E) (Fig. 22.4) were roughly comparable, making it difficult to select on this basis the most attractive (ie, associated with most positive emotions) walking frame as perceived by older consumers. However, for model B (Fig. 22.4) the ratings for some negative emotions were lower, and this differentiates it from the other walking frames. Recently, the PrEmo2 tool (a version of the PrEmo tool updated by Laurans and Desmet, 2012) was explored in a food-related context, studying the food-evoked emotions of seniors towards snack products (den Uijl et al., under review). The products could be differentiated on the basis of the PrEmo2 tool emotion profiles. This differentiation was present specifically for the valence (ie, pleasure/displeasure) dimension and to a lesser extent for the arousal (ie, activation/sleepiness) dimension. Despite the abovementioned results, Andersen, Gudmundsson, Achiche, and Boelskifte (2011) reported some difficulties when applying the method in the senior population. These

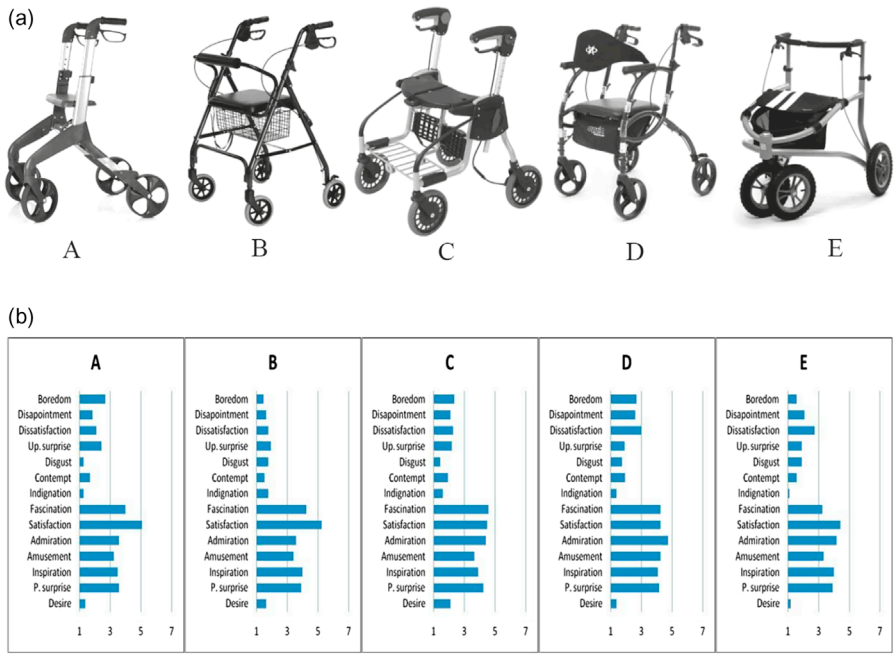


Figure 22.4 (a) Visualizations of the walking frame models (A–E) and (b) "mean emotion scores for the PrEmo tool emotions, separately for each walking frame model." *Source*: Adapted from Gudmundsson et al. (2011).

difficulties were related to their cognitive abilities: picture recognition, understanding of the scale/task/purpose, and concentration. Therefore, they proposed to adapt the tool for seniors by limiting the time for the task, using one-to-one sessions (ie, personally help a participant to complete the task), using big pictures, and using a discrete scale. To our knowledge, no published studies have yet applied the proposed adaptations in the senior population.

The Affect grid (Russell et al., 1989) is a quick tool to measure affect along the dimensions of valence and arousal, using a grid of 9 × 9 boxes. Participants are instructed to tick the box that best corresponds to their current feelings. Recently, den Uijl et al. (in preparation) explored the tool in an adult and two senior populations (86 normosmic older [65 +] persons; 70 hyposmic older [65 +] persons, and 71 adults [18–45 years old]). The three groups were able to discriminate products on the basis of the valence dimension. However, similar to the previously described findings by den Uijl et al. (2016), the seniors did not differentiate the products on the arousal dimension. In this group, the products that scored high on valence scored high on arousal as well, and vice versa. In contrast, for the adults, the products that scored high on valence did not necessarily score high on arousal. It could be that in the older group the reported differentiation in valence and arousal was too weak to be registered by the current measurement tools. Alternatively, the older persons may not have been able to distinguish between valence and arousal. Future research—focusing on seniors' food-evoked emotion responses towards foods other than snack products—is needed to better understand the difference in food-related valence/arousal perception between age cohorts.

The Geneva Emotion Odour Scales, GEOS (Chrea et al., 2009), UniGEOS (Ferdenzi et al., 2013), and the shortened version ScentMoveTM (Porcherot et al., 2010), are self-reporting methods to assess scent-evoked emotions. To our knowledge, so far, no scientific publications on the applications of these methods in senior populations are available.

The positive affect and negative affect scales (PANAS; Watson et al., 1988) are a 20-item questionnaire comprising positive affect (PA) and negative affect (NA) dimensions. Kercher (1992) applied the PANAS in a sample of old participants. Consistent with prior studies of younger samples, the PA and the NA dimensions proved to be completely independent of each other in this population. Later, Grühn, Kotter-Grühn, and Röcke (2010) applied the extended version of the questionnaire, the PANAS-X, in a senior population (for age details see Table 22.2). The results (Fig. 22.5) revealed an association between age and affect, regardless of sociodemographic or personality characteristics. Negative affect showed significant age-related declines, whereas positive affect—joviality, serenity, and surprise—showed significant age-related increases. Interestingly, the association of attentiveness, guilt, and hostility with age was less clear.

In summary, all the above discussed methods require the respondents to have a certain level of cognitive deliberation and ability in order to verbalize their thoughts and emotions (Gutjar et al., 2014). This is probably also reflected in the selection of mainly healthy and community-dwelling older participants in these studies (Table 22.2). However, it may be relevant to explore the application of self-reporting

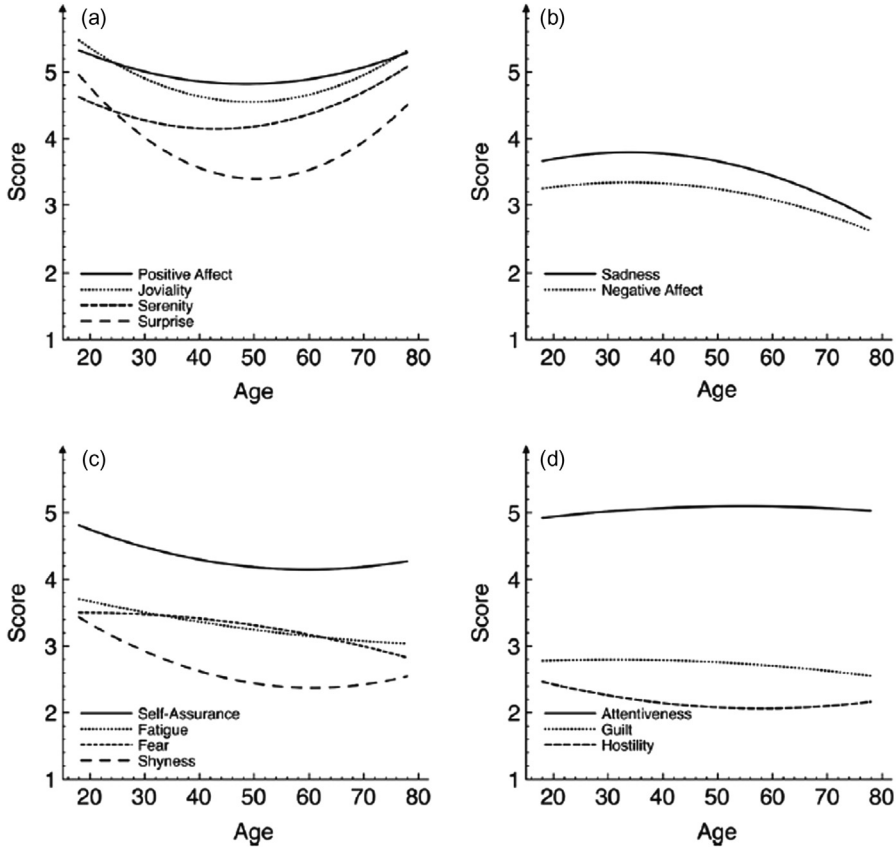


Figure 22.5 Estimated age patterns for discrete affects after controlling for sociodemographic and personality factors. Discrete affects are organized by their shape over the adult lifespan: (a) presents affects with a U-shaped function; (b) presents affects with a reversed U-shaped function; (c) presents affects with a linear-decline pattern; and (d) presents affects that show no association with age.
Source: Adapted from Grühn et al. (2010).

methods in frailer populations as well, because for frail elders self-reporting questionnaires may be more difficult to fill out due to the often-encountered declines in cognitive function and deliberative thinking (Craik & Salthouse, 2011).

In addition, following-up on the previously discussed multidirectionality and multidimensionality of seniors' emotions (Grühn et al., 2010; Labouvie-Vief et al., 1989), the use of self-reporting methods may be more valid for the senior population when a tailored emotion lexicon is used, rather than a standard one. For example, a subset of EsSense® Profile emotions that seniors considered applicable in relation to eating times has recently been defined (den Uijl et al., 2014). To this end, senior participants completed an online free sorting task, making groups of the 39 EsSense®

Profile emotion terms that they considered to be synonyms. After the participants had grouped all the terms, they were asked to select one term from each group that was most representative and most applicable in the context of eating times, denoted as group name. From these results, an emotion lexicon of 15 terms ("guilty," "warm," "happy," "enthusiastic," "adventurous," "whole," "eager," "nostalgic," "interested," "good," "pleased," "disgusted," "satisfied," "daring," and "pleasant") was composed, tailored especially to the examination of emotions related to seniors' eating-time experiences. We believe that such tailored emotion lexicons better suit seniors' expectations, and therefore may increase the likelihood of measuring their product-evoked emotions in a more valid way.

Finally, as also advised by Andersen et al. (2011), researchers must take seriously into account the obvious practical challenges that come with questionnaire-based research in seniors, such as participants' often-encountered diminished vision or hearing capabilities. Self-report questionnaires should be designed with the specific needs of the elderly populations of interest in mind, for example by adapting the sound volume, font size, picture size, and so forth.

4.2 Physiological emotion measures in the elderly population

In many recent theories of emotion, autonomic nervous system (ANS) activity is viewed as a major contributor to the human emotion response (see review Kreibig, 2010). Heart rate and skin conductance are the physiological measures most often studied in normal adult populations (Kreibig, 2010; see also Chapter 8). They have also been applied to some extent in elderly populations (Neiss et al., 2009; Uchino, Birmingham, & Berg, 2010). However, the evidence presented so far on whether or not the elderly are generally less or more physiologically reactive is at the moment inconsistent and depends very much on factors such as the actual type of physiological measure taken (ie, various cardiovascular measures, respiratory measures, and/or electrodermal measures), the context in which the measures are taken, and also whether or not age-relevant emotional themes are applied (Charles & Piazza, 2009; Kunzmann et al., 2005; Uchino et al., 2010).

In comparison to younger participants, diminished physiological responses are reported in the elderly in several studies. Elderly persons who discussed emotional conflicts (Kunzmann et al., 2005; Levenson, Carstensen, & Gottman, 1994); who relived emotional experiences (Labouvie-Vief, 2003); or who watched emotional films (Kunzmann et al., 2005; Tsai et al., 2000) displayed a diminished cardiovascular response. In line with this observation, elderly people also displayed a diminished startle response, diminished heart rate deceleration, and diminished corrugators' EMG response (ie, eyebrow wrinkling) to emotional pictures (Smith et al., 2005). In addition, a diminished skin conductance and respiratory response was reported when elderly people watched disgusting films (Kunzmann et al., 2005). However, several other studies report no age difference in skin conductance response (Kunzmann & Grühn, 2005; Neiss et al., 2009; Tsai et al., 2000), startle-blink responses (Smith et al., 2005), or cardiovascular and respiratory responses (Kunzmann & Grühn, 2005). What is more, in a recent meta-analysis based on 31 suitable studies, it was argued

that age is associated with lower heart rate reactivity but higher systolic blood pressure (SBP) reactivity during emotionally evocative tasks (for a review, see Uchino et al., 2010) and that for the SBP the effect could be further moderated by the degree of task activation.

So far, only one study has attempted to link age-related changes in physiological responses to emotional pictures to subjective (self-reported) measures of emotion. Neiss et al. (2009) observed that subjective ratings of emotions correlated with the physiological response in younger participants but not in older participants and that, in general, the elderly were less likely to show a measurable skin conductance response. They consequently hypothesized that, in older adults, perception of emotional events may not—unlike in younger adults—be closely linked to the physiological state induced by the emotion. Whether or not these observations really reflect differences in emotional processing or are caused by age-related changes in the skin itself is currently unknown. Therefore, more systematic research into physiological measures of emotion and their relation to self-reported measures of emotion in elderly populations seems warranted, prior to the deployment of physiological measures in the assessment of product-related emotions in the elderly.

4.3 Facial expression measures in the elderly population

An accurate recognition and expression of facial expressions is considered critical for proper functioning and interpersonal communication at every stage of life (Carstensen, Gross, & Fung, 1997; Isaacowitz et al., 2007). As mentioned in Section 22.3.3, the ability of seniors to recognize specific facial expressions seems to deteriorate over time (Isaacowitz et al., 2007; Riediger et al., 2014; Ruffman et al., 2009). Interestingly, this change in emotion recognition seems to depend on the source and type of the expressed emotions (Orgeta & Phillips, 2008; Riediger et al., 2014). For example, identifying and recognizing certain (negative) facial expressions (eg, anger, fear, sadness) seems to be harder for seniors than for adults. This observation is possibly related to the previously discussed positivity bias. Additionally, it seems harder for seniors to recognize emotions transferred through bodily or vocal expressions (Ruffman, Henry, Livingstone, & Phillips, 2008).

The automatized recognition of older persons' facial expressions is increasingly applied in disciplines like assistive domotics (eg, intelligent wheelchairs) and healthcare (eg, pain assessment). In these disciplines, facial expressions are used to develop "emotional intelligent" tools (Arima, Kii, & Murata, 2013; Masmoudi, Bouchouicha, & Gorce, 2011; Soumya, 2014). For example, in the field of assistive domotics, Nagasaka, Matsumoto, Fukaya, Takahashi, and Takeshita (2001) developed a remote-controlled monorail robot to automatically monitor seniors and improve/optimize their healthcare. Pineau, Montemerlo, Pollack, Roy, and Thrun (2003) developed the autonomous mobile robot "Pearl" (Fig. 22.6). This nursebot uses facial expressions to communicate with seniors, for example, in order to remind them to use the bathroom, eat, go to physical therapy appointments, or turn on the television for their favorite show. As a guide, Pearl can also aid seniors to find the way to the exercise room. Fernández-Caballero, Latorre, Pastor, and Fernández-Sotos (2014) reported



Figure 22.6 Example of a nursebot, "Pearl," which provides cognitive and spatial aid. *Source*: Adapted from Pineau et al. (2003).

on a robot that recognizes and interprets facial expressions, and assists older and/or frail persons accordingly, by, for example, providing alerts for medicine, regulating towards positive mood via music, light, color, and so on. Recently, Postma-Nilsenová, Postma, and Tates (2015) reported the first results of a web-based tool to detect confusion in seniors who watched a health instruction video. Further development of such a tool may be interesting for senior healthcare purposes. "Emotional intelligent" applications as described above have also been developed for wheelchairs. Comparable to the above-described robots, these intelligent wheelchairs can assist seniors with mild cognitive impairment to extend their independence (Faria, Vasconcelos, Reis, & Lau, 2012; Sobia, Brindha, & Abudhahir, 2014). Since, to our knowledge, no trials on the effectiveness of these assistive domotics for seniors have been published so far, more systematic research seems warranted here.

Besides emotion recognition by assistive tools, older people's facial expressions are of interest in the healthcare domain, where they are used to assess pain in older patients who can no longer communicate verbally (Abbey & Abbey, 2009; Hadjistavropoulos et al., 2014; Igier, Sorum, & Mullet, 2014; Sheu, Versloot, Nader, Kerr, & Craig, 2011). According to Kunz, Mylius, Schepelmann, and Lautenbacher (2008), facial responses to noxious stimuli are stable over time, underlining their potential as non-verbal measures in the healthcare domain. Hadjistavropoulos et al. (2014) in their review described the state-of-the-art in pain assessment in dementia patients. The authors stressed that facial expressions are important non-verbal markers for several pain assessment tools. Aubin, Giguere, Hadjistavropoulos, and Verreault (2007), as far back as 2007, proposed that the Abbey pain scale, PACSLAC, and PAINAD are most promising to capture relevant facial expressions for pain assessment. Despite the large number of currently available pain assessment methods, there seems to be no consensus yet on an instrument that can be applied in all cases and to

all patients. Therefore, Hadjistavropoulos et al. (2014) highlighted the need for future studies that further standardize the administration conditions and define normative values for interpreting the scores.

4.4 The assessment of mental health in older adults

Mental health and emotional well-being are as important in older age as at any other time in life. Although most older adults have good mental health, many are at risk of developing mental disorders, neurological disorders, or substance use problems later on. Over 20% of adults aged 60 and over suffer from a mental or neurological disorder (Murray, Vos, et al., 2012). The most common mental disorders in this age group are dementia and depression. Anxiety disorders affect 3.8% of the elderly population, substance use problems affect almost 1%, and around a quarter of deaths from self-harm are among those aged 60 or above (WHO, 2013).

Multiple biological, social, and psychological factors determine the level of mental health in young and old people alike. However, in addition to life stressors that are also common in younger people, many older adults—at some point in their life—lose their ability to live independently because of limited mobility, chronic pain, frailty, or other mental or physical problems, and may eventually require some form of long-term care (Hay & Diehl, 2010). They are also more likely to experience events such as bereavement on the loss of their life companion and/or close friends, a drop in socioeconomic status due to retirement, or a disability caused by a chronic disease (Dobrzyn-Matusiak, Marcisz, Bąk, Kulik, & Marcisz, 2014). In turn, all of these factors may result in loss of independence, loneliness, and psychological distress with increasing age.

The prevalence of major depression in older adults is lower than that observed among younger adults, but depression is still a significant problem for older adults and can be associated with other impairments, such as reduced physical and cognitive function (Blazer, 2003; Dobrzyn-Matusiak et al., 2014). Depression is thought to be both underdiagnosed and undertreated in primary care settings (WHO, 2013). Because of its high prevalence, disease burden, and huge economic costs, the prompt recognition and adequate treatment of mental disorders in older adults is of utmost importance.

Depressive symptoms can be assessed in research and clinical practice using various instruments that capture unique aspects of a depression syndrome (Holroyd & Clayton, 2000). Tools are available for diagnostic screening as well as for the measurement of treatment outcomes in elderly populations. These tools either make use of self-reporting by the elderly themselves or are based on interview-based observations made by a trained observer. In the elderly, the most commonly used screening measure for depression in later life is the geriatric depression scale (GDS). The GDS is a self-reporting scale developed by Yesavage and colleagues to measure depression in older populations (Yesavage et al., 1983). Its original version contained 100 items, but this number has been condensed to 30 items that are thought to be indicative of the presence or absence of depression. For practical details on the questionnaire, such as strengths, limitations, and guidelines to calculate the score, see Greenberg (2012) (Table 22.3).

Table 22.3 Example of a scoring ballot of the geriatric depression screening scale

Choose the best answer for how you felt over the past week		
1.	Are you basically satisfied with your life?	yes/no
2.	Have you dropped many of your activities and interests?	yes/no
3.	Do you feel that your life is empty?	yes/no
4.	Do you often get bored?	yes/no
5.	Are you hopeful about the future?	yes/no
6.	Are you bothered by thoughts you can't get out of your head?	yes/no
7.	Are you in good spirits most of the time?	yes/no
8.	Are you afraid that something bad is going to happen to you?	yes/no
9.	Do you feel happy most of the time?	yes/no
10.	Do you often feel helpless?	yes/no
11.	Do you often get restless and fidgety?	yes/no
12.	Do you prefer to stay at home rather than going out and doing new things?	yes/no
13.	Do you frequently worry about the future?	yes/no
14.	Do you feel you have more problems with memory than most?	yes/no
15.	Do you think it is wonderful to be alive now?	yes/no
16.	Do you often feel downhearted and blue?	yes/no
17.	Do you feel pretty worthless the way you are now?	yes/no
18.	Do you worry a lot about the past?	yes/no
19.	Do you find life very exciting?	yes/no
20.	Is it hard for you to get started on new projects?	yes/no
21.	Do you feel full of energy?	yes/no
22.	Do you feel that your situation is hopeless?	yes/no
23.	Do you think that most people are better off than you are?	yes/no
24.	Do you frequently get upset over little things?	yes/no
25.	Do you frequently feel like crying?	yes/no
26.	Do you have trouble concentrating?	yes/no
27.	Do you enjoy getting up in the morning?	yes/no
28.	Do you prefer to avoid social gatherings?	yes/no
29.	Is it easy for you to make decisions?	yes/no
30.	Is your mind as clear as it used to be?	yes/no

Source: Adapted from Yesavage et al. (1983)

One advantage of the GDS is the "yes/no" question format, which is thought to be beneficial for application in the elderly population. Most individuals complete the GDS in less than 10 minutes. The full version of the GDS was initially validated among patients hospitalized for depression and among elderly persons living in the community without complaints of depression or a history of mental disorder (Yesavage et al., 1983). Scores of 0 to10 are viewed as in the normal range, and scores of 11 or more are thought to be a possible indicator of depression (Brink, Yesavage, & Lum, 1982). Later, various shorter forms of the GDS were designed for use in settings in which time is limited due to fatigue and/or poorer attention spans (Hoyl et al., 1999; Sheikh & Yesavage, 1986). Nowadays, the validity and reliability of both

the 30-item and 15-item GDS have been demonstrated for various other subpopulations of the elderly, such as elderly in primary care, elderly in long-term care, and the oldest old (de Craen, Heeren, & Gussekloo, 2003; Hyer & Blount, 1984; Koenig, Meador, Cohen, & Blazer, 1988; Norris, Gallagher, Wilson, & Winograd, 1987; Rapp, Walsh, Parisi, & Wallace, 1988; Zgourides, Spofford, & Doppelt, 1989). Since the GDS does not maintain its validity in populations that contain large numbers of cognitively impaired patients (Burke, Houston, Boust, & Roccaforte, 1989; Burke, Nitcher, Roccaforte, & Wengel, 1992), an informant version of the GDS has been created by Nitcher, Burke, Roccaforte, and Wengel (1993), the so-called collateral source geriatric depression scale (CS-GDS). In contrast to the normal GDS, the CS-GDS is completed by an informant with extensive personal knowledge of the person in question, and validated versions exist of both the 30-item and 15-item CS-GDS (Brown & Schinka, 2005; Burke et al., 1997). Finally, the GDS has also been found to be valid for older people from different cultural backgrounds (Boey, 2000; Ertan & Eker, 2000; Iwamasa, Hilliard, & Kost, 1998; Izal & Montorio, 1993; Malakouti, Fatollahi, Mirabzadeh, Salavati, & Zandi, 2006; Pocinho, Farate, Dias, Lee, & Yesavage, 2009), making it a suitable scientific tool for cross-cultural comparisons on depression in later life.

In addition to the GDS, the Zung self-rating depression scale (SDS) is another self-reporting scale consisting of 20 items (Zung, 1965). The elderly are required to give graded responses (ie, never, sometimes, usually, and always). However, providing graded responses may be a confusing task, particularly for older or frailer elderly persons. Thus, they may require some assistance from the examiner or others to complete the form (Brink et al., 1982). Consequently, some authors advise against the use of the SDS in the research or clinical assessment of geriatric depression (Carroll, Fielding, & Blashki, 1973; Myers & Weissman, 1980).

Additionally, the Hamilton rating scale for depression (HAM-D) was initially developed as a measure of treatment outcome (Hamilton, 1960). Nowadays, it is also used as a screening tool. It is a 21-item rating scale used to systematize clinical observations of features related to depression. To this end, 10 items are ranked on a scale from 0–4, 9 items are ranked 0–2, and 2 items are ranked 0–3. A cut-off point is used somewhere between 18 and 20 to identify persons with probable depressive disorder (Clayton, Holroyd, & Sheldon-Keller, 1997). A trained observer—after conducting a 30-minute interview—completes the HAM-D. Even though the HAM-D is widely used for the assessment of depression in the general population (Maier & Philipp, 1985), it has not been well validated for use in frail elderly populations (Lichtenberg, Marcopulos, Steiner, & Tabscott, 1992).

A few studies have directly compared self-reporting tools with observer scale tools for the assessment of depression in the elderly. One study compared the GDS with the HAM-D in 30 patients with dementia and used a psychiatric assessment of depression for comparison (Lichtenberg et al., 1992). This study demonstrated that the GDS was superior to the HAM-D for detecting depression. It is postulated that because many of the patients had moderate dementia, the GDS, which requires a simple “yes” or “no” may be superior to the HAM-D, which, although it is an observer-rated scale, places the responsibility on the elderly person to come up with certain affect labels

and feeling statements. Another possible advantage of the GDS is that it is thought to elicit present-state answers, rather than requiring the elderly to use their memory.

Brink et al. (1982) compared the GDS with the HAM-D and revealed in a small study of 14 patients (mean age = 66 years) with a diagnosis of generalized anxiety disorder that the GDS was much more sensitive than the HAM-D in eliciting depressive symptoms. However, more research is recommended to further validate the HAM-D in the geriatric population (especially in various clinical settings) as well as to further study the ability of the GDS to elicit changes in depression over time in various elderly populations.

4.5 Measuring subjective well-being/happiness in the elderly

Satisfaction with life (ie, evaluating life in positive terms) and positive affect (ie, stressing positive emotional experience) are both subjective well-being (SWB) measures that are frequently studied in older adults. These measures are subjective, as they reside mainly within the experience of the individual. They include—in contrast to clinical measures of mental health—positive measures, and they also include, to various extents, a global assessment of all aspects of an elderly person's life (Diener, 2009).

1. Life satisfaction relates to the question of what leads people to evaluate their lives in positive terms and relies on the respondent's standards to determine what is a good life.
2. Positive affect denotes a preponderance of positive affect over negative affect, stressing pleasant emotional experience.

Although affect or satisfaction within a certain domain may be assessed, the emphasis is usually placed on an integrated judgment of the elderly's life. Numerous scales have been designed to measure both the affective and cognitive satisfaction components of well-being, and the measures may cover a period ranging from a few weeks to one's entire life (Diener, 2009).

Initially, measures of humans' well-being were mainly single-item survey questions, for example such as a 9-point scale anchored by "best life for you" at the top and "worst possible life for you" at the bottom (Andrews & Withey, 1974; Cantril, 1965; Gurin, Veroff, & Feld, 1960). Despite the obvious advantages of brevity for use in older populations, single-item scales have been criticized on a number of grounds (eg, McKennell, 1974). Firstly, when a single item is relied upon, the variance due to the specific wording of the item cannot be averaged out. Secondly, single-item scales tend to be less reliable over time than multi-item scales. Their scores tend to be skewed, with most responses falling in the happy categories (Andrews & Withey, 1974). Finally, single-item scales do not cover all aspects of SWB, but rely on respondents' integration of these prior to arriving at a single response. Diener (2009) stresses that SWB is composed of several components; this means that the information on the underlying components is lost when a single-item scale is used. Nevertheless, the fair validity and reliability of these scales suggest that they are adequate if a very brief measure of global well-being is required.

Several multi-item scales have been applied in older respondents, such as the psychological general well-being index (PGWB; Dupuy, 1984) and the satisfaction with

life scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985). Chassany, Dimenäs, Zeneca, Dubois, and Wu (2004) described the PGWB as a short tool to measure perceived well-being and distress. The tool consists of 22 questions in six dimensions (anxiety, depression, positive well-being, self-control, general health, and vitality). The total score can be compared to the available normative data (eg, on gender and nationality) to get an indication of overall well-being. The SWLS is a short five-item questionnaire that measures global cognitive judgments of satisfaction with one's life. A maximum of seven points is given to each item. A score of 20 is considered as average, and when somebody scores higher, this indicates—to various extents—satisfaction with life (Diener et al., 1985). Olsson, Hagnelius, Olsson, and Nilsson (2013) and Olsson, Hurtig-Wennlöf, and Nilsson (2014) recently applied the PGWB in a senior population to relate living situation, cognitive functioning, physical activity, and somatic biomarkers to subjective well-being. Greater physical activity, independent-living situation, and good cognitive functioning were associated with higher levels of subjective well-being. The SWLS has also been recently explored in a senior population. Błachnio and Buliński (2013) related physical health with life satisfaction and showed a mild positive life satisfaction in the aged population, despite a higher prevalence of age-associated diseases.

5 Conclusions

In this chapter, an overview was given of the current understanding of both emotional aging and the measurement of emotions in older persons. When people grow older, not all aspects of emotional aging are affected in the same way. Some aspects of emotional functioning are better preserved with increasing age than others. So far, all the above-discussed methods cover certain aspects of seniors' emotion experience, but none of them capture its sheer complexity.

In general, the measurement of emotions in elderly populations is a challenging task. The limited currently available tools originate from clinical practice settings and focus mainly on negative emotions. In addition, the majority of the currently available tools are suitable for use only in vital seniors, since they rely mainly on unimpaired cognitive functioning and the ability of those tested to verbalize their thoughts (Köster & Mojet, 2015). Obviously, these methods perform considerably less well in older persons who suffer from impaired vision/audition, cognitive-function decline, limited attention span, and/or other detrimental medical conditions. Attempts to counteract these limitations via assistance by a third person may at first sight look promising, but obviously bear the risk of misinterpretations—all the more so because mildly impaired elderly people might still be keen to please the experimenters or interviewers who are paying attention to them (Kintz, Delprato, Mettee, Persons, & Schappe, 1965; Tuorila, Andersson, Martikainen, & Salovaara, 1998). Consequently, both frail seniors with cognitive impairment and independently living seniors aged 80 and above are at the moment clearly understudied in emotional research. For the latter, this is especially unfortunate, since this group is

expected to grow to 19% of the senior population by 2050 (United Nations, 2013). Moreover, these elderly subgroups suffer most frequently from multiple health impairments, and thereby form a distinct part of the older population. Consequently, more research seems warranted here.

Another challenge for measuring emotions in the elderly is their heterogeneous nature (Moschis, 2003), as large differences exist in the size and personal characteristics of the studied populations. Most likely there are large differences in emotional expressions between different generations of seniors (eg, "silent generation" vs "babyboomers") (Moschis, 2003). In turn, these sociocultural differences between and within generations may also be reflected in emotional well-being, although there is not much scientific evidence on that. Moreover, differences between groups of seniors with regard to specific emotional associations (eg, regarding mealtimes: *Adventurous arousals* vs *Indifferent restrictives*) (den Uijl et al., 2014) may impact on their emotional experience. Therefore, seniors' heterogeneity should be taken into consideration when their emotions are being measured, and this requires the use of adequate sample sizes that will allow such segmentations.

So far, the majority of studies on emotional aging have adopted a cross-sectional approach, correcting for confounding factors such as education, medication use, and so forth. However, whether these adjustments sufficiently cover the interindividual variation between the different generations remains unclear. Longitudinal studies on changes in emotions over time would probably be more powerful in controlling for these interindividual differences. However, besides the obvious budget constraints, it is not clear whether the currently validated tools for the assessment of emotions are suitable for repeated testing without the occurrence of learning or boredom effects.

So far, little is known about the extent to which single and/or multi-item scales are influenced by age-related factors such as acquiescence, social desirability, and (mild) cognitive impairment. Furthermore, whether an investigator will use emotion measures specifically designed for, and validated in, senior populations or other emotion measures applicable to all populations will probably depend on the aim of the study. In the event of tools that contain geriatric-specific content being used to measure emotions, it will be difficult if not impossible to compare findings across samples using different age groups (Diener, 2009).

Besides these elderly-specific challenges in emotion measurement, there are some more general issues that will most likely apply to young and elderly populations alike. For example, in recent years it has been demonstrated that context is highly influential in human emotion responses (Piqueras-Fiszman & Jaeger, 2014a, 2014b, 2014c). Unfortunately, most of the emotion measurement tools discussed above have been applied in a lab/clinical situation, and this might compromise their external validity. Consequently, it seems plausible that the inclusion of a person-centered (evoked) context in explicit emotion measurements might render more ecologically relevant measurements (Köster & Mojet, 2015). Consequently, this should be encouraged in future research.

With regard to the type of emotions measured, the focus currently lies very much on the direct measurement of explicit emotions, that is, feelings or moods that are consciously perceived. In contrast, unconscious or implicit emotions—which, according

to Kihlstrom, Mulvany, Tobias, and Tobis (2000), people are not able to report but may still impact on their behavior and/or physiological responses—require an indirect measurement approach. At the moment, several more indirect measurement approaches are under development (Chapters Measurement of Consumer Product Emotions Using Questionnaires; Sentiment Analysis: Detecting Valence, Emotions, and Other Affectual States from Text and Conceptual Profiling). These might also prove to be a valuable addition to the researcher's toolbox for measuring seniors' emotions.

In summary, measuring emotions in humans is in itself already a challenging task. However, this task becomes even more challenging as humans grow older. More systematic research into how emotions can be assessed in older persons is a prerequisite to advance our current understanding both of emotional aging itself and of how to meet the emotional needs of various subpopulations of older persons.

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Translatability of Emotions

23

Anna Ogarkova
Swiss Centre for Affective Sciences, University of Geneva, Geneva, Switzerland

1 Introduction

With the advent of the so-called affective revolution (Davidson, Scherer, & Goldsmith, 2003), the words that label emotional experiences in natural languages have become a burgeoning field of enquiry. This chapter deals with one of the pertinent issues in this area—namely, that of translatability of emotion words across languages and cultures. Do translation equivalents—such as, for instance, English *happy*, German *glücklich*, or French *heureux*—mean the same thing? To what extent are cross-lingual correlates suggested to us by dictionaries equivalent in meaning, and what are the available approaches to measure their (dis)similarity?

Across the many and varied disciplines concerned with cross-lingual translatability of emotion words, the concept of equivalence is based on a fairly straightforward idea: in order to be considered equivalent, emotion words in different languages should share the same, or maximally similar, meaning. However, the way meaning is defined varies considerably across disciplines. In some approaches within emotion psychology, meaning is equated to a specific configuration of values on a vector of rating features (Fontaine, Scherer, Roesch, & Ellsworth, 2007; Fontaine, Scherer, & Soriano, 2013). Other psychological approaches propose that meaning is accessible through the position occupied by an emotion word on a set of general evaluative dimensions (Russell, 2003) or through the degree to which an emotion term shares a set of prototypical features with other words in an emotion category (Shaver, Murdaya, & Frailey, 2001; Shaver, Schwartz, Kirson, & O' Connor, 1987; Shaver, Wu, & Schwartz, 1992). In linguistics, a classical view is that meaning embraces denotation and connotation (Besnier, 1990), so cross-lingual translation equivalents would not only refer to the same, or very similar, emotional experiences, but also converge in evaluative judgments involved in thinking about those emotional experiences. Another classical model of meaning—adopted by most ethnographic and anthropological approaches to emotions—defines meaning as a tripartite union of the referential, the affective, and the social (Lyons, 1977); therefore, mutually translatable emotion words would refer to, or be used in, the same social contexts.

It should be noted, however, that in none of the relevant approaches is semantic equivalence assumed to be *an absolute value*. In line with the widely held assumptions that no word has exactly the same meaning in two different utterances (Ariel, 2002) and that there are no complete synonyms within a language, the absence of exact correspondences between words in different languages is one of the fundamental presuppositions in most semantic analyses of any disciplinary orientation (Nida, 1958).

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Thus, equivalence of any two emotion words in two different languages is always *a matter of degree*.

