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SCHEMATA IN COGNITIVE ANTHROPOLOGY

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The aim of this review is to examine the "schema" concept being developed in cognitive science from the perspective of cognitive anthropology. Cognitive science is the inter-disciplinary field that was originally formed around the joint interests of cognitive psychology and computer science and now includes cognitive anthropology and cognitive linguistics as well. Schemata (the plural), which are knowledge structures that are "the building blocks of cognition," pervade theorizing about cognitive organization and function in cognitive science (173). "Schema" is the most widely used term for these knowledge structures (7, 22, 39–41, 51, 80, 95, 96, 102, 120, 121, 142, 144–149, 151–154, 170–175, 205, 209, 212), but they are also referred to as "frames" (138, 219), "scenes" (69), "scenarios" (69, 159), "scripts" (1, 2, 183–188), "gestalts" (117–119), "active structural networks" (174), and "memory organization packets" (185).

"Schema" and these other terms, although they are conceptualized somewhat differently by different writers, depending on their particular aims and interests, bear a striking family resemblance to each other. The emphasis here will not be on differentiating among these terms and concepts, but rather on assembling a composite conceptualization that incorporates the most important aspects of all these variants. Because "schema" is the most commonly occurring term, it will be used for this composite concept, and the other terms will be reserved for distinguishing types of schemata and some of their interrelationships.

The schema notion and its importance in cognitive research have been described and examined in numerous previous reviews. These have been reviews concerned either with cognitive science as a whole (21, 94, 144) or with work in cognitive psychology (100, 101, 142), cognitive social psycholo-

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gy (89, 92, 203), or computer science (83, 140, 158). To date there has been no review that examined the importance of the schema notion in cognitive anthropology. Following general discussion of the schema concept in the first part of the review, attention will be focused in the second part on what D'Andrade (57) has termed "the cultural part of cognition."

SCHEMATA

Schemata are conceptual abstractions that mediate between stimuli received by the sense organs and behavioral responses (212). They are abstractions that serve as the basis for all human information processing, e.g. perception and comprehension, categorization and planning, recognition and recall, and problem-solving and decision-making (173). Schemata theory developed in reaction against associationist theories, which posited mental representations that directly reflected the external world (89). As Tyler, among others, has pointed out, "the structure of knowledge cannot consist of a mere picture of the world or even of a set of concepts which refer to or stand in a one-to-one relation with elements of the external world" (209, p. 98). Iconic representations of this sort are simply not rich enough to account for the complexity of human behavior. Much psychological research, however, continues to be conducted on the basis of associationism. See, for example, Wickelgren's recent review of learning and memory research, which adopts a strictly associationist perspective, maintaining that "there is no evidence supporting the hypothesis of unitary schema nodes, although they could exist" (216, p. 37).

Bartlett, who is generally credited with being the first to use the term schema in its contemporary sense [although Kant used the term in much the same sense in his *Critique of Pure Reason* (175)], argued that "the past operates as an organized mass rather than as a group of elements each of which retains its specific character" (7, p. 197). Remembering, Bartlett maintained, is constructive. Not all stimuli are stored in memory; rather, schemata are employed to provide "a general impression of the whole" and to construct (or reconstruct) "probable details" (7, p. 206). Much of the criticism directed at associationism has been concerned with demonstrating that there are significant differences between external stimuli and mental representations, with showing that schemata may omit much detail or include more information than is contained in the stimulus (89).

Basic to these criticisms is the view that schemata occur at differing levels of abstraction. At relatively low levels of abstraction there are schemata for perceiving geometrical figures, colors, faces, etc, while at higher levels there are schemata for comprehending complex activities and events. There are no important differences in kind between schemata for perception and comprehension: "perception is comprehension of sensory input" (175, p. 110). Schemata

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at particular levels of abstraction are not necessarily sensitive to schemata at other levels. Neisser (142, pp. 21–22) gives a particularly felicitous illustration of this. Observing someone smiling, he says, may involve only the perception of the shapes of teeth or changing positions of lips, or it may involve more abstract comprehension of a meangingful cultural act of "smiling," from which insights into the smiler's mood (e.g. happiness, cheerfulness, polite indifference) may be gained.

Schemata, unlike associations, are organic wholes comprised of parts that are oriented both to the whole and to other parts (209, p. 109; 117, p. 246). As Tyler states, they are indexical representations "founded in holistic simultaneity," whereas rules are symbolic representations "founded in linear sequentiality" (209, p. 100). Schemata are autonomous and automatic—once set in motion they proceed to their conclusion—and they are generally unconscious, nonpurposive, and irreflexive; rules, in contrast, are conscious, purposive, and reflexive, i.e. they have feedback loops that enable self-modification (209, p. 117). Tyler discusses the nature of rules at some length, distinguishing "five major branches of rule concepts": instructions, precepts, regulations, uniformities, and axioms (209, pp. 122–29).

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Structures

Probably the most influential discussion of schema theory is Minsky's article, "A Framework for Representing Knowledge" (138). Minsky uses the term "frame" in discussing knowledge representations, but he places frames in the schema tradition stemming from Bartlett. A frame, according to Minsky (138, p. 212), is "a data-structure for representing a stereotyped situation, like being in a certain kind of living room, or going to a child's birthday party" (138, p. 212). This aspect of the schema concept is elaborated by Rumelhart, who states that a schema is "a data structure for representing the generic concepts stored in memory," and that "there are schemata representing our knowledge about all concepts: those underlying objects, situations, events, sequences of events, actions and sequences of actions" (173, p. 34; see also 170, 171, 175). This representation may be thought of as "a network of nodes and relations" (138, p. 212). It is the "network of interrelations that is believed to normally hold among the constituents of the concept in question" (173, p. 34); moreover, it accounts for "any situation that can be considered an instance of the general concept it represents" (171, p. 266).

The highest levels of schemata are fixed and represent invariant aspects of concepts, whereas lower levels have terminals, or "slots," that must be filled by specific instances of data, that is, they have variables that are associated with, or "bound by" elements in the environment in particular instantiations of the schema (138, p. 212; 173, p. 35). "Instantiation," a term used widely in the schema literature, refers to the binding of particular elements to particular

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variables on particular occasions (173, p. 36). The schema underlying commercial events in our culture may be taken as an example (66, 69, 173). The schema has the variables BUYER, SELLER, MONEY, GOODS, and EXCHANGE (upper case is used to distinguish conceptual units from words). BUYER is a person who possesses MONEY, the medium of exchange, and SELLER is a person who possesses GOODS, the merchandise for sale. EXCHANGE is an interaction in which BUYER gives MONEY and gets GOODS, and SELLER gives GOODS and gets MONEY. An event is understood as a commercial transaction when persons, objects, and subevents in the environmental situation are bound to appropriate schema variables.

Variables, or slots, have associated conditions that restrict the elements that may be bound to them. These conditions, known as "variable constraints," are knowledge about typical values of variables (simple conditions requiring that the bound element be a person, an object, or a subevent), and knowledge about interrelationships among variables (more complex conditions requiring certain relations among elements bound to sets of variables). Variables in the commercial event schema are constrained by knowledge that BUYER and SELLER are normally persons, that MONEY is generally currency, that GOODS are usually inanimate objects, and that EXHANGES involve transfers between participants of objects that they own or possess, as well as by knowledge that the MONEY and GOODS variables are interrelated: the value of MONEY covaries with the value of GOODS (173, p. 35).

Variable constraints not only restrict variable binding but also assign "default values" to variables for which no matching elements are found in the environmental situation. Default values are expectations or "best guesses" determined by the typical or normal values associated with variables. Because they are not specifically justified by the situation, they are only weakly bound to variables and are easily detached if additional information is revealed that makes more accurate value assignment possible (138, pp. 212, 228). In a transaction interpreted as a commercial event, a transfer of money may be inferred even when no money is seen to have changed hands on the basis of the default values associated with the MONEY and EXCHANGE variables in the schema. Note that this illustrates the point made earlier that a schema may contain more information than the stimulus environment with which it is matched. The use of schemata as a basis for making inferences about stimulus situations is a topic that will be taken up below.

