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Research Article

THE IMPACT OF BIOPHILIC DESIGN ELEMENTS ON THE ATMOSPHERIC PERCEPTION OF THE INTERIOR SPACE

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ABSTRACT. Biophilic design, which is the way of turning back to its essence of human from the modern world, aims to create atmospheric differences in the interior where the human can be both physically and mentally comfortable. In the conditions where green areas lost with urbanization bring the city people away from the nature and longing for nature. As Biophilia means "love for life and living systems.", this design concept integrates the nature of our lives and born as a solution to liveable spaces. The elements of biophilic design are parts of a design approach that aims to reflect nature from the outside to the inside, towards creating a sensory atmosphere in which human beings can achieve comfort, health, and relaxation through connection with nature. With this study, it was examined that which sensorial strategies and elements used to design a biophilic interior and how it effects the atmospheric perception of the space with four phases; First, the term biophilia and biophilic design is introduced. Secondly, the design elements that affect the indoor atmosphere are covered in detail. In the third part of the research, the human factor is examined in mental, physical, and human scale framework, in the last part sensorial fundamentals of biophilic design is analysed in relation with biophilic design elements and concluded with a discussion about how the biophilic design elements affect the atmospheric perception in the space.

Keywords: *Biophilic Design, Human Factor, Atmospheric Perception, Interior Design, Sensorial Design.*

INTRODUCTION

It is human nature to change where he lives. Throughout history, every step taken to facilitate use and increase comfort, from shelters to today's buildings, has taken living spaces to the next level while moving away from the nature. The change for improvement in this living space, which is an integral part of human beings, ranges from living to aesthetics. Every step taken to solve problems, produce solutions and improve the existing one initiates a creative design process [1]. In the design process, biophilic design comes as a solution to meet our need for comfortable accommodation, while staying in touch with nature without breaking our relationship with our essence and to do this in the limited areas of the developing world. The way this design strategy turns into a solution is driven by theory, science, psychology, and practice [2].

There are three different ways to experience nature. Those are directly, indirectly, and as integrated into the space. Experiencing nature in the interior space within the framework of human-oriented design can be considered as the key point of biophilic design. Biophilic design can be experienced in a variety of sensory ways such as sight, sound, touch, smell, and taste [3]. Contacting plants, smelling them, feeling the flow of air, hearing the sound of nature, being close to natural materials, looking out of a window overlooking the nature view are all ways to invite nature to the interior. The integration of biophilic design elements into living spaces allows people to experience nature indoors. All natural elements within the framework of the biophilic design elements,

indirectly contribute to the perception of atmospheric space. All sensory elements perceived in the interior through the senses are effective in changing the physical and mental state of the person.

In the conditions of the modern world, people spend 90% of their lives indoors [6] but despite this a significant number of spaces that citizens spend their daily life like offices, schools, hospitals are designed without considering visual connection to the outside or air circulation, far from human scale and needs. This situation analysis is intended to reflect not only an indirect complaint about the uncomfortable spaces, but also to express that there should be natural elements around it to ensure that people are mentally and physically healthy. As emphasized in the “Biophilia Hypothesis” written by Keller and Wilson, the need for natural elements that surround us comes from both the genetic basis and the subsequent learning process due to the cultural development of human progress throughout history [11].

The aim of this study is to examine how the human-nature relationship reflects on interior spaces within the scope of a design strategy and in the framework of the biophilia phenomenon and to analyse the contribution of the Biophilic design method to the interior atmosphere in the sensory context.

The article is structured as follows. First, the term biophilia and biophilic design is introduced. Secondly, the design elements that affect the indoor atmosphere are covered in detail. In the third part of the research, the human factor is examined in mental, physical, and human scale framework, in the last part sensorial fundamentals of biophilic design is analysed in relation with biophilic design elements and concluded with a discussion about how the biophilic design elements affect the atmospheric perception in the space.

This article draws attention on the importance to the usage biophilic design elements in the interior space through a literature review about biophilia, biophilic design, sensorial design, human-design relations, and atmospheric design and searches the relation between those design elements and effects on atmospheric perception.

What is Biophilia and Biophilic Design?

The term biophilia was first used by the American psychoanalyst Erich Fromm in 1973 in the book "Anatomy of Human Destruction". This term, which Fromm uses with the definition of "passionate love of life and everything living", was introduced into the literature in 1984 by the American biologist Edward O. Wilson with the same meaning in his book "Biophilia" [7]. When we examine the word origin of the term "biophilia", which is a Greek word in essence, it is found that it essentially comes from the words "bio" (life) and "philia" (love) [3]. It can be said that the definition of "love of life or living systems" is derived based on the meanings of the words that create the terminology that gave its name to the design approach.

"Biophilia" refers to the emotional bonds that human have with other living organisms. Humans are essentially a part of nature and therefore their connection to nature is inherited. On the other hand, in the biophilia hypothesis written by Keller and Wilson, it is stated that biophilia is not just an insight, but a perception that is learned later and shaped by culture as people move away from nature. From generation to generation, change in technology, conditions, and life, supports the thesis of culture factor and post learning effect. Since the origins of humanity go back hundreds of thousands or even millions of years. As their language and culture developed, people began to refer to nature in the myths and metaphors they first created, using the living life and organisms they

saw in their surroundings. As a result of different assimilation and mythizing of the nature, sensory responses, genes, and culture began to form by evolving together [11].