In this chapter, we will focus on two interrelated issues. First, we will overview the relevant literature on the translatability of emotion, both broadly conceived, that is, in terms of the entirety of lexical designations for the emotions in different languages (henceforth referred to as emotion vocabularies, or lexicons), and with regard to individual emotion words, such as English *sadness* or French *tristesse*. Secondly, we will consider the available methodologies that can help establish cross-lingual (dis) similarity of emotion meaning.

2 Theoretical approaches

In the domain of comparative lexical research on emotion words (eg, Hupka, Lenton, & Hutchison, 1999; Russell, 1991), the issue of semantic equivalence has been frequently framed within the debate on universality versus cultural-specificity of emotion conceptualization and expression.

The universalist view unites a constellation of naturalistic, evolutionary, or biological theories of emotion that view emotions as "products of natural processes which are independent of social norms and conscious interpretation" (Ratner, 1989, p. 211), as biologically determined processes, depending on innately set brain devices laid down by evolutionary history (Damasio, 1994, see also Chapter 6). Most universalist theories argue that (some) emotional experiences are common to all people as a species (Ekman, 1999) and can be experienced regardless of whether they are named in language and, for that matter, regardless of whether or not they are conceptualized as instances of emotion. And while there is no cross-disciplinary consensus about what constitutes this universal level of emotions appraisals (Scherer, 2005), "core affect" dimensions (Russell, 2003), or relational themes (Lazarus, 1991), among numerous other parameters—the shared premise is that, since emotion words that have evolved in many different languages refer to the same, or very similar phenomena, their lexical designations should on principle be translatable across languages.

The alternative position, also known as relativist, prioritizes social, cultural, and linguistic factors in the construction of emotional meaning. On this view, emotions are assumed to be determined by systems of belief and values of particular communities (Armon-Jones, 1986; Kleinman & Good, 1985). This position is largely shared by various types of constructionism, such as social constructionism (Averill, 1980; Harré, 1986), which maintains that adult human emotions depend on social concepts and recognizes the social environment as a major regulator of emotional display (Ratner, 1997; Russell, 1991), or cultural constructivism, a cluster of theoretical approaches that conceptualize culture as a central factor that mediates emotional experience, conceptualization, and expression. And while there are multiple models of how specifically culture interacts with emotion in specific communities (see Leavitt, 1996, for an overview), the common denominator in these approaches is the reluctance to see emotions as "pre-cultural facts, as features of our biological heritage that can be identified independently of the cultural one" (Lutz, 1986, p. 297).

This research domain problematizes "emotion" as an inherently Western category (cf. Lutz & White, 1986) and argues that emotional qualities become more satisfactorily understandable in terms of cultural activities, concepts, and locally specific consensual ideologies (Levy, 1983, p. 129), as "models of and models for how one should feel and behave" (Myers, 1979, p. 345).

Both universalism and constructionism have generated some confirmatory evidence with regard to translatability of emotion words across languages. In the next section, relevant evidence for both views will be discussed.

3 Universality versus variation in emotion vocabularies: an overview

The similarities in emotion lexicalization in different languages are fairly broad and constitute commonalities, rather than universals in the strict sense of the word. Indeed, out of over 7000 languages (Crystal, 1997) spoken in the world, research on emotion lexis has focused on 200 languages at best, and doubts can be raised about the representativeness of any specific selection (Evans & Levinson, 2009).

Still, most languages investigated to date are reported to have specific words or expressions referring to what we call "emotional states" in academic English, such as anger, fear, surprise, or joy. For example, in a study of 64 languages representing 60 major geographical and linguistic groupings of the world's languages, complemented with four languages with fewer than 1 million speakers (Dehu, Mazahua, Toaripi, and Walpiri), Hupka et al. (1999) found dictionary translations of emotion terms from 25 categories established previously by Shaver et al. (1987) to be relevant for the description of the emotion domain in English. Congruently with this, the hypothesis that every natural language would have terms for "cognitively based feelings" (Wierzbicka, 1999b, p. 36) has been supported by numerous Natural Semantic Metalanguage (NSM) studies on five language families, including Indo-European (eg, Polish, Spanish, Russian, Portuguese), African (eg, Hebrew and Amharic), Austronesian (eg, Melayu-Papua, Malay, Filipino, Alamblak), Native American (Cree), and Sino-Tibetan (eg, Chinese).

Secondly, similarities have been established regarding the sequence of how emotion categories emerge in a language: specifically, "anger" is reported to be the first emotion category to evolve in any language that has emotion words, followed by "shame/guilt" (Hupka et al., 1999).[1] Indeed, if one considers the languages with the smallest emotion vocabularies—such as Chewong, Fante, or Dagbani—one would see that all these languages lexicalize four presumably basic emotional experiences, and these words are rough correlates of English *anger, fear/fright, shame/disgrace*, and *jealousy/envy* (Ogarkova, 2013, p. 51). Furthermore, universality of anger-, fear-, and shame-like feelings is also corroborated by NSM research: based on the evidence from a wide array of typologically distant languages, Wierzbicka (1999b)

[1] The centrality of these two emotions, anger and shame/guilt, has been explained by the need to maintain social control that was pertinent in all societies: anger and guilt are intrinsically related to violation of standards and have played an important role in regulating human behavior within a group (Hupka et al., 1999, p. 259).

hypothesizes that all languages would have words overlapping (though not identical) in meaning to the English words *angry, ashamed*, and *afraid* (p. 36).

The third aspect of cross-lingual similarity concerns the types of emotions that get lexicalized in different languages. Following the findings on the existence of five broad classes of emotion words at the basic level of categorization—anger, fear, sadness, happiness, and love (Shaver et al., 1987)—similar, although not identical, patterns have been reported for many other languages, such as, among others, Tagalog (Church, Katigbak, Reyes, & Jensen, 1998), Bahasa Indonesia (Shaver et al., 2001), Chinese (Shaver et al., 1992), Basque (Alonso-Arbiol et al., 2006), and Czech (Slaměník & Hurychová, 2006). Furthermore, a study of representative corpora from both different historical periods and across a variety of countries speaking a language (Delgado, 2007) has shown that labels for these basic emotions are most frequent in terms of language use.

Fourthly, comparable (although not identical and varying in salience) dimensions—such as valence, potency, and arousal (Osgood, Suci, & Tannenbaum, 1957) are reported to emerge in the analyses of emotion words in over 30 languages, such as English, Spanish, Vietnamese, Greek, Haitian Creole, Hong Kong Chinese (Herrmann & Raybeck, 1981), Italian, French, Catalan, Portuguese, and Romanian (Galati, Sini, Tinti, & Testa, 2008), Gujarati, Croatian, Japanese (Moore, Romney, Hsia, & Rusch, 1999; Romney, Moore, & Rusch, 1997), Woleaian spoken by the Ifaluk (Lutz, 1982), as well as in the research on a representative selection of 23 languages from Germanic, Romance, and Slavic language families and several isolates like Basque (Fontaine et al., 2013). These and other relevant studies suggest that implicit evaluations of whether emotion words (and the concepts behind them) are negative or positive, whether an emoter feels powerful/weak, aroused, or calm are a universal part of the connotation of emotion words.

Furthermore, in most languages studied to date, emotions can be represented not only by abstract psychological language (ie, emotion words such as *anger* or *fear*), but also via somatic expressions, that is, body-part phrases referring to both literal (eg, *she blushed*) and imaginary processes (eg, *his heart sank, it just makes my blood boil*) taking place inside, or with the body (Ogarkova, 2013, pp. 54–56; Ogarkova & Soriano, 2014b, pp. 148–150, for overviews).

Finally, impressive cross-cultural similarities have been observed in the ways people figuratively talk about their feelings. Following the pioneering work on major metaphors that "scaffold" verbal representation of emotions in American English (Lakoff & Kövecses, 1987), similar emotion metaphors have been identified in many other languages from typologically distant families, including African (Emanatian, 1995), Altaic (Matsuki, 1995), Baltic (Sirvyde, 2006), Indo-Iranian (Chand, 2008), Sino-Tibetan (Yu, 1998), and Slavic (Ogarkova & Soriano, 2014a, 2014b). For example, metaphorical expressions linking anger and fire (eg, *he was breathing fire*, *this ignited his fury* in English) can be found in languages as diverse as Chinese (Yu, 1995), Zulu (Taylor & Mbense, 1998), Japanese (Matsuki, 1995), Russian, Spanish (Ogarkova & Soriano, 2014b), or Persian (Mashak, Pazhakh, & Hayati, 2012).

However, the common aspects outlined above are subject to several limitations. These will be briefly discussed in the following sections.

3.1 Cultural salience of "emotion" and specific emotion categories

From a quantitative perspective, there are considerable differences among languages as to the number of different emotions that are lexicalized in them. While 1501 emotion terms have been catalogued in Dutch (Hoekstra, 1986), only half of this amount (750) have been recorded in Taiwanese Chinese (Boucher, 1979); yet smaller numbers of emotion words have been identified in Czech (Slaměník & Hurychová, 2006) and Indonesian (Shaver et al., 2001): 404 and 421, respectively. Furthermore, previous studies analyzed 330 Turkish, 256 Tagalog (Filipino), and 230 Malay emotion terms (Boucher, 1979; Church et al., 1998; Smith & Smith, 1995); dramatically less representative emotion vocabularies have been recorded by anthropologists and anthropological linguists working on several Pacific, Malaysian, and African cultures. For instance, around 160 emotion predicates and fewer than five emotion nouns were recorded in Dalabon, an aboriginal Australian language (Ponsonnet, 2014); 80 emotion terms have been elicited in the Palauan language (Smith & Tkel-Sbal, 1995); 58 affect-related and 31 emotion proper terms have been elicited in the Wolenian language spoken by the Ifaluk (Lutz, 1982). Finally, 14 and 9 emotion terms were gathered via a focus group interviewing methodology in two Ghanaian languages, Fante and Dagbani (Dzokoto & Okazaki, 2006), and only 7 words have been reported for Chewong (Howell, 1981). Obviously, some of these divergences can be explained by the differences in the methods used to elicit or collect emotion terms: indeed, methodological issues can explain why numerous studies on English emotion words repeatedly came up with different numbers of emotion terms ascribed to it, ranging from 518 (Russell, 1980), through 525 (Storm & Storm, 1987) to 2000 (Wallace & Carson, 1973) and 2186 (Bush, 1972). However, in some of the cases outlined above, the difference in the number of words for emotions in different languages is too large to be attributed to methodological issues only. In terms of translatability of emotion words, what these quantitative differences suggest is that no word-to-word correspondence across languages should be expected.

On the other hand, cross-lingual variability is also observed with regard to the number of emotion words within specific emotion categories, highlighting the disparities across cultures as to which emotions are elaborated as key and focal and which emotions are less salient (see Levy, 1983, for the concepts of "hypercognition" and "hypocognition"). For instance, "sadness" and "guilt" are reported to be muted in Tahitians (Levy, 1983) and so is "anger" in the Utku Eskimo (Briggs, 1970). By contrast, a widely quoted example of "hypercognition" of an emotion category in a culture (and, hence, language) is the case of shame in Chinese: 113 words referring to "shame" in Chinese emerge as an additional basic-level category (Shaver, Wu, & Schwartz, 1992) which further splits into two subordinate-level categories of lexemes: words denoting shame experiences proper, that is, "self-focus" shame (54.8%) and reactions to shameful actions of others, that is, "other-focus" shame (45.2%) (Li, Wang, & Fisher, 2004). Clearly, not all these terms would be readily translatable into other languages, especially those where "shame" is a less salient emotion category, as in American English (Wang & Fisher, 1994).

3.2 Alternative conceptualizations of emotions

Another divergence between languages in terms of how they label emotion words is that not all languages appear to classify the words referring to emotional experiences into a distinct category of experiential states. For one thing, some languages, such as Dagbani (Dzokoto & Okazaki, 2006) or Chewong (Howell, 1981), lack a super-ordinate, "umbrella" term for emotional experiences. Furthermore, when super-ordinate terms are available, these terms are oftentimes qualitatively different from the English word *emotion*. On the one hand, they can be narrower in their referential scope than the English term, so that more than one generic label is needed to capture all relevant words. This is the case of Turkish and Indonesian where several terms are used to speak generically about emotional states: three in Turkish—*duygu* "feeling," *heyecan* "excitement, enthusiasm," and *his* "feeling" (Smith & Smith, 1995, p. 105), and two in Indonesian—*perasaan hati* "feelings of the heart" and *emosi* "(negative) emotions" (Beatty, 2005). Conversely, generic-level affect terms in non-Western languages can have a wider referential scope than English *emotion* and thus encompass also the labels for affective dispositions/character traits, as in the Japanese category of *jodo* "emotion" that includes also the equivalents of English *considerate, motivated, lucky*, and *calculating* (Matsuyama, Kama, Kawamura, & Mine, 1978), or the labels for the physiological, or somatic states, such as hunger or thirst, as in the Fante and Anglo indigenous categories of *atsinka* and *seselelame* (Dzokoto & Okazaki, 2006; Geurts, 2002). In yet another group of languages, super-ordinate categories conflate the affective and the cognitive, as in the Balinese category of *keneh*, rendered as "feeling-thought" (Wikan, 1992), or the Shuar *anentaimia* (Boster, 2005). Likewise, the Ifaluk do not distinguish lexically between "feel" and "think"; thus, the most relevant word in this area, *nunuwan*, "[…] refers to mental events ranging from what we consider thought to what we consider emotion.[…] Thus, *nunuwan* may be translated […] as 'thought/emotion'" (Lutz, 1985, p. 17).

Overall, two alternative conceptualizations of emotions are widely discussed in the literature. First, numerous ethnographic reports contend that in many non-Western cultures—including the Ifaluk (Lutz, 1983), Balinese (Wikan, 1992), Pintupi (Myers, 1979), Samoan (Gerber, 1985), and A'ara (White, 1978)—emotions are seen as relational phenomena, embedded in social situations and taking place "between" people, rather than "inside" them. Accordingly, emotion words in those cultures function as "statements about the relationship between a person and an event (particularly involving another person), rather than as statements about one's introspection on one's internal states" (Lutz, 1986, p. 267). This suggests that, in translating emotion words from indigenous languages to Western languages, this social dimension entrenched in the meaning of emotion lexemes should be taken into account.

Another alternative type of emotion conceptualization relates to the salience of association between the affective and the somatic. While, as mentioned above, in most languages emotions can be named using body-part phrases referring to both literal and figurative processes that take place in and with the body, the role of such expressions considerably varies across languages. More specifically, many non-Western languages are reported to not differentiate between emotion and bodily sensation to

the same extent as the Western languages. Accordingly, a somatic expressions are more abundant in the emotion vocabularies of African languages (eg, Ameka 2002; Dzokoto & Okazaki, 2006; Geurts, 2002; Nida, 1958; Taylor & Mbense, 1998), as well as in the languages of several Asian and indigenous South and Central American cultures, such as Chewong (Howell, 1981) or Malay (Goddard, 2001). In Wolof, for example, one literal rendering of "anger" (*dafa mer* "she is angry") exists in parallel with at least five body-part phrases that label "anger" experiences of various shades of intensity (Becher, 2003). In terms of translatability, these observations highlight that abstract nouns denoting emotions in Western languages (eg, English *anger* or *fear*) are very likely to have somatic idioms as their best semantic matches in many indigenous vernaculars. And indeed, many reports by anthropologists and cross-cultural psychologists working on non-Western cultures appear to corroborate this prediction. For instance, lacking an abstract term for *enthrallment*, Luganda speakers use the metaphor "the person left us with our mouth open" instead (Hupka et al., 1999, p. 248). Likewise, Beatty (2005) writes that the Niasan have no word for English *guilt*, but "[…] they do have a phrase that could be adapted, *Itegu dödögu* which means, literally, 'my heart is pressed/nagged'" (p. 24).

In sum, as suggested by the brief overview above, there are both quantitative and qualitative divergences in how different languages lexicalize emotions. What qualifies as an emotion word in a language and how salient emotion lexis is in the entire vocabulary of a cultural group varies considerably across cultures. The next section will take a closer look at how individual emotion words compare across languages.

4 Translatability of individual emotion words

4.1 Cross-lingual asymmetries in lexicalizing emotions

4.1.1 "Culture-specific" emotions

Many cultural groups have in their affective repertoires the so-called culture-specific emotions. These emotions have two major characteristics. First, their lexical designations are particularly frequent (and thus, salient) in everyday discourse, written language, and self-report. Their second and more important trait is "untranslatability": the words that refer to culture-specific emotions in a language either do not have a one-word equivalent in other languages or, if a conventional translation is possible, nuanced specifications are necessary to properly render their meaning in other cultures.

Numerous reports about culture-specific emotions come from non-Western cultural groups, suggesting the untranslatability of Samoan *lotomama* ("socially approved feeling of happy passivity and willingness to agree with the desires of others"; Gerber, 1985), Ifalukian *fago* ("compassion"/"sad love"/"sadness"; Lutz, 1982, 1983), Chinese *chou* ("sorrow"/"worry"/"melancholy"; Ye, 2001), Javanese *sungkan* ("an inhibition of one's desires before a superior," an "attitude of constraint"; Geertz, 1959), or Japanese *ijirashii* ("a feeling associated with seeing someone praiseworthy overcoming an obstacle"; Araki, 1994). However, numerous reports exist about

untranslatable emotions in Western languages, such as *toska* ("yearning"/"craving"/"sadness") in Russian (Ogarkova, Fontaine, & Prihod'ko, 2013), *dojetí* "emotion-movement" and *lítost* "regret-pity" in Czech (Slaměník & Hurychová, 2006), *saudade* "sweet feeling of longing, yearning, homesickness, nostalgia" in Portuguese (Farrell, 2006), or *stenahoria* ("discomfort"/"sadness"/"suffocation") and *ypohreosi* ("deep sense of cultural and social obligation") in Greek (Panayiotou, 2004).

In terms of translation, since culture-specific emotions do not have straighfoward equivalents in other languages, multiple variants are used in practice to render their meaning in translation. For example, one study reports over 20 contextual translations of Russian *toska* in English, including *yearning*, *longing*, *pining, desire*, *regret*, *grieving, mourning*, *weeping*, *gloom*, *dismay, boredom, fatigue*, *exhaustion, suffering*, *wretchedness*, *sorrow*, *anguish*, *ache, pain*, *fretting*, *throes*, and *hyp* (Rudakova, 2002).

4.1.2 Lexical lacunae

Another group of studies reports that many languages do not lexicalize what we would see as common emotion words, such as *fear, anger*, or *surprise* in English. For instance, Levy (1973, p. 342) writes that Tahitians lack the words for *sadness* and *guilt*; the Ifalukians lack a word for *surprise* (Lutz, 1982). In some cases, the absence of a specific emotion word in a language can be explained by the cultural context: for example, an observation that African languages Fante and Dagbani do not have a word corresponding in meaning to English *loneliness* made the researchers working on these languages speculate if this gap may reflect a relative lack of instances in these two cultures when an individual is alone, as a result of the reality of Ghanaian rural life (Dzokoto & Okazaki, 2006, p. 130).

Guilt and depression are particularly frequent in reports of this kind. Among the languages reported to not have an equivalent of English *guilt* are Sinhala (Obeyesekere, 1981, p. 79), llongot (Rosaldo, 1980, pp. 139–140), Pintupi (Morice, 1978, p. 93), and Niasan (Beatty, 2005, p. 245). Likewise, lexical equivalents of English *depression* are absent in various North American Indian languages (Termansen & Ryan, 1970), Malay (Resner & Hartog, 1970), or Eskimo (Leff, 1973).

In this context, a straightforward way to have a closer look at the untranslatability of English *guilt* and *depression* is to consider the data reported in larger-scale studies involving many languages. One such study was conducted by Hupka et al. (1999) who sought to establish whether emotion lexemes from 25 emotion categories from Shaver et al.'s (1987) analysis of English emotion lexicon were recorded in the dictionaries of 64 languages, a selection that covered the typological variability of the world's languages. Table 23.1 provides a fragment of these data. For illustrative purposes, we additionally considered dictionary translations of English *anger*, an allegedly basic (Ekman, 1999) or modal (Scherer, 2005) emotion that would be expected to be universally lexicalized in all or most languages of the world.

And, indeed, according to Hupka et al.'s (1999) data, the dictionaries of only 4 out of 64 languages (Blackfoot, Bororo, Pemon, and Mazahua, all vernaculars spoken by tribes in Canada, Brazil, Venezuela, and Mexico) had no entry for *anger* (though synonyms/alternatives like "hate" or "vengefulness" were available). In these four

Table 23.1 Languages lacking dictionary entries for English *anger*, *guilt*, and *depression*

Language	Anger	Guilt	Depression
Blackfoot	*Sataimm* [wish evil]	*Ikook* [regret]	*Soohtsimm*
Bororo	*Macdő* [hate]	*Pogūro* [shame]	*Bi* [sad]
Pemon	*Ewan-ma* [to hate]	*Puirika* [to shame]	*Pokoi* [sad]
Mazahua	*Nžōküte* [vengefulness]	*Tsjeje* [shame]	*Čju'u* [sad]
		…	…
		[+ 28 other languages]	[+ 33 more languages]

Note: Cited in Hupka et al. (1999), selected and adapted from Appendix C, pp. 268–275. Words in brackets indicate that dictionaries did not have an entry for the English words *anger, guilt*, and *depression* and are the translations of alternative lexemes that were found.

languages (except for Blackfoot), dictionary entries for English *guilt* and *depression* were not found either. However, *guilt* and *depression* were also not recorded in the dictionaries of 28 and 33 further languages studied by Hupka et al. (1999), respectively, that is, in about a half of the studied languages.

4.1.3 "Syncretic" emotions

Another frequently reported case of asymmetrical lexicalization of emotions is when emotions conventionally differentiated in one language are not differentiated in another. Here, three frequently reported patterns can be discerned.

The first pattern is the conflation of anger and sadness. For instance, Leff (1973, p. 301) points out that, in several African languages, one emotion word covers what we would distinguish as *anger* and *sadness*. Likewise, Orley (1970, p. 3) observes that in Luganda, the verb *okusunguwala* ("to get angry") is frequently used as a translation equivalent of *to get sad*. Some blurring between anger and sadness can also be seen in the llongot word *liget*, which is commonly translated as *anger*, but also covers a range of emotions including grief (Rosaldo, 1984). Similarly, the Ifalukian word *song* covers what in English would be described as *anger* and sometimes *sadness* (Lutz, 1982, 1983).

The second pattern concerns shame and embarrassment. According to Levy (1983), these two emotions constitute "a lexically unified cluster in many or perhaps most parts of the non-Western world" (p. 131). Indeed, lexical distinction between shame and embarrassment is not made by Tahitians (Levy, 1973), Ifalukians (Lutz, 1980, p. 209), or the Newars of Nepal (Levy, 1983). The llongot (Rosaldo, 1983, p. 141) use one word, *belong*, to cover shame, timidity, embarrassment, awe, obedience, and respect. The Javanese use *isin* in reference to shame, guilt, shyness, and embarrassment (Geertz, 1959, p. 233). The Pintupi use one word, *kunta*, for shame, embarrassment, shyness, and respect (Myers, 1979, p. 361). In the Tamajaq language of the Tuareg people in Niger and Mali, *takarakit* is reported to convey shame, reserve, respect, and/or embarrassment (depending on the context of encounter, intention, and social relationship between parties) (Rasmussen, 2007, p. 238).

Table 23.2 Selected emotion words referring to more than one category identified in Shaver et al. (1987)

Language	Emotion word	Alternative translations
Ainu	Yaikatekara	To long for, to feel anxious about, to love
Amhara	Dənəggate	Alarm, dismay
Azande	Sanza	Jealousy, longing, desire for
Cree	Kisewa'sewin	Anger, wrath, passion
	Cheka'yetum	Happy, zealous
Kapauku	Utugu ekegai-a	Relieved, happy
Klamath	Q'oy	Disgusted, annoyed, hate
Lau	Fane	Excited, angry
Truk	Mááirú	Alarmed/frightened, astonished/surprised
Zulu	Dana	Sad, depressed, worried
	Khánu	Desire, lust, envy
Toaripi	Haikavora	Anxiety/worry, care

Note: Selected and adapted from Hupka et al. (1999), Appendix D, pp. 276–278.

Finally, the third pattern is the conflation in one word of the meanings of envy and jealousy, reported for 13 languages—among others, Amhara, Cree, Luganda, Tonga, and Zulu (Hupka et al., 1999).

Overall, lexemes that demonstrate this semantic "syncretism," or conflation of the two distinct emotional meanings, have been referred to in the literature as "composite" words (Hupka et al., 1999). Hupka and associates catalogue a total of 117 such words; the most interesting cases, in our opinion, are given in Table 23.2.

4.1.4 *One English emotion word has several equivalents in other languages*

Finally, a reverse pattern is observed where one English emotion term does not have a straightforward equivalent in other languages but corresponds to two or more emotion words. For example, as contended by many linguists, none of the Russian anger nouns satisfactorily corresponds to English *anger*. The most consensual proposal thus far is that the meaning of English *anger/angry* is best captured by the combination of two Russian emotion verbs: *zlit'sya* "to be angry, mad, but not necessarily at a particular person," and *serdit'sia* "to be actively cross at someone, to be upset with them and mad at them" (Pavlenko, 2008).

The motivations behind lexical differentiation of two or more emotional meanings that correspond to a single English emotion word are many and varied. For one thing, this could be the focus on the type of person(s) who causes an emotion experience: for example, Briggs's (1970) study of the Utku yielded no exact equivalent for *love* because, in this language, *naklik* (love for those who need protection, such as babies, puppies, or the sick) is lexically distinguished from *niviuq* (love for those who are charming or admired). Also, lexical differentiation can tap on the evaluation of the stimulus of an emotional experience: for instance, Ifaluk does not have a term that

corresponds to *surprise* because pleasant surprise, *ker*, is distinguished from unpleasant surprise, *rus* (Lutz, 1982); the same valence-related motivation underlies lexical differentiation between *Jelinsi Nyuli* "hate envy" and *Bomma Nyuli* "good envy" in Dagbani (Dzokoto & Okazaki, 2006). Yet another motivation behind lexical differentiation can refer to social context: for instance, Utku are reported to lack an exact equivalent of *fear* because fear of physical injury, *iqhi*, is distinguished from fear of social injury, *Him* (Briggs, 1970).

4.2 Partial overlap in meaning of translation equivalents: aspects of variation

While the body of work overviewed in previous sections reveals a complex network of (sometimes, very relative) correspondences between emotion words in different languages, the final issue that still needs to be addressed concerns the aspects of variation that contribute most to the differences in emotion term semantics. Here, the salience of several such aspects, or components, can be highlighted.

First of all, differences in the meaning of cross-lingual translation correlates frequently derive from the differences in the *typical antecedent events* of emotional experiences. For instance, Malay *malu* "shame" refers to an emotional experience that typically happens not only in the situations that would be easily recognized as prototypically shame-eliciting by speakers of English (eg, having done something wrong or foolish), but also in response to being teased, even in a relatively mild way (Goddard, 1996).

Secondly, differences between translation equivalents can relate the *subjective feelings* associated with the emotional experiences at stake. For example, Portuguese *saudade* is described as a word that denotes a more afflictive emotional experience than its typical English translations *nostalgia* and *missing* (Farrell, 2006).

Thirdly, cross-lingual glosses have been shown to refer to emotional concepts that differ with respect to *physiological symptoms* that accompany an emotional experience. For instance, research on Zulu suggests an (albeit, metaphorical) association of anger with nausea and vomiting (Taylor & Mbense 1998, pp. 198–200), which is not typical of anger as lexicalized in Western languages.

Finally, deemed translation equivalents can differ with regard to *expressive patterns* and *regulatory control* exerted on open manifestation of one's emotion. Most typical examples here are emotion words that refer to negative other-directed emotions like anger or hate (see Ogarkova, 2013, p. 61, for an overview). Here, while English *anger* is generally taken to imply a negative judgment of someone's action and an impulse for retribution (Lazarus, 1991), its glosses in languages spoken by collectivistic cultural groups—that is, those where open manifestation of negative affect is discouraged for the sake of maintenance of social harmony within a group—do not imply similar tendencies of acting back on the offender. For example, Malay *marah* "anger" is associated with sullen brooding rather than aggression (Goddard, 1996).

Further aspects of meaning that set apart cross-lingual glosses include various social aspects of situations where emotions occur and the characteristics of the agents involved (see Ogarkova, 2013, pp. 59–60 for a review of five relevant parameters).

However, the asymmetries in lexicalizing emotions outlined above do not necessarily mean that emotion words at stake cannot be translated from one language to another. What the overviewed evidence rather suggests is that the best (or, in some cases, the only possible) way of rendering an emotion word from one language to another may require using (1) a word from a different morphological class, as in the case of English noun *anger* being best rendered by two Russian verbs, (2) a somatic metaphor, as in translating English *guilt* in Niasan through a body-part phrase, or (3) a descriptive phrase, as in rendering Samoan *lotomama* ("socially approved feeling of happy passivity and willingness to agree with the desires") into English.

Therefore, if one aims to establish a best translation correlate of an emotion word in other languages, analyses of the semantic (dis)similarity of candidate items should be done with maximally appropriate methods. The next section will specifically address this issue.

5 Methods to assess semantic (dis)similarity of translation equivalents

Since lexical research on emotions has been conducted across a variety of disciplines—including ethnography, anthropology, linguistics, and cultural psychology, among others—the methods that have evolved to assess (relative) semantic equivalence of translation correlates are many and varied. In order to capture this variety in maximally general terms (and to avoid a disciplinary bias, as a cross-disciplinarily consensual theory of meaning is still far), it is useful to consider Frege's (1980) distinction between two aspects of meaning: the "sense," ie, the thought the word expresses, and the "reference," ie, the things or events "out there" in the world which a word points to. When applied to the assessment of meaning differences/equivalence of emotion words, this theoretical dichotomy results in two major methodological orientations. On the one hand, some approaches start with the deemed cross-lingual correlates (dictionary translations) and, in the course of the analysis, both similarities and differences of their meanings are proposed. The second methodological orientation to establish equivalence and/or relationship between emotion words is known as the mapping method (Boster, 2005). Here, the major criterion for semantic equivalence is shared reference—that is, the items are deemed equivalent if they point to the same phenomenon. In what follows, a brief account of these two methodological orientations is provided.

5.1 "Sense"-based methods

5.1.1 Linguistic approaches

In linguistics, a full palette of methodologies to study emotional meaning has emerged (see Soriano, 2013, for a comprehensive review). Of these, two paradigms have been particularly prolific in the last four decades: on the one hand, Natural Semantical Metalanguage (NSM), introduced in 1972 and advocated ever since by

linguist Anna Wierzbicka and her colleagues (Wierzbicka, 1996, 1998, 1999a; see also Section 3) and, on the other hand, Conceptual Metaphor Theory (CMT), articulated in the foundational works on emotion metaphors by Lakoff and Kövecses (1987) and Kövecses (1986, 1990) and used by a host of other studies using the approach (Kövecses, 2000, 2005; see also Section 3). Both methods converge in that similarities between emotions words (and concepts behind those words) are captured using a language-free *tertium comparationis*. In NSM, emotional meaning is explicated using a small inventory of basic meanings, known as semantic primes (eg, *feel*, *want*, *say*, *think*, *know*, *good*, and *bad*), which are universally lexicalized words or expressions and can thus be used to articulate culture-specific values and attitudes in terms that are maximally clear, translatable, and unbiased by a specific language. Such an unbiased inventory is crucial, as the lexical "grids" provided by natural languages not only impose certain constraints on classifying the emotions, but also can bias the speakers to interpret emotional experiences through the prism of a particular language (Wierzbicka, 1999b, p. 31).

In CMT, a common denominator to compare emotional meanings is a limited set of recurrent themes, or domains (the so-called target domains), such as physical objects or locations, illnesses/somatic states, natural phenomena (storms, floods), living beings (eg, plants or animals), or people (eg, opponents in a struggle), which underlie metaphorical talking about the emotions. These associations are observed in figurative expressions used to talk about emotions in most languages studied to date and highlight the universal mechanism of human thinking—that of representation of abstract concepts (including emotion concepts) in terms of concrete ones (Lakoff, 1993).

From the onset, NSM and CMT have had opposite motivations: while the main thrust of NSM was to demonstrate that deemed translation equivalents in the emotion domain (and concepts behind them) vary considerably across languages and cultures, even in case of "universal" emotions like anger or sadness (Wierzbicka, 1996, 1998), the major ambition of CMT was to show that emotion metaphors employed cross-lingually are based on the same or comparable associations. And, indeed, a host of studies have shown that anger, for example, is universally associated with target domains like fire (eg, *flames of anger*) or hot fluid (eg, English *boiling rage*) (Kövecses, 2000, 2005; see Section 3). However, the two approaches have similar limitations. In NSM, little effort has been made to empirically test NSM explications against intuitions of native speakers of the studied languages (but see Ye, 2013). Likewise, in metaphor research, the mere existence of the same emotion metaphor in different languages was frequently taken to speak about similarities in metaphorical representation. However, it is clear that, even when the same or similar metaphor applies to two comparable emotion concepts in two cultures (eg, the "ANGER IS A FLUID IN A PRESSURIZED CONTAINER" metaphor in English or Chinese, cf. Yu, 1995; Kövecses, 2000, 2005), those metaphors are not necessarily equal in their saliency within the domain; that is, some domains may be more relevant (frequent) in the representation of one emotion concept as compared to its equivalents in other languages.

In response to this limitation, corpus-based quantitative methods have evolved in metaphor research (Ding, 2011; Ogarkova, 2007; Ogarkova & Soriano, 2014a, 2014b; Ogarkova, Soriano, & Gladkova (in press); Stefanowitsch, 2004, 2006). Making use

of various statistical tools, these approaches make it possible to calculate the degree of association between an emotion word and each of the conceptual metaphors it is employed in. Furthermore, due to the focus of specific lexemes, corpus-based metaphor studies allow us to investigate not only broad emotion categories (eg, those labeled by prototypical emotion words such as *anger, fear, sadness*), but also emotion varieties within those categories (eg, *frustration, fury, irritation* in the broad category of "anger"). This latter aspect is particularly valuable from the translational perspective, as the statistical analysis of co-occurrences of emotion words in specific metaphorical contexts makes it possible to identify a better match of an emotion word among several alternatives in another language.

A similar shift towards the use of quantitative methods is observed in cognitive lexical semantics. One such recent method is the "behavioral profile" approach (Divjak & Gries, 2006, 2008), a corpus-based method in cognitive semantics where the meaning of an emotion word (and the concept behind that word) is established on the basis of "behavioral" information about the term. Several applications of this approach to emotion terms provide a very granular analysis of usage tendencies of both near-synonyms in a language and translation equivalents across languages (eg, Krawczak, 2014).

5.1.2 Psychological approaches

In contrast to linguistic approaches that are mostly based on observational data (eg, corpora), lexical research on emotion in cross-cultural psychology largely relies on elicitation, that is, on various types of semantic similarity ratings performed by native speakers of various languages. Here, a most prolific paradigm to study semantic dis(similarities) of emotion words is the dimensional approach (Fontaine et al., 2013; Galati et al., 2008; Moore et al., 1999; Romney, Moore, & Rusch, 1997). In this approach, semantic similarities and differences between emotion words are assumed to be captured by a set of global dimensions, much in the vein and under the influence of the cross-culturally validated empirical research on the structure of connotation underlying various semantic domains in natural languages (Osgood et al., 1957).

While profilic and replicated across a wide variety of languages (see Section 3), the dimensional approach studies have the limitation of focusing on a fairly small and abstracted part—namely, that of a relative position of a term in a dimensional space. With this degree of specificity, it is unsurprising that relevant studies report a considerable semantic similarity between translation pairs across languages. For example, using judged-similarity tasks of 15 English and Japanese emotion terms by Americans and Japanese speakers, Romney, Moore, and Rusch (1997) found that a remarkable part (66%) of the semantic meaning of the emotion terms was shared by Americans and Japanese, and only 6% was language-specific.[2] Another limitation of dimensional studies relates to the elicitation method: here, language speakers' spontaneous (uncontrolled) semantic similarity judgments do not allow us to understand or further explore the *reasons* for those classifications.