Framing

The term "frame" has recently been used by linguists, principally Fillmore (66–70) and Chafe (39–41), in discussing the relationship between structures in language and underlying schemata. Language itself is, of course, a knowledge system—a system of conceptual abstractions, both unconscious, holistic sche-

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mata and conscious, reflexive rules (209, pp. 119–21). Although most contemporary linguistic analysis treats language solely as a system of rules, omitting any consideration of the role of schemata in language structure and process, a particularly lucid analysis of both the rules and schemata involved in past tense formation was recently published by Bybee & Slobin (33). The frame concept of Fillmore and Chafe is not concerned with the organization of language itself, but rather with how lexical and grammatical forms both structure and express underlying schematic representations (69, p. 127; 39, p. 46; see also 50, 64, 102, 120, 121).

The basic notion in framing is that lexical items and grammatical categories and rules are associated in memory with schemata and parts of schemata. Frames and schemata "activate" each other: linguistic forms bring schemata to mind and schemata are expressed in "linguistic reflexes" (66, p. 124; 67, p. 25). Lexical and grammatical forms are the means by which schema variables are labeled and verbalized. "Frame" is an appropriate term because what these language structures do is organize schemata for verbalization by focusing attention on certain variables and not on others. For example, a number of lexical items can activate the commercial event schema, e.g. *buy, sell, pay, cost, spend, charge*. Each of these words selects particular aspects of the schema for highlighting or foregrounding, while leaving others in the background unexpressed (66, p. 25; 69, p. 103). *Buy* focuses on the exchange from the buyer's perspective, and *sell* from the seller's perspective; *cost* focuses on the money-goods relationship, and so forth. Further examples of framing have been discussed in two recent articles: Langacker (120) describes how the single word *orphan* frames a "functional assembly" of kin relations and the life cycle, and Quinn (159; see also 160a) discusses how the key word *commitment* frames three polysemous meanings, PROMISE, DEDICATION, and ATTACHMENT, in the cultural scenario (i.e. schema) for American marriage.

The frame concept is generally used in a wider sense, originally formulated by Bateson (12) and later elaborated by Goffman (82). Frake, in his recent discussion of the dangers inherent in plying frames, assumes this Batesonian view in describing frames as the basic units of interpretative context, as the means by which "people organize their conception of what is happening at this time" (74, p. 4). This more general notion of framing may be dubbed "contextual framing" to distinguish it from "conceptual framing," the latter being a special case of the former (67). Contextual framing, like conceptual framing, involves associations between underlying schematic representations and the means of their expression. In contextual framing, the same reflexive relationship holds between schemata and frames, but the framing of contexts is accomplished not only on the basis of linguistic forms but also nonlinguistic communicative means, such as tone of voice, facial expression, appearance, gestures, and body postures and movements (74). Underlying conceptions of

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events are associated with the verbal and nonverbal devices by which they are expressed, and these devices shape and organize the conceptions they express.

Contextual framing by means of linguistic devices has been most extensively explored in "The Ethnography of Speaking," a tradition of sociolinguistic research originated by Hymes (97), who remains its leading spokesman. In this area of research, which was reviewed not long ago by Bauman & Sherzer (13), speech events and the language used in realizing them are described in their full reflexivity, e.g. poetry in a particular society is found to be expressed in language characterized by such formal devices as rhyme and meter, and these linguistic properties are shown to be what provides for its recognition as poetry. Tannen (201) adopts a more strictly linguistic approach in attempting to answer the question, "What's in a frame?" In analyzing oral narratives told by Greek women in recounting the contents of a film, she discusses 16 types of surface linguistic features in relation to underlying structures of expectation (i.e. schemata).

Fine-grained analysis of contextual framing by nonverbal means has been done by McDermott and his colleagues (135), who examined the body positionings, or postural configurations, assumed by a group of school children and their teacher during a reading lesson. Their analysis shows that the teacher and children, in taking up and leaving positionings, both express the current state of the reading context and provide each other with the means for organizing their interaction in the ongoing lesson. Basso's (10) description of Western Apache portraits of "the Whiteman" represents something of a culmination of this line of research. It is a seriously amusing account of how interactions that are potentially insulting and therefore dangerous are framed through a combination of both verbal and nonverbal devices (e.g. a joking variety of Western Apache English, discourteous repetitions of requests and demands, a loud tone of voice, and repeated handshaking and backslapping) as nonserious "whiteman joking"—as play in which "the Whiteman" is brought to life in vivid, wholly unflattering portraits.

Prototypes

A schema is also a prototype (51, 66–70, 102, 117, 173, 175). It is a stereotypic, or generic, representation of a concept that serves as a standard for evaluating the goodness-of-fit between schema variables and elements in the environment. Variable binding is constrained by typical or average values of schema variables, not by absolute values (175, p. 105). Conditions on variables specifying that a bound element must be, for example, a person or an object of a particular sort define prototypical instantiations, but less typical elements may be bound if they bear a family resemblance to it, i.e. if they are sufficiently similar to it (163–165, 167). Similarity is, of course, a matter of degree: some elements resemble prototypes more closely than others. Default values are

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prototypical or near prototypical values. In the schema for commercial events, BUYER is prototypically a person, although it may sometimes be bound by a corporation or institution; SELLER is prototypically a person who owns GOODS, although less typically it may be a salesman or middleman; and MONEY is prototypically cash, but it may also be a check, a charge card, or an I.O.U.

This notion of prototype schemata has lent itself to the development of a theory of meaning, recently christened "prototype semantics" by Coleman & Kay (51). A basic tenet of this theory is that the prototype schema (or schemata) underlying a concept corresponds to the meaning of the concept. Lexical meaning "consists in a cognitive prototype to which various real and imagined events may correspond in varying degrees" (51, p. 26). Linguistic forms, as stated in discussing framing, organize and express schematic representations; the point to be added now is that, because the schemata underlying conceptual categories are taken to be prototypes, these categories have analog representations (164). Meanings are determined on the basis of overall resemblance to prototype schemata. Elements that possess some (but not necessarily all) of the properties defining the prototype are instances of the concept. Thus, membership in semantic categories is a "more" or "less" matter and the boundaries of categories are frequently blurred or fuzzy; elements are instances of categories to a degree and instances differ in the degree to which they are members (51, 102, 104, 105, 109, 111, 112, 116, 164, 165). This approach to meaning is often referred to in anthropology as "extensionist semantics."

The prototype theory of meaning contrasts with what Fillmore (66) labels "checklist" theories of meaning. These are theories that posit digital representations of concepts (164), and have in common the view that meanings can be specified in terms of conjunctions of discrete properties, called variously "distinctive features," "semantic components," and "criterial attributes." Elements that display the list of properties defining a concept are instances of the concept. Thus, membership in semantic categories is a "yes" or "no" matter and the boundaries of categories are clear-cut and definite; elements are either instances of categories or they are not and all instances are equivalent as members. "Componential analysis," as practiced in anthropology and linguistics, is an example of a checklist theory (cf 11, 84, 85, 122).

Prototype theory is not new in anthropology, although it recently has been taken up with considerable enthusiasm in other disciplines, most notably psychology, where work by Rosch (163) has triggered a burst of research. This psychological work has been reviewed by Mervis & Rosch (136). Although not always acknowledged, the development of the prototype concept began with Lounsbury's work on kinship semantics (125–127, 190). Lounsbury's seminal articles demonstrated that the primary meaning of kinship terms derives from the genealogically closest of the types of kin (kintypes) that are included as

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instances of kin categories, and that this focal or prototypical sense is extended to the more distant kintypes also included in kin categories. Shortly after Lounsbury's work, the extensionist approach was employed by Berlin & Kay (20) in their pioneering study of basic color categories and by Berlin and his associates (15–18) in their work on ethnobotanical taxonomies.

Berlin & Kay's book (20) set off an explosion of research on color classification systems, which has shown rather convincingly that color categories are organized around prototypes (91, 164), and that they are nondiscrete or fuzzy categories in which membership is a matter of degree of approximation to prototypes (103). A further particularly important finding of this research, established most thoroughly by Kay and McDaniel, is that color prototypes are "based on panhuman neurophysiological processes in the perception of color" (103, p. 644; see also 220). Rosch (164) argues that color categories are a special type of category. They are prime examples of what she calls "attribute categories," biologically based categories of perceptual sensations that are "general attributes of concrete things" (164, p. 23). Other examples of attribute categories are geometrical shape categories, which have "wired-in" prototypes for circle, square, and equilateral triangle (163), and categories of facial expressions, which have physiologically determined prototypes for happiness, sadness, anger, fear, surprise, and disgust (61).

Rosch (164) contrasts attribute categories with "object categories." These are categories of concrete entities, such as plants, animals, vehicles, furniture, and so forth, that are not assumed to be biologically based but that are nonetheless organized in terms of prototypes and approximations to prototypes. A particularly popular and productive domain for investigating the internal structure of object categories has been the domain of "containers for liquids." Kempton (104, 105), for example, has shown that categories of drinking vessels (cups, mugs, coffee cups) are fuzzy categories organized in terms of focal members and grades of membership (see also 109, 111, 112). The prototype notion has also been applied in studies of social categories. The line of research on kin categories initiated by Lounsbury has been continued in a number of studies (14, 36, 189). Kay (102) has analyzed the prototype semantics of Tahitian race and class categories. Cantor & Mischel (34) have reviewed research on prototype categorization in abstract person categories, such as *extrovert*, *madman*, and *activist*. And Coleman & Kay (51) have studied prototypical *lies*, speech acts that are wholly abstract entities.

Embedding and Linking

A schema generally includes a number of embedded subschemata as constituent parts, each of which interacts in its own right with elements in the environment (142, p. 23). A schema, in other words, is most often a complex structure in which variables are bound by subschemata (138). Overall, then,

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schemata are organized as hierarchical structures in which schemata at the higher levels represent the most general concepts, and schemata at successively lower levels represent more and more specific concepts. Schemata at the lowest level are atomic, i.e. primitive concepts that are components of knowledge that do not break down into constituent parts or further subschemata (174, p. 106).

Taxonomies are the type of hierarchical organization formed on the basis of relations of class inclusion. A commercial event can be understood as "buying dinner in a restaurant" or as "buying a Whopper in a fast food restaurant," for example. Other types of hierarchical organization of schemata are formed on the basis of other types of conceptual relations, e.g. part-whole relations, causal relations, Fillmore's case relations, among others (65; see also 37, 209). Understood generally, a commercial event framed as *buying* involves a BUYER who EXCHANGES MONEY with a SELLER for GOODS. EXCHANGE, however, is not a primitive concept; its schematic representation contains subschemata for DO, CAUSE, and TRANSFER. It represents an event in which a BUYER DOES something that CAUSES two TRANSFERS of possession, one of MONEY from BUYER to SELLER and another of GOODS from SELLER to BUYER [this example is simplified from (78), pp. 212–25]. A commercial event, then, may be comprehended either in general in terms of a major schema alone, omitting any consideration of its internal structure, or more deeply in terms of embedded subschemata (175, p. 106).

Schemata are also organized sequentially. Subschemata embedded in a schema may be ordered to represent changes over time or in location, cause-effect relationships, and sequencing of stages or actions in events (138, p. 234). Continuing the commercial event example, the exchange of goods and money involves two states of affairs, the state prior to the exchange and the state after the exchange. The transfer of possession that characterizes exchanges is represented by two temporally ordered subschemata that share the same set of variables but in different arrangements: one represents the earlier state in which the BUYER POSSESSES the MONEY and the SELLER POSSESSES the GOODS, and the other represents the later state in which the BUYER POSSESSES the GOODS and the SELLER POSSESSES the MONEY (138, p. 240).

Schemata are not only organized into complex hierarchical structures, they are also interlinked with other schemata to form still larger structures. In a commercial event, the money one participant gives another may be specified as a *tip, bribe, ransom, tuition, retainer, change, rebate,* etc (69, p. 114). The framing of this money as a *tip,* for instance, serves to characterize it as money given in exchange for services (rather than goods) and, at the same time, to link the commercial event schema with a wider schema, about which numerous inferences can be made, e.g. that the services involved are those of a waiter or waitress in a restaurant (66, p. 28).

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Linkage such as this to wider schemata differs from linkage that organizes schemata into ordered sequences or chains. "Eating in a restaurant," to take a widely discussed example, is an event whose representation is comprised of a sequence of linked schemata—ENTERING, ORDERING, EATING, and EXITING (183, 188). These schemata, termed "scenes," are in turn comprised of sequences of actions; TIPPING the waitress and PAYING the check are two of the constituent actions in the EXITING scene, for example. The sequence of actions defining scenes and larger-scale events is an elaborate causal chain: each action in the sequence results in conditions that enable the next action and must be completed before the next action can be started (188, p. 45). The term "script," first adopted by Schank and Abelson (1, 2, 183–188), has come to be the standard label for these sequences of schemata. Scripts are considered at greater length in the second part of this review.

Processes

Schemata are not only data structures, they are also data processors. As Neisser puts it, a "schema is not only the plan but also the executor of the plan. It is a pattern *of* action as well as a pattern *for* action (142, p. 56). Schemata are active processes whose primary activity is the construction of interpretations of experience; they are procedures capable of evaluating their own goodness-of-fit to elements in the environment and of thereby accounting for them (173, pp. 37, 39).

As stated, the top levels of schemata are fixed and invariant, whereas the bottom levels contain variables that are bound by elements in the environment. All the schemata interrelated in a complex schema operate individually in processing information at their respective levels, and supply each other with information for processing. More general higher level schemata direct the overall processing of information, motivating and coordinating the activities of lower level embedded subschemata; more specific lower level schemata pass information along to other low level schemata that follow them in sequential order and feed information up to the wider schemata in which they are embedded (142, pp. 56, 124).

There are two basic modes of processing. "Bottom-up processing," also termed "data-driven processing," is processing initiated when data are bound to variables in bottom level subschemata that move upward to activate the higher level schemata in which the subschemata are embedded. "Top-down processing," also called "conceptually driven processing," is processing initiated when top level schemata activate embedded subschemata in the expectation that these subschemata will fit the data (22, p. 140; see also 21, 45, 146–148). Data-driven processing moves from part to whole, and conceptually driven processing moves from whole to part (173). Data-driven processing is subconscious, automatic, and guided by the principle that "all the data must be

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accounted for," while conceptually driven processing is conscious, purposive, and guided by high level plans and goals (22, p. 148; see also 209, pp. 98–112).

Top-down and bottom-up processing occur simultaneously, and each requires the other. Expectations are combined with data in constructing interpretations of experience, and schemata are judged to account for elements in the environment when there is goodness-of-fit between expectation and data (22). An example liberally amended from Rumelhart (173, pp. 42–43) may make this somewhat abstract discussion of "mixed initiative processing" more concrete. The event in question occurs in a large enclosure in which automobiles are on display. A number of people are milling around, chatting, and examining the automobiles. The setting, people, objects, and activities suggest that the automobile dealership schema may be relevant to achieving an understanding of the event. Thus activated by bottom-up processing, the high-level auto dealership schema in turn sets off top-down processing of its subschemata. Because an expectation associated with this high-level schema is that automobiles will be bought and sold, one of its subschemata is the now familiar commercial event schema. Top-down processing activates this subschemata, initiating searches for data that may be bound to appropriate schema variables. The GOODS variable may potentially be bound by the automobiles, and a well-dressed man engaged in kicking tires and slamming doors is a reasonable candidate for the BUYER variable. The fact that the man is well-dressed suggests wealth, a possible binding for the MONEY variable. And the presence of a broadly smiling man in a checkered sportscoat who approaches the well-dressed man and engages him in jovial conversation suggests a potential binding for the SELLER variable.