[2] In this study, the remaining part of variance was accounted for by individual factors (9%) and sampling and measurement error (19%) (Romney et al., 1997, p. 5493).

An innovative method in this field that partially overcomes these limitations is the GRID approach (Fontaine et al., 2007, 2013). In GRID, the meanings of emotion words are accessed through the ratings that native speakers make on the 144 features (ie, questions) derived from a broad range of emotion theories that address six emotion components, namely: (a) appraisals of events; (b) psycho-physiological changes (bodily sensations); (c) motor expressions (face, voice, gestures); (d) action tendencies; (e) subjective experiences (feelings); and (f) emotion regulation. These mean ratings on the 144-feature inventory constitute the meaning profiles of emotion terms on which both intralingual and cross-lingual analyses could be performed. Unlike in the classical dimensional studies that rely on spontaneous similarity judgments, the GRID method provides a very granular output that allows us to see which (clusters of) rating features in which emotion component(s) best captures the (dis)similarity between translation pairs.

What is more, GRID makes it possible to address several of the translatability problems outlined in Sections 3 and 4. For example, Ogarkova, Fontaine, et al. (2013) apply GRID to investigate the deemed culture-specific Russian emotion concept of *toska*, which lacks congruent translation correlates in other languages, both Western European and Slavic. This study demonstrates the potential of the GRID method to both conclusively establish the category to which *toska* belongs and to specify the degree and content of its partial overlap with other emotion categories (candidate to be important for its meaning), as well as to suggest the best translation correlates of Russian *toska* in other languages. Furthermore, GRID is able to capture a relatively higher salience of some emotion characteristics as part of the meaning of emotion words in one language as compared to another. For example, an analysis of meaning differences between translation pairs in two Slavic languages (Ukrainian and Russian) shows that opposing interpersonal (anger, hate) and fear-related emotion words in Russian imply a higher regulatory control of the labeled emotions than their translation equivalents in Ukranian (which can be underpinned by relatively more collectivistic versus more individualistic orientations of the Russian and Ukrainian cultures, respectively) (see Ogarkova, Fontaine, et al., 2013). Finally, the GRID approach is also capable of capturing the presumably minute meaning divergences between cross-lingual cognates, that is words of the same etymological origin. For instance, in their study of English *frustration* and its cognates in three other European languages (German *Frustration*, French *frustration*, and Spanish *frustración*), Soriano and Ogarkova (2012) report that English *frustration* is qualitatively different from its cognate terms in the other three languages, specifically in that the English word is considerably closer to the "anger" prototype, that is, that of an expressive and powerful negative emotion.

However, a concern with the GRID approach is that it adopts an etic, rather than an emic approach to emotion words. Etic versus emic dichotomy is used in anthropology to highlight the differences in approaching the studied phenomena: an emic approach entails an account "from within" a culture, on terms that are relevant for this specific cultural community, whereas an etic approach presupposes conducting the analyses on terms that can be applied to other cultures; therefore, an etic account is "culturally neutral" in that there is a presupposition of the common basis on which cultures can be compared. In GRID, the features included in the rating instrument prioritize the

holistic, culture-neutral view of the emotion as, above all, "an episode of interrelated, synchronized changes in the states of all or most of the five organismic subsystems in response to the evaluation of an external or internal stimulus event as relevant to major concerns of the organism" (Scherer, 2005, p. 697). In response to this limitation, a modified GRID questionnaire enriched with features targeting various social aspects of meaning was proposed (Ogarkova, 2013, pp. 59–60; Soriano et al., 2013, pp. 342–343). Using this updated questionnaire in further research on the varieties of anger lexicalized in several languages has shown that social aspects of meaning differentiate not only translation equivalents in different languages, such as various anger terms in English, Spanish, and Russian (Ogarkova et al., in press), but also set apart the meanings of anger words within the same language (eg, Russian) as spoken by two culturally different groups (eg, Ukraine and Russia) (Ogarkova, 2012).

5.2 "Reference"-based methods

In contrast to the "sense"-based methods where, in order to assess sematic (dis)similarity of translation correlates in different languages, one straightforwardly compares potential candidates (suggested by dictionaries or conventional usage), in the "reference"-based approach, one presents the same emotionally evocative stimuli to native speakers of different languages and asks them to identify the emotion(s) expressed or evoked by those stimuli. Then, the degree to which speakers of different languages converge in labeling the stimuli is assessed. Thus, in the mapping approach, translation is a *consequence*, rather than a prerequisite of the analysis (cf. Boster, 2005).

An example of the use of emotional expressions as referents is an emotional face-naming task by Boster (2005). In this experiment, 22 photographs of an actor and an actress expressing emotions were presented to native speakers of five languages (English, Spanish, Polish, Italian, and Shuar). Comparing the English terms *angry, fear, happy, sad*, and *surprised* that were used to label the pictures by English speakers to the terms elicited in the other four language groups, Boster (2005) made a note of those labels in the five languages under study that were mutually translatable (ie, which were dictionary translations of the English terms). For instance, across the five languages, only two groups (English- and Polish-speaking) used mutually translatable labels for angry faces (*angry* and *złość*), whereas the labels elicited by happy and surprised faces yielded dictionary translation equivalents in four cases out of five. On average, mutually translatable responses were obtained for three out of five languages (60%). Interestingly, labeling by Shuar speakers was the least congruent with that of the speakers of the other four languages. Specifically, only one term, *warawai* ("happy"), was elicited. The closest coordinates to the English terms *angry, sad*, and *surprised* in Shuar were the terms *etser* "grinning teeth," *uutiawai* "weeping," and *wanka* "mouth open," although literal emotion nouns are available in Shuar to label those emotions. Clearly, these findings relate to somatic encoding as the basic means of emotion lexicalization in many non-Western cultures (see Section 3).

A different approach to the use of evocative stimuli within the mapping paradigm was illustrated in a study that employed emotional *situations* as evocative stimuli (Ogarkova, Soriano, & Lehr, 2009, 2012). Twenty emotion situations in four emotion

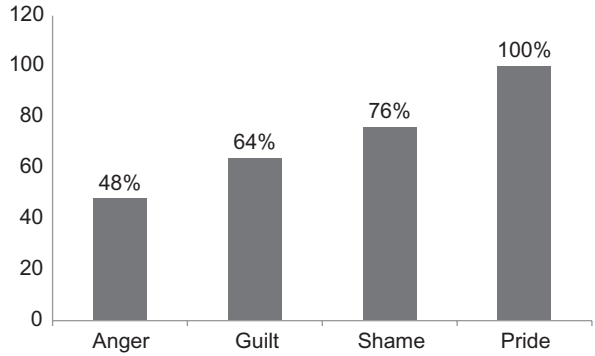


Figure 23.1 Congruence of reference equivalents with dictionary translation (Ogarkova et al., 2009).

categories (anger, shame, guilt, and pride) were presented to the speakers of five European languages (English, French, German, Spanish, and Russian). The participants were instructed to free-label the emotions they would feel in those situations. The analysis of most frequent labels assigned by the speakers to each of the situations suggested a general pattern where most variability occurred in labeling anger scenarios, followed, in the ascending order of cross-lingual consensus, by guilt, shame, and pride (Fig. 23.1). When labeling pride scenarios, speakers in all five groups used conventional dictionary translations (ie, English *pride*, French *fierté*, Spanish *orgullo*, German *Stolz*, Russian *gordost'*). Fairly congruent also was labeling in shame situations: three scenarios out of five produced mutually translatable words in all five languages; in two remaining scenarios, dictionary translations were obtained in 60% of the cases. The average congruence of reference equivalents with dictionary translation for shame situations was 76%.

Labeling guilt situations was less consensual: in one situation, speakers of all languages used mutually translatable words (English *guilt*, French *culpabilité*, Spanish *culpa*, German *Schuld*, Russian *vina*), but, in others, congruence ranged from 40% to 80% (mean 64%). Finally, anger scenarios yielded the highest variability in labeling responses (48%).

A further qualitative analysis of the disparities in emotion situation labeling suggested that those are underpinned by culture-specific display rules, that is, informal norms about when, where, and how one should express emotions (Matsumoto, Seung, & Fontaine, 2008). Specifically, the variance in labeling can be related to the different cultural expectations in the respective societies as to what emotions are (un)welcome in terms of being explicitly named and, therefore, admitted as being experienced (see Ogarkova et al., 2012, for further details).

In sum, it appears that, regardless of the specific type of stimuli (facial expressions or emotion scenarios), the studies that use the mapping approach yield contextual equivalents that do not always cohere with dictionary translation. Therefore, the added value of the entire methodological orientation of mapping is that it makes it possible to study not only abstracted, decontextualized emotional meanings, but also sociocultural patterns of use of emotion words in real-life settings.

6 Conclusion

Translation equivalence in the emotion domain is a broad topic that has been variously theorized in many disciplines and has yielded a yet larger and multiaspectual body of empirical findings. Our overview has revealed five general similarities in emotion labeling across the world's languages. For one thing, there is reliable evidence that most languages have terms referring to what is conventionally defined as "emotional states" in academic English. These emotion categories emerge in different languages in approximately the same order and words for some emotions, such as anger or shame, can be expected to be lexicalized universally. From a qualitative perspective, in most languages of the world, emotions can be represented via literal and figurative body-part expressions and emotion metaphors that are similar across different cultures. Finally, in terms of qualitative differences between the emotions (and emotions words), the same implicit evaluations (such as valence, power/potency, and arousal/intensity) are inherently present in the meaning of emotion words across languages.

However, these commonalities are undermined by many and varied divergences. On the one hand, we observe considerable fluctuations in the overall sizes of emotion vocabularies in different languages, and the same holds true for specific emotion categories. Qualitatively, a distinct lexical category of "emotion" is not universally encoded in language, and generic-level terms that emerge in different languages can include tokens from other domains, such as physiological or mental states. This, coupled with the divergencies in the cultural makeup of various societies, gives rise to alternative conceptualizations of emotions, such as conceptions of emotions as interpersonal phenomena or somatic, rather than affective, states.

Considerable asymmetries are also observed in the comparison of individual emotion words in different languages. Many languages are reported to have untraslatable culture-specific concepts; many others lack the labels for what speakers of Western languages would see as common emotions (anger or surprise). Furthermore, in some languages, emotional meanings differentiated in English or other Western languages are spanned together and vice versa. Even in cases of a core overlap of meaning, several aspects, including the social parameters, still differentiate between deemed translation correlates. In a practical sense, what these asymmetries suggest is that any study that uses translation equivalents culled from dictionaries should carefully consider the existing literature for the potential sematic divergence between the target words. Another solution is to recruit a linguist for both the selection of the words and interpretation of the findings.

This said, our brief overview of the methods also suggests that an approach that would maximally adequately capture all relevant disctinctions between translation correlates in the emotion domain is yet to come. Future studies should ideally combine both etic and emic elements, ensuring both "thick" descriptions of "experience-near" concepts, much in the vein of current anthropological approaches, and, at the same time, provide a measurable output of semantic (dis)similarity, as in the GRID approach. Observation of language-in-use, as advanced in current linguistic

approaches, should ideally be complemented with testing the results against the intuitions of language speakers, and vice versa. Translations of emotion terms provided by dictionaries should be put to test in mapping studies. Overall, methodological triangulation, that is, a combination of methods for the sake of cross-fertilization and accumulation of the insights affordable with each of the methods, should be central in further research on translatability of emotion words. Emotions, after all, are multifaceted phenomena whose nature should only be studied in a cross-disciplinary and cross-methodological fashion.

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Different Ways of Measuring Emotions Cross-Culturally

24

Yulia E. Chentsova-Dutton[1] *and Samuel H. Lyons*[2]
[1]Georgetown University, Washington, DC, United States
[2]Northeastern University, Boston, MA, United States

There is no doubt that our emotions reflect our evolutionary heritage. Most humans around the world experience and express broadly similar emotional responses to significant events, such as bonding with others, prevailing over challenges, losing something or someone, or coping with threats to self or others. A rapidly expanding body of work illustrates that our emotions also reflect our cultural contexts. For example, a minor insult is more likely to trigger physiological and behavioral signs of rage among people from cultural contexts that emphasize honor concerns (eg, American South; Cohen, Nisbett, Bowdle, & Schwartz, 1996). Much of what we currently know about emotions is based on emotions of college students in North America and Western Europe, two sets of cultural contexts that are not representative of the world's diversity (Henrich, Heine & Norenzayan, 2010). Recently, researchers have been extending the study of emotions to people in cultural contexts with different models of emotions that are important, appropriate, desirable and functional. There is much to gain from pursuing this work. In doing so, we may learn more about emotions, about culture and about the interactions between the two, as well as examine practical questions that involve both constructs (eg, comparing people's responses to a political campaign). This chapter will review extant work in the field, with a special attention to methodological challenges posed by assessing emotions across cultural contexts and best practices for doing so.

1 Defining and studying emotions

The study of emotions is not a task for the faint of heart. Many challenges await the intrepid researcher who wants to contribute to this rapidly developing area. Emotions are multicomponential responses to threatening or rewarding events that involve numerous changes, including those in subjective experience (eg, how intensely one feels an emotion), cognitive appraisal (eg, whether an event is perceived to be self-relevant or controllable), actual and perceived physiological responses (eg, heart beat), and action readiness and behavior (eg, feeling ready to withdraw or actually withdrawing from a threatening situation) (see chapter: Theoretical Approaches to Emotion and Its Measurement for a discussion on theories of emotions). These sets of changes are only loosely associated with each other (Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005), making it difficult to infer one component of emotions

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from observing others. Thus, researchers needs to capture as many of these components as they can to get a good handle on this elusive construct.

The task of assessing emotions is made even harder by the fact that people are aware of their emotional reactions and able to respond to them. As emotional responses unfold, they trigger efforts to map them onto familiar emotional categories, such as anger or pride, and enact emotional scripts, such as communicating these emotions to others or regulating them depending on the situational or cultural demands (Gross, 2014; Lazarus & Folkman, 1984; Lindquist & Barrett, 2008; Miyamoto & Ma, 2011; Neumann, 2000; Wilson-Mendenhall, Barrett, Simmons, & Barsalou, 2011). All of this further complicates the researchers' efforts to assess the emotions, as it is challenging to differentiate emotional response itself from the effects of regulating this response (Gross & Barrett, 2011).

Finally, the task of assessing emotions is made more complex still by the fact that emotions are rapidly wilting flowers. That is, most people tend to quickly return to their emotional baselines even after some of the most exhilarating or traumatizing experiences (see Gilbert, Pinel, Wilson, Blumberg, & Wheatley, 1998; for a review). This tendency is so predictable that some forms of psychotherapy (eg, exposure therapy) place a solid bet on patients experiencing a drop in negative emotions that are evoked in a therapy session (Abramowitz, Deacon, & Whiteside, 2010). Hence, it is not surprising that most emotions elicited in the laboratory will endure for only a few minutes. Since retrospective and global measures of emotions are imperfect substitutes for capturing them in the moment (Robinson & Clore, 2002a, 2002b; Schwarz, 2012), an emotion researcher must worry about the temporal resolution of his or her measures.

To tackle these challenges, researchers studying emotions should be prepared to assess multiple aspects of emotional reactivity, to be sensitive to the potential impact of conceptualization and regulation, and to be able to assess emotions as they unfold in the moment. Despite these challenges, the number of researchers willing to take them on continues to grow. Among them are an increasing number of scholars and practitioners who do so while balancing another formidable challenge: That of studying emotions across cultural contexts.

2 Defining culture

Cultures are complex sets of shared meanings, values and corresponding behavior and cultural products. As such, cultures exist "in the head" as well as "in the body" and "in the world." The former (culture in the head) includes shared lexica of emotion words, models of experiencing and expressing emotions, and beliefs about emotions. A related set of mental representations and physiological manifestations may be described as "culture in the body" and includes the ways in which people detect, conceptualize, and report actual and imagined physiological changes associated with emotions. Finally, "culture in the world" refers to patterns of observable situations, emotional behavior, and cultural products. Culture and psychological functions, such as emotions, mutually constitute one another (Markus & Kitayama, 2010). This means that as culture shapes the ways in which people experience and express

emotions, the emotions themselves also affect cultural change and maintenance. For example, people's emotions serve to transmit elements of culture, such as behavioral norms and stories (Berger & Milkman, 2012; Heath, Bell, & Sternberg, 2001).

Cultures are widely shared in a sense that an individual living in a particular cultural context is likely to be exposed to and affected by this context's norms, practices, and values. For instance, an American is likely to be exposed to the idea that it is good to feel and display happiness, whereas a Russian is likely to be exposed to the idea that happiness is associated with foolishness. Yet, people can respond to their cultures in a wide variety of ways, ranging from acceptance to doubt and rejection. People are not merely cookie-cutter images of their cultures, and knowing something about a cultural context does not allow us to extrapolate to a person. In practice, this means that a researcher cannot assume that cultural membership conveys any psychological information about particular research participants. Studies focusing on culture need to assess rather than assume cultural differences in models of emotions. Of course, most researchers will find it impractical, if not impossible, to carefully assess all or even most of the different aspects of culture. Nonetheless, when designing a study, researchers need to strive to capture aspects of culture that are relevant to their research question.

3 Cultural equivalence

A key set of methodological concerns that are specific to cultural psychology relate to cultural equivalence. Any researcher designing a study or interpreting its results needs to be concerned with ensuring that their measures are reliable and valid. When assessing emotions across cultural contexts, researchers need to also ensure that the methods, participants, research settings, and constructs that are being studied, the meanings and significance of these constructs, and the language and psychometric characteristics of the assessment tools are comparable across different cultural contexts (Butcher, Perry, & Dean, 2009; Hui & Triandis, 1985; Poortinga, 1989). One should not simply translate questionnaires and export a study designed for a particular cultural context to another without careful work with local experts to ensure cultural equivalence.

Let us imagine a US-based researcher who studies empathy by observing the way participants respond to a distressed confederate. Suppose this researcher would like to conduct this study in another cultural context, such as Russia. In order to ensure cultural equivalence, this researcher would need to work with Russian colleagues to ensure that the study can be conducted with a comparable sample and in a comparable setting. It is not enough to assume that superficial similarities signal equivalence. Being a student or a worker in one context can mean something very different in terms of representativeness (eg, class, religion) in another. For example, studying new army recruits or customers of high-end electronics has different implications in countries that do or do not mandate a military service and those that differ in their socioeconomic distribution. Hence, a commercial or academic researcher needs to know and think through the implications of a membership in a particular population in the cultural context(s) under investigation. The most important question to ask is whether these implications may affect the results of the study.

Our researcher interested in empathy would also need to take steps to make sure that behaviors and relationships that are central to the study (eg, public expression of distress and interactions with a stranger) have the same meanings across the two contexts. In the case of our example, this is difficult to ascertain. The simple act of being in a psychological study may be interpreted differently by participants from different contexts. Whereas our participants in Western cultural contexts tend to be familiar and comfortable with the concept of being the subject of investigation, participants in other cultural contexts may find the experience unfamiliar, and, therefore, potentially embarrassing or threatening. A researcher needs to be tuned in to these differences and ensure that the results of the study are not driven by differences in response to the setting itself.

In addition, the specific methods of the study may be interpreted differently across cultural context. Returning to our example, a staged social interaction is ripe for different interpretations. In some contexts, such as Russia, most contacts with strangers are likely to be met with initial distrust. In others, such as the United States, helping strangers is common and appropriate. In many contexts, it is easy to convince research participants that a confederate is not familiar to them and yet shares their cultural context (eg, another psychology major, a neighbor). In other contexts, it is hard to imagine that two people may be studying in the same department of a university or live nearby and not know each other or of each other. Hence, our researcher would need to talk to her cultural informants and pilot participants to explore the meaning and relational implications of the study design. She may need to redesign the study in such a way as to minimize any cultural differences in responses to the study procedure.

Finally, research materials would need to be as comprehensive to the Russian participants as they are to their American counterparts. For any measures that are translated into Russian, the original English version and a translated and back-translated version need to be compared. Yet, this is only the first step. Often, terms that do not have identical meanings in two languages can nonetheless be easily recognized as the closest equivalents across two languages. For instance, the Russian word *schastye* is the closest equivalent of English *happiness*. Most translators would not hesitate to translate and backtranslate these terms as equivalent. Yet, the Russian term refers to a much more intense and rare form of positive emotion than the English one. Russians do not experience *schastye* because someone made them their favorite dish or because they make it to their scheduled flight after being caught in traffic. It is an emotion that is reserved for rare experiences, such as falling in love or accomplishing a very important goal. A standard translation–back-translation approach would miss these important semantic differences. It should not be seen as the be-all and end-all of culturally sensitive research. A better approach is to use teams of bilingual experts to ensure that the key terms have the same meanings and connotations in both languages and use synonyms in cases when such equivalence cannot be achieved. Although this approach takes more time than simply translating the scales, it allows researchers to reduce the possibility of different samples responding to questions in different ways due to divergent meanings. Another approach is to use nonverbal measurement tools, such as the Self-Assessment Manikin (SAM; see Morris, 1995). Finally, piloting of all measures should be used to ensure that they have the same psychometric properties (ie, reliability, validity, structure) across the different contexts.

In summary, a well-conducted study that examines culture and emotions is a much more time-intensive and laborious process than a study of emotions in a single cultural context. It requires familiarity with a new context as well as additional steps to ensure that the measures are culturally appropriate. When taken together, the challenges of studying emotions and studying culture demand carefully conducted multimethod studies that are at once empirically rigorous and culturally sensitive. We will review different methodological approaches that can aid researchers in satisfying these goals.

4 Measures of emotions in cultural psychology

Researchers studying emotions in different cultural contexts borrow methods from mainstream emotion research as well as develop additional methods that are unique to cultural psychology. We will review these measures, starting from measuring emotions "in the head" and expanding to ways emotions can be captured "in the world."

4.1 Emotions "in the head"

When measuring emotions in the head, we are assessing people's reports of experienced emotions as well as their beliefs about emotions. These types of emotional reports can be assessed using a variety of self-report approaches, including retrospective and in-the-moment questions, and storytelling.

4.1.1 Self-report surveys

Self-report surveys of emotions are cheap and easy to administer to large groups of people across many different cultural contexts. These questionnaires might ask participants to rate the intensity and/or frequency of their past, present, future, hypothetical, ideal, or average emotional experiences. They can be administered at a single time point or longitudinally, whether online, through the mail, or in person. One area of cross-cultural emotion research that has made excellent use of survey methods is that focusing on subjective well-being. Diener, Diener, and Diener (1995) examined predictors of subjective well-being across 55 nations using data from large-scale survey studies. They have observed that country-level economic and social variables, like gross domestic product (GDP) per capita and civil rights, were positively associated with subjective well-being. Additionally, culture-driven differences emerged in the frequency of reported positive affect. For example, East Asians reported experiencing happiness less often than European Americans. Other survey studies have also observed this pattern of findings (Eid & Diener, 2001; Kitayama, Markus, & Kurokawa, 2000; Schkade & Kahneman, 1998; Veenhoven & Ehrhardt, 1995). These findings are in line with cultural differences in the emphasis on experience and expression of happiness (Bellah, Sullivan, Tipton, Swidler, & Madsen, 1985; Russell & Yik, 1996). Taking this research further, Kitayama et al. (2000) have shown that positive emotions such as happiness meant different things to Americans and Japanese. Whereas feeling good was associated with interpersonally disengaged

positive feelings, such as pride, for the former, it was associated with interpersonally engaged positive feelings, such as a feeling of respect, for the latter.

Another pattern that emerges from the work using self-report questionnaires is that East Asian cultural contexts foster experiences of mixed emotions, or occasions when a person feels several different, and potentially contradictory, emotions at once (Leu et al., 2010). Indeed, positive and negative emotions are negatively correlated in the United States, but positively correlated in Japan (Kitayama et al., 2000). East Asian cultural emphasis on dialecticism, or an acceptance of contradictions (Nisbett, Peng, Choi, & Norenzayan, 2001), is thought to contribute to this tendency (Hui, Fok, & Bond, 2009). In East Asian cultural contexts, people tend to anticipate that positive emotions, like happiness and pride, may engender negative consequences, such as interpersonal tension or avoidance of harsh reality (Uchida & Kitayama, 2009), or vice versa. One implication for commercial emotion researchers is that liking and disliking of products cannot be assumed to reflect the same dimension across cultural contexts and need to be assessed separately.

These studies showcase the promise of self-report measures in cultural psychology. By using them, researchers are able to assess a variety of different aspects of people's emotional experience and beliefs about emotions. Yet, this method is not without its limitations. One challenge that emerges when comparing reports of emotional experience across cultural contexts is that it can be difficult to interpret people's ratings of their own emotions. We know that in some domains, people tend to rate themselves relative to their social context (a reference-group effect; see Heine, Lehman, Peng, & Greenholtz, 2002). If people in different cultural contexts actually experience emotions with different frequency or intensity, they can collectively create different reference norms. Paradoxically, this can mean that self-report ratings can disguise actual differences in affective experience. For instance, mild anger may be rated as more intense in contexts that discourage anger or vice versa.

In addition to the reference-group effect, other types of reporting styles that can present challenges include tendencies to habitually agree or disagree with presented items (acquiescence and disacquiescence response styles, respectively, see Tellis & Chandrasekaran, 2010 for work on these biases in consumer ratings), and a tendency to use midpoint values on a scale (midpoint responding) as opposed to more extreme values (extreme response style). These response styles are known to differ across cultural contexts in both emotion research studies (Baumgartner & Steenkamp, 2001; Chen, Lee, & Stevenson, 1995; Gilman et al., 2008; Van Herk, Poortinga, & Verhallen, 2004) as well as product-liking work (De Beuckelaer, Zeeman, & Van Trijp, 2015; Yeh et al., 1998). For example, East Asians are more likely to show the midpoint response style relative to North Americans (Chen et al., 1995; Yeh et al., 1998). Because these differences have been detected for domains that allow researchers to use clear benchmarks to examine reporting styles (eg, comparisons with actual behavior, Van Herk et al., 2004), it is clear that they reflect the tendency to use response scales differently rather than actual preferences. If a researcher anticipates that her data could be affected by reporting biases, she would need to statistically adjust for them by standardizing participants' reports (Fischer, 2004), using Likert scales with more specific labels (eg, specific timeframes for frequency) and testing whether this resolves the issue, or providing participants with guidance on rating

themselves relative to a specific reference group, such as a typical student. Consumer rating research suggests that methods such as paired comparisons are less affected by rating biases than scaled items (De Beuckelaer, Kampen, & Van Trijp, 2013). Another strategy that is more time-intensive involves calibrating participants' ratings using standardized sets of emotional stimuli or vignettes (eg, King & Wand, 2007) and providing a description of emotional characteristics that correspond to each anchor of the scale. Researchers that need to ascertain that the reported levels of affect (rather than their correlations) are valid may consider turning to such methods.

Complementing and building on this work, other research has examined reports of normative and ideal emotions. These studies have demonstrated that ideas about emotions are associated, but nonredundant, with reports of experienced emotions. For example, one study has shown that the more individualistic cultural contexts of the United States and Australia appear to promote much more uniform norms regarding positive emotions than the more collectivistic cultural contexts of Taiwan and China (Eid & Diener, 2001). Participants from the former set of cultural context were more likely to report that all positive emotions were desirable and appropriate than participants from the latter, who were more likely to view pride, a self-focused emotion, as less desirable and appropriate than other positive emotions. Although desirability of positive emotions was associated with their frequency, the patterns observed for the two sets of ratings (ideal vs experienced) were not identical. For instance, higher uniformity of norms did not translate into higher uniformity of experience in the United States and Australia.

Adding to the complexity, emerging work on people's ideas about ideal emotional states demonstrates that although across cultural contexts people report that positive emotions are ideal, those in the United States are more likely to view high-arousal positive emotions, such as euphoria, as ideal and less likely to view low-arousal positive emotions, such as feeling calm, as ideal than those in East Asian cultural contexts (Tsai, Knutson, & Fung, 2006). Knowing more about ideal emotions in different cultural contexts is important because these ideas are used to guide choices of activities and favorite products that are thought to maximize desirable emotions (eg, Tsai, Chim, & Sims, 2015). This means that people in different cultures may look for different emotional effects from their favorite products. Once again, this pattern of preferences was observed for the reports of ideal emotions and was not mirrored by experienced emotions, perhaps because people have limited mastery of regulating their emotions to their ideal states. Taken together, these data suggest that researchers interested in emotional norms need to assess them directly rather than infer them from the emotional experiences.

Collectively, these studies illustrate that survey methods are a powerful tool for making cross-cultural comparisons of emotions, as they allow for the quick, convenient, and cost-effective collection of vast amounts of data within and across different cultural contexts. This work also signals the need to differentiate between measuring emotions and beliefs about emotions. Of course, one methodological concern here is that asking people to rate their emotions over a long period of time or in general creates a risk that participants may not remember enough of their actual emotions to provide an accurate response. To compensate, they may fall back on their general knowledge about emotions rather than actual emotional experiences (Kim-Prieto, Diener, Tamir, Scollon, & Diener, 2005; Robinson & Clore, 2002a). One way to address this problem is by measuring emotions in the moment.

4.1.2 Experience sampling

The timeframe in which questions are posed influences the kind and intensity of emotions reported by participants (Kim-Prieto et al., 2005; Robinson & Clore, 2002a, 2002b). When a survey questionnaire is administered during or immediately after an emotional experience, a participant has relatively direct access to this experience in episodic memory and may report on it relatively accurately. On the other hand, when questionnaires instruct people to report on their emotional experiences retrospectively or on average, access to this emotional information is greatly diminished. Consequently, participants may be more likely to report their trait affect or mood, rely on heuristics (eg, availability heuristic), or tap into the more stable and accessible personal or cultural beliefs about emotions when reconstructing their emotional experiences. For example, East Asians tend to place less value on positive affect than European Americans (eg, Heine, Lehman, Markus, & Kitayama, 1999). As a result, the former might report experiencing happiness less frequently than the latter when asked for an average estimate (as in Diener et al., 1995), irrespective of how often they actually feel happy in their daily lives. Indeed, several studies reported no differences in the frequency of positive affect when East Asians and European Americans rated their emotions in the moment, yet differences did emerge in retrospective ratings (Oishi, 2002; but see Scollon, Diener, Oishi, & Biswas-Diener, 2004). Similarly, trait reports of negative affect differ across cultural contexts, but momentary reports do not (Scollon et al., 2004).

Experience sampling (ES) methods allow researchers to measure momentary, naturally occurring emotional experiences over time. To do so, ES studies employ devices such as palmtop computers or cell phones, which prompt participants to rate the intensity and/or frequency of their emotions at random times during the day. ES devices can also prompt participants to rate their emotions at fixed intervals or following a certain event (Scollon, Kim-Prieto, & Diener, 2003). If palmtop computers are unavailable or too costly, paper or internet-based diaries may be used.

ES has several advantages over traditional survey methods in cross-cultural emotion research. By mitigating memory biases associated with retrospective or global reports (Robinson & Clore, 2002a, 2002b), we can disentangle culturally informed *emotion beliefs*, which might be reported in retrospective surveys, from participants' *actual emotional experiences*, as captured by ES. In addition, ES offers an ecologically valid method for assessing emotions as they naturally occur throughout the day. This is especially important because the dynamic and reciprocal relationship between participants' emotions and their cultural environments may be more apparent out in the world than inside the laboratory (see chapter: Emotions Studied in Context: The Role of the Eating Environment). This approach also allows us to identify situational triggers for particular emotions and examine whether they are culturally specific. In commercial research, ES can be used to examine the relationships between people's momentary emotions and concerns and their consumer choices.

As an example, consider Scollon, Howard, Caldwell, and Ito's (2009) study, which examined the role of ideal affect in momentary emotional experience. Participants used palmtop computers to rate the intensity of their in-the-moment emotions (eg, "How happy are you feeling?") at random prompt times. Participants also filled out

an ideal affect questionnaire, as well as retrospective and global reports of emotion. Ideal affect was associated with global and retrospective reports of emotion, but not with online emotional experience as measured by ES. The ES method did not provide the same information as global or retrospective reports, indicating the importance of using ES alongside other self-report methods.

ES has seen a boom in popularity over the past decade and is now considered an essential tool in the battery of emotion assessment. A related approach that has recently emerged examines momentary emotions that are reflected in social media messages, such as Twitter and Facebook (eg, Bazarova, Taft, Choi, & Cosley, 2013; Roberts, Roach, Johnson, Guthrie, & Harabagiu, 2012). However, the use of these methods in cross-cultural research, particularly commercial research, has not matched its rise elsewhere. ES should be viewed as a frontline tool in measuring emotions across cultural contexts, especially in the quest to understand the real-life dynamic between our emotions and our world.

4.1.3 Emotional appraisals

In addition to assessing frequency and intensity of emotions or their desirability and appropriateness, self-report measures have also assessed appraisals, or cognitive evaluations of emotional events that contribute to experiences of emotions. Appraisal theories of emotion (eg, Ellsworth & Scherer, 2003; Frijda, 1993; Lazarus, 1991; Ortony, Clore, & Collins, 1988) contend that how we evaluate (appraise) a situation shapes our emotions. Measures of appraisals typically center on several key dimensions, including personal salience, pleasantness, responsibility, control, novelty, and compatibility with social norms (Ellsworth & Scherer, 2003). Researchers ask participants to rate how strongly they agree with a set of statements about an emotional situation, such as "I felt in control of what happened" (Siemer, Mauss, & Gross, 2007). Studies measuring appraisals using self-report inventories show that different appraisals are associated with different emotions. For example, anger is linked to appraisals of goal obstruction, unfairness, and other-accountability (Kuppens, Van Mechelen, Smits, & De Boeck, 2003), whereas sadness is marked by appraisals of lack of control, self-accountability, and unexpectedness (Siemer et al., 2007; Smith & Ellsworth, 1985).

Studies suggest that emotion-specific appraisal patterns do not hold across all situations, individuals, or cultural contexts (Kuppens et al., 2003; Mesquita & Ellsworth, 2001; Mesquita & Walker, 2003; Wallbott & Scherer, 1995). For example, because North American cultural contexts place an emphasis on independence and agency, European Americans tend to focus on control and responsibility when appraising situations (Markus & Kitayama, 1991). On the other hand, East Asian cultural contexts tend to promote the perception that situations are either multiply caused, inevitable, or caused by luck (Imada & Ellsworth, 2011; Nisbett et al., 2001). As a result, East Asians tend to de-emphasize control and responsibility in their appraisals (Matsumoto, Kudoh, Scherer, & Wallbott, 1988; Mesquita & Walker, 2003). When cultural contexts shape appraisal tendencies, they also shape emotional responding (Imada & Ellsworth, 2011; Mesquita & Walker, 2003; Scherer & Brosch, 2009). The European American tendency to make agency-based appraisals promotes

emotions that enhance feelings associated with personal agency, like anger and pride (Kitayama, Mesquita, & Karasawa, 2006; Mesquita & Ellsworth, 2001). On the other hand, East Asians emphasize appraisals of social cost and social adjustment, promoting socially engaging emotions, such as shame and respect (Kitayama et al., 2006). These studies suggest that measuring appraisal is useful for explaining cross-cultural differences in emotional response tendencies. One should be careful to ensure that the dimensions of appraisal chosen by researchers are representative of the cultural context's dominant appraisal tendencies. If such knowledge about a cultural context is limited or unavailable, it may be appropriate to be over-inclusive when selecting appraisal dimensions for questionnaires.