The binding of these variables activates new bottom-up processing, which confirms the expectations of the auto dealership schema and eliminates from consideration alternative general schemata that might have been invoked at the outset of processing, e.g. the auto show schema in which the expectation is not that automobiles will be bought or sold but that they simply will be exhibited. This example is a heuristic fiction, oversimplified to the point of artificiality, but it illustrates how top-down and bottom-up processing work in concert to evaluate the success of schemata in providing interpretations of experience. More complex and realistic examples of schematic processing can be found in articles by Rumelhart (170–175) and Bobrow & Norman (22, 144–146).

Memory

There is general agreement that schemata are mental representations located in memory—that they are frameworks selected from memory when new situations are encountered (138). The structure of memory itself, however, has received relatively little attention (151, 185). Discussion of memory has for the most part been conducted in terms of Tulving's (207) distinction between

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semantic and episodic memory. The basic difference generally recognized between these two types of memory is that schemata in episodic memory represent specific knowledge, i.e. knowledge that is idiosyncratic, particular, and directly reflective of subjectively experienced stimuli, whereas schemata in semantic memory represent general knowledge, i.e. knowledge that is encyclopedic, relatively permanent, and known independently of experience (151, 175).

Researchers have tended to emphasize one or the other of these types of meaning. Some (52, 53) have concentrated on abstract semantic categories linked in hierarchical networks by class inclusion relationships, e.g. *animal, bird, robin*. Theories of semantic memory have recently been reviewed by Smith (195). Others (183, 184, 188) have focused on experiential groupings of concepts linked together by cooccurrence in events and episodes, e.g. *hammer, wood, nail*. Schank, the leading advocate of episodic memory, goes so far as to argue that memory is basically episodic in nature, that very few—perhaps no more than ten—hierarchical supersets actually occur in memory (183, p. 255). In recent work, however, Schank proposes different levels of memory structures for representing different sorts of knowledge; these levels—"event memory," "general event memory," "situational memory" and "intensional memory"—vary in the degree to which they reflect particular experiences (185, pp. 259–61). The semantic/episodic memory issue has not yet been resolved, but it is reasonable to conclude, even if only provisionally, that memory must contain schemata that represent concepts abstracted from particular events and episodes as well as schemata that represent concepts formed on the basis of particular experiences.

CULTURAL SCHEMATA

Schemata differ in their distribution in populations: some are universal, some idiosyncratic, and some cultural. Universal schemata are uniform in the human species because of innate faculties of the mind and/or inherent divisions in the natural world; idiosyncratic schemata are unique to particular individuals as the result of their personal histories and life experiences; cultural schemata are neither unique to individuals nor shared by all humans, but rather shared by members of particular societies (37, pp. 20–21). Cognitive anthropologists are concerned with cultural schemata, with "the cultural part of cognition," as D'Andrade (57) has recently phrased it. Unlike cognitive psychologists, who want to learn how the brain deals with all sorts of information, including cultural information, cognitive anthropologists focus on how systems of cultural knowledge are constrained and shaped by the machinery of the brain. The assumption here is that, as the result of its regular transmission from generation to generation, cultural knowledge comes to be organized in such a way that it

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"fits" the capacities and constraints of the human mind (57, p. 182). As succinctly stated by D'Andrade, the program for studying cultural cognition is to "search for commonalities in knowledge systems built into language in order to find out basic characteristics of human thought" (56, p. 3).

The anthropological concern with the interface between systems of cultural knowledge and basic psychological factors is clearly illustrated by Lounsbury's work on kinship semantics. Lounsbury, it will be recalled from the "prototype" discussion, demonstrated that categories in systems of kin classification are regularly organized in terms of prototypes (focal kintypes) and extensions (nonfocal kintypes that are equated with focal kintypes). This general finding about kin classification systems points to the existence of underlying psychological mechanisms that interface with the prototypes-with-extensions organization of kin categories (57, p. 182). Lounsbury's pathbreaking work, as already mentioned, has been followed up by a great deal of research in many nonkinship domains. In psychology, Rosch's work (163–168) has been particularly significant in spearheading efforts to elucidate the psychological factors involved in prototype categorization. Lakoff's (117a) most recent work has also contributed importantly to this line of research.

In the following sections, research exploring the organization of complex cultural schemata is reviewed. Attention is first focused on three types of complex schemata found in the organization of cultural content: object schemata, orientation schemata, and event schemata. Then brief surveys are presented of research concerned with the role of these complex schemata in two currently very active areas of cognitive research, metaphor and narrative.

Object Schemata

Recent research has advanced understanding of the complex schemata underlying a wide range of object classification systems. Object categories, as mentioned in discussing prototypes, are categories of concrete entities. Some of the object classification systems that have been studied are classifications of plants (15–20, 26, 28, 90), animals (27, 29, 93), manufactured objects including vehicles, tools, clothing, and furniture (168), containers (104, 105, 109), persons (34), kinsmen (189, 190), occupations (32), ethnic identities (179), personality descriptors (108, 215), illnesses (55), and emotions (128).

Taxonomies, which occur widely in cultures and have been studied extensively by anthropologists, are a familiar type of classification system. In taxonomic classifications, wider, more general and narrower, more specific categories stand to each other in class inclusion, or "kind of," relations (see 37, pp. 75–77). The English ethnobotanical category *tree*, for example, includes the *oak* category, and *oak* is a kind of *tree*. Other categories included in the *tree* category are *maple, pine, elm, spruce,* and *poplar*. The *tree* category is included in the superordinate category *plant,* as are the categories *bush, grass,*

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and *vine*, and *oak* includes the subordinate categories *white oak, post oak, scrub oak, red oak, jack oak, pin oak,* and *burr oak*.

Ethnobiological taxonomies are the most thoroughly studied object classification system. Thanks largely to the work of Berlin and Brown and their associates (15–19, 26–29), much is now known about their structure, growth, and development. A major finding is that categories in ethnobiological taxonomies are grouped into mutually exclusive hierarchical ranks, which have been labeled "kingdom," "life form," "generic," "specific," and "varietal" (16). The kingdom rank category is the all-inclusive unique beginner; it is the highest level category and delimits the entire domain (e.g. *plant* in English ethnobotany). Life-form rank categories are the next most inclusive categories. They are few in number and are labeled by primary lexemes (e.g. *tree, grass, vine*). Categories of generic rank are next in inclusiveness. By far the most numerous categories in ethnobiological classification systems, generic categories are also generally labeled by primary lexemes (e.g. *oak, maple, pine*). Generic categories that dominate lower level categories (many do not) immediately include specific rank categories, which in turn include categories of varietal rank. Specific categories are few in number and varietal categories are rare. Lexemes for both are generally binomial secondary lexemes (e.g. *white oak, post oak, scrub oak*).

Berlin (16, 17) has shown that generic rank categories comprise the core of ethnobiological classifications in simpler societies. They are not only the most numerous but also the psychologically most salient or basic categories. Basic level categories are those categories in a classification system that are most frequently used in everyday interaction, most easily recalled by informants, and earliest in ontogenetic development (58). Dougherty (58) has revised Berlin's account of basic level categories, demonstrating that while generic rank categories are most salient in the ethnobiological classification systems of people who interact frequently with their biological environment and whose subsistence depends directly on it, categories superordinate to the generic level (i.e. life-form categories) are most salient in the systems of people who do not maintain a high degree of interaction with their biological environment. Which level is basic in a taxonomic classification system is not fixed but rather determined relative to the overall salience, or cultural significance, attached by society members to the objects classified in the system.

Basic level categories have been described for nonbiological classification systems as well. Rosch and her associates (168) have established the existence of a "basic object level" in their studies of classifications of manufactured objects such as vehicles, tools, clothing, and furniture. *Vehicle*, for example, is a superordinate category dominating *car, bus,* and *truck*, which are basic level categories dominating such subordinate categories as *sportscar, city bus,* and *pickup truck* (168). Basic level categories have long been recognized in studies

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of color classifications, e.g. *red, green, yellow, blue* (20), and kin classifications, e.g. *uncle, aunt, nephew, niece* (190). Cantor & Mischel (34) have described basic level person categories, e.g. *extrovert, madman, joker, activist*.

Another type of classification system that has received attention is the constituent, or partonomic, classification system (6, 25, 31, 62, 134). Higher level and lower level categories in this kind of classification system are connected by part-whole relations. In English ethnoanatomical classification, for instance, *fingernail* is a part of *finger, finger* and *palm* are parts of *hand, hand* and *forearm* are parts of *arm,* and *arm* is a part of *body* (6, pp. 347–48). Like taxonomies, partonomies also have a basic level of abstraction: *hand, foot,* and *eye* are basic level categories that are dominated by superordinate categories *arm, leg,* and *face* and in turn dominate subordinate categories *finger, toe,* and *pupil*. Other constituent classification systems include membership classifications such as *family,* which has among its members *father, son,* and *brother,* and *baseball team,* which has the members *shortstop, pitcher,* and *manager* (176).

Functional classification systems are constructed on the basis of instrumental, or "used for," relations. Superordinate and subordinate categories in this kind of classification system are related functionally. One way in which shoes, for example, are classified in our culture is by function: a *jogging shoe* is a shoe used for jogging, and a *tennis shoe* is a shoe used for playing tennis. Many basic level categories in classification systems that have been treated as taxonomically related to superordinate categories are shown actually to be functionally related (183). Rosch's taxonomies of manufactured objects are, in fact, not strictly taxonomies at all: a *vehicle* is any kind of object that can be used as transportation, and *car, bus,* and *truck* are categories of objects that function as vehicles. While relations of basic level categories to subordinate categories are generally taxonomic, relations to superordinate categories are very often nontaxonomic (183, 218). It may even be the case that superordinate taxonomic categories occur only in ethnobiological classifications (218).

This survey of object classification systems supports two important observations. First, it establishes that the complex schemata underlying conceptual systems are not simply ad hoc collections of simpler schemata, but rather integrated, organic wholes oriented around a basic level of abstraction. Second, it also supports the idea that underlying psychological capacities must be shaped in a way that is consistent with the basic level organization found in object classification systems.

Attributes, as pointed out in discussing prototypes, are properties or qualities of objects, typically features of form, such as color, shape, texture, or size, and features of function, such as use for sitting, for clothing, or for food. What is a category and what is an attribute of a category is determined relative to level of

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analysis (136). *Red* and *blue,* for example, are at one level subject to analysis as categories, as the large literature on color classification testifies (20, 91, 103, 164, 220). At a higher level RED and BLUE are units in the analysis of categories. They are primitive elements connecting concepts with objects in the world that do not decompose into constituent parts.

Attributes are of two sorts. Absolute attributes are inherent properties of objects (a *ball,* for example, may have the properties RED, ROUND, and SMOOTH). Relative attributes, on the other hand, are not properties of objects themselves. They are properties of relationships between objects and norms for those objects (a person may be OLD or RICH relative to the norms for age and wealth) and between objects and other objects (an *owner* is a person who POSSESSES an object and a *father* is a person who is the male PARENT OF a child). More detailed discussion may be found in Casson (37, pp. 84–86; see also 35, 49, 63, 122, 197, 209, 214).

The basic level in classification systems is the most inclusive level at which perceptual and functional attributes are shared by most members of each of the categories and at which contrasting categories are maximally discontinuous (165, pp. 30–31). The categories *chair* and *car* are examples. Members of superordinate categories share only a small number of attributes: *furniture* includes chairs, tables, and beds, and *vehicle* includes cars, buses, and trucks. In both cases, included objects share few properties. Members of subordinate categories share bundles of common attributes, but these attributes overlap extensively with the attributes of contrasting categories: *kitchen chair, desk chair, easy chair,* and *city bus, school bus, cross-country bus* are sets of contrasting categories that have many overlapping attributes in common.

Orientation Schemata

Orientation schemata are complex schemata that represent knowledge about spatial orientations (110). Particularly in anthropology, schemata of this type are often referred to as "cognitive maps." Their overall organization is hierarchical. A complex schema representing general spatial concepts occurs at the topmost level, and a number of subschemata representing object concepts are embedded at lower levels. Orientation schemata represent knowledge about spatial relations among objects and their relative positions in the physical environment; they always include a representation of the self because "Ego and world are perceptually inseparable" (142, pp. 113–17). Kuipers (110, pp. 132–34), in proposing a formal model of spatial knowledge, argues that cognitive maps contain three classes of representations: representations for knowledge about particular environments, descriptions of the current position of the self (the "You Are Here" pointer), and representations of processes that manipulate the other two kinds of knowledge, i.e. routes, which are procedures for moving the "You Are Here" pointer through the environmental representation.

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Cognitive maps range from representations of very small- to very large-scale spaces. Maps of relatively small-scale spaces have been formulated by Neisser (142, pp. 111–13), who describes a cognitive map of an office and its setting, and by Linde & Labov (123), who describe schemata for the spatial layouts of apartments. In *The Image of the City*, Lynch (129, pp. 46–83) describes large-scale maps of portions of cities, showing that they generally contain five types of elements: paths (routes through the city), edges (boundaries, such as rivers or railroad tracks), districts (sections of the city), nodes (junctions where paths meet), and landmarks (outstanding features, such as tall buildings or mountains). Wallace's (211) classic account of "driving to work" illustrates the use of just such a large-scale cognitive map. T. Gladwin (81) and Oakley (150) have described the complex orientation schemata used by native navigators during lengthy sea voyages in Oceania.

Orientation schemata are used not only in traveling through cities and navigating at sea. They are also used in imagining city travel and sea voyages. Cognitive maps can be detached from their original environments and used abstractly to picture the environments they represent (142). Detached in this way from actual environments, they can serve as mnemonic devices. The "Method of Loci" is a well-known device employed widely in performing feats of memory (23). First invented by the ancient Greeks, the method depends on the representation in cognitive maps of a series of locations along a path or route. Items to be memorized are imagined one at a time in association with each of the locations along the path. Recall of the items in the original order, in the reverse order, or individually out of sequence is achieved simply by taking a mental stroll along the path and examining the images associated with the various locations. In an example related by Harwood (88), the holes of a familiar golf course were used as the loci where images of 18 items for memorization could be mentally placed. "A brown (Bron-) slavic (-slaw) skier (-ski) lying sick (Mal-)" could, for example, be mentally located near a sand trap on the third green, so that later, in attempting to recall the third item in a series, the name Bronislaw Malinowski would be brought to mind by envisioning the third green and its associated image (88, p. 783).

Cognitive maps, like classification systems, are organic wholes. They are not just assemblages of object schemata, but rather integrated conceptual systems that include specific object concepts in general representations of spatial knowledge (142). Furthermore, just as basic level organization in object classifications suggests the existence of matching psychological factors, so the spatial organization of object concepts in cognitive maps suggests the existence of correspondingly organized underlying psychological mechanisms (23, 142).

Attributes of orientation concepts are properties of physical space, e.g. up and down, above and below, tall and short, left of and right of, in front of and in back of. UP/DOWN, ABOVE/BELOW, and TALL/SHORT are relative attributes because they are properties of relationships between objects in physical

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space. An object has the attributes UP or DOWN, for instance, depending on its position on a vertical axis (defined by the force of gravity) relative to a horizontal plane (ground level) (43, pp. 241–42). Attributes like LEFT/RIGHT and FRONT/BACK are defined in terms of spatial relationships to a canonical, or prototypical, person (44, 54, 132, 139). This person, or self, is typically upright, has significant parts (e.g. head, front, back, right side, and left side), and moves and sees in a forward direction (43, 77).