4.1.4 Storytelling

Another tool for assessing people's knowledge of their emotions is the examination of their emotional narratives or storytelling. In emotion research, storytelling tasks are most often used when studying emotion socialization in children (eg, Aznar & Tenenbaum, 2013; Cervantes, 2002; Cervantes & Callanan, 1998; Martin & Green, 2005). Parents and children are asked to construct a story using a set of scenarios. These stories are then coded for study-relevant dimensions, such as the frequency of emotion words, causes of emotions, or descriptions of emotional behaviors. For example, Cervantes (2002) instructed Mexican-American mothers and their children to invent a story about scenarios centering on separation, conflict, loss, and reunion. The stories were coded for use of emotion labels, valence of emotions and their causes, consequences, and regulation. Mothers and children tended to use more negative than positive emotion words, perhaps due to cultural beliefs that young children are capable of dealing with negative topics. Storytelling tasks may therefore serve as a rich source of information about cultural models of emotions. This approach might also be used to measure emotions outside of developmental contexts, particularly in cultural contexts with rich oral storytelling traditions. Dyadic or group storytelling might be a useful task for examining how individuals in a particular cultural context come to mutually construct emotions. This might move the focus of emotion measurement beyond the individual to the group.

In summary, self-report measures offer us many advantages when it comes to studying emotions across cultural contexts. They allow for rapid data collection with large samples spanning multiple cultural contexts. They also permit us to assess feelings, as well as appraisals contributing to these feelings, and beliefs about them. Reliance on this set of methods also creates a number of challenges. Namely, researchers need to attend to conceptual equivalence of the emotion terms and appraisal dimensions, ensuring that they are capturing culturally salient dimensions of emotional experience. In addition, it is imperative that researchers pay close attention to characteristics of languages spoken by their participants that may lead them to respond to questions a certain way. One example is that of the West African languages spoken by Ghanaians. In these languages, emotion terms tend to include terms for body parts, making it hard to not attend to the body while describing one's emotions (Dzokoto & Okazaki, 2006). Although it is impossible to cleanly separate language from culture, researchers should be aware of linguistic characteristics that may affect their results

(see chapter: Cross-Cultural Studies of Emotions). Finally, they need to ensure that people across cultural contexts use self-report scales in a similar manner, minimizing any cultural differences in reporting styles. Ultimately, the best way to use participants' reports of emotions is alongside other measures of emotions that do not share the same limitations, such as capturing emotions "in the body" or "in the world."

4.2 Emotions "in the body"

In addition to subjective experience, emotions also involve changes in autonomic nervous system (ANS, see chapter: The Psychophysiology of Emotions) activity, such as increases or drops in heart rate or breathing that prepare us to respond to rewards, challenges, and threats in our lives. Researchers have also examined facial muscle contraction. Additionally, monitoring changes in the patterns of central nervous system (CNS) activation allow us to examine how emotional cues are processed by the brain. Because capturing physiological signals is far more costly and labor-intensive than collecting self-reports and requires a permanent or portable laboratory, relatively few studies have utilized this approach. Of the studies that have examined physiological changes, most have focused on the ANS activity, although a few have studied the way in which emotions are represented in the brain.

4.2.1 ANS activity: actual and reported changes

Most, although not all (Vrana & Rollock, 2002) studies examining ANS activity have observed cultural similarities in response to emotion elicitors (Levenson, Ekman, Heider, & Friesen, 1992; Soto, Levenson, & Ebling, 2005; Tsai, Chentsova-Dutton, Freire-Bebeau, & Przymus, 2002; Tsai & Levenson, 1997; Tsai, Levenson, & McCoy, 2006). Researchers have argued that cultural norms of emotions do not tend to regulate physiological changes, as they are neither controllable nor visible to other people (Tsai & Levenson, 1997). Against the backdrop of these similarities, differences emerge in people's experiential reports of physiological sensations (Breugelmans et al., 2005; Philippot & Rimé, 1997; Scherer & Wallbott, 1994; Scherer, Wallbott, & Summerfield, 1986). For example, Breugelmans et al. (2005) have examined Indonesian, Belgian, Mexican, and Indian participants' reports of bodily sensations experienced in the context of positive and negative emotions. This study has shown substantial cross-cultural agreement in the reported sensations. Participants from different cultural groups reported that sadness is associated with feeling cold, whereas fear is associated with feeling weak in the knees. In addition to these similarities the researchers have also observed notable cultural differences. Unlike the other cultural groups, the Raramuri Indians reported feeling weak in the knees not only when they were afraid, but also when they felt joy, anger, surprise, and shame, suggesting that this physiological sensation is salient to the Raramuri general script of emotions. The overall pattern observed in these studies is that the type of emotion (eg, anger vs surprise) accounts for approximately a third of variance in the reports of physiological sensations. In comparison, the influence of cultural context is significant, but more modest, accounting for less than 10% of variance (see Philippot & Rimé, 1997). How do we make sense of these reports? Accumulating studies suggests that people's

reports of physiological changes represent their schemata of emotions rather than the actual changes associated with emotions (Chentsova-Dutton & Dzokoto, 2014; Rimé, Philippot, & Cisamolo, 1990). In other words, whereas actual measurements of physiological changes suggest that emotions in the body are largely universal, people's reports of these changes seem to tap into some culturally universal and some culturally specific representations that are divorced from the actual changes in the bodies of the people providing such reports. Clinical and marketing studies alike can benefit from examining these representations in domains where autonomic arousal is salient (eg, treatment of anxiety disorders, marketing of energy drinks). At this point, relatively few studies have focused on these differences and more work is sorely needed.

4.2.2 CNS activity

Only a handful of studies have examined the ways in which cultural context affects CNS activity (Adams et al., 2010; Chiao et al., 2008; Derntl et al., 2012; Komaki, Moriguchi, Ohnishi, & Maeda, 2006). There is every reason to expect that differences in other domains, such as emotional experience, behavior, and regulation, should be reflected in different patterns of brain activity. Indeed, such differences have been observed for emotion recognition. Adams et al. (2010) have demonstrated differential patterns of brain activation in people trying to infer emotions of others from the same versus a different cultural group. Another study has shown that Japanese and European American participants alike showed greater amygdala activation in response to fear expressed by people from the same (vs another) cultural group (Chiao et al., 2008). Amygdala activation is known to be associated with emotional responses, particularly threat responses. These findings are in line with behavioral data suggesting that it is easier for people to recognize facial expressions of emotions posed by members of their own cultural group (Elfenbein & Ambady, 2003). CNS data can be helpful in generating models of neural mechanisms of these differences.

Finally, one line of research has combined ANS and CNS data to examine patterns of cultural similarities and differences in physiological consequences of emotion regulation. Emotion regulation studies conducted with European Americans have demonstrated that suppression, an emotion regulation strategy that aims to minimize the expression of emotion, is associated with heightened physiological reactivity relative to reappraisal, a strategy that aims to alter the meaning of an emotional event (Gross & Levenson, 1997). However, these studies were conducted in a North American cultural context that places value on emotional expression. Physiological costs of suppression may be reduced in cultural contexts that reinforce and automatize emotional restraint, such as East Asian cultural contexts (eg, Bond, 1993). Indeed, a number of studies comparing European Americans and Asian Americans or East Asians have reported that the pattern of heightened physiological arousal and threat-patterned physiological responses to expressive suppression are observed for participants from the former but not the latter set of cultural contexts (Butler, Lee, & Gross, 2009; Mauss & Butler, 2010; Zhou & Bishop, 2012). Indeed, some studies have suggested that suppression may even be functional in East Asian cultural contexts (eg, Gan et al., 2014).

Adding another set of physiological measures to this body of literature, recent studies have utilized event-related potential (ERP) recordings to examine CNS responses during emotional regulation. ERP is a noninvasive measure that takes advantage of the fact that our brain produces changes in electric activity as we consider novel or emotionally evocative stimuli, such as pictures (see Davidson, Abercrombie, Nitschke, & Putnam, 1999). ERP is recorded from participants' scalps using electrodes. It is relatively inexpensive and thus often used in cross-cultural research. When allowed to experience and regulate emotions naturally in one study, Japanese and French participants showed similarities in their initial ERP responding to the emotional images (Hot, Saito, Mandai, Kobayashi, & Sequeira, 2006). Yet, the two groups diverged from each other on later components of the ERP, consistent with lower levels of emotional processing among the Japanese. Similarly, another study has reported a reduction in the later component of the ERP among Japanese who were instructed to suppress their emotional expressions (Murata, Moser, & Kitayama, 2013). The same pattern was not observed for European Americans. These data suggest that Japanese participants in these two studies were more effective in their ability to down-regulate emotional processing than their American counterparts. Studies examining brain activation can help researchers confirm their hypotheses or generate new models of cultural shaping of emotional reactivity. Thanks to work such as this, we increasingly understand that culturally reinforced modes of emotion regulation can be relatively effortless and automatic.

Of course, researchers need to be mindful of the common pitfalls of using these measurements. In particular, both ANS and CNS activity serve and reflect many different functions, of which emotional reactivity is but one. The first author once interpreted a cultural group difference in finger temperature and pulse amplitude as evidence of different levels of emotional reactivity, only to realize that participants from these two groups happened to randomly arrive at the lab on days that varied in outdoor temperature. Once outside temperature was entered into statistical analyses, cultural group differences disappeared. This is but one example of the ways in which physiological signals can be influenced by nonaffective factors, ranging from metabolic demands to cognitive processes. Designing adequate baseline conditions that are highly similar to the experimental tasks with the exception of different emotion valence and arousal is the key here. Replicating small studies with adequate samples and a range of methods would also increase our confidence in small-sample physiological studies.

In addition to these concerns, researchers examining ANS and CNS activity need to carefully consider the cultural equivalence of the impact of having one's bodily or brain signals measured. In some cultural contexts, participants may be less likely to have exposure to such measurements and more likely to be concerned about potential risks of such procedures (known to be minimal). The first author has observed that Ghanaians required a longer-than-usual (relative to Americans) baseline period while wearing the electrodes before they were able to relax and habituate to this condition. Careful piloting and debriefing should be utilized to pick upon and address such threats to methodological equivalence.

As technology evolves, physiological recording is becoming increasingly available to researchers interested in culture, in terms of both costs and portability. A number of

relatively low-cost systems for collecting ANS and EEG data are now on the market. It is also increasingly possible for researchers to carry their physiological laboratories from one context to another to ensure equivalence (see, eg, Chentsova-Dutton & Dzokoto, 2014). Additionally, more affordable and portable systems that are capable of accurately measuring ambulatory physiological data as people engage in ecologically valid tasks are entering the market. This is an opportune moment to include these types of measures in research. Commercial research in particular can greatly benefit from use of physiological recordings to assess people's approach and avoidance responses to products or advertisements without relying on their subjective reports. Note, for example, a relatively recent and promising addition to the toolkit of a marketing research is neuromarketing research (Vecchiato et al., 2011). We are optimistic about the possibilities this creates for enabling researchers to bridge their understanding of the ways emotions are shaped by culture in the body and in the world.

4.3 Emotions "in the world"

Studies of emotions in the world comprise examinations of cultural products, patterns of observable behavior or situations that convey information about typical or desirable emotions in a particular cultural context. In our review, we will discuss recent research examining the way emotions are reflected in different aspects of culture, such as books you may read to kids, smiles of people around you, frowns of the Olympic athletes upon realizing that they have lost the decisive match, or typical situations that elicit anger. Along with other cultural psychologists, we contend that these sources provide researchers with valuable information and help us glean some of the mechanisms of emotional socialization in a cultural context.

4.3.1 Cultural products

Typically, cross-cultural emotion research examines how cultural context might influence one's emotional responding and beliefs. However, it can also examine the inverse: how an individual's emotional responding and beliefs might influence his or her cultural context. One manifestation of this relationship can be found in cultural products. Cultural products are "public, shared, and tangible" artifacts (Morling & Lamoreaux, 2008, p. 200) that can "both reflect and reinforce cultural ideas" (Koopmann-Holm & Tsai, 2014, p. 1096). Examples of cultural products examined in recent research include children's storybooks (Boiger, De Deyne, & Mesquita, 2013; Tsai, Louie, Chen, & Uchida, 2007; Wege et al., 2014), dictionaries and presidential speeches (Oishi, Graham, Kesebir, & Galinha, 2013), sympathy cards (Koopmann-Holm & Tsai, 2014), newspapers (Oettingen & Seligman, 1990), print advertisements (Kim & Markus, 1999), and other media like television and internet. From these cultural products, researchers can extract information about the shared emotional experiences and beliefs in a particular cultural context. Although much of the extant work has relied on human coders, increasingly, algorithm-based approaches such as sentiment analysis (see Chapter: Sentiment Analysis: Detecting Valence, Emotions, and Other Affectual States From Text) are used to examine emotions across vast

samples of text obtained on the internet (see Stieglitz & Dang-Xuan, 2013; Thelwall, Buckley, & Paltoglou, 2011).

To illustrate how researchers use cultural products to assess models of emotions, consider Tsai et al.'s (2007) study, which examined differences in ideal affect between Taiwan and the United States. The researchers hypothesized that children's storybooks would reflect dominant cultural beliefs about affect, such that Taiwanese books would more likely display low-arousal positive affect (eg, calm) and American books would more likely display high-arousal positive affect (eg, excitement). The 10 best-selling picture books for children aged 4–8 years were selected for Taiwan and the United States. Emotional expressions of animals and humans depicted in each storybook were coded using the Facial Action Coding System (Ekman & Friesen, 1978). For example, high-arousal positive expressions of excitement involved open eyes and smiles, whereas low-arousal positive expressions of calm involved closed eyes and smiles. They also coded smile size (controlling for face size) and the arousal level of activities performed in the books (eg, walking as low arousal, running as high arousal). Consistent with their hypothesis, this study found that compared to Taiwanese storybooks, American storybooks contained a greater proportion of high-arousal positive (vs low-arousal positive) emotional expressions, wider smiles, and more high-arousal activities.

Aside from emotional images, researchers can also examine emotional texts, including newspapers, dictionaries, and speeches. For example, Oettingen and Seligman (1990) compared the explanatory styles of newspapers in East and West Berlin. They selected articles about the 1984 Winter Olympic Games to ensure that both sides would be reporting on the same events. Overall, West Berlin news stories provided relatively more optimistic causal explanations for specific Olympic events than East Berlin stories, even though East Germany had greater Olympic success that year. In another study that examined dictionaries as the cultural product, Oishi et al. (2013) collected definitions of *happy* and *happiness* from dictionaries across 30 nations. They hypothesized that conceptualizations of happiness across cultural contexts would most often emphasize good fortune and luck. In each definition, they coded the presence of this theme and found that 24 of the 30 nations included some idea of fortune or luck in their definitions of happiness. Dictionaries from countries like the United States, Ecuador, and Kenya did not, reflecting an unusual cultural model that emphasizes personal agency rather than luck as the driver of happiness.

Researchers can use cultural products to assess many culture-level constructs, including widely shared beliefs about emotions (eg, Tsai et al., 2007), conceptualizations of emotions (eg, Oishi et al., 2013), and the general emotional atmosphere of a certain place and time (eg, Oettingen & Seligman, 1990) independently from using self-reports. However, this is true only to the extent that the selected cultural products represent the cultural context that is being studied. A researcher should seek to understand a cultural context well enough to be in a position to determine this and be ready to examine generalizability of their samples of cultural products. For example, in Tsai et al.'s (2007) study of children's storybooks, Western authors had written many of the best-selling Taiwanese stories. Consequently, there was a concern about whether these books reflected Western or Taiwanese cultural values. Nonetheless, when the comparison between the United States and Taiwan was limited to Western-authored

books, the cultural differences in ideal affect remained, suggesting that Western stories that became popular in Taiwan were concordant with Taiwanese models of emotions and were, therefore, representative of this context.

Commercial research is in an excellent position to examine the ways in which commercial products shape emotions and are shaped by them (see Mogilner, Aaker, & Kamvar, 2012). Culturally congruent products may best appeal to their target audience, eliciting positive emotional responses (Thomson, MacInnis, & Park, 2005). In turn, this audience may shape the models of emotions offered by the products through their consumer choices.

4.3.2 Observed behavior

Another way in which emotions are manifested "in the world" is naturally occurring behavior. By observing people, researchers can infer valuable information about the ways in which emotions are felt and regulated in a given cultural context. Consider the study of East versus West German newspapers that was described earlier (Oettingen & Seligman, 1990). In addition to examining print stories about the Olympics, these researchers also visited typical local bars in East and West Berlin and systematically observed customers' behaviors. They found that, in line with the pattern observed based on the newspapers, bar patrons in East Berlin were less likely to show positive emotional behavior, such as smiling, laughing and upturned posture, than their counterparts in West Berlin. Another study observed spontaneous emotional expressions of the Olympic athletes competing for a gold medal in judo. The researchers observed that athletes from 35 different countries showed remarkably similar initial emotional expressions in response to winning or losing decisive matches (Matsumoto & Willingham, 2006). Moreover, another study comparing blind and sighted athletes showed that even blind athletes showed similar expressions, suggesting that innate factors may shape these initial responses, in line with an evolutionary perspective on emotion (Matsumoto & Willingham, 2009). These findings are consistent with a long-standing body of work showing substantial cross-cultural similarities in people's recognition of emotions (eg, Ekman et al., 1987), particularly when images of emotional expressions: (1) represent very stereotypical and intense versions of these expressions (eg, a surprise face with a wide open mouth or strongly raised eyebrows) and (2) are presented without any additional contextual cues (also see Aviezer et al., 2008; Masuda et al., 2008; for examples of cultural shaping of recognition of more contextually rich facial stimuli).

Cultural context does play a role in the regulation of initially uniform expressions. Only a few seconds after judo players learned whether or not they won or lost a match, athletes from different cultural contexts began diverging in their expressions, with athletes from more individualistic cultural contexts showing more intense expressions than athletes from more collectivistic contexts (Matsumoto, Willingham, & Olide, 2009). This study illustrates that cultural norms of emotions do shape emotional behavior, taking only a few seconds to "catch up" to the unfolding of universal expressions of reveling in victory or agonizing over defeat.

Unfortunately, observation of actual emotional behavior is a time-intensive assessment technique that requires extensive training. As a result, relatively few studies of emotion more generally, and culture and emotion, in particular, use this approach.

Of those, even fewer examine naturally occurring behavior. Instead, most present participants from different cultural contexts with standardized elicitors of emotions, such as images or films, or examine posed photographs, assuming that any differences in the observed emotions may be indicative of emotions that are characteristic of the cultural context (eg, Matsumoto & Kupperbusch, 2001; Soto et al., 2005; Tsai et al., 2006; Tsai et al., 2002). These studies tend to report cultural differences in emotional behavior, suggesting that it is shaped by culture (eg, Tsai et al., 2006). Although some of these studies find cultural differences in emotional behavior that mirror those observed for reports of emotions (Mauss, Butler, Roberts, & Chu, 2010), others do not (Soto et al., 2005), reinforcing the need to concurrently assess both aspects of emotional reactivity.

Another line of research has found that people from different cultural contexts show culturally "accented" facial expressions of emotion (Elfenbein & Ambady, 2002; Elfenbein, Beaupré, Lévesque, & Hess, 2007; Marsh, Elfenbein, & Ambady, 2003). For example, Elfenbein et al. (2007) have compared emotional expressions portrayed by Québecois and Gabonese individuals. Although they observed many cross-cultural similarities in the ways that emotions were portrayed on the faces of these participants, there were also a number of subtle and not-so-subtle differences or nonverbal accents. For example, although more than half of Québecois participants (53%) showed a prototypical happy expression combining a smile with "smiling" eyes, this expression was far less common among the Gabonese participants (27%). Moreover, other studies found that such nonverbal accents are most easily interpreted by people who share the same cultural context (Elfenbein & Ambady, 2003), suggesting that some of the emotional signaling is culture-specific.

Researchers interested in incorporating nonverbal behavior in their multimethod assessment of emotions must attend to several concerns. First, they need to decide whether to employ coding systems that use human coders (eg, FACS or SPAFF; Coan & Gottman, 2007; Ekman & Friesen, 1978) or rely on emerging computer-based coding systems (eg, FaceReader; den Uyl & van Kuilenberg 2005). Each of these comes with its own challenges, such as extensive coder training for the former, and demands on the image quality for the latter. Researchers also need to think about the ways in which facial behavior may be affected by the self-awareness induced by the recording and the situational constraints of being in the lab or in a particular situation outside the lab. Remarkably few studies have included observations of emotional behavior in people's homes. Most of these studies are developmental, examining interactions between parents and children (eg, Havighurst, Wilson, Harley, Prior, & Kehoe, 2010; Mendes, Seidl-de-Moura, & de Oliveira Siqueira, 2009). More researchers studying adults need to carefully observe facial behavior across different settings in their target cultural contexts to ensure that they are capturing ecologically valid behavior. Although studies have examined self-reported behavior and display rules across a number of cultural contexts (Matsumoto et al., 2008), we know little about the ways in which actual behavior maps onto these reports. Finally, researchers need to attend to nonverbal accents in facial expressions that may characterize emotional expressions in the target cultural contexts. When these conditions are met, measures of emotional behavior can add a lot of value to research on consumer behavior (Matsumoto, Hwang, Harrington, Olsen, & King, 2011) or culture and emotions by balancing shortcomings of other methods of assessment.

4.3.3 Situation sampling

Recently, more and more studies have been using another approach to examine emotion in people's lives. This approach bridges "in the head" and "in the world" methods by asking people to describe typical situations that may elicit particular emotions in their cultural context (Boiger, De Deyne, et al., 2013; Boiger, Mesquita, Uchida, & Barrett, 2013; Grossmann, Karasawa, Kan, & Kitayama, 2014; Savani, Alvarez, Mesquita, & Markus, 2013). A systematic analysis of these situations allows researchers to examine similarities and differences in culturally salient emotions. For example, situations eliciting anger, a self-asserting emotion, tend to be more common in the United States than in Japan (Boiger, Mesquita, et al., 2013). When pursued along with systematic observations to ensure that participants' reports of typical emotions reflect reality, situation sampling can be very helpful in examining the mechanisms of cultural differences and similarities in emotions. Although this approach is relatively novel and underutilized in the field, it has much to promise to a culture and emotion researcher. Commercial researchers can likewise benefit from situation sampling by systematically examining types of situations that are associated with different types of thoughts and emotions, and, consequently, different types of consumer behavior across cultural contexts (see Zhuang, Tsang, Zhou, Li, & Nicholls, 2006 for an example of cultural differences in response to situational factors).

5 Culture and emotions: the new frontier

In summary, a researcher who seeks to examine emotions across cultural contexts is taking on the challenges of capturing culturally salient aspects of emotions in culturally informed ways. Despite these challenges, this work has much to offer to researchers. For academics, incorporating culture into our research programs allows us to better understand the nature and functions of emotions. Recent work (Boiger, Mesquita, et al., 2013) has begun to explore the dynamic relationships between cultural models of emotions and occurrence and/or perception of situations that promote culturally beneficial emotions. In doing so, this work informs emotion researchers about the remarkable plasticity of emotions in response to their context, and vice versa. For nonacademic researchers, examining emotions across cultural contexts is essential to creating new ways to market products, services, and public policy initiatives that appeal to emotional preferences of their target audiences. For instance, in line with research on cultural differences in mixed emotions, East Asian audiences are more likely to prefer advertisements that evoke mixed emotions than are European Americans (Williams & Aaker, 2002). Finally, lay public, business professionals, and diplomats alike can benefit from the work that examines the role of emotions in cross-cultural communication (eg, George, Jones, & Gonzalez, 1998).

Many exciting areas of culture and emotion research are underexplored and open to new waves of research. One of the most critical of these areas is inclusion of relational context, ranging from microcontexts, such as emotional conversations between friends or family, to larger contexts, such as organizations and neighborhood. Studies

of relational context of emotions can generate particularly fertile terrain for examining the dynamic nature of emotions and the ways in which they unfold over time and dynamically influence, and are influenced by, relational cues. Although many North American and Western European labs have begun studying these effects, culture and emotion research is lagging behind despite its capacity to examine the influence of diverse cultural models of social relationships on emotions.

Another area that is in dire need of further work is the area bridging different areas of work that focus on emotions. Affective science, clinical psychology (see chapter: Emotions in Clinical Practice), political psychology (eg, Marcus 2003), and commercial work on emotions (eg, Laros & Steenkamp, 2005) overlap in their areas of investigation. Yet, cross-area communication is limited. Much can be gained from learning about work in these areas. Clinical research provides emotion researchers with great opportunities to examine the full range of emotional phenomena (eg, the heights of positive affect in mania) and ponder functional and dysfunctional aspects of emotions. Most forms of mental illness involve emotional symptoms, such as depressed, anxious or irritable mood or deficits in emotional regulation (Kring, 2008). Adding cultural context into the picture can allow researchers to examine the ways in which cultural models of emotions affect expressions of psychopathology (Ryder, Ban, & Chentsova-Dutton, 2011). Of course, studying mental illness is not the only way to examine extreme forms of emotions. Examining other types of unusual or extreme emotional experience can test our assumptions about emotions and help us identify the role of emotions in processes such as group violence or political action (Feddes, Mann, & Doosje, 2015; Iyer, Schmader, & Lickel, 2007; Rimé, Kanyangara, Yzerbyt, & Paez, 2011). Finally, both political and commercial research can help us better understand how emotions drive tangible behavior, such as voting for particular candidates and issues and purchasing particular products (Brader, 2005; Laros & Steenkamp, 2005).

As emotion research increasingly links psychology with fields such as genetics, neuroscience, neuroimmunology, and sleep research, to name but a few, it also becomes increasingly important to understand the ways in which biological factors such as genes, brain structure and activation patterns, sleep, and functioning of neuroviral and neuroendocrine systems affect and are affected by emotions. Very few papers in cultural psychology have bridged this frontier in affective science (eg, Kim et al., 2011). Yet, it appears to be a particularly fertile area for further investigation, focusing on the ways in which genetics interacts with culturally shaped practices, such as sleeping arrangements, emotion socialization, emotion and stress regulation strategies, and explanatory styles in shaping functional and dysfunctional affective outcomes.

With these and many other research areas open for exploration, culture and emotion is an area that is ripe for investigation. Our take-home message for researchers is to become experts in attending to the cultural context and taking it seriously. We encourage them to be open-minded to the possibility that some of their "natural" or "evidence-based" assumptions about emotions may not hold in another cultural context. Much of the older research on emotions relies on a key assumption: that culture comes late to the emotion party, coloring between the lines that are preset by evolution. As a result, many older studies have compared emotions in different cultural contexts

without systematically measuring culture. Although the assumption of universality may be valid for some emotional phenomena (eg, immediate response to evolutionarily significant emotional events, such as rotten food or poisonous insects), it may not be so for others (eg, complex emotional responses that unfold in social interactions). It is essential for researchers to take cultural factors seriously and measure them well.

Although it may not be possible for researchers to become experts in a wide range of human cultural contexts, it is possible for them to become experts in the steps that one takes to learn more about a new cultural context. This process should involve working closely with local informants and observing the ways in which a cultural context shapes actual emotions (ie, in-the-moment experience and behavior), ideas about emotions (ie, when are they functional and dysfunctional, what emotions are ideal or undesirable?), emotional behavior and descriptions of emotions in the cultural products. It should involve meticulous piloting of all procedures in an effort to ensure that as many aspects of the study as possible (eg, constructs of interest, language used to describe them, psychometric characteristics of all measures, research setting, procedure) are culturally equivalent.

The process of collecting data in a new cultural context should also involve careful debriefing of the participants and local informants in an effort to identify aspects of the study that "stand out" to them as funny, awkward, incomprehensible, or offensive. A question that is meaningful and clear in one cultural context may not be in another. Often, these observations reveal cultural differences in models of emotions. The lead author was once told by a Russian participant that a grammatically correct question ("Did you choose to feel happy?") that was easily comprehended by American participants sounded like "How high do you walk?" to this participant. In other words, the concepts and dimensions evoked by this question made little sense to the participant despite the fact that she understood it. This observation led to additional piloting and refinement of this question to ensure that it was comprehensible to all participants. It also signaled the fact that Russian models of emotions did not portray them as voluntary and self-driven. Forgoing the step of building rapport with research participants and seeking their feedback would have obscured important cultural differences and produced measures with limited validity. Finally, researchers should remember that although a given person or a group of participants in a study may or may not reflect their cultural norms, they will almost certainly be aware of intersubjective norms of their cultural context and will rely on them to frame their own experiences and behavior. Tapping these cultural models can be helpful in understanding one's data. Of course, following these steps will not substitute for deep engagement with and knowledge of a particular cultural context. Yet, they can help a researcher to cautiously extend their work to understudied cultural contexts in a culturally sensitive way.

In conclusion, this chapter has described methods that are commonly utilized by researchers that study emotions across cultural contexts. As we have described, this field presents the scholars with many challenges. We would like to remind our readers of the rewards. Emotions are critical to what it means to be human. They are also critical to what it means to be human in a particular time, place, and social world. Learning about these complex worlds and their interactions with our fears and joys is a rewarding and challenging journey.

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Measuring and Understanding Emotions in East Asia

25

Keiko Ishii and Charis Eisen
Faculty of Letters, Kobe University, Kobe, Japan

Emotions are understood as psychological processes in an innate and automatic system, leading people to behave adaptively in an environment, which helps them survive. However, people's subjective experiences of emotions are not just a direct reflection of this system; rather, these are the result of how people interpret physiological responses based on implicit beliefs and norms regarding interpersonal relationships in society. These findings are documented in cumulative studies in cultural psychology. Over the last two decades, cultural psychologists have explored the relationship between culture and the mind and have reported that psychological processes, including daily emotional experiences, vary across cultures (eg, Mesquita & Frijda, 1992; Suh, Diener, Oishi, & Triandis, 1998). In this chapter, we describe the theoretical framework of emotions from a cross-cultural perspective and review a selection of related findings on the cultural dependence of emotions. We also address the core question of this book—how to measure emotions, focusing on online responses and the situational approach—as well as give advice on how to measure emotions in East Asia and propose future directions.

1 Theoretical framework and a selective review

Culture is a collective-level phenomenon comprising both socially shared meanings, such as ideas and beliefs, and associated scripted behavioral patterns (Kitayama & Uskul, 2011). Given the idea of "self" as a social product (Mead, 1934) and as a system for the regulation of a person's thoughts and actions according to the surrounding cultural environment (Kitayama, Duffy, & Uchida, 2007), views of the self manifest as a set of behavioral tendencies in a particular culture.

The self is considered independent and separate from other people in Western cultural contexts, but it is interdependent and connected with other people in Eastern cultural contexts (Markus & Kitayama, 1991). In Western cultural contexts, people are encouraged to search for desirable internal traits and attributes and to express them. They are likely to share the assumption that the thoughts of each individual, which are considered to represent internal traits, are unknowable in principle unless expressed explicitly. On the other hand, in Eastern cultural contexts, people are encouraged to find a meaningful position in social networks and adjust to others' expectations. They are likely to share the assumption that the thoughts of each individual, which are considered shared by being embedded in a given situation, are knowable in principle once the situation is sufficiently understood.

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Interpersonal influence and the pursuit of personal goals are emphasized when the view of the independent self is highly valued (Morling, Kitayama, & Miyamoto, 2002). People are motivated toward behaviors related to achieving personal goals and influence in social environments and situations where the idea of independence prevails. They have emotional experiences related to the accomplishment of independence (eg, self-esteem and pride in oneself), which are known as disengaging positive emotions (Kitayama, Markus, & Kurokawa, 2000), through personal achievement. On the other hand, interpersonal harmony and adjustment are emphasized when the view of the interdependent self is highly valued (Morling et al., 2002). People are motivated toward behaviors related to adjustment and harmony in social environments and situations where the idea of interdependence is widespread. They have emotional experiences related to the accomplishment of interdependence (eg, respect and friendly feelings), which are called engaging positive emotions (Kitayama et al., 2000; see Table 25.1 for a list of positive and negative engaging and disengaging emotions). For instance, the concept of saving face is particularly important in East Asia as it is linked to self-improvement and perspective-taking and thus helps maintain social harmony (Heine, Lehman, Markus, & Kitayama, 1999). Previous research supports the idea that the most prevalent emotions in a given cultural context are those that fit the cultural norms (Mesquita & Leu, 2007). Accordingly, influencing others during emotional episodes is beneficial for Westerners but not for Asians, whereas adjusting benefits East Asians, especially in positive situations. Emotions congruent to the cultural norms lead to happiness.

Table 25.1 Positive and negative engaging and disengaging emotions: socially engaging emotions are encouraged stronger than socially disengaging emotions in East Asia (Kitayama, Mesquita, et al., 2006)

Emotion type	Emotion
Positive engaging emotions	Friendly feelings
	Close feelings
	Respect
	Sympathy
Positive disengaging emotions	Pride
	Superior
	Top of the world
	Self-esteem
Negative engaging emotions	Guilt
	Indebtedness
	Shame
	Afraid of causing trouble on another
Negative disengaging emotions	Sulky feelings
	Frustration
	Anger

These cultural differences in the views of the self and the practices that emphasize influence and adjustment lead to hypotheses on the recognition of emotions and emotional experiences. For example, people's implicit beliefs about others' emotional expressions are likely to differ cross-culturally. People in Western cultural contexts are likely to think that other people's emotional expressions manifest in their internal reactions, whereas East Asians probably believe that other people's emotional expressions are constituted by interpersonal relationships, in addition to their internal reactions. As another example, emotional experiences associated with the social practices emphasized in a given culture (eg, influence in Western cultures and adjustment in East Asian cultures) presumably produce happiness. The following section briefly summarizes existing research regarding (1) the recognition of emotional information, (2) the predictors of happiness, (3) co-occurrence of positive and negative emotions, and (4) indigenous emotions in East Asian cultures.

1.1 Recognition of emotional information

Reflecting cultural differences in people's implicit beliefs about others' emotional expressions, East Asians are supposably more sensitive than Westerners to social contexts (eg, other people's emotional expressions). Testing this prediction, Masuda et al. (2008) asked Japanese and North American participants to rate a central person with a facial expression (eg, happy) (see Fig. 25.1 for examples of the stimuli used in



Figure 25.1 Example of stimuli used to detect context sensitivity in emotion recognition in Masuda et al. (2008).

this study). This person was surrounded by other people showing a similar (eg, happy) or a different (eg, angry) facial expression. As expected, Masuda et al. (2008) found that the Japanese were more influenced by the surrounding people's emotions than North Americans were when rating the central person's emotion. A follow-up study by Ito, Masuda, and Li (2013) indicated that this cultural difference in the influence of contextual information was limited to background facial emotions. While both European Canadians and East Asians were influenced by a nonsocial affective background in judging the intensity of a central person's facial emotions, only East Asians were influenced by background facial emotions when making a judgment. Moreover, European Canadians were less influenced by background facial emotions, as they considered individuals' emotional expressions more as internal reactions.

Extending Masuda and colleagues' findings, Tskhay, Ishii, and Rule (2015) used a face–body composite task where the body can be processed as contextual information for the facial emotions (Aviezer, Trope, & Todorov, 2012) to determine cultural differences in the effect of the intrapersonal social context. They found that participants were less accurate in their judgment of facial emotions when these were incongruent with the emotions of the body, and they were more accurate when the emotions of the face and the body were congruent. More importantly, this tendency was greater among the Japanese than among the European Canadians, providing further evidence for the East Asian tendency to include background information in their perception of emotions.

These studies suggest that reflecting implicit beliefs about someone's emotional expression—as a construct of a (social) situation and personal reaction for East Asians, as opposed to merely internal attributes for Westerners—East Asians are likely to recognize emotional information holistically. This holistic perception benefits social relationship maintenance, which is of extreme importance in East Asian cultures. However, the emphasis on interdependence could produce negative outcomes in East Asian cultures. For example, East Asians and Asian Americans tend to experience higher social anxiety than European Americans (Norasakkunkit & Kalick, 2002; Okazaki, 1997). Moreover, the Japanese show a higher level of attachment-related anxiety and avoidance than European Americans (Ishii, Miyamoto, Mayama, & Niedenthal, 2011). There are also cultural differences in the extent to which a person may be concerned about other people's approval of his or her behavior (Suh et al., 1998). Given previous findings, depending on the culture, a person may be more or less vigilant about nonverbal signs implying that he or she is falling short of others' expectations or undermining social harmony. One example is the gradual disappearance of a smile, which should be a dynamic cue indicating that expectations have been violated. Using the morph movie paradigm (Niedenthal, Halberstadt, Margolin, & Innes-Ker, 2000), Ishii et al. (2011) examined European American and Japanese cultural differences in the sensitivity to the disappearance of facial expressions. The results showed that compared to European Americans, the Japanese judged the disappearance of smiles faster and were particularly attentive to its signs. On the other hand, there was no cultural difference in detecting the disappearance of others' frowns. This suggests that the disappearance of others' negative expressions does not pose a threat to social relationships and thus, neither the Japanese nor the Americans are urged to adjust their behavior.