Event Schemata

Event schemata represent a wide range of activities and interactions, varying from simple actions like giving and taking to complex scenes like ordering a meal in a restaurant. In studying event concepts, investigators have devoted considerable attention to determining the elementary units out of which schemata for events are constructed. Researchers in linguistics (38, 65, 98, 115, 133, 169, 217), artificial intelligence (182–184, 188), and psychology (137, 174) have devised numerous systems of primitive elements. The earliest of these theories were proposed by linguists working in Generative Semantics, particularly Lakoff (115), and Case Grammar, particularly Fillmore (65). The principal aim of this linguistic research, which postulated primitive predicates and case relations as elementary units, was to represent the semantic structures underlying lexical items and sentences. Research in artificial intelligence and psychology stemming from this linguistic work adopted the same aim, plus the additional goal of developing computer models of these semantic representations (175, 182–184).

These theories, which are very similar despite notational differences, all posit sets of primitive predicates and recognize a basic distinction between primitive actions and primitive states (see especially 65, 115, 182). Primitive acts are predicates that specify active relationships in propositions. Examples are DO, GO, PROPEL, GRASP, CAUSE, CHANGE. Primitive states are predicates that specify nonactive states of affairs. Examples include BE, TALL, ALIVE, KNOW, POSSESS. Some investigators (e.g. Schank) maintain that while there is a large number of primitive states, there is a limited set of primitive acts, perhaps as few as 11 (183, 188). Others (e.g. Minsky) argue that the collection of primitive concepts is quite large (138).

These theories also propose elementary concepts specifying the ways in which arguments are related to primitive predicates in propositions. In their influential original formulations, Fillmore (65) and Chafe (38) posited sets of "cases" or "roles" to account for relationships between concepts in argument positions and their predicates. These notions have been clarified and refined in more recent research (68, 78, 141, 174). A current list of cases would include AGENT, OBJECT, RECIPIENT, EXPERIENCER, INSTRUMENT, LOCATION, SOURCE, and GOAL.

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To illustrate, the GIVE schema is a relatively simple action schema (78; see also 174, 175). It is composed of a predicate and three arguments: an AGENT GIVES an OBJECT to a RECIPIENT. GIVE is not, however, a primitive concept. Its representation breaks down into subschemata for DO, CAUSE, and TRANSFER; that is, it is an event in which an AGENT DOES something to CAUSE an OBJECT to be TRANSFERRED to a RECIPIENT. DO and CAUSE are primitive concepts, but TRANSFER is not. The representation of TRANSFER includes further subschemata for CHANGE and POSSESS, which are primitive elements; it is an event in which POSSESSION of an OBJECT CHANGES from AGENT to RECIPIENT.

Schemata, as described earlier, are linked into ordered sequences or chains. This is accomplished by way of causal, or contingency, relations. Actions and states are conditionally connected: a state is usually or necessarily followed or accompanied by an action, and an action is the usual or necessary consequence or concomitant of a state (see 37, p. 82). Schank (183, 188) very usefully distinguishes five kinds of causal relations that are needed in accounting for linkages between schemata: RESULT causation (action RESULTS IN state change), ENABLE causation (state ENABLES action), DISABLE causation (state DISABLES action), INITIATION causation (state or act INITIATES mental state), and REASON causation (mental state is REASON FOR action). Causal linking may be illustrated by specifying the relations that connect states and actions in a simple event: John, being thirsty, opens a can of beer and takes a drink (188, p. 28–30).

John is THIRSTY (state)
INITIATES
John DESIRES beer (mental state)
REASON FOR
John DO something (unspecified action)
RESULTS IN
beer can OPEN (state)
ENABLES
John INGEST beer (action).

Persons and objects in events stand to states and actions in the various case relationships: John is AGENT of DO and INGEST and EXPERIENCER of THIRST and DESIRE.

Linked schemata of this sort that represent recurrent, conventionalized activities and interactions are known as "scripts." Schank and Abelson (1, 2, 183–188), who originated the script notion, have generally defined a script as a "predetermined, stereotyped sequence of actions that defines a well-known

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situation" (188, p. 41). Recently, however, Schank has revised this definition, stating that a script is not a data structure that is available in one piece in memory, but rather a structure that is reconstructed from memory as it is needed to interpret experience (185, p. 264; see also 24). Agar's (3) account of *getting off,* or *shooting up* (injecting heroin), a central event in the culture of *street junkies* (urban heroin addicts), can be rephrased as an example of a script. The organization of some of the sequenced actions comprising this event is as follows:

junkie COOKS (heats) heroin and water mixture (action)
RESULTS IN
heroin DISSOLVED (state change)
ENABLES
junkie DRAW (transfer) heroin into works (action)
RESULTS IN
works PRIMED (state)
ENABLES
junkie HIT (insert) works into vein

Case relations in this event include: junkie is AGENT of COOK, DRAW, and HIT; works is INSTRUMENT of HIT and RECIPIENT of DRAW.

The GETTING OFF script is an example of what Schank & Abelson (188) call an "instrumental script." It is an invariant sequence of actions that is employed, generally by one participant, to accomplish a particular task (188, p. 65). Dougherty & Keller's (59) "taskonomies" can be regarded as further examples of instrumental scripts. The two other types of scripts identified by Schank and Abelson are "personal scripts" and "situational scripts." Personal scripts are idiosyncratic sequences of actions that single actors use to achieve personal goals (e.g. making a date with a waitress in a restaurant), and as such are not of much cultural interest (see 199). Situational scripts have been the principal focus of script research. They pertain to specific situations—characteristically institutionalized public situations—in which several participants assume interconnected roles and, on the basis of shared understandings, cooperate to achieve certain well-defined goals (188, p. 61). ORDERING in a restaurant is a situational script, comprised of a chain of actions and states linked by causal relations, e.g. EXAMINING the menu, CHOOSING food items, SUMMONING the waitress, etc (188, p. 42–43).

The GETTING OFF and ORDERING scripts may be viewed from a wider perspective as constituents of still larger conceptual structures, as subscripts or scenes in wider scripts. GETTING OFF is causally linked in a cyclical chain of events with two other events, COPPING (buying heroin) and HUSTLING (getting money) (4, pp. 44–46):

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junkie POSSESS bread (state)
ENABLES
junkie COP heroin (action)
RESULTS IN
junkie POSSESS heroin (state)
ENABLES
junkie GET OFF/SHOOT UP heroin
RESULTS IN
junkie BE STRAIGHT (i.e. not sick) (state)
ENABLES
junkie HUSTLE bread (action)
RESULTS IN
junkie POSSESS bread (state)

ORDERING in a restaurant, as stated earlier in discussing linking, is one of four scenes that comprise the full restaurant script: ENTERING, ORDERING, EATING, and EXITING (188). Several of Frake's important articles (71–73) are accounts of aspects of Subanun and Yakan culture that could be rephrased as scripts.

A final point to note about event schemata is that events represented in scripts are very likely basic level categories. Rosch (165, pp. 43–44) has tentatively concluded on the basis of pilot research that events like "making coffee," "taking a shower," and "going to statistics class" are basic level event categories, as contrasted with such superordinate event categories as "getting out of the house in the morning" or "going to afternoon classes" and such subordinate categories as "picking up the toothpaste," "squeezing the toothpaste," and so on. More research is needed here, but this seems to be another case in which the organization of systems of cultural concepts suggests underlying psychological mechanisms.

Metaphor

Recently, the nature of metaphor has become a topic of considerable interest in anthropology, linguistics, and psychology. A vast topic, metaphor has been approached from a large number of theoretical perspectives (9, 99, 152–156, 177, 181, 206). The strategy here will be to focus on metaphor research employing schema theory.