A follow-up study by Ishii, Kim, Sasaki, Shinada, and Kusumi (2014) raised the question of how cultural norms and practices that emphasized the importance of social approval would modulate the associations between genotypes and processing of emotional cues. To answer this question, Ishii, Kim, et al. (2014) examined the association between a gene in the serotonin-transporter-linked polymorphic region (*5-HTTLPR*) and the response to the disappearance of positive and negative facial emotions in two cultures that differed in their emphasis on concerns about social approval. They found that the Japanese with the s/s genotype of *5-HTTLPR* tended to detect the disappearance of facial expressions with greater perceptual efficiency than those with s/l or l/l genotypes did; this reflected cultural norms and practices that emphasized concerns about others' expectations and the disruption of harmony. This tendency was missing among North Americans, representing a culture that did not foster, and might in fact discourage, vigilance about social approval. These results provide evidence that people with the s/s genotype of *5-HTTLPR* are more sensitive to environmental changes than those with the long allele but only when the environmental change is culturally important. This outcome supports a gene–culture interaction model that considers a genetic basis for the susceptibility to the environment and addresses the extent to which a particular culture moderates the association between genes and behavioral and psychological tendencies [see Kim et al. (2010) for more details on the gene–culture interaction model].

1.2 Cultural differences in predictors of happiness

Is there a universal recipe for happiness? As already observed, the cultural emphasis on either social embeddedness or autonomy shapes the meaning of emotions. For example, anger may be elicited either by not getting what a person wants (in the West) or by violations of normative behavior (in East Asia) (Kitayama, Mesquita, & Karasawa, 2006). Similarly, predictors of happiness differ across cultures and correspond to ideas of independence and interdependence (eg, Oishi & Diener, 2001). For instance, Kitayama and colleagues (Kitayama, Mesquita, et al., 2006; Kitayama et al., 2000) demonstrated that the general positive emotional experiences (eg, happiness) reported by North Americans are strongly associated with emotional experiences related to the achievement of independence (eg, self-esteem and pride in oneself), which are known as disengaging positive emotions. In contrast, they demonstrated that the general positive emotional experiences reported by the Japanese are strongly associated with emotional experiences related to the achievement of interdependence (eg, respect and friendly feelings), which are called engaging positive emotions. In each culture, the causes of happiness reflected the people's respective cultural models.

To investigate people's understanding of happiness in Japan and the United States, Uchida and Kitayama (2009) asked a group of Japanese and American undergraduates to describe up to five characteristics of happiness, and they selected a representative subset with about 100 descriptions for each culture. They then asked another group of Japanese and American undergraduates to sort the descriptions selected from their own culture into meaningful groups based on semantic similarity. Submitting the sorted data to a multidimensional scaling analysis, Uchida and Kitayama (2009)

Table 25.2 Five factors of happiness (Uchida & Kitayama, 2009)

Factor	Example
Positive hedonic experience	Joy, smiling
Personal achievement	Feeling good about myself, getting what I want
Social harmony	Having good friends, being nice to others
Transcendental reappraisal	Letting people avoid reality, not lasting long
Social disruption	Envy, jealousy

identified dimensions for the meaning of happiness for each culture and obtained a mental map of happiness, consisting of two dimensions (positive–negative and independent–interdependent). Regardless of the culture, five clusters were found (see Table 25.2). However, positive hedonic experience was placed closer to personal achievement in the Americans' mental map of happiness, whereas it was placed closer to social harmony in the Japanese's mental map of happiness. Moreover, the Japanese were more likely to describe nonpositive aspects, characterized by transcendental reappraisal and social disruption. This Japanese result suggests that they are likely to experience a mix of positive and negative emotions. As mentioned later, this tendency might come from Confucianism, particularly the dialectical thought of yin and yang.

1.3 Mixing of positive and negative emotions

Cultural differences in the likelihood of the co-occurrence of positive and negative emotions were revealed in several studies. For example, Kitayama et al. (2000) found that the reported frequency of positive emotional experiences in daily life was negatively correlated with that of negative emotional experiences in the United States, except for one correlation between the reported frequency of engaging positive and negative emotions. On the other hand, in Japan, all the correlations between positive and negative emotions were positive, regardless of engaging and disengaging emotions. In Japan, the experiences of positive and negative emotions are thus likely to co-occur. This tendency is not specific to the Japanese. The co-occurrence of positive and negative emotional experiences was observed more strongly among Chinese and Koreans compared to Americans (Bagozzi, Wong, & Yi, 1999).

More recently, Miyamoto, Uchida, and Ellsworth (2010) examined whether the co-occurrence of positive and negative emotions depends on situations in Japan and the United States. They found that despite similarities in the situations in which Japanese and American participants experienced both positive and negative emotions, the Japanese were more likely to mention both positive and negative emotions in self-success situations (eg, "When I knew that I scored higher than my friend, I was so glad. At the same time, I feel sorry for my friend because I know my friend worked harder than me."). No cultural difference was found in self-failure situations (eg, "When I knew that my brother accomplished something, I was so proud of him. At the same time, I felt jealous of him because he was praised by my parents.").

Researchers have proposed the dialectical thought shared by East Asians as a potential source of cultural differences in mixed emotions. For instance, Ji, Nisbett, and Su (2001) suggested that dialectical thought was represented in how people perceived change, indicating that the Chinese would be more likely than European Americans to believe that events were constantly changing. In one study, the participants were presented with a set of positive and negative scenarios. At the end of each scenario, an observer made a contrary comment (eg, "This could be a bad thing" for a person who won the lottery). The Chinese participants were more likely to regard the observer's prediction of changes as wise. In contrast, the European American participants were more likely to view the observer's prediction of changes as jealousy.

To rule out an alternative explanation for the cultural differences in the experience of mixed emotions, namely, that these would be due to the differences between individualism and collectivism, Schimmack, Oishi, and Diener (2002) provided evidence of the influence of dialectical thought by examining the relationship between positive and negative emotions in Asian, non-Asian collectivistic, and Western cultures. They analyzed the data obtained from a cross-cultural survey on emotional experiences (Diener & Suh, 1999; Suh et al., 1998) and computed the correlations between positive and negative emotions in 38 countries. They found that the national differences in the extent to which positive emotions were related to negative emotions were predicted by the level of prevalence of Asian dialectic philosophies, even when controlling for the level of individualism–collectivism.

1.4 Indigenous emotions

Through ethnographic work, cultural anthropologists have identified emotional categories and elements that are specific and unique in a particular culture (see chapter: Translatability of emotions, for more details on culturally specific emotions in non-Western cultural groups). For example, the emotion *liget* is close in meaning to anger among the Ilongot people of the northern Philippines, where males engage in the practice of headhunting. However, *liget* is associated with markedly different aspects through language and cultural practice (Rosaldo, 1980) and cannot be captured sufficiently by the Western concept of anger. While anger can be associated metaphorically with spiciness, wildness, energy, competition, and violence, the connections between these diverse thoughts and practices among the Ilongots are more than just metaphorical. Ilongots experience chilies, storms, being excellent gardeners, courtship, and being headhunters as exemplifying what they call *liget*. Moreover, although both anger and *liget* are likely related to somebody's harm, in the case of *liget*, one does not necessarily have an urge to hurt somebody, as one does in the case of anger. The fierce headhunter does not kill because he wants to hurt, punish, and inflict pain but because he desires to prove that he is as good as anybody else. *Liget* spurs people to action, gives them strength and courage, enables them to go beyond their limits, and leads them to achievements and triumphs.

As another example, *fago* (Lutz, 1985, 1988), a central emotion among the Ifaluk in the South West Pacific, is a mixture of sympathy, love, and melancholy. It is assumed that a strong link between the suffering of one person and the nurturing of

others underlies *fago*. For example, if you *fago* someone you have lost, it helps to be with other people so that you will not feel or think about the loss (Lutz, 1985). In contrast to grief, *fago* applies not just to the lost person but also to all those people to whom that person is close. In the Ifaluk culture, being with people means being with kinsfolk, and *fago* is felt for those who have no kin. "When the Ifaluk say that they *fago* the person who is without kin, they say that people need, above all, to be embedded in a network of others who take care of them" (Lutz, 1988).

Amae is another indigenous emotion. It is "a peculiarly Japanese emotion," which represents "the true essence of Japanese psychology" (Doi, 1981). Derived from the Japanese adjective *amai* (sweet), *amae* implies the feelings of warmth, security, and intimacy experienced when someone knows that a counterpart will provide unconditional regard (Marshall, Chuong, & Aikawa, 2011). *Amae* is the noun form of *amaeru*, an intransitive verb, which means to depend on and presume another's benevolence/indulgence; thus, *amae* indicates helplessness and the desire to be loved. The requester of *amae* is usually motivated by the need to feel positively regarded, understood, accepted, and be intimate with another person (Rothbaum & Kakinuma, 2004). *Amae* is also recognized as a key ingredient in loving relationships, perhaps more so than the notions of romance that are commonly emphasized in the West. This illustrates the importance of comprehending the concept if someone wants to understand Japanese culture. Illustrating the vast significance of the concept, Marshall et al. (2011) found a positive influence of *amae* in the day-to-day relationship perceptions of Japanese couples. People reported an enhanced quality of the relationship when their partners requested *amae* because doing so highlighted the closeness of their relationship; requesting *amae* was an expression of the deep need to maintain or increase closeness and intimacy. Furthermore, receiving *amae* was significantly related to an improved quality of the relationship and to low conflict.

One of the problems of studies focusing on indigenous emotions is that researchers have rarely examined them cross-culturally but have assumed that these emotions cannot be perceived in cultural contexts other than the original. To gain a greater understanding of the uniqueness, power, and influence of *amae*, Niiya, Ellsworth, and Yamaguchi (2006) conducted a cross-cultural study in Japan and the United States to examine how Americans would react to situations including *amae*, an unnamed emotion in American culture. They created scenarios to compare the concept of *amae* (operationalized as experiencing more positive than negative emotions) when a friend or a relative made an inappropriate request, as opposed to not making any request, or made the same inappropriate request to another friend or relative instead. The hypothesis suggested that the Japanese would experience positive emotions when being requested by a friend or a relative to accommodate an inappropriate favor because they inferred a closer relationship when being asked the favor. The Americans were also expected to experience *amae* positively but for different reasons; in addition to showing the closeness of the relationship, it would indicate a person's control over the situation. There were no expected differences between the condition in which the friend did not ask anyone for help and the condition in which the friend asked another friend for help, as neither implied a close relationship to constitute *amae*. Congruently, the data showed that the Japanese and the Americans felt more

positivity and less negativity when they were asked a favor than when they were not asked a favor. However, the reasons why people reacted positively toward *amae* were not identical in the two cultures. For the Japanese, *amae* implied closeness, trust, and security in the relationship. On the other hand, for the Americans, issues of patronage and pity might play a role, creating a heightened sensitivity to issues of control and the balance of power. Thus, *amae* might be used as a tool for affirming relationships in Japan and for asserting the sense of control in the United States.

2 Implications for measuring emotions in East Asia

As discussed, emotions are cultural; different components of meaning are associated with them. Some emotions do not play a significant role, are more or less desirable, and have various functions, depending on the culture. People experience emotions to different extents and in diverse kinds of situations, and they emotionally respond to their environment in culturally specific ways. With this knowledge, how can emotions be measured cross-culturally? People live within a cultural system, but they are usually unaware of cultural influences on their behavior. Culture is tacit in the sense that it is embedded in daily routines, practices, communication styles, interpersonal discourses, public representations, and products. Engaging routinely in these customs and practices guides people to behave appropriately without thinking explicitly about the cultural dependency of this normative behavior. This implies that measuring emotion implicitly is crucial to capture cultural variations. Therefore, we introduce two useful methods for measuring emotions in East Asian cultures—online responses and the situational approach. We discuss these methods based on the evidence reviewed in this chapter.

2.1 Online responses

As previously described, compared to North Americans, the Japanese were more likely to consider both the central person and the surrounding people when judging emotional expressions, and they did so because of cultural norms and practices of interdependence (eg, Masuda et al., 2008). Are the Japanese aware of their tendency to include background information in their perception of situations? If so, it would be wise to use an attitudinal questionnaire because it seems direct and simple compared to the implicit measurements of the effect of the surrounding people. However, given that culture is tacit, depending on attitudinal judgments would miss primarily cultural effects, which emerge through individual engagement in cultural practices and customs in an unconscious and routine manner. Therefore, researchers should adopt a measurement of spontaneous and online responses to social settings to evaluate an individual's actual behavior [see Kitayama (2002) for the argument and other problems of using an attitudinal questionnaire in cross-cultural research]. Indeed, Masuda et al. (2008, Study 2) measured eye movements during the same emotional judgment task to provide further evidence of the effect found in their first study, which was

based on subjective rating. They found that while both North Americans and Japanese paid attention mostly to the central person during the first second, thereafter, the Japanese started to focus on the surrounding people.

In addition to avoiding biases due to self-reports, spontaneous and online responses to social settings enable researchers to examine whether and to what extent the cultural effects are firm and persistent, as well as to explore whether culture induces plastic changes in the brain function and structure. In the field of cultural neuroscience, intensive studies have investigated whether and to what extent culture is inscribed into the brain (Chiao & Ambady, 2007; Han & Northoff, 2008; Kitayama & Uskul, 2011). Examining cultural influences on neural processing enhances the understanding of cultural similarities and differences in the processing of emotions. For example, previous research has demonstrated that people can recognize emotions more accurately when they are expressed by members of the same cultural group than by members of other cultural groups (eg, Elfenbein & Ambady, 2002). This in-group advantage effect has been confirmed by a neuroimaging study; Chiao et al. (2008) found that both Japanese and North American participants showed greater activation of the amygdala in response to fear expressions of members of their own culture than to those of members of the other culture, respectively. In another case, Murata, Moser, and Kitayama (2013) reported differences in brain responses when Asians and European Americans were presented with unpleasant or neutral pictures while being instructed to either suppress emotional expressions or just view them passively. The mean amplitude of a specific component of the event-related brain potential, called the late positive potential (LPP), which is related to emotional regulation strategies, was measured. Both Asians and European Americans initially showed an equally pronounced LPP at the midline-parietal electrode, but only Asians subsequently showed around 1600 ms after the stimuli onset, a significant decrease of the parietal LPP in the suppression condition (see Fig. 25.2).

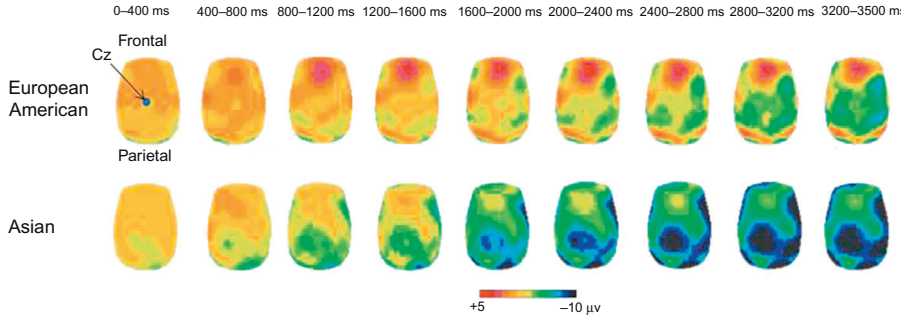


Figure 25.2 Differences in brain responses of Asians and European Americans when presented with unpleasant pictures and asked to suppress emotional expression (Murata et al., 2013). *Note*: The figure shows topographical maps for difference in the amplitude of the LPP (emotional suppress condition—passive view condition) for unpleasant pictures in each 400-ms time window for European Americans (*top*) and Asians (*bottom*).

The finding of Murata et al. (2013) corresponds to a cultural norm; emotion suppression is encouraged in East Asian cultures because it is believed that emotion expression sometimes disturbs harmonious relationships. While measuring brain activity is complex and costly, asking participants explicitly about their attitudes toward emotion suppression would likely miss the cultural effects. People might hold explicit attitudes against emotional suppression (eg, suppression is not good because it is dishonest), but they are accustomed to suppress their emotions unconsciously. Even if people do not completely endorse all aspects of their cultural model, they still embody the concepts unconsciously (Shweder, 1991).

2.2 Situational approach

Cultural values are embedded in daily routines, practices, communication styles, interpersonal discourses, and public representations in which people engage unconsciously and routinely. The prevalence of situations and their interpretations differ across cultures, and which situations elicit which emotions depends on the cultural relevance of each situation. Thus, analyses focusing on the situations and the concepts that people hold are crucial. As previously reviewed, Miyamoto et al. (2010) analyzed in which situations cultural similarities or differences would emerge, concerning the co-occurrence of positive and negative emotions. Focusing on specific situations as well, Uchida and Kitayama (2009) found cultural similarities and differences in the concept of happiness. Moreover, Niiya et al. (2006) adopted a situational approach and examined the concept of *amae* cross-culturally. In addition to these cited studies, Kitayama, Markus, Matsumoto, and Norasakkunkit (1997) showed that whereas daily situations sampled in the United States fostered the tendency of self-enhancement, daily situations sampled in Japan fostered the tendency of self-criticism. Together, these studies suggest a correspondence between psychological processes and social situations in each culture but caution against a generalization across cultures.

We note a possible interaction of situational effects not only with culture but also with individual differences. For example, as reviewed, Ishii, Kim, et al. (2014) found that the Japanese with the s/s genotype of *5-HTTLPR* tended to detect the disappearance of facial expressions with greater perceptual efficiency than those with the s/l or l/l genotype did, whereas there was no difference between the genotypes in North Americans. These results would reflect cultural differences in the extent to which people experience vigilance about social approval in daily situations. At the same time, given the difference in the sensitivity to the disappearance of facial expressions between the genotypes in Japanese, situational influences will not be homogeneous in a cultural group. Situational influences might be found more strongly in individuals with a particular set of psychological traits or genotypes.

On a different note, East Asians' perception of emotions in a holistic way (eg, Masuda et al., 2008) suggests that their emotional experiences would be less consistent across situations and interpersonal relationships compared to those of Westerners. Related to this issue, Oishi, Diener, Scollon, and Biswas-Diener (2004) used an experience sampling method in Japan, India, and the United States by examining whether situations affected emotional experiences. The participants were asked to report their

moods and select the current situation from six alternatives at random moments, five times per day for 7 days. This method would allow researchers to observe the cross-situational consistency of emotional experiences in each situation (ie, between-person analyses) and cross-situational consistency of emotional experiences within a person (ie, within-person analyses). Oishi et al. (2004) found that whereas in the between-person analyses, the cross-situational consistency of the emotional experiences was pervasive regardless of the culture, in the within-person analyses, the cross-situational variation was larger among the Japanese than among the Americans, irrespective of the pleasantness of their moods. These results suggest not only cultural similarities in the mean sizes of the emotional experiences in each of the situations but also cultural differences in how individual emotional experiences depend on the situations. Recently, statistical tools were developed, enabling researchers to model sequential processes across contexts by specifying groups who experience different types of emotion sequences in various situations, thereby allowing within-culture and across-culture analyses at the same time (eg, CLASSI; Ceulemans & Van Mechelen, 2008).

In sum, considering situations is crucial in cross-cultural examinations of emotions because social situations themselves often foster emotional experiences that fit with practices and norms in a given culture. Especially the following two points militate in favor of the situational approach: the possibility of examining individual differences in addition to an interaction between culture and situation, which is consistent with a culture×person×situation approach (see Cohen, 2007 for more details on the approach); and lower cross-situational consistency within a person in East Asians. This suggests that considering situations is particularly important for researchers to examine individuals' emotional experiences in East Asians.

3 Conclusions

In this chapter, we have selectively reviewed the literature on emotions in East Asia, focusing on the recognition of emotional information, emotional experiences, and local emotions. These findings suggest that the patterns of emotion differ across cultures and are ingrained in local cultural contexts. Specifically, in East Asian cultures, where the interdependent self, harmonious relationships, and dialectical thought are emphasized, we draw the following conclusions: (1) People are likely to pay attention to background emotional information and are sensitive to cues implying that a person is falling short of another's expectations, for example, the disappearance of smiles. (2) Well-being is likely to be associated with engaging positive emotions, such as friendly feelings and respect, but they are also characterized by negative aspects, such as transcendental reappraisal and social disruption. (3) Both positive and negative emotions occur even in positive (eg, self-success) situations.

Moreover, engaging routinely and unconsciously in cultural practices and discourses fosters psychological processes, including emotional experiences and the processing of emotional information, which are accommodated in a cultural environment. In this regard, measuring online responses and adopting a situational approach

in addition to using self-report questionnaires, would be beneficial to address cultural similarities and differences and enhance the understanding of emotions in East Asia. These measurements are not mutually exclusive. Although we referred to problems of using attitudinal questionnaires to emphasize online responses and the situational approach, we do not intend to deny its advantages. Rather, future research combining various measurements would contribute to a further understanding of the details of cultural influences on emotions.

Although this chapter has mainly focused on cultural differences, we do not imply that these differences are based on national boundaries or that the patterns of emotional experiences and recognitions are homogeneous among people within the same cultural context; neither do we define culture solely in terms of independence and interdependence. The existence of local emotions addressed in this chapter would reject such a static and dichotomous view. Indeed, the prevalent patterns of emotions differ across socioecological factors, including residential mobility (eg, Oishi, Lun, & Sherman, 2007), social class (eg, Kraus, Piff, & Keltner, 2009), and voluntary settlement (eg, Kitayama, Ishii, Imada, Takemura, & Ramaswamy, 2006). Oishi et al. (2007) showed that people with a higher level of residential mobility felt happier when their partners perceived themselves accurately. Kraus et al. (2009) found that people belonging to a lower social class were likely to pay attention to background emotional information and that this tendency was emphasized when the feeling of a low sense of control was induced. Kitayama, Ishii, et al. (2006) demonstrated that in Hokkaido, northern Japan, happiness was better predicted by disengaging positive emotions than engaging positive emotions, reflecting the ethos of independence encouraged by the history of voluntary settlement [see also Ishii, Kitayama, and Uchida (2014) for the feature as a hybrid of the interdependent culture of mainland Japan and the independent culture associated with the frontier settlement in terms of the predictors of happiness]. Therefore, measuring these socioecological factors and examining how cultures interact with the factors would shed light on what aspects of East Asian cultures influence the peculiar patterns of emotions.

In future research, integrating related research fields, such as cultural psychology, social and cultural neuroscience, and genetics, can increase the understanding of how emotional experiences and recognitions are constituted by the cultural contexts of East Asia. Although adopting a model of gene–culture interactions is a step toward such an integration, developing a framework that bridges these multiple perspectives would be beneficial for the understanding of emotions as an interplay between biological mechanisms and cultural factors.

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Emotion Measurement: Integrative Summary

26

Herbert L. Meiselman
Herb Meiselman Training and Consulting, Rockport, MA, United States

The purpose of this book, *Emotion Measurement*, is to present in one place the collected wisdom and information about what emotion is, and how it is measured. Up until this point, information on emotion has grown in the academic, research communities, the clinical communities and in the applied, commercial communities. The goal of this book is to try to bridge that gap among academic, clinical, and commercial approaches to emotion, and especially to measuring emotions. In all of these areas of research, the measurement of emotion is an important component of the overall field of emotion research.

The purpose of this integrative summary chapter is to present the important issues from each chapter in *Emotion Measurement* relative to the topic of measuring emotions, the main theme of the book. This summary chapter is not aimed at repeating everything in every chapter. Rather the goal is to extract many of the critical points related to emotion measurement. The reader is encouraged to follow up on the points raised in this summary chapter by going back to the individual chapters of *Emotion Measurement*. Also, the purpose of this summary is not to smooth over differences in approach, orientation, and method among the chapters; there are differences, and this is the very essence of emotion research at this point.

Emotion Measurement is divided into the following main sections:

1. Basic studies of emotion
2. Methods for studying emotions
3. Studying emotions in practice/Applications of emotion methods
4. Cross-cultural studies of emotions
5. Integrative summary

It is hoped that this summary will serve as a stimulus for further discussion between basic research on emotion and applied research on emotion, and among the different disciplines involved in emotion research. Each area has a lot to offer the other areas, but up to this time there has been very little interaction between basic and applied, or among the various disciplines. This is understandable because each area of emotion research is large. But by increasing the dialog on emotion measurement, I hope that this volume will serve to stimulate further discussion and further interaction among all of the researchers in emotion, and will stimulate further progress in solving some of the problems in emotion measurement.

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1 Basic studies of emotion

The first section of *Emotion Measurement* deals with basic studies of emotion. These include the theoretical bases of emotion research and emotion measurement, presented in chapters "Theoretical Approaches to Emotion and Its Measurement" and "Navigating the Science of Emotion." And then two biological chapters, on the Sensory Basis of Emotions (see chapter: The Role of the Senses in Emotion), and the Physiology of Emotions (see chapter: The Psychophysiology of Emotions). With the growth of emotion research in recent years, these areas have also advanced.

Géraldine Coppin and David Sander open the first section of the book with an overview of theoretical approaches to emotion and its measurement. They take a broad view of the definition of emotion and emotion theory, stating at the outset that "The topic of emotion rarely leaves individuals unemotional." This sets the right tone for this section of the book, and for the book as a whole; we will see a tremendous amount of material, reflecting different points of view about the nature of emotion, and different methods reflecting those differences. At the very beginning of the book, in chapters "Theoretical Approaches to Emotion and Its Measurement" and "Navigating the Science of Emotion," we already see differences between two approaches to theory.

Coppin and Sander begin by addressing the complexity of defining emotion, noting that different definitions of emotion often emphasize different aspects, including physiology, behavior, psychopathology, and evolution. And even the classification of emotions, for example, into positive and negative, is not straightforward in both basic and applied research. The definition of emotion continues as a fundamental issue, and it affects the models of emotion.

Coppin and Sander offer the following definition of emotion: "an emotion is an 'event-focused, two-step, fast process consisting of (1) relevance-based emotion-elicitation mechanisms that (2) shape a multiple emotional response (ie, action tendency, automatic reaction, expression, and feeling' (Sander, 2013, p. 23)." The authors note that emotions include both the emotional response and the eliciting mechanisms. Readers interested in further discussion of emotion definition will find definitions of emotion in many chapters throughout the book (especially see chapter: Navigating the Science of Emotion by Lisa Feldman-Barrett).

Coppin and Sander present what they see as "the three major theories of emotion—basic emotion, dimensional and appraisal theories—all describe emotion as a phenomenon with multiple components…" and they list those components as (1) expression, (2) action tendency, (3) bodily reaction, (4) feeling, and (5) appraisal. In addition to the multiple components, emotions are widely thought to involve both elicitation and emotion response, and the elicitation is thought to be part of the emotion. And the eliciting objects must be relevant to the person. Finally, emotion onset is quick, and emotion duration is short, much shorter than other affective states. The reader might wonder why it is important to understand emotion theory in order to understand emotion measurement; for much of the history of emotion research, the two concepts have been linked. Specific theories are often associated with specific measures, and conversely, specific measures of emotion are often tied to theory.

Emotions as expressions: emotional expressions are well-known, especially facial expressions, and increasingly body actions and postures. To date, vocal expression has been much less studied but there is occasionally a promise of more to come in this area. Emotional facial expression is covered by Hwang and Matsumoto (see chapter: Measuring Emotions in the Face), and is also noted in several other chapters. According to Coppin and Sander, basic emotion theories are based on both facial expression and on evolutionary psychology. For the reader new to this area, keep in mind that the words basic, primary, fundamental, and discrete are used interchangeably, and although there is disagreement on how many emotions are basic and which emotions are basic, most views include fear, disgust, anger, sadness, surprise, and enjoyment. Coppin and Sander end this section with a review of criticisms of basic emotion theory based on facial expression, focusing especially on its presumed universal, cross-cultural character. Coppin and Sander review the major methods for measuring facial expression, the Facial Action Coding System (FACS), also covered by Hwang and Matsumoto (see chapter: Measuring Emotions in the Face), electromyography (EMG) which can see invisible muscle movements, facial image analysis, thermal analysis, and measurement of facial muscle contractions. The last two methods do not require sensors on the face. Measurement can also be applied to the recognition of facial expression, voice expression, and sweat cues (as noted by Rouby et al., in chapter: The Role of the Senses in Emotion).

Emotions as action tendency. Coppin and Sander review the background of treating emotions as action tendencies, such as approach, avoidance, domination, and submission. Authors have raised the same question of universality for action tendencies as for facial expressions. The two most commonly mentioned action tendencies are approach and avoidance, and these are often measured with "push and pull" responses, with self-reports, and with electroencephalography.

Emotions as bodily reactions. Coppin and Sander review the early literature on emotions as bodily reactions, comparing the peripheralist view and the centralist view, ending in the recent review of Kreibig (2010), showing that autonomic response patterns of basic emotions can be discriminated. But we are no clearer on why these discriminations are possible, and what to do about the many other "nonbasic" emotions. Coppin and Sander review the influence of these arguments for the development of other theories of emotion. Unfortunately this argument on the primacy of bodily reactions does not seem to help us in deciding how to measure emotions, although Coppin and Sander emphasize that "to the best of our knowledge, all current major theories of emotion consider bodily reactions as an aspect of emotion." Furthermore, Coppin and Sander note that cardiovascular and electrodermal measures are most common, and these are covered by Norman, Necka, and Berntson (see chapter: The Psychophysiology of Emotions). Coppin and Sander also note the use of subjective perception of bodily sensation, and again, the olfactory stimuli from sweat and other sources.

Emotions as feelings. Coppin and Sander note that the words emotion and feeling are often used as synonyms. Emotion questionnaires are often based on asking for the person's feelings. Theories of emotions as feelings include the often-cited circumplex model of emotion (Russell, 1980) with axes for valence and arousal.

Despite its widespread use, the circumplex model has a number of critics on different issues, leading to differences in the definition of emotion, and the model of emotion. The reader interested in these issues is directed to chapters "Theoretical Approaches to Emotion and Its Measurement" and "Navigating the Science of Emotion" on theory. There are many examples of the measurement of emotions as feelings in this book, because many of the methods (Section 2) and applications (Section 3) focus on self-reports of feelings. Coppin and Sander confirm that "no physiological or brain responses have been specifically associated with specific feelings," thus limiting the use of physiological measurement in applied emotion research. This same point is raised by Cardello and Jaeger in their chapter (see chapter: Measurement of Consumer Product Emotions Using Questionnaires). And Coppin and Sander note the findings that some feelings might be common across cultures, and others might be culture-specific. The interested reader should look at the applied chapters for cross-cultural results, and to the entire section (Section 4) on cross-cultural emotion research.

Emotions as cognitions. Coppin and Sander begin this section by outlining the basic argument between the primacy of emotion and cognition, with Zajonc arguing that emotion is primary, and Lazarus arguing that cognition is primary. Coppin and Sander present appraisal theories of emotion in some detail, noting that "The appraisal process is made based on specific criteria, which differ across authors, but most agree on novelty, intrinsic pleasantness (or unpleasantness), predictability, goal-relevance (ie, their significance for the individual's goals), coping potential (ie, the individual's ability to cope with the consequences of the event), and normative significance (ie, the compatibility with personal or social norms and values)." Coppin and Sander link appraisal theories to the senses, making them of potential value to the measurement of sensory-based emotions during product development (see chapters: Emotions of Odors and Personal and Home Care Products, Emotions Elicited by Foods, and Emotion in Beverages). Coppin and Sander point out the large number of methods for measuring appraisal, including questionnaires, facial expressions, voice, psychophysiological responses, and brain imaging. There does not seem to be a consensus on how to measure these responses.

Coppin and Sander conclude with some advice on emotion measurement, namely that all ways of measuring emotions are appropriate depending on the goals of the work. They also emphasize the risk of impacting emotions when one is trying to measure them, and the importance of a realistic environment (context) on emotion measurement. The latter topic is covered by Edwards et al. in chapter "Emotions Studied in Context: The Role of the Eating Environment," and is mentioned in many other chapters.

Lisa Feldman-Barrett provides a broad review of emotion theories, and the implication of emotion theory for emotion measurement. She begins by organizing emotion theories into classical and construction approaches. In the classical approach "an emotion is understood as separate and independent ability, or *faculty*, with it's own separate *processes*," and each emotion is different from every other emotion, and each emotion has a physical basis. The basic emotions are usually thought of as including anger, sadness, fear, disgust, surprise, happiness, "and perhaps a few others," but

Barrett notes the lack of agreement on what is included in basic emotions. The reader will notice the different emphasis in chapters "Theoretical Approaches to Emotion and Its Measurement" and "Navigating the Science of Emotion" in reviewing basic emotions. Barrett applies her perspective to measurement of emotions, noting that the physiological and self-report measures of emotion should not be expected to agree, because they are measuring at different levels of analysis.

Barrett presents a great deal of data and references in support of her argument that the problem with basing your measurement approach on the classical view is that the classical view does not fit the data, including the following: (1) measurement of the face, the body, and the brain does not correlate with demonstrating some underlying mechanism; (2) neuroimaging data do not identify brain areas for specific emotions, nor do other measures of brain activity; (3) facial expressions are not specific for emotions, either using facial EMG or observer reports like the FACS (see chapter: Measuring Emotions in the Face; for another view of facial expression); (4) there is no autonomic measure for any emotion. Some of these points are also covered by Norman et al. in chapter "The Psychophysiology of Emotions".

Barrett presents the construction approach to emotions, which she has recently organized into a theory, called the conceptual act theory and more recently the theory of constructed emotion (Barrett, in press). A key part of this approach is that any emotion refers to a category or population of instances of that emotion. For example, all instances of happiness are not identical, but they share some common features. And the physiology underlying the emotion will be variable also. The constructionist approach specifies how the emotion was caused, not the observable consequence (the emotion) as argued by the classical view. Barrett then presents a detailed view of her own constructionist theory, and details the connection of her theory to underlying biology.

Barrett presents the implications of the constructionist approach for measurement of emotions, noting that this approach requires multimodal measurement, not just facial, or physiological, or self-report. As noted above, measurement at any one level will not necessarily correlate with other levels. She argues that emotions are made in the human mind, and do not exist in nature, waiting to be found and measured. And she concludes that "Thus, for now, verbal report, even with all of its failings, may be the best means of assessing the experience of emotion in a quick and efficient way." But she is quick to point out that the emotion experienced in one instance might differ in another instance, or in another person, or certainly in another culture. And the experiences of self-reports of emotions are shaped by the emotion terms provided to respondents. The reader will see some similar views throughout the book, for example, in chapter "Measurement of Consumer Product Emotions using Questionnaires," and some very different views as well, for example, in chapter "Measurement of Affective Responses to Exercise: From 'Affectless Arousal' to 'The Most Well-Characterized' Relationship Between the Body and Affect."

Barrett ends her chapter with a review of the history of emotion thinking on both the classical and constructionist positions. And she makes a final argument for the superiority of the constructionist approach in the long run, whether or not we are at that point right now.

Catherine Rouby, Arnaud Fournel, and Moustafa Bensafi begin their chapter on the senses with a broad introduction on the role of the senses, emphasizing that each sense works independently of other senses, but they are integrated centrally. Their review covers five main senses (touch, hearing, sight, taste, and smell). They describe the peripheral sensory receptors and the central nervous system sensory centers, as well as the role of the senses in emotional life. They emphasize that the role of the senses in emotion can be observed when they function poorly, even slightly, leading to impacts on well-being and mental health.

Touch has an important role in contact in humans, and touch is involved in both positive (affiliation) and negative (pain) stimulation. Touch is critical for parent–infant bonding, sexual and social life, and interestingly, the exchange of body odors. And, touch is part of the sensory mix that produces flavor in foods.

Smell and taste are two of the most emotional senses, both of them heavily involved in food pleasure and food disgust. Smell or odor responds to volatiles in the air. It signals the presence of dangerous odors including spoiled food; it recognizes pleasurable odors, and it influences social behavior. Handshaking releases chemicals, and humans frequently smell their hands when alone. Also, people communicate their emotional states, including fear, through axillary secretions. Taste responds to chemicals in solution. Sweet taste is a major reinforcer, and bitter taste a major negative stimulus, and both of these responses are present at birth.

Audition or hearing responds to vibrations in the air. It is especially sensitive to the human voice, and to music. Music even produces electrodermal responses. Vision or seeing depends on the rods and cones in the retina. The visual system is very sensitive to faces, recognizing gender, age, identity, and the feelings and intentions of others. In this regard the authors refer to the FACS, which is covered later by Hwang and Matsumoto. Rouby et al. note that there is a specialized face-processing network that is separate from the usual visual processing area used for general object recognition.

Rouby et al. present a fascinating look at the senses during development, beginning with the fetus and the newborn. They also present what we know about interactions among different sensory systems, emphasizing the role of congruency—that is, the extent to which sensory stimuli combine in an appropriate way. Congruency seems to have an effect for smell–taste, smell–vision, and smell–touch combinations. Interestingly, there appear to be instances of cross-cultural differences in sensory interactions involving facial and vocal expression. Data comparing Japanese and Dutch suggest that Japanese rely less on the face and more on voice in communicating emotion. We will return to the topic of cross-cultural research at the end of the book, with many comparisons of East Asians and Westerners.

The final chapter (see chapter: The Psychophysiology of Emotions) in the first section of the book covers Psychophysiological Measures of Emotion by Greg Norman, Elizabeth Necka, and Gary Berntson. We will see physiological measures referred to throughout this book for two reasons; first, people are genuinely interested in the physiology underlying emotional behavior. Second, there is a broad discomfort with relying entirely on self-reports of emotion, leading to the use of behavioral measures such as facial scaling, or physiological measures such as heart rate, or the newer measures such as sentiment analysis from text material.

Norman, Necka, and Berntson begin their chapter with the history of psychophysiological measurement of emotion, going back to the 19th century, and the conflicting views that carried into the later 20th century. The authors try to reach a clear conclusion to the search for discrete emotions and autonomic nervous system function, and while there is "some evidence of emotion-specific ANS responses," the evidence is still not strong on such relationships. And these results do not include the general failure to find any relationship between autonomic activity and emotions other than the more commonly studied basic emotions.

Norman, Necka, and Berntson review the more recent models of the psychophysiology of emotions, including the somatovisceral afference model of emotion (SAME; Cacioppo, Berntson, & Klein, 1992). This model covers the continuum from discrete emotions resulting from somatovisceral patterns, to individualized discrete emotions resulting from undifferentiated physiological arousal. Concerning the former discrete emotions, different forms of disgust have been linked in very complex ways to specific peripheral and central neural activity, and to specific somatovisceral activity. In the middle of this continuum are the situations in which ambiguous information leads to emotions, and in some cases the same peripheral physiological activity can lead to different emotions in different individuals. Thus, "the SAME model…provides three routes by which somatovisceral afferents may influence emotional experience: emotion-specific autonomic patterns, somatovisceral illusions, or cognitive labeling of unexplained physiological arousal. From this perspective, the traditional tendency to view the mechanisms underlying emotion in terms of a simple central–peripheral dichotomy is untenable."

Norman, Necka, and Berntson introduce the concept of rerepresentation, that is, that the evaluations of emotional stimuli are not discrete events, but occur repeatedly at different temporal levels of the nervous system. Thus both sensory and physiological information are processed at different levels leading to different temporal responses. The authors suggest that these rerepresentations might account for the differences between individuals in their response to emotional stimuli.

Norman, Necka, and Berntson review the various measures of autonomic nervous system activity relevant to emotions. They begin with, and emphasize, cardiovascular measures, going into some detail about how affective processes can increase blood pressure and heart rate, and hormone levels. And, further, they note that there can be individual differences in these responses.

The electrodermal skin response is based on the sympathetic nervous system innervation of the eccrine sweat glands. Recall that the output of sweat glands was seen as a stimulus for emotion by the olfactory system (see chapter: The Role of the Senses in Emotion). Electrodermal activity is widely used in psychological research as "an objective index of affective processes." It is also used to reflect higher subcortical and cortical areas, for example, those involved in decision-making.

Hormones are another measure of psychophysiological functioning related to emotions. Stress hormones work on the body during the normal response to environmental and neurophysiological changes, but can also contribute to the effects of psychopathology. Norman, Necka, and Berntson outline the effects of the hypothalamic–pituitary–adrenal hormone system, and note the widespread measurement of related hormones

including cortisol. However, they caution on the need for some measurement requirements for dealing with these measures.

Norman, Necka, and Berntson conclude their chapter with an interesting discussion on the relationship between psychological and physiological events related to emotions. They note that so-called one-to-one relationships, in which the psychological event is associated with one, specific physiological event is rather in psychophysiology, and also not seen with emotions. This is the basis for much of the frustration over the years in trying to link physiological measurement with emotion measurement. The authors discuss the other possible relationships of the two domains, psychological and physiological.

2 Methods for studying emotions

The first two chapters in this section deal with behavioral and physiological methods for studying emotions, in other words, methods other than self-reports. Some researchers prefer these methods because they might appear more objective, and free from the biases of self-reports. Others do not like these methods because they find it difficult to connect these measures to how people feel.

2.1 Behavioral methods

Ruben Jacob, Ortiz, and Cardenas present an overview of several behavioral methods for measuring emotions. They begin with an overview of what an emotion is, joining other chapters in grounding their particular topic in their perspective of emotion. The behavioral measures reviewed are facial scaling, covered in more detail in the next chapter, and also measurement of voice and gestures (body expressions). They also cover the interactions among these three behavioral measures, and their application to product design, a subject of later chapters in this book. In their theoretical introduction, Ruben et al. outline the multidimensional characteristics of emotions, specifically the cognitive, physiological, thought-action responses, facial and vocal responses, and finally the subjective emotional experiences. This discussion is a good place to consider the various levels of emotional responses, and how each chapter in *Emotion Measurement* chooses to tap into one level of the system and measure it. It is a good place to recall Barrett's warning that measuring at one level does not necessarily predict other levels.

Jacob, Ortiz, and Cardenas include behavior in their list of important elements in recognizing emotions: focus on the stimulus event, focus on the positive or negative appraisal to determine relevance to the individual, the synchronization of the relevance and the context of the situation, possibility of change in emotions, behaviors appropriate to the emotions, the intensity of the emotions, and their duration.

Jacob, Ortiz, and Cardenas review behavioral measures, beginning with voice and vocal behavior, noting that "vocal and verbal characteristics deliver excellent parameters to measure if an individual is experiencing particular emotions." The specific measures used are voice tone and volume, speech fluency, vibration, and

verbal content. There appear to be questions about the relationship of voice tone and specific emotions, especially when it comes to valence, since strong emotions might elicit strong voices whether positive or negative. The authors cite methods to analyze vocal and verbal aspects of speech. These include EMOVoice (Wagner, Lingenfelser, & André, 2011), which uses acoustic voice analysis based on a number of specific physical measures of voice, such as pitch and intensity. There are a series of voice analysis methods that work as apps on smartphones, including Memotion ("Memotion (Emotion Analysis)," 2015), EMOSpeech ("EMOSpeech. Speech emotion recognition," 2015), and EMOVoice.

Jacob, Ortiz, and Cardenas next review facial measurement of emotions, treating it as a behavioral method, not a physiological method based on musculature. They begin by differentiating primary and secondary emotions, noting that the former are easily recognized facially, while the latter "may be more complex and difficult to read (Matsumoto, Keltner, Shiota, Frank, & O'Sullivan, 2008)." And they also differentiate microexpressions and macroexpressions. They note some of the facial measurement systems, including the FACS and the Expression Facial Coding System (FACES), and they further note the upgraded 3D software for FACS and for other commercially available emotion measurement tools such as FaceReader from Noldus (http://www.noldus.com/human-behavior-research/products/facereader), and BP4D-Spontaneous (Zhang et al., 2014).

The next area is body expressions and body postures. One practical advantage is that viewing the body might be more easily done than viewing the face from different angles and with blocked views. However, the authors point out that studies of body expression and posture are far fewer than the traditional studies of facial expression. Nevertheless there is evidence linking emotions and postures (Mauss & Robinson, 2009). They point out methods to measure body movements, such as the VICON Motion System using six cameras in a tridimensional space, which identifies four emotions (sadness, anger, joy, and fear) (Kapur, Kapur, Virji-Babul, Tzanetakis, & Driessen, 2005).

Jacob, Ortiz, and Cardenas next discuss the newest area of behavioral measurement, involving measures from more than one modality (voice, facial, body), and showing recent interest and work (deGelder, 2015). The authors report research on vocal and facial dimensions, facial and body, body and vocal, and the combination of all three. And finally, Jacon, Ortiz, and Cardenas discuss how behavioral measures are applied in product design and research and the product evaluation of the resulting products; these topics are the subject of chapters later in this volume.

2.2 Facial scaling

Hysiung C. Hwang and David Matsumoto (see chapter: Measuring Emotions in the Face) cover the direct and indirect approaches to facial measurement of emotions. They point out that direct methods are more frequent, involving direct measurement of the facial muscles and then classification into emotion expressions. They also review the indirect methods that involve judgments of facial expressions.

Within direct measures of facial expressions they cover the FACS, primarily used for adults, the Maximally Discriminative Facial Movement Coding System (MAX), primarily used for infants, and facial EMG, which is used less often. Hwang and Matsumoto note that they view automated expression recognition systems as not fully developed, not mature, at this point. Some of these methods, especially the FACS, are covered in other chapters as well, especially chapters "Behavioral Measures of Emotion" and "Short-term Time Structure of Food-Related Emotions: Measuring Dynamics of Responses."

Hwang and Matsumoto present an introduction to facial musculature, noting the 20 muscles in the face, which may function independently of each other or as a group. While there is often an emphasis on the universality of facial muscles, Hwang and Matsumoto note that there are individual differences in the presence and symmetry of muscles. However they note that the muscles required to produce the so-called universal facial expressions exist in all cadavers studied and with minimal gross asymmetry. And the same facial muscles exist in adults and newborn infants.

The FACS is the classical system for measuring visible facial behavior. "FACS identifies 44 independent, observable movements of the facial mimetic musculature that are called Action Units (AUs). Each AU refers to the most elemental, independent movement of the facial mimetic musculature." Hwang and Matsumoto note that FACS coding is atheoretical, and FACS can be applied to any facial behavior, including emotional expressions and facial gestures, but also including the facial movements of eating and chewing. FACS identifies which facial muscles are innervated based on the changes that occur in the face. "Coding can also involve the rating of the intensity, laterality, and timing (onset, apex, and offset) of individual AUs. Because any of the 44 AUs can occur independently of each other, and depending on whether each AU is coded for intensity, laterality, and timing characteristics, FACS coding can be comprehensive, complex, and labor intensive." Hwang and Matsumoto note that investigators must first determine which facial expressions are associated with which emotions. They further note that there is strong evidence for full-face expressions of seven emotions: anger, contempt, disgust, fear, happiness, sadness, and surprise. Hwang and Matsumoto conclude their presentation of FACS by stating that "FACS is widely acknowledged to be the most comprehensive and objective system available. To our knowledge there has never been a published critique of it as a methodological system to measure facial behaviors. Formal psychometric evaluations of FACS have reported good to excellent reliabilities in the occurrence, intensity, and timing of individual AUs and for corresponding measures of emotion configurations across different emotion eliciting techniques (Sayette, Cohn, Wertz, Perrott, & Parrott, 2001)."

While FACS can measure facial expressions associated with emotions, the method is time-consuming and expensive, leading to the development of other methods for measuring emotional expression. EMFACS, for example, targets only a subsample of AUs, making it more efficient. In addition, Hwang and Matsumoto describe the MAX anatomical system for infants, and the less laborious System for Identifying Affect Expressions by Holistic Judgment (AFFEX). AFFEX requires integrating information from the whole face. Finally, Hwang and Matsumoto describe the use of electromyographic recording of muscle activity, "even those that do not result in observable

changes in expression; this is clearly an advantage of this system over those based on visibly observable appearance changes. Facial EMG also requires no coders; data are available immediately at the conclusion of recording, although often subjected to post-collection signal processing." Hwang and Matsumoto note the limitations of electromyographic recording of facial expression with a list of both physical measurement problems as well as possible influence on the person being measured.

Hwang and Matsumoto go on to describe indirect methods for measuring emotions on the face based on observer judgments. Here an observer categorizes or rates facial expressions on emotion scales. Hwang and Matsumoto note that these observer judgments are limited because we do not know exactly to what the observer is responding. Finally, Hwang and Matsumoto describe a communication approach, including the method known as the Slide Viewing Technique.

As we will see in other sections of this book, Hwang and Matsumoto conclude that the researcher must select the best method to match their situation and their goals. "FACS and its derivatives and MAX/AFFEX offer the best technical solutions to the problem of identifying the facial behaviors that may occur when emotions are aroused, because they directly measure the activity of specific facial muscles. If the facial behaviors to be coded come from adults, FACS may be the better solution; if the facial behaviors come from infants, MAX or BabyFACS is the solution. If the goal is to measure any kind of facial behavior, regardless of whether it is related to emotion signaling or not, then FACS is the preferred solution."

Hwang and Matsumoto then turn to the use of facial scaling in the consumer products industry, the same application taken by Cardello and Jaeger in the following chapter on self reports. Many other chapters later in the book address consumer product application. Whereas Cardello and Jaeger argue that physiological and facial measurement can be intrusive and/or rely on interpretation, Hwang and Matsumoto argue that "self-reports are known to be unreliable and affected by many factors that confound their interpretation (Holbrook & Batra 1987, 1988) because self-reported information can be influenced by demand characteristics, subjective bias, and socially desirability rather than reflecting the actual experience and feeling at that moment. For that reason researchers in many applied areas have turned to biometric markers of emotional states to provide better, more objective measures of consumer's emotional reactions." Some of the measurement problems with emotion self-reports are discussed in chapter "Measurement of Consumer Product Emotions using Questionnaires" by Jaeger and Cardello.

In their applied studies Hwang and Matsumoto studied the response to four product categories (beauty care, personal grooming, household care, and health care), addressing the products themselves as well as product concepts, usage, or television ads. Some of these product categories are also addressed in chapter "Emotions of Odors and Personal and Home Care Products" by Porcherot-Lassallette et al. The researchers used an abbreviated version of the FACS, focusing solely on specific AUs related to emotion signaling. The results of these consumer tests revealed some surprising results: (1) emotion classifications expected to find positive emotions including happiness, but instead found mainly negative emotions including disgust, anger, and contempt; (2) expression intensities found mainly of low and moderate

levels, in agreement with other commercial studies (see Chapters 15–19 on product emotions); (3) partial expressions of emotions was much more common than full-face expressions; (4) expression was relatively short, averaging only 1.5 seconds; and (5) there were no differences in the results as a function of product category or assessment type. It is interesting to compare this method and these results with the temporal measurement approach of Jager in chapter "Short-Term Time Structure of Food-Related Emotions: Measuring Dynamics of Responses."

Hwang and Matsumoto studied the level of agreement between self-reports of emotion and facial expressions. They calculated the number of times the self-report and the facial expression agreed, and found lack of agreement 61% of the time. To me this raises serious questions of what we are measuring, and I conclude that the two measures measure different things, and we have to learn what those are.

2.3 Emotion lists and lexicons

Two chapters in this book cover the topic of emotion lists. Both emphasize word lists or lexicons, and the questionnaires that are based on them. Researchers often look for methods that can take the place of questionnaires, but as you can see in this book, questionnaires are still very widely used. This is because of their ease of use in many settings, and their ability to test a large number of emotions. However, some feel that questionnaires are open to many biases and problems; these deficits are also covered in these two chapters as well as in other chapters, such as by Jaeger and Cardello (see chapter: Methodological Issues in Consumer Product Emotion Research Using Questionnaires). The following chapter also addresses alternative methods, based on their own emotion lists.

Daniel Grühn and Neika Sharifian (see chapter: Lists of Emotional Stimuli) cover the topic of lists of emotional stimuli including words, images, faces, and film clips. They point out that standardized lists of emotions are a big asset for the research community, providing easier design and comparison of research. Of course a requirement is that the context and the time period of the standardized list match those of the situation in which it will be applied. Grühn and Sharifian propose that emotion lists be evaluated based on a novel emotion matrix of five characteristics, specifically, ecological validity (like real life), temporal resolution (processing time), controllability (internal validity), complexity (number of aspects, the opposite of controllability), and emotional intensity (lower for words, higher for films).

Word lists: Probably the most common format for studying emotions are emotion questionnaires, and the first list format presented is word lists. Grühn and Sharifian argue that word lists are high in temporal resolution and in controllability, and low in the other factors, most notably ecological validity and intensity. Responding to words is not like responding to real-life situations. One of the complexities of using word lists is that positive words occur more frequently in everyday usage and are shorter than negative words. Grühn and Sharifian recommend that positive and negative emotion words be matched for word frequency and word length, since these influence cognitive processing.

Grühn and Sharifian present sources of word lists:

1. The Dictionary of Affect (Whissell, 1989, 2009) with 8734 words including ratings (3-point scales) for pleasantness, activation, and imagery.
2. Affective Norms for English Words (ANEW, Bradley & Lang, 1999) with 1034 words rated (9-point) for valence, arousal, and dominance.
3. Warriner, Kuperman, and Brysbaert (2013) rated 13,915 English words on valence, arousal, and dominance, and these words are tied to earlier studies on word frequency and age-of-acquisition.
4. English EMOtional TErms (EMOTE, Grühn, 2015) with 1287 nouns and 985 adjectives on valence, arousal, emotionality, concreteness, imagery, familiarity, and clarity of meaning. Adjectives were also rated on control, desirability, and likeableness; and nouns were rated for memorability.

And two age-dependent measures in European languages:

5. The Age-dependent Evaluations of German Adjectives (AGE, Grühn & Smith, 2008) with 200 German adjectives rated on valence, arousal, control, imagery, self-relevance, and age-relevance
6. The French Emotional Evaluation List (FEEL, Gilet, Grühn, Studer, & Labouvie-Vief, 2012) with 835 French adjectives rated on valence, arousal, and imagery.

The authors note that for both AGE and FEEL younger and older adults evaluate emotion words differently.

Emotional images: Grühn and Sharifian argue that images are high in temporal resolution, and low to moderate in the other factors. It is difficult to elicit strong emotions with images, except perhaps the emotion of disgust. Grühn and Sharifian present sources of images:

1. The International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1999) rated valence, arousal and dominance using Self-Assessment Manikins. It might seem a bit dated.
2. The Geneva Affective Picture Database (GAPED; Dan-Glauser, & Scherer, 2011) with 730 images aimed at positive human and animal babies, landscapes), negative and neutral responses.
3. The Nencki Affective Picture System (NAPS, Marchewka, Żurawski, Jednoróg, & Grabowska, 2013) with 1256 images of people, faces, animals, objects, and landscapes.
4. The Affective Image Database (AID, Grühn, Kapkin, & Sharifian, 2015) with 7232 images of animals, humans, objects, indoors, and outdoors, rated on valence and arousal (7-point).

Emotional faces: Faces have low to medium ecological validity but it is the highest of any of the four list categories, high temporal resolution, low to medium complexity and intensity, and medium controllability. Grühn and Sharifian present sources of emotional faces:

1. Picture of Facial Affect database (POFA, Ekman & Friesen, 1976) contains 110 black and white faces showing six emotions: happiness, sadness, surprise, fear, disgust, and anger.
2. The Productive Aging Lab (PAL) Face database (Minear & Park, 2004) contains 1142 black and white faces, ages 19–93, showing neutral expressions or emotions.
3. FACES (Ebner, Riediger, & Lindenberger, 2010) contains 2051 images from young, middle and older adults with six emotions (neutral, sadness, disgust, fear, anger, and happiness).

Grühn and Sharifian also noted the development of several non-Caucasian databases.

Emotional film clips: According to Grühn and Sharifian, film clips are closer to real life, with higher ecological validity and higher complexity. Film clips have low to moderate temporal resolution and low control (because of the complexity), but higher intensity (probably the highest of all of these lists). Film clips are often used to elicit a small number of discrete emotions, so that the film lists are not as extensive as words. Grühn and Sharifian present several older attempts to use film clips, followed by more recent work:

1. Schaefer, Nils, Sanchez, and Philippot (2010) rated 70 French film clips showing seven emotions (anger, fear, disgust, sadness, amusement, tenderness, and neutral). Film clips were rated based on their discreteness, intensity, and level of positive and negative affect.
2. Set of Emotion-Elicitation Movie Scenes (SEEMS, Sharifian & Grühn, 2015) contains 21 English film clips representing eight discrete emotions (neutral, sad, amusement, happiness, anger, tenderness, fear, and disgust) rated on valence and arousal as well as on 20 emotion terms.

Grühn and Sharifian discuss the obstacles to the development and use of emotion lists: the structure of emotion (discrete or dimensional) and its assessment, and the role of individual differences. Since emotion lists have been very dependent on self-report data, the development of corroborating measures other than self-report, such as physiological measures, could advance the field. And Grühn and Sharifian look forward to the identification of key group effects beyond those already identified for age, perhaps culture, occupation, and education. Readers interested in age should also look at chapter "Studying Emotions in the Elderly" by den Uijl and Kremer, and readers interested in culture should look at the cross-cultural chapters (see chapters: Translatability of Emotions; Different Ways of Measuring Emotions Cross-Culturally; and Emotion Measurement: Integrative Summary).

One of the potential uses of emotion lists, as described above, is the design of emotion questionnaires. The methodology of emotion questionnaires is the subject of several chapters in this book. Cardello and Jaeger (see chapter: Measurement of Consumer Product Emotions using Questionnaires) present a number of mainly recent attempts to measure emotions in response to products using questionnaires. And for those readers who have questions or doubts about self-report questionnaires of emotions, Thomson presents his approach to conceptual profiling in chapter "Conceptual Profiling." Cardello and Jaeger (see chapter: Measurement of Consumer Product Emotions Using Questionnaires) address the application of questionnaires in the product setting, in both academic and commercial research. They begin by noting the many methods which have been developed to study emotions in consumer product experience, including self reports, physiological methods, and behavioral methods (facial, vocal). They conclude, "Although many of these methods are useful for the identification and/or discrimination of different human emotional states, many pose challenges for direct application and/or unobtrusive measurement in product research settings." They present examples of the emphasis on negative emotions in clinical questionnaires, the use of intrusive hard-wired sensors or artificial positioning

of the body for many physiological and behavioral measures, and the interpretation required for facial and vocal expressions. Thus, they differ from Hwang and Matsumoto's preference for facial scaling, with their preference for questionnaires in the commercial product setting. Recall that Feldman-Barrett also favored self reports in chapter "Navigating the Science of Emotion." Cardello and Jaeger point out that the recognition of many emotions resulted from verbal report rather than other physiological and behavioral methods, and the use of verbal reports (questionnaires) was widely accepted and applied in the study of product emotions. Cardello and Jaeger go on to argue that the current view of emotions emphasizes broad families of emotions rather than a small number of basic emotions, again differentiating the questionnaire approach from some other approaches which find large numbers of emotions to be difficult to measure.

Cardello and Jaeger are careful to distinguish emotion lexicons and emotion questionnaires. Recall that Grühn and Sharifian (see chapter: Lists of Emotional Stimuli) used the term lists to refer to standard lists of emotion terms, pictures, and other emotion stimuli. Cardello and Jaeger use emotion questionnaires to refer to a specific set and number of emotions. Consumers respond with checked responses (check all that apply or CATA) or with scaled responses (numbered scale, labeled scale, unstructured line scale). Lexicons provide a large vocabulary of words for a particular product class (all foods, all beverages, all perfumes, etc.) or multiple product classes. Cardello and Jaeger present a number of lexicons, and then a number of recent product emotion questionnaires. With this terminology, Grühn and Sharifian were talking about lexicons.

Cardello and Jaeger begin by presenting a number of English and non-English lexicons:

1. Richin's Consumption Emotion Set (CES, Richins, 1997) with 47 words in 7 clusters. Also see chapter "Emotions Studied in Context: The Role of the Eating Environment" for application of the CES.
2. Hierarchical Model of Emotions (Laros & Steenkamp, 2005), 316 words from 10 emotion (theoretical) studies, 173 negative, 143 positive, divided into 4 positive and 4 negative categories.
3. Lexicon of Feelings (Thomson & Crocker, 2014), 59 feeling words in 12 clusters of 2–4 words each. Also see chapter "Conceptual Profiling" by Thomson. Applicable across English, German, French, and Italian.
4. Non-English Lexicons (French, Italian, and German).

Cardello and Jaeger present a number of emotion questionnaires for testing products.

1. The Geneva Emotion and Odor Scale (GEOS) of 36 emotion terms in 6 categories, and ScentMoveTM (Porcherot et al., 2010) with six scales each composed of the three most representative words from the above categories, and UniGEOS with 25 terms in 9 categories. Also see chapter "Emotions of Odors and Personal and Home Care Products" on the development and application of these questionnaires.
2. The EsSense Profile with 39 emotions (mainly positive) rated on a 5-point scale and EsSense25 with 25 emotions (King & Meiselman, 2010; Nestrud, Meiselman, King, Lesher, & Cardello, 2015). Also see chapter "Emotions Elicited by Foods" for the application of these scales to foods.

3. EmoSemio (Spinelli, Masi, Dinnella, Zoboli, & Monteleone, 2014), product category specific, 23 terms (16 positive, 7 negative) in sentence form.
4. The Product Emotion Instrument (PrEmo, Desmet, Hekkert, & Jacobs, 2000) with animated cartoon characters showing 12 emotions. Also see chapter "Emotion-driven Product Design."

Cardello and Jaeger review the psychometrics of scaling as applied to emotions. They also discuss the application of best–worst scaling, its possible advantages in cross-cultural research, and its possible disadvantages in terms of being time-consuming for specific applications. Readers interested in this alternative scaling approach are referred to chapter "Conceptual Profiling." Cardello and Jaeger recommend that the choice of response scale represents a careful decision on the part of researchers, and that the decision should be made clear to readers of research reports.

Cardello and Jaeger note that developing mobile technology will influence data collection in the future, providing opportunities to measure emotions in real time at the point of purchase and/or point of consumption.

Cardello and Jaeger compare responses to emotion stimuli in the form of actual products, product names, and product pictures. Research on (food) products uses these different forms of stimuli. In-house commercial testing of products, usually in what is called a central location test (CLT), uses actual products, although usually not in the full size. A food product is often tasted, smelled, and eaten. In internet testing the stimuli are usually branded or unbranded product names or a picture of the product, with or without its packaging. Cardello et al. (2012) tested food names and food products (chocolates, potato chips) using the EsSense Profile noted above. The names of "chocolate" and "potato chips" produced large emotional responses for many of the emotions on the Essense Profile. Cardello et al. concluded that the food names elicit memories of a "quintessential product," which are stronger in emotions than the actual product experience. Cardello et al. observe that the same outcome was observed when product liking was measured for product names and actual products. Cardello and Jaeger conclude that "In a sense, products are never as good as we think of them to be nor as bad as we think of them to be. So too for emotional intensity, it seems that products are never as emotionally intense as we think them to be nor as devoid of emotional impact as we think them to be." Another phenomenon related to product names is the role of expectations which has been studied extensively with respect to product liking by Cardello (2007).

2.4 Sentiment analysis

One of the key distinctions in the methods reported in this book is the issue of whether the method uses solicited information or not. Self-report questionnaire data are solicited, but remain very widely used. Physiological and facial scaling data are not necessarily solicited, but the respondent is usually aware of the data collection process, which is sometimes cumbersome and intrusive. Those looking for affective data without interrupting the daily flow of life should be interested in sentiment analysis, or the analysis of textual material including social media messages. Especially for young people, social media communication is now one of the leading modes of

communication, and is open to analysis for affect. Saif Mohammad begins his presentation of sentiment analysis with a broad definition of what is included in sentiment analysis including the automatic determination of valence (positive/negative), and more generally the automatic determination of affective states towards a person, object or event. By automatic it is meant that the determination is by means of computer processing, not by on-the-spot human judgment. There are several clear advantages to this approach; as already noted it is completely unintrusive, the raw material is emitted by the subjects in the regular course of their daily lives. Furthermore, it is unstimulated or unsolicited. And it is possible to collect such data in huge quantities, quantities much greater than any other method in this book.

The methods for determining valence and emotion from text material depend on statistical machine learning teachniques, and to a lesser degree on rule-based approaches. Mohammad notes that sentiment analysis is being applied to a large number of public and commercial topics, including: (1) public health, including both mental and physical health; (2) politics and political issues and events; (3) brand management and customer relations; (4) education; (5) tracking social media; (6) detecting personality traits; (7) understanding gender differences in language use; (8) literary and music analysis; and (9) visualizing emotions.

Mohammad outlines the challenges to conducting sentiment analysis, including: (1) The complexity and subtlety of language which is more than the sum of its words (some very negative statements contain no negative words); (2) The need to include word modifiers (not bad is not the same as bad); (3) Words can be used in very different contexts with different meanings; (4) Words may communicate multiple emotions; (5) Difficulty of some forms of language including sarcasm, irony, humor; (6) Terms and spellings unique to social media; (7). Emotion is communicated through pitch and emphasis, and also with written markings; (8) The combination of language and facial expression; and (9) Cross-cultural differences, especially for certain behaviors and topics.

Mohammad discusses in some detail the different levels of sentiment analysis, from words and phrases to full sentences, social media messages, and product reviews and whole documents. Interestingly, in the context of this book, sentiment analysis has been extensively applied to products and services, sometimes utilizing sentence-level analysis. Another area of research in sentiment analysis has been research on subjectivity.

A lot of the research and hence the discussion of emotion sentiment analysis has been based on the theory of basic emotions, and we know that some researchers and practitioners in the emotion field accept and others reject this. On the practical side, it means that sentiment analysis of emotions fcouses on a small number of emotions. However, Mohammad and Kiritchenko (2015) showed that when the number of emotions was expanded from under 10 to 500, connected to hashtags, it improved the performance of the analysis.

Mohammad discusses the application of crowdsourcing to get a large number of untrained consumers to help with language analysis. Amazon Mechanical Turk and CrowdFlower are two crowdsourcing platforms, as well as The NRC Emotion Lexicon (Mohammad & Turney, 2010, 2012), which contains 14,000 words, and

another from Warriner et al. (2013) with 13,915 words. Lists of words with valences include the MPQA Subjectivity Lexicon of 8000 words (Wilson, Wiebe, & Hoffmann, 2005), another list of 6800 words from Hu and Liu (2004), the Adjective Norms for English Words (ANEW) with 1034 words (Bradley & Lang, 1999), and AFINN (Nielsen, 2011) with 2477 English words. The reader can see that the problem in many of these tasks is to select the most appropriate list to use. In addition, some lists appear in foreign languages, although Mohammad emphasizes that most of the sentiment analysis work is in English.

2.5 Conceptual profiling

Thomson's chapter (see chapter: Conceptual Profiling) on conceptual profiling provides an alternative method to those who feel that self-report of emotions through emotion questionnaires is problematic because of the assumption that we can access our emotions consciously. The issue of conscious/unconscious self-report of emotions has been discussed by many people who prefer implicit approaches rather than explicit approaches to measure what we very broadly call emotions in this volume. Thomson spends considerable time on the definition(s) of emotion, and how conceptualizations fit into the overall discussion of emotions. The conceptual associations that we have in response to people, objects, or events are also referred to as latent or implicit associations. These associations do not refer by what the stimulus is, but what it means or how it makes you feel. Thomson discusses the general psychology of the unconscious and the preconscious, noting that conscious thoughts represent a small percentage of the total, and concluding "It is the capacity of conceptual profiling to access the preconscious, thereby revealing previously hidden insights, that makes it especially valuable to brand, packaging and product designers." Thomson summarizes by saying that "…conceptualizations trigger emotions."

Thomson notes that the history of product development in the past 50 years or so has seen the improvement of consumer products, so that now most products are high quality from the sensory and functional perspectives—they taste/smell good, and they do what we expect that category of product to do. But the high failure rates of new products suggests that "…current research methodologies are failing to predict longer-term product adoption!" Moving back to the theoretical level to deal with this situation, Thomson explains his Duality of Reward Hypothesis, with two aspects of reward, reward via immediate sensory pleasure and reward via emotional outcome. Thomson goes on to discuss the relationship of reward to liking, noting that self-report measures of emotion are highly correlated with liking, but liking is not the same as reward. The missing piece of reward is hopefully captured by conceptual profiling. In the context of this book, the importance of conceptual associations is that they trigger emotions according to Thomson. Thomson puts conceptual associations into the context of product evaluation, enumerating the important aspects of products: (1) Sensory profile; (2) Functional profile; (3) Conceptual profile; (4) Liking; (5) Emotional outcomes; and (6) Totality of reward—unmeasureable. Conceptual associations do not substitute for emotions in our work; they are an added step, and according to Thomson provide important information.

Thomson reviews the measurement of conceptual associations, including both concept description and quantification. Concept description involves developing a conceptual lexicon, using trained interviewers. This typically produces a lexicon of 20–30 emotional and abstract terms and 15–25 functional terms. The terms can involve both positive and negative terms, because "brands and products are often differentiated on the basis of what they are not!" The terms usually work for a specific product category, and often can be used for that category for a long time period. Thomson notes that lexicon development appears to work equally well cross-culturally. On the down side, lexicon development is usually time-consuming and expensive. With this in mind, Thomson reports 30 conceptual terms drawn from their experience over the past 5 years, based on frequency of use, general applicability, and discriminatory power.

The quantification of emotional and abstract associations is conducted using best–worst scaling—an indirect method of scaling that is useful for measurement of abstract attributes. Respondents choose one term/attribute as best and another as worst. The reader interested in best–worst scaling is referred to chapter "Conceptual Profiling" and other references on this scaling method. For our purposes, it should be noted that best–worst scaling is also labor-intensive, requiring longer questionnaires and longer testing. To get around this Thomson and Crocker (2014) developed the faster "Bullseye" method in which respondents drag and drop a sequence of conceptual terms onto an image of concentric circles resembling an archery target, and this is assumed to require low conscious processing. The terms come from the lexicon that has been established for that product/product category.

Thomson provides a number of interesting examples and case studies drawn from his commercial experience. These include:

1. Emotions associated with color, whether the color be associated with the environment or with objects in that environment. Color affected 21 of 30 emotions in MMR's General Conceptual Lexicon.
2. Emotions of unbranded products, where Thomson conceptualizes brands themselves as "bundles of conceptual associations." Thomson notes that with unbranded products, the category effect of that particular category of products tends to overwhelm the consumer response. Thomson argues that this is a problem with more conventional emotion analysis of unbranded products using questionnaires.
3. Brand–product consonance, which is Thomson's approach to the "fit-to-brand" issue in product marketing.

Thomson concludes his chapter by restating his view that conceptual associations represent a constructive addition to the literature concerning people's affective responses.

2.6 Temporal analysis

We now turn from *what* is being measured, to *when* it is measured. Gerry Jager's chapter (see chapter: Short-term Time Structure of Food-Related Emotions: Measuring Dynamics of Responses) on the temporal dimension of emotion measurement raises important questions for everyone doing emotion measurement: when should emotions

be measured, and for how long, and how fine should the measurement be in temporal terms? Jager begins her chapter by noting her preference for a dynamic approach, rather than the traditional static approach that uses static stimuli such as pictures but perhaps compromises the ecological validity of what is happening. Jager notes that a dynamic approach requires a different set of methods. Jager notes in several places that the very definition of emotion and the theories of emotion set limits on what an emotion is, and hence on the temporal measurement of emotion.