One line of research has been concerned with showing how schema theory can account for the comprehension of metaphors (152–154, 172). In general terms, a metaphor states an equivalence between two concepts from separate domains. The metaphor, "George is a lion," for example, states an equivalence between a human being, George, and an animal, a lion. *George* is the "tenor" of the metaphor, the concept that is continuous with the topic of discourse,

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and *lion* is the metaphor's "vehicle," its discontinuous concept (180, p. 7). Placing the two concepts in juxtaposition, the metaphor forms a concept that subsumes both tenor and vehicle (9, pp. 96–97). The Western Apaches, to cite one of Basso's (9) examples, convey the concept "living earth dweller who wastes food" by juxtaposing *carrion beetle* (vehicle) and *whiteman* (tenor) in their "Wise Words" metaphor, "Carrion beetle is a whiteman." In schema theory terms, the comprehension of metaphors like "George is a lion" and "Carrion beetle is a whiteman" depends on similarities and dissimilarities among the values bound to variables in the schemata underlying tenor and vehicle (154, pp. 359–60). General variables that are similar are maintained as variables in the metaphorical concept (George and lions are ANIMATE BEINGS and carrion beetles and whitemen are LIVING EARTH DWELLERS); specific variables that are dissimilar are omitted from the metaphor (George does not have PAWS or TAIL and whitemen are not INSECTS); and at least one specific variable (or subschemata embedded in a variable) that is shared is recognized as a crucial variable in the metaphorical concept (George and lions have COURAGE, STRENGTH, and AGRESSIVENESS and whitemen and carrion beetles WASTE FOOD) (9, 180).

A second line of metaphor research employing schema theory deals with larger-scale metaphorical processes. This is the research of Lakoff & Johnson (118, 119), which is concerned with demonstrating that much of everyday experience is structured by metaphorical concepts. In essence, Lakoff and Johnson's argument is that basic abstract concepts that are not clearly delineated in experience, such as ARGUMENT, TIME, LOVE, and IDEAS, are metaphorically structured in terms of other basic concepts that are more concrete in experience, such as WAR, MONEY, TRAVEL, and FOOD. Metaphorical structuring is not simply a matter of individual concepts but rather of "experiential gestalts"—multidimensional structured wholes (i.e. schemata) that coherently organize experience in terms of natural dimensions of experience, e.g. participants, parts, stages, causes, purposes (119, p. 81).

The metaphorical concept ARGUMENT IS WAR is an example that Lakoff & Johnson (119) treat at some length. Conversation that is seen as argument is understood as such on the basis of the ARGUMENT IS WAR metaphor. ARGUMENT, an abstract, not clearly delineated concept, is "partially structured, understood, performed, and talked about in terms of WAR," which is a more concrete concept that emerges naturally from the experience of physical combat (119, p. 5). The WAR schema specifies an event in which participants are adversaries who attack and defend positions, plan strategies, maneuver, advance, retreat, counterattack, declare truces, surrender, and triumph. The ARGUMENT schema, derived systematically from the WAR schema, represents an event in which participants are adversaries embattled in a conflict of opinions (not actual combat), who struggle over positions, gain ground, win or lose, and so on.

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Lakoff & Johnson (119, p. 7) argue that the systematicity of metaphorical concepts illustrated in this example is reflected in the language used in talking about these concepts and that, as a consequence, linguistic expressions are a source of insight into and evidence for the nature of the human conceptual system. Again, the research strategy, as stated in the passage quoted earlier from D'Andrade (56, p. 3), is to look for regularities in knowledge structures that are built into language to discover basic properties of thought. Some everyday speech formulas or fixed-form expressions reflecting the ARGUMENT IS WAR metaphor are evident in the following sentences (119, p. 4):

> Your claims are *indefensible*. He attacked *every weak point* in my argument. His criticisms were *right on target*. I *demolished* his argument. He *shot down* all my arguments.

Lakoff & Johnson (118, 119) distinguish three types of metaphors: ontological, orientational, and structural. Ontological metaphors are used in comprehending events, actions, activities, and states. Events and actions are metaphorically conceptualized as objects, activities as substances, and states as containers. The metaphor IDEAS ARE FOOD, which entails

IDEAS ARE OBJECTS, is apparent in a great many expressions.

> What he said *left a bad taste in my mouth*. All this paper has in it are *raw facts, half-baked ideas,* and *warmed-over theories*. I *can't swallow* that claim. That's *food for thought* (119, pp. 46–47).

VITALITY IS A SUBSTANCE is evident in

> She's *brimming* with vim and vigor. She's *overflowing* with vitality. He's *devoid of* energy. That *took a lot out of* me. I'm *drained* (119, p. 51).

and LIFE IS A CONTAINER is reflected in

> I've had a *full* life. Life is *empty* for him. Her life is *crammed with* activities. *Get the most out of* life (119, p. 51).

Reddy (161) has analyzed a particularly intriguing and subtle example, the "conduit metaphor," which structures both lay and many linguistic conceptions of language.

Orientational metaphors are used to structure abstract concepts that are not well grounded in experience in terms of concrete concepts arising from experience with spatial relationships. For example, UP-DOWN metaphors include, among many others,

HAPPY IS UP/SAD IS DOWN

> I'm feeling *up*. My spirits *rose*. You're in *high spirits*. I'm feeling *down*. I'm *depressed*. He's really *low* these days.

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HEALTH IS UP/SICKNESS IS DOWN

> He's at the *peak* of health. He's in *top* shape. He *fell* ill. He *came down with* flu. His health is *declining*.

CONTROL IS UP/BEING CONTROLLED IS DOWN

> I'm *on top of* the situation. He's in a *superior* position. He's in the *upper* echelon. He's *under* my control. He *fell* from power. He's *low man* on the totem pole (119, p. 15).

Structural metaphors are used in comprehending complex, highly structured concepts. While ontological and orientational metaphors are basic in providing the means of referring to concepts, quantifying them, orienting them, and so on, structural metaphors provide for the use of "one highly structured and clearly delineated concept to structure another" (199, p. 61). In structural metaphors, the constituent structures of complex object, orientation, and event schemata serve as the means of structuring other complex schemata. The ARGUMENT IS WAR metaphor is an example of a metaphor based on a complex event schema. LIFE IS A GAMBLING GAME is another structural metaphor involving a complex event schema. LOVE IS A JOURNEY is a structural metaphor based on an orientation schema:

> Look *how far we've come*. We're *at a crossroads*. We'll just have to *go our separate ways*. I don't think this relationship is *going anywhere* (199, p. 44).

Examples of metaphors based on complex object schemata have also been published: Basso (8) has described how the Western Apache classification of human body parts is used metaphorically in classifying parts of pickup trucks and automobiles, and Casson (36) has shown how a Turkish kin address system is extended metaphorically in addressing nonkin.

Narrative

Narrative is another burgeoning area of research in anthropology, linguistics, and psychology. Like metaphor, narrative is a huge topic that has been studied from a variety of perspectives (see 30, 42, 60, 75, 76, 79, 87, 114, 124, 194, 202, 208). Again, the strategy here will be to review only research employing the schema concept.

The three types of complex schemata described in this review have all been shown to provide the underlying organization for narrative discourse. Narratives based on event schemata have been by far the most extensively studied, undoubtedly because they are the most widely occurring, and will, for this reason, receive the most attention here. But interesting accounts of the use of

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object and orientation schemata in organizing narrative have also been published. In describing "the way of the hot pepper," a Cuna curing chant used against high fever, Sherzer (193) shows how the Cuna "hot pepper" taxonomy is projected onto a parallelistic verse pattern. The chanter inserts names for taxonomic categories into the verse pattern, beginning at the top of the hierarchy and moving down through a series of included subcategories, then returning to the top and moving down through another series of included subcategories, repeating this process through as many as 53 verses (193, pp. 283–84). Linde & Labov (123) describe the use by apartment dwellers of cognitive maps of the layouts of their apartments in producing "imaginary tour" narratives, and Harwood (88) discusses the use by Trobriand narrators of a spatial orientation schema representing locations in the Trobriand Islands as a mnemonic device in recounting particular myths and relating them to other myths in the totality of Trobriand mythology.