Jager introduces affective chronometry for its description of the temporal features of affect, describing the shape and amplitude of emotions over time (Davidson, 1998). Jager goes on to present some key variables of interest: frequency, intensity, response latency (time between onset and peak intensity), recovery time (time for an emotion to dissipate), focus (unit of consideration), type of measure (explicit, implicit), time window (milliseconds, seconds, minutes, hours?), and sampling type (intermittently, continuously).

Jager describes three different approaches to measuring emotions over time: (1) self-reports, (2) measuring variability in the shape and intensity profiles of emotion episodes and how they relate to duration (Heylen, Verduyn, Van Mechelen, & Ceulemans, 2015), and (3) measuring the Temporal Dominance of Emotions (TDE; Jager et al., 2014). Measures of self-report over time include different approaches to the task, including using the ratio of positive to negative emotions in the Positive and Negative Affect Schedule (PANAS) at discrete points in a series of measurements surrounding the consumption of chocolate, and alternatively using the affective chronometry introduced above, and using it to depict emotion duration and emotion intensity over time.

The second approach, time intensity profiles of emotion episodes, was recently applied to anger (Heylen et al., 2015). People were asked to recall recent anger experiences and estimate its duration (in seconds, minutes, hours), as well as an emotion grid that depicted anger intensity over time. The resulting data were analyzed using an advanced statistical technique that helped to identify clusters of respondents. For this anger example, they identified a cluster with shorter response latency, and a second cluster with longer response latency. Jager notes that this temporal analysis yields new information about responding to emotions.

The third approach is called TDE (Jager et al., 2014) based on the Temporal Dominance of Sensations (TDS) from sensory and consumer research. In TDS, sensory attributes such as sweetness occur over time; in fact up to 10–12 attributes (sensory attributes or emotion attributes) can be studied simultaneously, with the respondent selecting which attribute is most dominant. The calculation of the response functions (TDE curves) is based on calculating the proportion of panelists that select an attribute (emotion) as dominant, and plotting that against time. These dominance curves show the percentage of respondents choosing the same attribute, but do not show the intensity of their experience. The time scale is converted from real time to standardized time from 0% to 100%, allowing one to compare the responses of people who actually experienced different durations of that dominant emotion. The statistics of these calculations is a field within sensometrics.

Jager et al. (2014) recently applied this approach in a study of chocolate assessing both the sensory (TDS) and the emotional (TDE) attributes. Indeed, Jager et al. found that different emotions characterized different chocolates at different times in their consumption. Thus, TDE represents a genuine increase in information about the emotions generated by products.

Jager presents the temporal dynamic perspective on facial expression and neurophysiological expression of emotion, in addition to self-reports. Jager presents the latest developments in the FACS (introduced by Hwang and Matsumoto in chapter: Measuring Emotions in the Face), the FACSGen 2.0, "a new animation tool for creating realistic, both static and dynamic, 3D facial expressions based on FACS (Roesch et al., 2011)." Jager notes that FACS does not include the "temporal unfolding of the emotion" in the way we saw with the TDE method above, and which are now assumed to be critical parameters of the emotion experience. As an example, Jager presents the time course of the development and following relaxation of a smile or a fearful expression, and tries to link these events to brain activity through fMRI.

Jager presents two experiments that demonstrate the value of a more temporal, dynamic approach, using nonbehavioral methods. It was demonstrated that cognitive processes within 300 milliseconds of a stimulus, signaled a negative event, and produced a negative facial expression (frowning). A positive response (smiling) seemed to occur a little later, 350–600 milliseconds after a stimulus. Another study also showed specificity toward positive and negative stimuli, and also showed their dynamic nature. And both studies confirm that when you study an emotional response it might yield different findings, with these studies showing negative emotions presenting before positive emotions (in terms of millisecond differences).

Jager concludes by emphasizing that a dynamic view of emotion adds to what we know about emotion measurement. "However, measuring dynamics in emotion responses adds a novel dimension by revealing a pattern in different components of emotion responses that develops over time. Several studies supported the notion that different facial expressions (happy, angry, fearful) and the associated physiological responses (changes in heart rate, skin conductance) develop at their own specific rate over time. Consequently, responses to the same event or stimulus may produce very different patterns of results depending on the time or stage in the emotion process at which they are assessed." The advances of a dynamic approach come with limitations, including the necessity for expensive equipment, sophisticated statistical analysis of large data sets, the statistical assumptions of these types of data, and the biases of working in the laboratory rather than in other natural environments.

2.7 Exercise

Panteleimon Ekkekakis and Zachary Zenko begin their chapter (see chapter: Measurement of Affective Responses to Exercise: From "Affectless Arousal" to "The Most Well-Characterized" Relationship Between the Body and Affect) on affective response to exercise with a review of 19th and 20th century history of psychology, and the role of exercise in psychology. The 19th century views are also referred to in

chapter "Theoretical Approaches to Emotion and Its Measurement" by Coppin and Sander, and they form an interesting backdrop to the 20th century when the study of feelings was absent from psychology under the restrictions of behaviorism and cognitivism.

Ekkekakis and Zenko suggest that the first modern publication connecting exercise and affect was a 1967 paper in the *New England Journal of Medicine* connecting anxiety and exercise. In response to this conclusion, people began investigating the relationship of exercise and feelings (Morgan, Roberts, & Feinerman,1971) yielding the findings: "even though significant psychologic changes were not observed, the majority of the subjects tested in these studies reported that the exercise bouts were exhilarating and they 'felt better' following the exercise" (Morgan et al., 1971; p. 425). The authors concluded that the failure to find positive effects of exercise lay with the measuring instrument, and soon two new measurement instruments provided the needed data, the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970) and the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971). Ekkekakis and Zenko raise the question of why exercise is not more popular if it makes you feel good, and if people are driven to feel good.

Ekkekakis and Zenko present a detailed analysis of how research methods become fixed and not easily subject to change and replacement—apparently this was the case with exercise and affect. I am familiar with the use of emotion questionnaires in product research, mainly food and personal care products, and some of those domains started with traditional emotion questionnaires, but realized that those questionnaires would not work for commercial products (King & Meiselman, 2010).

Ekkakis and Zenko then critically discuss three different instruments for measuring emotion/affect in the context of exercise: (1) the STAI (Spielberger et al., 1970), which is used to study exercise but was designed to measure anxiety in response to a "threat"; (2) the POMS (McNair et al., 1971), used to study exercise for close to 50 years, but often interpreted as reflecting "mood"; (3) the PANAS (Watson, Clark, & Tellegen, 1988), which the authors claim has been misinterpreted to mean all pleasant and unpleasant states.

Ekkekakis and Zenko turn to the progress of more recent times in studying affective responses to exercise, and characterize this field as an exemplar of the relationship of physiological arousal and affect. The authors conceptualize the study of exercise and affect as a three-step process, and recommend this process for anyone studying affect—therefore this chapter should be of interest, not only to those studying exercise, but to everyone reading this book on emotion measurement. The three-step process involves the following steps:

1. Select the focus of study—core affect, emotion, mood. The authors emphasize that these three different concepts have different definitions, and studying one of them should not lead to conclusions about the others. Core affect does not have a specific cause or object, and is present most or all of the time. "Examples of core affects include pleasure, displeasure, tension, and calmness." Emotion is a response to a particular stimulus involving cognitive, physiological, and behavioral systems. And mood may not have a clear stimulus, with "diffuse" causes, and may last much longer than emotions. This is one of the only places in the book where affect, emotion, and mood are clearly defined and described.

2. Choose a theoretical framework. The authors point out that certain theoretical positions are associated with certain measures. Some researchers within the field of emotion measurement appear to be working without a clear theoretical foundation—and Ekkekakis and Zenko argue that is wrong. But the pragmatic researcher interested in emotions associated with products might simply want to compare two products—does this require a theoretical framework?
3. Choose the psychometrically strongest measure from those available in that theory.

Ekkekakis and Zenko provide an example of applying this three-step approach, and then call for the application of this approach in other research on emotions, not just limited to exercise. In providing this example, they introduce the Feeling Scale (FS; Williams et al., 2008), a single-item report of "present feelings" with an 11-point response scale from very good to very bad, and used in exercise research.

2.8 Questionnaire methods

Many chapters in this book utilize emotion questionnaires, and in the chapters dealing with commercial application of emotion measurement, questionnaires are used even more frequently. The goal of chapter "Methodological Issues in Consumer Product Emotion Research Using Questionnaires" by Sara Jaeger and Armand Cardello is to address the measurement issues and methodological challenges of these questionnaires, many of which are presented in chapter "Measurement of Consumer Product Emotions Using Questionnaires" by Cardello and Jaeger. They note that they do not cover cross-cultural questionnaire usage, but fortunately that topic is covered by other chapters below.

Jaeger and Cardello begin by addressing the effect of the number of emotions and the order of presentation of those emotions in questionnaires. They note that many product emotion questionnaires began with 35–40 emotions, and later produce shorter versions of about 20 words. Jaeger and Cardello cite studies showing that more emotions are checked when the emotion list is longer, and higher mean emotion ratings when the list is shorter. They also note the work of Ares et al. (2013) who reported higher frequency of emotions with shorter emotion lists. They note that the finding of more emotions with longer lists is compatible with the argument that longer lists provide richer emotion data, but also with the argument that longer lists create a demand characteristic for a greater number of emotion responses. Jaeger and Cardello offer a possible mechanism for this over-response, that of halo dumping, a response bias when respondents receive a limited list with which to describe a product. Despite the potential for biases with different-length emotion lists, Jaeger and Cardello conclude that there is no optimal number of emotion words in an emotion questionnaire, and that the number of emotions should depend on the purpose of the work. In high-volume product testing, probably a shorter emotion list is appropriate, while detailed study of a new product might demand a longer emotion list.

Following the discussion of the number of emotions in emotion questionnaires, Jaeger and Cardello discuss how to order those emotions, pointing out the use of alphabetical order, random order, and different fixed orders. While it has been reported that alphabetical order versus random order did not affect results using the

EsSense Profile (King, Meiselman, & Carr, 2013), Jaeger and Cardello recommend that any fixed word order be used with caution based on experience with sensory testing of products. An additional point of item order deals with other questions that might be asked in questionnaires. In product testing, many questionnaires ask for a rating of overall liking, but the evidence is mixed on whether liking is affected when measured before or after emotions. Jaeger and Cardello caution about collecting hedonic and emotion data together, but they note that if you do this, you should be consistent in doing it, so that tests are comparable.

Jaeger and Cardello address whether different instructional sets and contexts influence emotion responses on questionnaires. They first note that Yes/No forced-choice questions encourage deeper thinking than check-all-that-apply questions. Two unpublished studies are presented; in the first study, subjects were given instructions to respond taking time "carefully" or respond with "immediate reaction," and they found double the number of emotion responses for the slow versus the fast group using the EsSense Profile. In the second study, they also found double the number of emotion responses with slow versus fast instructions. Jaeger and Cardello advise researchers to plan instructions which are appropriate to their situation, emphasizing that "Those who consider emotions to capture non-cognitive responses may have reason to use the approach which promotes faster responding." Jaeger and Cardello note that effects of instructions have not been studied for some variables, for example, whether emotions are elicited during or following product consumption.

A number of chapters within this volume address the context of emotions, especially chapter "Emotions Studied in Context: The Role of the Eating Environment," but the topic is also addressed in the product chapters (see chapters: Emotions of Odors and Personal and Home Care Products, Emotions Elicited by Foods, and Emotion in Beverages). Jaeger and Cardello begin their treatment of context with evoked consumption contexts, noting that some food research is done in natural eating locations and in constructed (nonnatural) locations, including so-called "immersive" environments (Sester et al., 2013).

Piqueras-Fiszman and Jaeger (2015) found that emotion associations can greatly differ when respondents imagine that products are consumed in different contexts (eg, breakfast, lunch, or dinner). They also found that positive emotions were more frequent in consumption contexts that were considered more appropriate, and negative emotion words were more frequent when the context was considered less appropriate, for example, breakfast cereal in the office versus breakfast cereal in the home. In general, evoked contexts can be imagined based on written or pictorial information, with a variety of methods available. And some emotion scales are being developed for specific locations such as upscale restaurants (Han, Back, & Barrett, 2009; Han & Jeong, 2013), while other researchers use more standard questionnaires (see chapter: Emotions Studied in Context: The Role of the Eating Environment). Jaeger and Cardello advise that, when using evoked contexts, the context must be appropriate for both the product and the consumer segment being targeted.

Jaeger and Cardello review the limited studies on other contextual variables including time-of-day effects for food items, eating alone in a university cafeteria producing stronger negative emotions (Edwards, Hartwell, & Brown, 2013), and ambiance,

including color, in an experimental restaurant (Jacquier & Giboreau, 2012). Jaeger and Cardello conclude that the testing situation, either real or evoked, should be as close as possible to the probable real-life context for the product, and they cite the future potential of immersive technology and sensory simulation to deliver more options for testing.

A key issue in commercial versus academic testing of foods and other products is the population for testing (see Meiselman, 2012, 2015). Most commercial research is conducted on product users; most academic research is not. King and Meiselman (2010) showed that product users give higher emotion ratings, and tend to use positive emotions while nonusers tend to use negative emotions. Jaeger and Cardello point out that while this makes sense, other research has not confirmed this relationship between product use and emotion ratings or emotion valence (Piqueras-Fiszman & Jaeger, 2014), and some research has shown mixed support for user effects (Jaeger & Hedderley, 2013).

Jaeger and Cardello also examined the demographics of gender and age. They report several studies showing higher ratings by men of positive emotions associated with food, and point out how this differs from the stronger emotion ratings sometimes seen from women in food product testing, and the more general conclusion that "women are more emotional than men" (eg, Diener, Sandvik, & Larsen, 1985). The results for age are somewhat limited, and the effects mixed, some showing higher emotions with age in response to food, or higher negative emotions with increasing age, or higher positive emotions. The reader interested in emotions in the elderly is referred to chapter "Studying Emotions in the Elderly" by den Uijl and Kremer. There is limited research on general consumer psychology, but Jaeger and Cardello report effects on both positive and negative emotions related to food using the Emotional Intensity Scale and the Private Body Consciousness.

Two critical questions in product testing are how many samples can be tested in the same session and how many people should be tested. Sometimes, one just needs to compare a product redesign to the original product (two samples), but other times one wants to compare a product to all of its major competitors which might be 10 samples. King et al. (2013) suggested that two samples is the optimal number for testing. There are little data on the effects of number of respodents, but in the product sensory field, the norm is now 100+ people per segment to be tested. So for a typical simple product test, 100+ people might be needed, but for a more complex test with several population segments, you might need many hundreds to reach 100+ per segment. In studying the consumer, segmentation by product emotion respones might become more frequent (Köster & Mojet, 2015).

Jaeger and Cardello finish their extensive methodological review with the issue of how consumers view the collection of emotion data with respect to products. They discuss the personality differences of ability/difficulty of describing emotions. Some earlier questionnaires (Gohm & Clore 2000) used questions such as "It is difficult for me to find the right words for my feelings" and "I am able to describe my feelings easily." The authors own research (Jaeger, Cardello, & Schutz, 2013) reported difficulties of some respondents describing their emotional reactions to products using emotion questionnaires. Another approach to ability/difficulty of describing

emotions comes from research on how much people trust their feelings, with some research showing more positive respones in people with more trust. In their qualitative research on New Zealand consumers, Jaeger et al. (2013) report that consumers found the EsSense Profile "was an easy and even fun process for some participants," "was intuitive," and "did not require much thought, either because it was easy for participants to decide how they felt and/or that they responded based on their gut feeling." However, the connection between the emotions listed and the foods consumed was not clear to all, and some emotion terms seemed too similar, making the overall 39-item questionnaire too long, and making the overall task "odd/weird/unusual" for some respondents. This negative response to emotion ratings (vs checklists) was also found by King and Jaeger (2014), but not by King et al. (2013) for scaled and checklist data or by Piqueras-Fiszman and Jaeger (2015) with check-all-that-apply emotion data. Jaeger and Cardello conclude that this type of consumer-centric research needs to be repeated with other consumers using other questionnaire methods and other data-collection techniques. For the time being, it appears that emotion rating questionnaires provide more detailed data but might also provide negative complications for some consumer respondents. Up to the present time, too much of the methodological research has been done on the EsSense Profile, probably because of its popularity for (food) product testing. As consumer product testing continues and expands, more methodological testing will add to this database of best practices.

3 Studying emotions in practice

Overall, this volume on Emotion Measurement presents a more positive approach to emotions in general, or perhaps it is a more balanced approach than the approach traditionally seen in emotions. This traditional approach is typified by the *Handbook of Emotions* with its many chapters on negative emotions and only one or two chapters on positive emotions, which are labeled "Positive Emotions" to distinguish them from the rest of the volume. This is a correct representation of where the field was for many decades. That changed with the growth of Positive Psychology, and the growing application of emotion measurement to consumer products such as food (see chapter: Emotions Elicited by Foods by Silvia King) and beverages (see chapter: Emotion in Beverages by van Zyl) and personal and home care products (see chapter: Emotions of Odors and Personal and Home Care Products by Porcherot-Lassallette et al.). Chapter "Emotions in Clinical Practice" also emphasizes positive emotions such as empathy.

3.1 Clinical practice

Ulrich Kramer (see chapter: Emotions in Clinical Practice) brings us to an important area of emotion research, the field of clinical treatment and research. Anyone interested in emotion measurement has observed the major role played by clinical psychology and psychiatry in the development of the field of emotions and the development of methods to measure emotions. Kramer emphasizes the importance of emotions

in clinical practice, stating "In clinical practice, when treating patients presenting with psychological (or medical) problems, emotions are central. There is hardly any therapeutic approach which does not give explanations for emotional phenomena…."

Kramer presents clinical tools developed by clinical researchers and practitioners working with emotions in psychotherapy, and then reviews categories of instruments used by clinicians for assessing emotion: self-report questionnaires, observer-rated methods, and physiological methods. In an approach that is different from commercial applications of emotion in this volume, Kramer notes that the choice of emotion assessment depends on the theoretical view of the professional concerning emotions, the aim of the assessment, and practical considerations such as time and cost.

Kramer points out that the emotion in the clinical setting results from emotions related to the interaction between therapist and patient, and emotions resulting from the situation that brought the patient to the therapist. Furthermore, the emotions on display in the clinical setting help to guide the course of therapy. All of this demands an assessment of the emotions presented, but Kramer notes the relative lack of specification of emotional assessment in severe mental disorder. Kramer adds the possibility that clinical patients might report only superficial emotions, or might have problems expressing their emotions. Kramer goes on to point out the problems of self-report measures as stressed by others in this volume and concludes that "the sole use of self-report questionnaires for assessing emotion in clinical practice is inherently limited." This brings us to a similar question we see in other chapters in this volume, what is the best method to measure emotion in general and in the context of specific issues addressed within each chapter?

The appropriate behavior of the therapist according to Kramer is to assume an empathic stance, meaning that the clinician works from within the patient's emotional experience. In this way empathy becomes both an intervention tool and an assessment tool. This empathic approach began in client-centered therapy, and according to Kramer, spread to other forms of clinical practice. Kramer goes on to distinguish seven different clinical interventions involving empathy: (1) empathic understanding; (2) empathic following; (3) empathic affirmation; (4) empathic evocation; (5) empathic exploration; (6) empathic conjecture; and (7) empathic refocusing.

Kramer lays out the different structures of emotions in clinical practice: the primary, secondary, and instrumental emotions. Primary emotions are the immediate reactions to external events and are the emotions that most nonclinicians consider to be emotions. They can be further divided into adaptive and maladaptive emotions. Primary maladaptive emotions were adaptive at an earlier phase of the person's life, but are no longer adaptive. Secondary emotions occur after primary reactions, and can have a social context and influence. And instrumental emotions have an interpersonal component to the expression of a particular emotion.

Finally, Kramer presents a large number of methods to capture emotions in the clinical setting. The reader is referred to chapter "Emotions in Clinical Practice" by Kramer, and to the references for each method. Some of these methods we will see elsewhere in this book, and some methods are unique to the clinical setting. Some methods are self-report methods, and again, due to Kramer's skepticism about the validity of self-report, some methods are physiological or observer report.

3.2 Context

John Edwards, Heather Hartwell, and Agnes Giboreau begin their chapter (see chapter: Emotions Studied in Context: The Role of the Eating Environment) on emotions in the eating environment with a brief discussion of the terminology of contextual research, which is helpful because other authors in this book address the issue of context, especially the product chapters (odorous products, food, beverages), but other chapters as well. They begin with a standard, very broad, dictionary definition: "The surroundings or conditions in which a person, animal, or plant lives or operates." (Oxford English Dictionary, 2015). Some authors prefer the more specific *social* and *physical environments*, while others prefer "*soft* environment and the *built* or *concrete* environment" and "*tangible* and *intangible* environment." And finally, there is growth in the various terms ending in "-*scapes,*" such as "*foodscapes.*" Other more traditional words include *ambience, atmosphere*, and the more general *environment*. In defining environments researchers sometimes characterize their environments as real(istic) or typical, the term to be used by the authors "to represent research undertaken in a 'working setting' as opposed to a laboratory setting." For the reader interested in context, this discussion is important, because contextual research is described with many different terms, many of which appear to be making claims about their approximation to real life.

Edwards, Hartwell, and Giboreau go on to discuss meals, which are the context for most eating. Perhaps most importantly, they state that "there is really no uniform family meal pattern," especially when viewing the meal globally. And despite the popular press about the downward trend in family meals, "…it is unclear whether there is a demise in family meals or simply a changing family meal structure." So, two popular assumptions about eating context are challenged, concerning the structure of meals and the frequency of family meals. What is becoming clear is the growing list of benefits associated with family meals in the health of families. Edwards et al. discuss the frequency and timing of meals, both of which have changed markedly over the centuries, from a two meal per day pattern to a three meal per day pattern, and perhaps to a less fixed pattern evolving today. As with meals, the assumptions about snack frequency might be distorted. Defining snacks as "anything consumed between the three main meals," it cannot be concluded that in general snack frequency has increased, or has replaced meals. What is increasing in many countries is eating out of the home, which in some cases is replacing the home setting as the main context of meals.

There is a long history of contextual research on food acceptability, that is, how much food is liked in different surroundings, and "As a general rule, identical food items are rated differently in different environmental locations; the 'better' the dining facility, the higher the food acceptability ratings." Edwards et al. present the comparable studies for emotions in various typical environments (meaning nonlaboratory settings), including mid-scale to upscale restaurants in a Canadian theme park, resort hotels, and a Norwegian winter park. In studies of service failures in restaurants, they note that the observation that "older consumers have more positive emotions after service recovery efforts than younger customers" fits in with the positivity bias observed in elderly emotions (see chapter: Studying Emotions in the Elderly by den Uijl and

Kremer). And the importance of empathy following service failures fits in with the role of empathy in clinical psychology (see chapter: Emotions in Clinical Practice by Kramer). Another important element of context or environment is appropriateness, originally discussed in the food literature with respect to food liking. Piqueras-Fiszman and Jaeger (2015) have applied appropriateness to emotions, showing more frequent and stronger positive emotions in more appropriate contexts.

Edwards et al. discuss the differences and advantages of laboratory research and research in typical environments, and refer back to Meiselman's call for the study of "real foods in real environments" (Meiselman, 1992). They also point out that just as there is no consensus on the balance of laboratory and typical research environments, there is no consensus on how to measure emotions in the laboratory and typical environments. Edwards et al. point out that most food emotion studies have focused on something less than a meal, often one food, and have often used subjects with eating disorders. They conclude that "Until relatively recently, no studies have sought to measure emotions in a typical environment where complete meals are consumed." Edwards et al. present a number of methods for studying emotions, including interviews, laddering and means-end chain analysis, and questionnaires (which are discussed in chapter: Measurement of Consumer Product Emotions Using Questionnaires by Cardello and Jaeger and in chapter: Emotions Elicited by Foods by King).

Finally, Edward, Hartwell, and Giboreau discuss the practical issues involved in studying emotions in typical eating environments. These include the choice of locations, and subjects, and involve practical issues such as the food being free or paid for. Edwards et al. present three case studies: (1) a large-scale questionnaire study of a university student cafeteria, (2) a questionnaire study of the color of a dining room, and (3) a smaller, more in-depth interview study of a student cafeteria.

3.3 Product design

Edwards, Hartwell, and Giboreau present the very broad area of context or environment, and Desmet, Fokkinga, Ozkaramanli, and Yoon discuss the very broad area of product design. They address the relationships between emotions and product design, noting that emotions come into play with "things and events that matter to us, which includes seeing, buying, using and owning consumer goods." Whereas many people look for simplistic connections between emotions and products, Desmet et al. emphasize the complex relationships between how people feel and their products, with different people feeling differently about the same product and feeling differently at different times and in different contexts. This leads to the subject of their chapter, "emotion-driven design," and its theory and method. The authors present six key conclusions from the growing empirically based "emotion knowledge." They argue that these conclusions operate over a range of situations, products, and consumers. The first three conclusions from emotion knowledge deal with what emotions are in the context of consumer products, and the last three conclusions address how these product emotions are aroused. I will review their conclusions, and then present three product emotion chapters dealing with odorous products, foods, and beverages.

The first conclusion is that positive product emotions are numerous and highly diverse. A larger number of positive emotions permits designers to work with the nuances among these different emotions. These different emotions have different effects on consumers, and understanding these different effects can be used to motivate consumer behavior. The large number of emotions and the different emotions associated with different products mean that emotions can contribute to distinguishing products. Product developers and designers can select an emotion for the product and for the product package.

The large number of positive emotions produces a greater degree of "emotional granularity," meaning emotion discrimination. Desmet et al. argue that increased emotion discrimination produces greater empathy toward understanding consumer emotions. It is interesting that both the clinical chapter in this book and the product design chapter both emphasize the role of emotion empathy. The existence of increased positive emotion granularity has led to the development of methods to better understand positive emotions, such as the "'Positive Emotional Granularity card set' (PEG cards) developed by Yoon, Desmet, and Pohlmeyer (2013). The set consists of 25 cards that incorporate definitions of emotions, eliciting conditions, and visuals of expressive behavioral manifestations."

The second conclusion or insight from Desmet et al. is that people often *enjoy experiencing negative emotions*. Desmet et al. note some of the situations in which negative emotions are sought after, such as difficult puzzles, sad movies, and rollercoaster rides. Desmet et al. argue that negative emotions could be brought into consumer products if designers better understood the appeal of some negative emotions, and the fact that negative emotions remain negative when consumers do not feel they can avoid the consequences that exist in real life. Negative emotions "provide an edginess and engagement to product experiences that can surpass that of positive emotions. Secondly, negative emotions are typically easier to evoke in high intensity than purely positive emotions…." Fokkinga and Desmet (2013) included, and even emphasized, negative emotions in their three-step process involving emotions and product design. The design system includes a database of 36 negative emotions. This process is quite different from the heavily positive emotion lists used in the chapters below for odorous products and food. In the chapter on beverages, van Zyl pays special attention to the use of negative emotions in beverage emotion profiling.

A third conclusion is that consumer emotions are nuanced and mixed. Desmet et al. make the important point that consumer product emotions are the same emotions as emotions experienced in response to life's events. However, product emotions are usually lower in intensity, and this can be noted in the product emotion data presented in the next few chapters. Strong emotions in response to products are possible, but are rare. Also, product emotions uually occur in combinations of several or many emotions, and these combinations of emotions occur over a time period, as noted in chapter "Short-term Time Structure of Food-Related Emotions: Measuring Dynamics of Responses" by Jager. These points are important when one is deciding what method to use to measure product emotions; the method must be able to handle many emotions, and emotions that are weak to moderate in intensity.

Desmet et al. emphasize that the complex nature of product emotions requires special methods to measure them, and especially requires methods with an adequate range of emotions. Traditional social science methods with small numbers of emotions might not be appropriate. They recommend pictorial methods, which are "easy to administer, are quick and require little effort from the respondent, enable the measurement of low-intensity emotions, can be used with a variety of respondent populations (including children and respondents with different languages), and enable an efficient integration of qualitative and quantitative research. Moreover, they can be administered in real-life situations, and analyzing resulting data does not require specialist knowledge or equipment." One pictorial self-report method is the Product Emotion Measurement Instrument (PrEmo; Desmet et al., 2000) with 14 emotions. PrEmo is different from standard questionnaires in that it is an animated character which shows animated movement and sound. Respondents rate seven positive emotions and seven negative emotions on a 5-point scale of intensity. Interestingly, this is one of the few self-report methods that contain equal numbers of positive and negative emotions; the PANAS does also. Researchers need to balance two opposing questions: should the emotion list have more positive emotions because of the positive emotion bias seen in most consumer responses, or should the emotion lists balance positive and negative emotions in order not to bias or lead the consumer, and to provide an equal opportunity to respond with both valences?

Desmet, Fokkinga, Ozkaramanli, and Yoon move from focusing on reactions to products to focusing on what causes emotions, emphasizing that emotions highlight what people care about. Desmet et al. emphasize that emotions serve as an entry point to gain insights on consumer wants and needs. Jaeger and Cardello discuss, in their chapter, some of the problems in consumers using emotions to express their feelings. Thus, Desmet et al. make understanding emotions an important part of the design process, because they can serve as an entry to other important consumer feelings. They point out the Emotion Capture Card (ECC) method from Ozkaramanli et al. (2013), which probes consumers on the concerns underlying their emotions. And they emphasize the need to study emotions in context (as addressed by Edwards et al. in chapter: Emotions Studied in Context: The Role of the Eating Environment).

The fifth insight noted by Desmet et al. is the conflict arising from choice. The choice and consumption of products involve choices and sometimes conflict; for example, which dessert to choose (or not choose), which car to choose, etc. These choices sometimes present both positive and negative emotions to the individual making the choice, and Desmet et al. suggest using these different emotions to design different product solutions to the choice.

The sixth insight concerns context, but not in the same use as seen elsewhere in this book, namely the context of product consumption. Desmet et al. refer to the context that arises from product consumption; that is, the product might lead to other activities, and they evoke emotions. Desmet et al. point out that a (narrow) product-focused view of emotions and products might miss some important relationships for emotions, because they recommend a "more holistic than a traditional product-focused view." And they include the negative emotions in this thinking, suggesting that one can reduce negative emotions as part of product design, as well as increase positive emotions.

3.4 Product emotions

The chapter on product design (see chapter: Emotion-Driven Product Design) leads to a series of chapters which address consumer emotion responses to products, odorous products, foods, and beverages. This section begins with chapter "Emotions of Odors and Personal and Home Care Products" by Porcherot-Lassallette, Delplanque, Ferdenzi, Gaudreau, and Cayeux on odors of personal and home care products. Porcherot-Lassallette et al. begin their chapter with a thorough review of the role of odor in products, which they see as having a major role. They note that the pleasantness or valence of products and their odors affect mood, with pleasant odors associated with positive moods, and unpleasant odors associated with negative moods. Furthermore, they point out that odors can induce relaxation or excitation, both behaviorally and physiologically. Porcherot-Lassallette et al. describe the pharmacological and psychological mechanisms which have been put forward for the role of olfaction on emotion. The former are assumed to exert a direct effect on the body, while the latter are assumed to operate through experience and learning. The evidence at this point favors a psychological mechanism, based on the association of emotions to odors.

Porcherot-Lassallette et al. discuss what is measured in their studies of product-related emotions, and by inference, what other researchers study with other classes of products. Beginning with a definition of emotion, Porcherot-Lassallette et al. note that various measures of conscious and unconscious emotion responses cover different aspects of the emotion definition, including physiological indices, action tendencies, motor responses, cognitive tests, and feelings. They caution, however, whether true emotions are elicited, and prefer the term "potential emotions" for feelings measured with questionnaires, which need to be confirmed with other measures including behavioral and physiological. Therefore, they prefer to call the affect elicited in verbal reports to be feelings, rather than emotions. The reader interested in the definition of emotion and the distinction of feelings and emotions is referred to their discussion, and also the related discussion by Thomson (see chapter: Conceptual Profiling).

Porcherot-Lassallette et al. list current product emotion questionnaires, for both food and nonfood (personal and home-care) products, and then review the development of the Geneva Emotion and Odor Scale (GEOS, Chrea et al., 2009). As with most questionnaires, the GEOS began with a long list of 480 emotion terms obtained from the literature. Porcherot-Lassallette et al. discuss the translation issue in collecting the emotion terms. The challenges of language translation with emotion terms is discussed by Ogarkova in chapter "Translatability of Emotions." The model resulting from their work was named GEOS and has six emotional categories (see Chrea et al., 2009, for more details). The scale has five positive emotional categories and only one negative category. The importance of the positive emotions was observed earlier in a food context by Desmet and Schifferstein (2008), who found that, in general, consumers have positive predispositions toward past food experiences. It was also underlined by Gmuer, Guth, Runte, and Siegrist (2015), who found that up to 70% of the food-associated emotional terms were positive from a systematic, linguistic-based approach.

A cross-cultural approach applying the same procedure in six cultures showed that five emotional categories were commonly obtained in all cultures: (1) Happiness/Delight, (2) Sensuality/Desire, (3) Energy, (4) Soothing/Peacefulness, and (5) Unpleasant feelings. Four emotional categories were more culture-specific: (1) Hunger/Thirst (United Kingdom, United States, Brazil), (2) Interest/Amusement (China, Singapore), (3) Nostalgia (United Kingdom, Brazil, China, Singapore), and (4) Spirituality (Singapore). Porcherot-Lassallette et al. note that geographic proximity appeared to underlie the closeness of feelings; the closer the countries, the more similar the feelings from odors.

In further pursuit of a global scale, Porcherot-Lassallette et al. selected the three most representative terms from each of the nine categories noted above, except for the two terms from spirituality. This yielded 25 terms; 10 of them were consistently selected by the 6 cultures (ie, relaxed, happy, disgusted, irritated, unpleasantly surprised, sensual, romantic, desire, energetic, and refreshed); 4 additional terms were used by at least 5 cultures; and 3, from culture-specific emotional categories, were used by only 1 culture (ie, impressed, melancholic, and spiritual feeling). These selections produced the UniGEOS scale (Ferdenzi et al., 2013) in four languages (English, French, Portuguese, and Chinese), grouped into nine emotional categories.

Porcherot-Lassallette et al. describe how odors and emotions influence behavior, using the model proposed by Stevenson (2010), (1) ingestion, (2) avoiding environmental hazards, and (3) social communication, and they try to locate the emotional categories of UniGEOS within these functions of human olfaction. The authors conclude that the representation of feelings by UniGEOS outperforms the more standard representation of feelings in a valence by arousal space.

Porcherot-Lassallette et al. present different approaches for measuring odor-related feelings in sensory testing, of products or odors. They review experience using a shorter version of GEOS/UniGEOS, called ScentMove, that uses just six scales of three terms rather than 36 different scales under GEOS. The UniGEOS version uses nine scales. They also discuss the use of the check-all-that-apply method as compared with the scaling approach used in GEOS. Porcherot-Lassallette et al. note that laboratory settings for emotion testing may overestimate differences among products, and recommend in-home testing as well as more controlled laboratory testing or CLT (see chapter: Emotions Studied in Context: The Role of the Eating Environment), and the chapters on foods (see chapter: Emotions Elicited by Foods) and beverages (see chapter: Emotion in Beverages). Furthermore, in the home setting they evaluated a product at different points of product use, beginning with opening the product to evaluations following product use. This is an example of temporal testing which is receiving more attention in both basic and applied emotion research (see chapter: Short-term Time Structure of Food-Related Emotions: Measuring Dynamics of Responses).

Porcherot-Lassallette et al. continue with a discussion of expectations of emotions, noting that how the consumer reacts to a product is a function of both the expectations and attitudes leading to the product, and the feelings elicited by the product itself. They include in this discussion the perspective of Thomson on emotional conceptualizations (see chapter: Conceptual Profiling).

Silvia King begins chapter "Emotions Elicited by Foods" with a broad view of food and emotion, including the whole food experience viewed at the different stages of food choice, food purchase, food preparation, consumption, and even postconsumption. This is rather different to the traditional view of emotions as a response to an event; with food, and with odorous products above, we have a series of events taking place over hours, days, and weeks, and each with a different set of emotions.

King begins with studies of emotions at the stage of food purchase, emphasizing that such studies must address the food itself and the packaging if present. In fact, the package often contains the emotion message that the manufacturer wants to pass on to the consumer. In several references, Thomson and colleagues have emphasized the importance of packaging emotions (Thomson, 2015; also see chapter: Conceptual Profiling).

In the next phase of food preparation, there is a potential range from minimum food involvement all the way to intense food involvement. King references unpublished work from McCormick and Co., Inc. when consumers in their own homes tested products with the same flavor, but varying in level of preparation. Results showed that the consumers' level of interaction with the food (high, medium, low) affected results. Low-interaction consumers felt more calm and less worried, while high-interaction consumers felt more adventurous and excited, and moderate-interaction consumers felt more comforted, relaxed, and satisfied. With food, and perhaps with other consumer products, consideration of product emotions begins well before product consumption, and earlier stages of product–consumer interaction might be critical in predicting emotion effects.

King moves on beyond food selection, purchase, and preparation to food consumption, which has received the most attention according to King. King describes two of the different types of consumer tests for sensory, hedonic, and emotional testing, the CLT and the home use test (HUT). King notes that CLT involves small portions of the food, while HUT involves full portions combined with other parts of meals or snacks. This is an example of contextual effects when testing consumer products, a topic addressed more broadly in chapter "Conceptual Profiling," but also addressed in several other product emotion chapters (eg, see chapter: Emotion in Beverages). King describes test results comparing emotion data from CLT and HUT using the EsSense Profile of 39 emotion terms specifically designed for food testing (King & Meiselman, 2010). The emotion response was higher in the home test than in the CLT during food consumption, with 20 emotions (out of the 39) showing stronger response during food consumption.

Finally, King addresses the postconsumption phase, noting that this has received less attention in the commercial world. But this is the time period that has received a lot of attention in the health field, where many have studied the impact of consumption on feelings/emotions after eating, namely guilt for restrained eaters (see Macht, 2008, for a review). The reader is also referred to chapter "Short-term Time Structure of Food-Related Emotions: Measuring Dynamics of Responses" on temporal aspects of emotions by Jager. At the moment, most commercial research examines emotions at the time of product consumption (for food and beverages) or product application (for personal care and home care products); this will probably change in the future as we take a broader look at product emotions before, during, and after consumption.

Just as King presents the different stages of involvement with food, she also discusses the different forms of the food, from the name only, to the food category, the product itself, and the brand. While food product might be studied most frequently for emotions, the others are studied also. Product names are studied when internet testing is used; the consumer sees only a food name, and perhaps a picture. A food name involves "the consumer's memory of the food, past experience and/or expected experience with the food." Cardello et al. (2012) have reported that the intensity of emotions is stronger in response to food names compared to actual food products. King points out that "Products within a category may elicit different emotional responses. Understanding the emotional landscape of a product category can be used to identify new product opportunities or points of differentiation between brands as well as guide product development to formulate products that fit consumers' expectations of the product." King emphasizes the important role of emotion testing for products including product improvements, cost optimization, and ingredient changes. And King notes that the published literature on many of these studies is limited because of the proprietary value of the results.

And finally, King considers the branded product situation, noting the recent interest in comparing branded and unbranded products. She cautions, however, that "products with strong brand loyalty are quickly recognized by their consumers, either based on packaging, shape, flavor etc." Therefore, studying unbranded products can be difficult, if the unbranded product is recognized by product users.

King makes some interesting points about the role of negative emotions in (food) product testing. The EsSense Profile questionnaire (King & Meiselman, 2010) has mainly positive emotion terms. King notes that negative emotions have a limited role in traditional product–consumer testing where they receive very low average scores. But, she notes that more negative emotions can be studied when the products are very new and vary from the current market products. Both King on foods and van Zyl on beverages note the possible value of studying negative emotions, for example, in the instances where negative emotions decline under some conditions or formulations.

The chapter on Emotion in Beverages by van Zyl (see chapter: Emotion in Beverages) places beverage emotions into the multifactor model of product, person, and context including preceding events. The chapter begins with one of the best examples of emotion and products anywhere, the custom of tea drinking in Britain, and its comforting and refreshing associations. Van Zyl summarizes the role of emotion measurement in product development by noting that companies not only want products which please the consumer but which fit an image which should be consistently presented in their advertising and packaging, as well is in the attributes of the product. This point is emphasized by Thomson and Crocker (2015) in their approach to product, packaging, brand, and advertising. Thomson was one of the first to emphasize that emotions had to be considered along with hedonic and functional aspects of products.

Van Zyl emphasizes that negative emotions are important also, even though the (main) goal of a product might be to increase positive emotions such as relaxation or calmness. Beverages are also expected to reduce negative emotions. Van Zyl and Meiselman (2015) demonstrated this in an eight-country study in which one of the

questions was whether "their favourite beverage 'makes me feel less like that?'" Van Zyl calls for the use of before–after comparisons of emotions as one way of seeing these changes. Many products are evaluated only after consumption or sampling, making the identification of these changes more difficult. Van Zyl also recommends the use of TDE methods (see chapter: Short-term Time Structure of Food-Related Emotions: Measuring Dynamics of Responses by Jager) to simultaneously measure positive and negative emotions, although she points out that the number of emotions studied must be smaller.

Cultural influences on beverage emotions are also noted in this chapter; the reader is referred to Chapters 23, 24, 25 for more treatment of cross-cultural research including language. Van Zyl reports results of cross-cultural research on emotional reactions to one's favorite beverage, showing that respondents from Spain showed less emotional involvement with beverages than respondents from several English-speaking countries and Mexico. When the study was repeated in Portugal and Brazil, respondents from Portugal showed a similar response as those from Spain only for wine, but for beer and spirits their response was similar to those of respondents from Brazil and Mexico. Van Zyl suggests that these country/cultural differences can contribute to the development of emotion questionnaires; for example, Ferrarini et al. (2010) found a smaller number of wine emotions in Italy than those typically found in cultures outside southern Europe, where wine might play a different role in the emotional lives of people.

Context is another variable which is considered by van Zyl with respect to beverages, and for good reason, because as she points out, "Many of the situations in which beverages are consumed are social occasions. Apart from the beverage itself, the company, the location and the reason for the consumption may all have an effect on the emotions of consumers."

Van Zyl closes her treatment of emotions in beverages with a discussion of the choice of methods with which to study beverage emotions. She distinguishes the needs of academic research (where she suggests that larger differences might be involved) from commercial research (where small product differences are often being compared). During the early stages of commercial product development, van Zyl suggests that "methods such as PrEmo, facial recognition of emotions or physiological methods might be relevant as a screening tool to separate several products into those which may have potential and those which are not suitable." In later stages of product development, there might be more interest in subtle differences in emotions, and whether the products conform to the product concept. These goals require detailed measurement of a larger number of emotions, and van Zyl mentions many of the commercial methods covered in other chapters of this volume. Van Zyl also considers both facial scaling and physiological methods for use in the study of beverage emotions. She notes that studying facial expression during drinking is difficult because of the drinking vessel in front of the face. And her own experience with studying beers with facial expression in a large UK sample showed no product differentiation. She suggests that facial measurement might be useful in product screening, where one tests a large number of product samples with large differences in attributes and in liking. When product differences are very small, she suggests that facial scaling might

not be applicable. Van Zyl also reports limited success with studying physiological responses with beverages, again, especially when product differences are small.

Van Zyl presents recommendations for designing emotion questionnaires for beverages, noting that "The words used have to make sense to the respondents who will be using the lists." This recalls the observations of Jaeger and Cardello (see chapter: Methodological Issues in Consumer Product Emotion Research Using Questionnaires), that some respodnents could not make sense of emotion lists used in product research. Van Zyl discusses different emotion lists for different beverages; there is some tendency in the field of commercial emotion questionnaires to use the same standard list for every different product, even when the products differ, although Spinelli et al. (2014) have shown a product category-specific method, called EmoSemio. Van Zyl also identifies another general issue with lists of emotions for questionnaires—some of the terms listed are not emotions. Van Zyl makes it clear that the task of designing an emotion list for a specific product category can be time-consuming, usually involving a series of qualitative and quantitative studies. Van Zyl argues that the effort is probably worth it when the development of an emotion list is followed by a long series of product studies. An alternative approach would be to use an existing list from the same or similar product category.

3.5 Happiness and disgust

The next two chapters involve two of the most commonly studied emotions, one positive and one negative, happiness and disgust. These appear on most lists of emotions, most theories of emotions, and most questionnaires of emotions. In fact, a number of separate questionnaires have been developed specifically aimed at these two emotions.

Jaime Kurtz and Cheryl Welch (see chapter: The Emotion of Happiness) introduce the emotion of happiness, noting its emergence in the 1990s with the growth of positive psychology. Kurtz and Welch describe measures of happiness, which they equate with subjective well-being, based on the idea that happiness is subjective (If you say you are happy, you are happy). Happiness contains both cognitive (satisfaction with life) and affective (frequent positive emotions) components, and shows high stability within individuals. The reader interested in happiness is also referred to chapter "Different Ways of Measuring Emotions Cross-Culturally" by Chenstova-Dutton and Lyons, who cover cross-cultural research on happiness, and how happiness is viewed differently in different cultures.

Kurtz and Welch review measures of happiness, including momentary responses including one-item mood scales, the PANAS (Watson et al., 1988), or the Visual Analogue Mood Scale (VAMS; Van Rijsbergen, Bockting, Berking, Koeter, & Schene, 2012). Other measures are used for longer time periods, including the Experience Sampling Method (ESM; Csikszentmihalyi, Larson, & Prescott, 1977; Wirtz, Kruger, Napa Scollon, & Diener, 2003), and the Day Reconstruction Method (DRM; Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004).

Some measures are recommended for both momentary happiness measurement and for longer happiness state measures, including: the VAMS already noted above, and the newer VAMS-R (Kontou, Thomas, & Lincoln, 2012) with better psychometrics;

also the PANAS, or Positive Affect and Negative Affect Schedule (Watson et al., 1988) also noted above, and the newer PANAS-t (Gonçalves, Benevenuto, & Cha, 2013) for use on Twitter posts. Kurtz and Welch also include the FACS that was introduced in this book by Hwang and Matsumoto, and referred to in several chapters.

Kurtz and Welch describe global measures of happiness/subjective well-being, including some single-item measures: "Taken all things together, how would you say things are these days?" (Campbell, Converse, & Rodgers, 1976), and "How dissatisfied or satisfied are you with your life overall?" (Angrave & Charlwood, 2015). A popular approach has been to measure life satisfaction, including the five-item Satisfaction With Life Scale (SWLS) rated on a 7-point agree–disagree scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985). SWLS results is positively correlated with income, and negatively correlated with anxiety, depression, and cell phone usage! And, finally, we get to some happiness scales, including the four-item Subjective Happiness Scale (SHS; Lyubomirsky & Lepper, 1999), in which the responses contain levels of happiness. Higher scores on SHS correlate with positive outcomes. Kurtz and Welch conclude that these simple measures outlined above are fast and easy but are subject to several response biases, a point we have noted in several other chapters on self-report measures.

The answer might be two other methods including experience sampling (ES) over time (ESM, Csikszentmihalyi et al., 1977), more recently collected with electronic hardware and most recently with smartphones. The method provides very detailed data, but can be seen as burdensome and expensive because it depends on multiple samplings per day. The other method is the DRM (Kahneman et al., 2004) which takes about 1 hour to conduct, which is still long for some testing situations. It focuses on the previous day and provides similar data to ESM.

In the future, Kurtz and Welch see more biologically based measurement of happiness, and more natural, nonlaboratory research because of developing technology. Thus we see in the measurement of happiness some of the trends that we see in other chapters in this book.

Megan Viar-Paxton and Bunmi Olatunji begin chapter "Measurement of Disgust Proneness" on disgust proneness with the recent history of disgust research, tracing the shift in thinking of disgust from a defensive mechanism aimed at curtailing eating unsafe things, to a broader disease avoidance and protective function involving more than food items. Disgust varies in individuals, but is thought to exist to some degree in everyone. Extreme disgust results from a low threshold of what is disgusting or a heightened response to anything disgusting—either cause of extreme disgust can tie into psychopathology. Viar-Paxton and Olatunji relate individual differences in disgust to a range of personal and social phenomena: cultural perceptions of personal attractiveness, predicting mate preferences, behavioral shifts during pregnancy, political and religious ideology, and choice of profession.

Viar-Paxton and Olatunji describe the influence of disgust on consumer decision-making, related to the product design and development chapters in this book. They report research showing that simply stating that a piece of clothing had been previously worn by another led to lower product ratings, and simply touching a respondent while shopping also led to a lower product rating. Beyond the interpersonal causes

of disgust, it can also be shown that when a desirable product touches an undesirable product, the contamination reduces the desirability of the item. This recalls some of Rozin's classical work on contamination through touching, even when no direct threat can be seen from the contact.

Viar-Paxton and Olatunji present different self-report measures of disgust, noting that the measures differ in how they conceptualize disgust, and how they measure it. They first present the Disgust Scale (DS), which probably reflected the shift from a strictly food orientation for disgust to a broader orientation (Haidt, McCauley, & Rozin, 1994). The DS contains 32 items, with 16 true–false items, and 16 items on a 3-point scale. The DS covers eight domains, including but not all limited to food: (1) Food, (2) Animals, (3) Body Products, (4) Body Envelope Violations, (5) Death, (6) Sex, (7) Hygiene, and (8) Sympathetic Magic. Unfortunately, the subscales have low to moderate reliability, and the 3-point narrow response scale might limit responses. The DS is available in a number of European and Asian languages. The Disgust Scale-Revised (DS-R, Olatunji, Cisler, Deacon, Connolly, & Lohr, 2007) was designed to address these problems, by removing seven items yielding a three-factor model (Core Disgust, Animal-Reminder Disgust, and Contamination-based Disgust) and increasing the response scale to five points.

The Disgust Emotion Scale (DES; Walls & Kleinknecht, 1996) has 30 items addressing five domains of six items each (animals, injections and blood draws, mutilation and death, rotting foods, and smells), and also uses a 5-point response scale (from 0—no disgust or repugnance to 4—extreme disgust or repugnance). The DES relies on responses to specific stimuli for disgust (urine, vomit, etc.) and therefore also correlates well with psychopathology measures, just like the DS.

The Disgust Propensity and Sensitivity Scale (DPSS, Cavanagh & Davey, 2000) refers to the "extent to which disgust is experienced" (propensity) and the "extent to which… disgust is experienced as dangerous" (sensitivity). The DPSS contains 32 items, with 16 items for propensity and 16 items for sensitivity. It is not clear whether these two factors are independent, but the two factors might aid in interpreting disgust, as the ease with which disgust is experienced (propensity) might be different to how negatively they experience disgust (sensitivity).

We have seen with other emotion questionnaires in this book that there is a tendency to reduce the length of longer emotion lists. Thus, the DPSS was reduced to form the 16-item DPSS-R (Van Overveld, De Jong, Peters, Cavanagh, & Davey, 2006), still supporting a two-factor model, but with questions about how items loaded onto factors. Interestingly, the possibility is raised that cross-cultural differences contributed to different results on the DPSS-R, as discussed in the cross-cultural chapters later in this book. The DPSS-R was further reduced to form the 12-item DPSS-12 (Fergus & Valentiner, 2009), with better psychometrics, and still supporting a two-factor model of disgust propensity and disgust sensitivity. Further work has produced a 10-item scale, and has also called for consideration of a third factor, called "self-focused/ruminative disgust." Interestingly Viar-Paxton and Olatunji note that while the 10- and 12-item versions of the DPSS have better psychometrics, the 16-item version continues to be the most widely used. This raises the interesting general question of whether the most frequently used version of a questionnaire, or most

frequently used questionnaire overall, is the best instrument. There appears to be a conservative approach to retaining older measures, and resisting newer measures even when the evidence would support a change. This issue was also discussed in chapter "Measurement of Affective Responses to Exercise: From 'Affectless Arousal' to 'The Most Well-Characterized' Relationship Between the Body and Affect" on exercise by Ekkekais and Zenko. This issue could also be related to institutional and commercial long-term use of measures, and the collection of longitudinal sets of data using the same measure.

The Three Domains of Disgust Scale (TDDS; Tybur, Lieberman, & Griskevicius, 2009) is a 21-item self-report measure across three domains: "*moral* disgust (eg, deceiving a friend), *sexual* disgust (eg, hearing two strangers having sex), and *pathogen* disgust (eg, stepping on dog poop)." The TDDS uses a 7-point Likert scale from 0 = not at all disgusting to 6 = extremely disgusting. Follow-up research has raised questions about the generality and stability of the three domains.

The Child Disgust Scale (CDS) was developed to assess disgust as a predictor of anxiety in children. The CDS (Viar-Paxton et al., 2015) is a 14-item scale, with two factors: Disgust Affect (ie, the emotional experience of disgust) and Disgust Avoidance (ie, behavior towards disgusting stimuli) as well as a general disgust score. The response scale is a 3-point temporal scale (Always, Sometimes, Never). Research on this new scale is on-going.

Viar-Paxton and Olatunji argue that "exclusive reliance on self-report measures of disgust can be limiting," and recommend "that a combination of self-report measures and behavioral tasks can facilitate a more comprehensive assessment of disgust." Viar-Paxton and Olatunji present several examples of behavioral measurement of disgust from the clinical situations of treating various phobias (for insects, for blood, etc.). Viar-Paxton and Olatunji also include the assessment of disgust using facial coding, specifically the FACS, previously presented in this book by Hwang and Matsumoto (see chapter: Measuring Emotions in the Face). Viar-Paxton and Olatunji discuss whether the specific elicitor of disgust needs to be considered in the assessment of what the proper facial expression of disgust might be. While the proponents of facial measurement argue for its universality (as one of its key attributes), Viar-Paxton and Olatunji used data from children to suggest that the recognition of facial expression might be learned, not innate, and that issues in child measurement might limit its applicability. Throughout this book we have seen that for almost every measure of emotion there are proponents and opponents; that is the frustration of Emotion Measurement, but also the opportunity to continue to research this area. We have also seen a general apprehension about self-report measures.

Viar-Paxton and Olatunji discuss measurement issues; while this discussion is aimed at the measurement of disgust, many of the issues could be applied to the measurement of other emotions, or even all emotions. Some of these issues are discussed elsewhere in the book, particularly in the chapters by Cardello and Jaeger (see chapter: Measurement of Consumer Product Emotions Using Questionnaires), and by Jaeger and Cardello (see chapter: Methodological Issues in Consumer Product Emotion Research Using Questionnaires). The first issue discussed is the response scale; most are ordinal scales, but are treated as interval scales. This is a general issue

in much consumer research, and probably in much clinical research as well. Another issue raised is the fact that the same items/situations are used as stimuli to elicit disgust, and also used to describe the domains of disgust, leading to higher correlations between the two.

Viar-Paxton and Olatunji note that (limited) research shows agreement between cultures globally, and major variability within a culture. They warn against including behaviors for study that show large cultural-specificity (such as eating insects). And, interestingly, they note that disgust itself might be defined differently in different cultures. The topic of cross-cultural emotion measurement is addressed in chapters by Chentsova-Dutton (see chapter: Different Ways of Measuring Emotions Cross-Culturally) and Ishii (see chapter: Measuring and Understanding Emotions in East Asia), and the topic of translation is addressed by Ogarkova (see chapter: Translatability of Emotions). Viar-Paxton and Olatunji note the high percentage of disgust research on Caucasian people, and the very few comparisons of Caucasians with other races. While everyone might experience disgust, there probably are important cross-cultural differences in how disgust is conceived and how to measure it. Finally, there is little agreement on the number of disgust domains, and how disgust is conceptualized might differ in consumer research versus clinical research.

3.6 Elderly

Most chapters in this book deal with the measurement of emotions in healthy adults, but one chapter addresses the measurement of emotions in the fastest-growing segment of the population, the elderly, and also the very elderly. The latter group, the very elderly, are not the typical focus of research, because of the difficulty in studying them and the fact that commercial research is more interested in the potential purchases of younger people. Stefanie Kremer and Louise den Uijl begin their chapter on emotions in the elderly with statistics on the projected increase in the number of elderly, and the projected increase in the age of the elderly. Kremer and den Uijl note that "Human ageing comes with various physiological and psychological changes, which in turn impact to various extents on older persons' emotional experiences, emotion regulation, emotion perception, and/or emotion-related attention and memory." Interestingly, there is no agreed-upon definition of elderly, so Kremer and den Uijl consider all studies of persons over age 55, noting and documenting that elderly over age 80 and frail elderly are both understudied.

While noting the cognitive, sensory, and other declines in the elderly Kremer and den Uijl note that a key element of the elderly group is their heterogeneity, both physiologically and psychologically. They report a study in which elderly were segmented based on the different emotions they associate with mealtimes, yielding four segments labeled "*Pleasurable averages, Adventurous arousals, Convivial indulgers*, and *Indifferent restrictives*." Concerning sensory declines, Kremer and den Uijl pay special attention to the olfactory sense, which is also treated by other chapters in this book (especially the chapters by Rouby and Bensafi and by Porcherot-Lassallette et al.).

Kremer and den Uijl review a number of theories on how people age emotionally, but they find very different theoretical views presented, especially in view of the large diversity within the emotional aging process. Kremer and den Uijl discuss the differences between the elderly and younger people concerning the experience of emotions, the regulation and control of emotions, the recognition of emotions in others, and emotion-related memory. The elderly demonstrate a positivity bias, with both higher positive affect and lower negative affect. The elderly also differ in emotion regulation, exhibiting greater emotional control for both negative and positive stimuli. This is reflected in less physiological response. The elderly also demonstrate less ability to recognize emotions in others, especially for negative stimuli, perhaps as part of the general positivity bias noted above. This bias may also account for the tendency of elderly to remember positive emotional stimuli better than negative ones. Kremer and den Uijl note that these studies do not always make clear whether the elderly being studied are comparable to the younger people in their sensory and other functions.

So what is the overall assessment of emotional functioning in the elderly. Kremer and den Uijl warn that most of the studies deal with elderly ages 55–75, with very few above age 80; so we still do not know what happens in the very elderly—a population which is projected to increase by a large percentage. They conclude that "The experience of emotions and the ability to regulate emotions seem to be preserved and may sometimes even improve with increasing age. In contrast, abilities related to emotion perception seem to deteriorate, as does the ability to remember (negative) emotional information." Despite these changes and challenges, the elderly tend to report high emotional well-being.

Kremer and den Uijl document the application of various emotion questionnaires to the elderly, noting that there is relatively little published data on the elderly. Their own study recently used the shortened EsSense25 (Nestrud et al., 2015) containing 25 emotions. In this study, 84 older normosmic persons (ie, with a normal sense of smell; 65+ years old), 70 older hyposmic persons (ie, with an impaired sense of smell; 65+ years old), and 80 younger adults (18–45 years old) tasted snack products (gingerbread and chocolate). The elderly differed from the adults on the specific emotions and valence of those emotions, and showed lower scores on some negative emotions.

Kremer and den Uijl also present research using the PrEmo (Desmet et al., 2000), which uses an animated cartoon character to express an emotion for approximately 1 second, with both movement and sound (see chapter: Emotion-driven Product Design by Desmet et al.). They present a study of walking frames, where the positive emotions did not distinguish products, but the negative emotions did. In their own research Kremer and den Uijl used PrEmo2 (Laurans & Desmet, 2012) studying emotions in response to snacks. They found that the elderly again differed in emotion intensity. Kremer and den Uijl report some cognitive processing problems by the elderly in using PrEmo.

Kremer and den Uijl also report a study using the Affect grid (Russell, Weiss, & Mendelsohn, 1989) where participants are instructed to tick the box in a 3×3 matrix of valence and arousal that best corresponds to their current feelings. Den Uijl, Jager, de Graaf, Waddell, and Kremer (2014) again found effects of valence but not arousal. The PANAS (Watson et al., 1988) questionnaire was used in studies. Grühn, Kotter-Grühn, and Röcke (2010) applied the extended version of the questionnaire, the PANAS-X, in a senior population, and found reduced negative affect and increased positive affect.

Kremer and den Uijl discuss the possible use of a "tailored emotion lexicon" for testing of the very elderly or frail elderly, and den Uijl et al. (2014) has recently reported a 15-item emotion lexicon for eating based on elderly responses in a free sorting task conducted on-line starting with the EsSense Profile. Kremer and den Uijl also advise that the special needs of the elderly need to be considered when designing or administering questionnaires.

Researchers have sought physiological measures of emotion with the elderly, just as has been done with adults (see chapter: The Psychophysiology of Emotions on physiological measures), but to date no consistent results point to the elderly showing results different from adults based on which measures are taken, the context, and the themes involved in the research. Some studies have shown lower physiological responses for elderly, but others have shown the opposite. In one study trying to relate physiological responses to self-reports of emotion in adults and in elderly, Neiss, Leigland, Carlson, and Janowsky (2009) observed that they too correlated in adults but not in older participants. Results seem more consistent for facial expression measures, with the elderly showing increasing trouble recognizing facial expressions, especially negative ones like anger, fear, and sadness. This might be another reflection of the positivity bias noted above. Kremer and den Uijl present an interesting introduction to the related fields of "assistive domotics" and "healthcare" for elderly, both of which rely on assessing facial expressions as a measure of an individual's status.

Kremer and den Uijl present a detailed look at several measures of depression, one of the major mental health challenges of the elderly. Kremer and den Uijl close with a presentation of measures of well-being. These include the Psychological General Well-Being index (PGWB; Dupuy, 1984) and the SWLS (Diener, Emmons, et al., 1985). The PGWB consists of 22 questions in six dimensions (anxiety, depression, positive well-being, self-control, general health, and vitality). The SWLS is a five-item questionnaire measuring global judgments of satisfaction with one's life. A maximum of seven points is given to each item. In a recent study using the PGWB, greater physical activity, independent-living situation, and good cognitive functioning were associated with higher levels of subjective well-being. A recent study using the SWLS showed mild positive life satisfaction in the elderly.

4 Cross-cultural studies of emotions

A final section of the book addresses the issues and problems of cross-cultural measurement of emotions. This is an area of growing importance for both basic and applied research on emotions. In both areas researchers are looking for emotion measures that work across cultures, so that one can compare the results from one country to another country. In the past we have depended on simple translations of questionnaires to move questionnaires around the globe, without proper consideration of whether the emotion concept(s) involved make any sense in the new location. We have come to realize that simple translation might not produce a comparable measurement instrument in the new location.

The chapters on cross-cultural research begin with chapter "Translatability of Emotions" by Anna Ogarkova on translatability of emotions across languages and cultures. Ogarkova begins by asking whether translated words mean the same thing and have the same meaning, and she answers that this depends on the discipline of the inquiry. Ogarkova points out the use of vector ratings of values in emotion psychology, as well as the position of the word on a set of general evaluative dimensions, as well as other possibilities. Linguistic meaning involves the combination of denotation and connotation, involving both meaning and the evaluation of meaning. Anthropology views meaning as the combination of the referential, the affective and the social, extending the use of meaning to use in social contexts. Having the same meaning is always viewed as relative, not absolute.

Ogarkova notes that the "question of equivalence has been frequently framed within the debate on universality vs. cultural-specificity of emotion conceptualization and expression," a topic which we have seen before in this volume. She finds that there is supporting evidence for both points of view, both universals and culturally specific emotion terms. The take-away from this discussion is that we should not expect simple word-to-word translations for many emotion words, but rather complex relationships between emotions in one language and those in another language.

The situation is perhaps best shown by what Ogarkova calls asymmetries in emotion language including the following:

1. Culture-specific emotions than cannot be translated with a single word.
2. Lack of basic and secondary emotion labels for English words in another language.
3. Problematic differentiation of two or more terms.
4. And the reverse, when one English word has several equivalent words in another language.

Differences in language usage are also reflected in other aspects of the situation, including the typical preceding events (the context), the subjective feelings involved, and the physiological responses involved, and the typical behavior expressed in response to the emotion.

A number of methods are used to measure similarity or dissimilarity across languages, including (1) quantitative approaches which are called corpus-based approaches (the reader is invited to see the chapter and the references provided for more detail); (2) lexical research based on similarity ratings, such as the dimensional approach on a set of global dimensions. Overall, the reader will be impressed by the complexity of the translation issue, and with the tools available to study it in more detail. For those planning to conduct research cross-culturally, the problem of translation is a major issue with the use of questionnaires and other verbal methods.

In the next cross-cultural chapter (see chapter: Different Ways of Measuring Emotions Cross-Culturally) Yulia Chentosova-Dutton and Samuel Lyons look directly at measuring emotions cross-culturally, beyond the language issue by itself.

They note that emotion research is increasingly studying groups beyond English-speaking countries and the West. They begin with a definition of cultures: "Cultures are complex sets of shared meanings, values and corresponding behavior and cultural products." Culture exerts influence in the mind (eg, emotion language), the body (eg, the physiology of emotion), and more broadly in the environment.

Chentsova-Dutton and Lyons set a high standard for cross-cultural research on emotions: "When assessing emotions across cultural contexts, researchers need to also ensure that the methods, participants, research settings and constructs that are being studied, the meanings and significance of these constructs, and the language and psychometric characteristics of the assessment tools are comparable across different cultural contexts.... One should not simply translate questionnaires and export a study designed for a particular cultural context to another without careful work with local experts to ensure cultural equivalence." The latter is what is often done, simple translation and application in a new cultural context.

Next, the chapter reviews self-report surveys conducted cross-culturally. They note the study of subjective well-being in 55 countries by Diener, Diener, and Diener (1995), and the observation of less frequent reports of happiness in East Asians compared to European Americans. This is also related to the different meaning of happiness in the two cultures. Another interesting contrast of East Asians and the West (specifically the United States) is the observation of mixed and sometimes contradictory emotions at the same time, which is more prevalent in Asians. The reader is referred to the next chapter by Ishii and Eisen for more information on East Asia. Chenstova-Dutton and Lyons note that: "One implication for commercial emotion researchers is that liking and disliking of products cannot be assumed to reflect the same dimension across cultural contexts and need to be assessed separately."

Self-reports have limitations as well, as we have noted in a number of chapters in this book. One is the reference group effect, that is, how emotions are described when the reference group encourages or discourages that emotion. And acquiescence and disacquiescence response styles, emphasizing agreement or disagreement. Also the tendency to use mid-points of scales, which is well known with Asians compared to people from the United States when doing emotion ratings and product-liking ratings. An alternative to self-report questionnaires is ES in which computers or cellphones prompt the individual to rate their emotions during the day. "This approach also allows us to identify situational triggers for particular emotions and examine whether they are culturally specific. In commercial research, ES can be used to examine the relationships between people's momentary emotions and concerns and their consumer choices."

Chentsova-Dutton and Lyons note the related work on analyzing social media messages although they claim that sentiment analysis has not been applied to cross-cultural work; sentiment analysis is covered by Mohammad in chapter "Sentiment Analysis: Detecting Valence, Emotions, and Other Affectual States from Text." They also review emotional appraisals and storytelling (especially for children).

Chentsova-Dutton and Lyons move on to physiological studies of emotions. They note that most studies of the autonomic nervous system have found cross-cultural similarity, not difference, and this extends to the similarity in how people feel in response to specific emotions in different cultures. However they note some differences, not in the underlying physiology, but on how the emotions is experienced. There are limited research data on central nervous system differences cross-culturally. Improvements in equipment and technology should expand the whole physiological area of research.

Another avenue of research is the examination of cultural products, often text material. This used to be done by coding of text material, but now sentiment analysis is being used. A typical study is presented showing that American storybooks contained a greater proportion of high arousal positive emotional expressions, wider smiles, and more high arousal activities. Another study compared definitions of happiness in 30 countries, finding 24/30 nations emphasize luck, while 6/30, including the United States, emphasize personal agency. The authors note that commercial research is well placed to examine how products shape consumer emotions and are shaped by consumer emotions. The interested reader is referred to earlier chapters on commercial products, and on product design.

Chentsova-Dutton and Lyons discuss the observation of behavior, but note that this approach to studying emotion is time-consuming and requires extensive training. Further, the observation of behavior usually does not use natural situations and natural stimuli, instead depending on standardized stimuli such as images. This situation is similar to the training required for facial recognition; in fact, Chenstova-Dutton and Lyons mention the study of "culturally 'accented' facial expressions," that is slight differences between cultures. Finally, the approach of situation sampling is described. This method can be combined with observing behavior. Chentsova-Dutton and Lyons end their chapter with a look into the future of cross-cultural emotion research, and the many opportunities and challenges ahead.

The third chapter on cross-cultural research intentionally gets away from the English-speaking and Western orientation of most emotion research and focuses on emotions in East Asia. Keiko Ishii and Charis Eisen begin with a definition of culture, noting "Culture is a collective-level phenomenon comprising both socially shared meanings, such as ideas and beliefs, and associated scripted behavioral patterns (Kitayama & Uskul, 2011)." Further they note that "The self is considered independent and separate from other people in Western cultural contexts, but it is interdependent and connected with other people in Eastern cultural contexts (Markus & Kitayama, 1991)." Thus we see that even with the definition of culture, we see a different emphasis in West and East. The different emphasis produces a different focus of emotion research, for example, self-esteem and pride in the West with its focus on independence, and respect and friendliness in the East with its focus on interdependence. And beyond the simple choice of emotions, is the role of those emotions in interactions; people in the West might influence each other during emotional episodes, whereas Asians might adjust to the emotional situation.

Ishii and Eisen present a summary of emotion research with East Asians including the following topics:

1. East Asians are more sensitive to other people's emotional expressions.
2. Happiness is more related to engaging positive emotions for East Asians.
3. Happiness was placed closer to personal achievement in the Western view of happiness, but closer to social harmony in the East Asian view.
4. Co-occurrence of positive and negative emotions is related to Asian philosophies, even when controlling for the level of individualism–collectivism.
5. Unique indigenous emotions in East Asian cultures.
6. Contextual effects must be examined cross-culturally to look for differences.

Ishii and Eisen conclude that people emotionally respond to their environment in culturally specific ways. This requires that we use sensitivity in collecting attitudinal data on emotions in different cultures.

5 Conclusions

This book on *Emotion Measurement* covers a very broad range of topics and methods. The first conclusion is that there is no one method that is clearly superior for all applications. Methods include physiological, behavioral, and self-report methods. Every method has its advantages and its limitations—the method must be selected for application to the specific needs of a study. While a number of authors use and recommend self-report methods, there is also a great deal of concern about possible biases in self-report emotion data. A similar conclusion about no one best candidate can be made about the theoretical frameworks available to the researcher—and many authors in *Emotion Measurement* recommend that we all should work within a theoretical framework, rather than in an atheoretical way. A frequent issue in the use of all methods is the consideration of context, where the method will be applied, and what limitations the research context places on the research. My own bias is that we need more research conducted in more realistic or typical contexts, rather than in controlled, laboratory settings. Concerning the measurement of emotions, some methods clearly work with smaller numbers of emotions, and other methods work with larger numbers of emotions. Again we need to design research toward a particular purpose, but I would argue that, in general, more emotions is better than fewer emotions. Not only should we have more emotions, but we should have the right balance of positive and negative emotions. Many chapters have emphasized the value of positive emotions, but other chapters have also emphasized the value of negative emotions. We need to be aware of the tendency to continue using outdated methods, even when newer methods are available. And finally, we need to look at emotion methods from a very broad cross-cultural perspective, constantly asking whether the method and the questions mean the same thing in different cultures.

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