Event schemata that are used in producing narratives are generally referred to as story grammars or story schemata. They are global structures that break down into two major constituents: a setting subschema, which is comprised of a series of states specifying the time and place of the story, and an episode subschema, which is comprised of an external event and the protagonist's reaction to it (175). Episodes generally involve a problem-solving motif: something occurs that makes the protagonist set up a goal, which he or she attempts, successfully or unsuccessfully, to attain (171, 175). There have been many formulations of story schemata, which, although they vary in detail, generally incorporate this problem-solving motif (107, 130, 131, 162, 170, 171, 198, 204, 210). The EPISODE schema proposed by Rumelhart (170, 171, 175) is representative. This schema specifies relationships among several variables: an initiating EVENT, a GOAL, and an attempt, or TRY, to accomplish the goal. The TRY variable is a subschemata that specifies the internal structure of the attempt (or attempts) to attain the goal. It takes much the same form as the General Problem Solver proposed in Newell & Simon's (143) theory of problem-solving.

Rumelhart's (171, 175) story about Mary and the icecream truck illustrates this EPISODE schema.

> Mary heard the icecream truck coming down the street. She remembered her birthday money and she rushed into the house.

The major constitutents of this EPISODE are an EVENT (Mary HEARS the icecream truck), which initiates a GOAL (Mary WANTS icecream), which is the reason for a TRY (Mary TRIES to get icecream). The principal constituents of the TRY schema are an ACTION (selecting a problem-solving method, here BUYING) and a GOAL (the icecream). The BUY schema, it will be recalled,

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requires the BUYER to have MONEY (Mary rushes into the house and gets her birthday money) (171, pp. 271–73; 175, pp. 113–15).

The bulk of the story schema research is culture bound in that it is designed to account only for stories in the general European tradition (106). Though it is hardly news that story-telling traditions are quite different in non-Western societies, only a handful of studies have systematically examined cultural differences in story schemata (46–48, 106, 162). This work has, however, revealed specific differences in the way story schemata affect the comprehension and recall of stories. Particularly impressive is Rice's (162) demonstration that American college students recall American stories more accurately than Eskimo stories because the former fit their American story schema and the latter, which have their own distinctive structure, do not.

Story schemata, as described to this point, are hierarchical structures in which processing is top-down. A second approach to narrative comprehension concentrates on bottom-up processing. Schank (183, 184, 187, 188), the leading proponent of this approach, argues that stories are interpreted not only in terms of high level schemata like SETTING and EPISODE, but more importantly in terms of the stereotyped sequences of actions that comprise scripts. The restaurant script, for example, is invoked in interpreting the following simple story:

> John went to a restaurant. He ordered chicken. He left a large tip. (188, pp. 47–48)

Mention in the story of a *restaurant* and the actions of *ordering* and *tipping* is sufficient environmental input to instantiate the restaurant script. On the basis of this instantiation, the story is understood more fully than it is represented in the three sentences. Actions not mentioned in the story are supplied as default values of script variables, so the story is interpreted as

> John went to a restaurant. He sat down. He read the menu. He ordered chicken. He ate the chicken. He left a large tip. He paid the check. He left the restaurant (188, p. 48).

Gaps in the causal chain linking actions in the event are filled in by inferences made on the basis of knowledge represented in the script. It is explicitly stated in the story that John ENTERED the restaurant and ORDERED chicken, so it may be inferred that in between these actions he SAT down and READ the menu; it is also specified that John, having ORDERED chicken, TIPPED the waitress, so it may be inferred that he ATE the chicken; and because TIPPING precedes PAYING and LEAVING, it may be inferred that John EXITED the restaurant (188, p. 48). "The waitress," "the menu," and "the check," which

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are not mentioned in the story, are included in the inferred account because knowledge of the roles and props (i.e. agents, recipients, instruments, etc) involved in restaurant events is also contained in the script.

Inference is a major topic in discourse analysis, to which investigators working in several traditions have contributed (5, 86, 87, 113, 114, 157, 176, 178, 191, 192, 196, 200). In addition to Schank's (183–188) pioneering work, schema theory research on inferences and event chains has been done by Warren, et al (213), who have developed an "inference taxonomy," a classification of mutually exclusive categories of inferences, including three major types of inferences and a number of subtypes: logical inferences (motivation, psychological cause, physical cause, and enablement), informational inferences (pronominal, referential, spatiotemporal, world frame, and elaborative), and value inferences (evaluative). In discussing a particularly detailed ethnographic example, Trobriand litigation discourse, Hutchins (95, 96) describes a general schema for possession and transfer of land tenure rights, showing how actions and logical connectives that are only implicit in discourse about land tenure cases are supplied by inferences made on the basis of cultural knowledge represented in the general schema. Quinn (160) provides a detailed critical review of Hutchins' contribution to the continuing development of schema theory in cognitive anthropology.

CONCLUSION

The preceding sections have described schema theory and its wide range of applicability in cognitive anthropological research. Research and results from many seemingly disparate fields of cognitive study have been drawn together and discussed in terms of a single, comprehensive and coherent, explanatory framework. New work in cognitive anthropology specifically guided by schema theory has been considered and familiar work has been reconsidered in light of this perspective. One conclusion suggested by this review is that schema theory offers a broad, unified theoretical framework that has the potential to integrate research in cognitive anthropology and cognitive science generally. Although already evincing some of this enormous promise, schema theory is still in the early stages of its development. At present, it is undoubtedly overly powerful and too general. It is invoked in providing accounts of a great many different kinds of data, often in a way that does not take into consideration the particularity of specific aspects of cognitive organization and processing. The work of the next few years hopefully will fill in the details of a unified schema theory and specify the factors that constrain the structure and function of specific varieties of schemata. A second conclusion, then, is that the development of schema theory offers a very exciting prospect for future research in cognitive anthropology.

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Annual Review of Anthropology
Volume 12, 1983

CONTENTS

OVERVIEW

Evolution of a Teacher, *Sherwood L. Washburn* 1

ARCHAEOLOGY

Variation in Prehistoric Agricultural Systems of the New World, *Ray T. Matheny and Deanne L. Gurr* 79

Remote Sensing, *Michael Parrington* 105

Analysis of Style in Artifacts, *Stephen Plog* 125

Professional Responsibility in Public Archaeology, *Thomas F. King* 143

Concepts of Time in Quaternary Prehistory, *G. N. Bailey* 165

Current Directions in West African Prehistory, *S. K. McIntosh and R. J. McIntosh* 215

Theoretical Issues in Contemporary Soviet Paleolithic Archaeology, *Richard S. Davis* 403

BIOLOGICAL ANTHROPOLOGY

The Stone Age Prehistory of Southern Africa, *Richard G. Klein* 25

Human Heat Tolerance: An Anthropological Perspective, *Joel M. Hanna and Daniel E. Brown* 259

Adaptation to High Altitude, *Lorna Grindlay Moore* and *Judith G. Regensteiner* 285

LINGUISTICS

A Survey of Afro-American English, *John Baugh* 335

A Decade of Morphology and Word Formation, *Mark Aronoff* 355

Schemata in Cognitive Anthropology, *Ronald W. Casson* 429

REGIONAL ANTHROPOLOGY

Anthropologists View American Culture, *George D. Spindler and Louise Spindler* 49

Anthropology in Eastern Europe, *Joel Martin Halpern and David A. Kideckel* 377

(*Continued*)

Annu. Rev. Anthropol. 1983.12:429-462. Downloaded from arjournals.annualreviews.org
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CULTURAL-SOCIAL ANTHROPOLOGY

Contemporary Hunter-Gatherers: Current Theoretical Issues in Ecology and Social Organization, *Alan Barnard* 193

Biomedical Practice and Anthropological Theory: Frameworks and Directions, *Robert A. Hahn and Arthur Kleinman* 305

INDEXES

Subject Index 463

Cumulative Index of Contributing Authors, Volumes 6–12 476

Cumulative Index of Chapter Titles, Volumes 6–12 478

Annu. Rev. Anthropol. 1983.12:429-462. Downloaded from arjournals.annualreviews.org
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