In the biophilia hypothesis, it is stated that human beings provide ecological functions to the structures they live in, strengthening the bonds and at the same time, allowing them to adapt, develop and continue their evolutionary struggle. In addition, it was mentioned that the insufficiency of nature relationship in the buildings where people live, brings the need to experience nature aesthetically. Man's aesthetic perception of nature often occurs around living organisms, and humans are aesthetically more attracted to relatively large animals [11].

Biophilic aesthetic perception can also be defined as a legacy that has been left to us since evolution [14]. According to Salingaros, there are more than one determinant of indoor well-being. These can be divided into nature and geometrically imitating nature. The geometric imitation of nature is associated with memory and instincts received by our ancestors through evolution from nature that are geometrically coded for survival. For this reason, the state of love and need for nature, defined as biophilia, leads us to experience spaces internally. In this way, while internalizing the space we are in, we seek sensory clues from our essence. We integrate these elements into our spaces by adapting to the innovative living order and architecture and obtain the healing and mentally comfortable living spaces of biophilic design.

Biophilic design can be basically divided into organic (naturalistic) design and local (ground-based) design. In organic design, people use shapes and forms in a space directly, indirectly, or symbolically with the natural environment. Natural lighting, ventilation, natural materials, water, fire, plants, forms shapes and colours inspired by nature are design elements. Locally evaluated biophilic design, on the other hand, designs that foster the commitment of culture, history, and ecology to the subject. The local design path establishes the link between man and nature through "valuing nature" without modifying the local ecology [13].

As Architect Steve Kieran said in his lecture at the Yale university in 2005 *“We will never achieve an ethical architecture that is beautiful and sustainable until nature is integral and at the core and at the substance and being of the architecture, not added on. If it ain’t beautiful, it can’t be sustainable. Buildings must shelter and inspire”* [13].

Biophilic Design Elements That Affects Interior Atmosphere

The concept of atmosphere is used as a synonym for mood, emotion, ambience, or tone. In Böhme's definition of atmosphere, *"atmospheres are a phenomenon based on a kind of movement in space, an expanded quality of emotion."* [5, 20]. Aesthetic understanding depends on perception. Perception is related to the neurological processing of visual information. The first factor affecting the perception is the atmosphere of the space due to its instant perception [5].

The biophilic design changes the indoor atmosphere not only have to be the changes made inside, but it is also possible to change the interior atmosphere with an outdoor design that it is connected to the interior sensually. Every design decision, from the green roof that connects to the space, to a vertical garden positioned outside, a view of nature visible from the window, to the smell of flowers that are planned to come inside with a breeze, are external factors that contribute to the interior atmosphere. It is undoubtedly the extraordinary physical attraction of animals that makes the aesthetic beauty of nature so fascinating to man and this attraction power follows a state of admiration for the aesthetic beauty of nature [11]. Animal-human relationship is an important component of

biophilic design. It is the establishing a relationship with the living animal, using animal patterns and forms resembling animals is one of the methods used to invite nature indoors since ancient times. Although the use of live animals indoors is challenging and calls into question the concept of nature ethics, experiencing animal life indoors does not necessarily mean keeping them indoors. Animals can be integrated into the interior in their natural habitats by creating observation points with green roofs, gardens, aquariums, and binoculars, or with furniture, patterns, and pictures.

At this point, it should be mentioned that not only animal figures, but also other patterns that reflect nature are used to remind nature in interior spaces. All shapes, figures and patterns representing nature can be used in this context. These areas of use can vary from carving to stained glass, from printing to texture. The use of naturalistic forms is also seen in design movements like Rococo, Orientalism, Art Nouveau, Arts and Crafts and Art Deco.

Daylight, on the other hand, have contributions to human health, space perception and way finding in the interiors [3]. Just as the longing for nature is defined as biophilia, the sensual longing for natural light is called *"photophilia"* and *"topophilia"* for natural environments [17]. We need light to perceive our environment in three dimensions, but it is not the only benefit of daylight. To be healthy, we also need vitamin D, which we can get from the sun through our skin, this is of great importance for both our health and our feeling healthy. Another thing that sunlight provides us with is our perception of time. Our circadian rhythms, our instinctive perception of time, control our sleep cycle with melatonin secretion, and this rhythm enters the rhythm with sunlight. In case rhythms like jetlag are disrupted, we need sunlight again to return to order [14].

When daylight examined in terms of a design material, it is seen that natural light in the space, creates different spatial perceptions in a diffuse way, directly or by creating shadows. The introduction of natural light into the interior bring creative changes in the atmosphere can also be supported by strategic design decisions such as colour, space organization and with use of materials like glass and reflective surfaces. Changing daylight from hour to hour, changes the atmospheric perception in the interior with the change of light angle.

Another necessary factor for a biophilic design to be successful is the provision of good natural ventilation flow. The correct entrance and exit of natural air are very important not only in terms of biophilic design but also in terms of creating a sustainable environment. Experiencing air indoors may differ with variables such as direction of the flow, breeze strength, temperature, pressure, and humidity. Window placement and shape or more extensive mechanisms such as a pressure stabilizer have great importance in terms of controlling these different variables [3]. With the right techniques, it is possible to invite the scent of nature, the sea, flowers, and the soil odour inside, to ensure the flow of air together with the correct building positioning, exterior landscape design and window placement. In this way, you can smell the fragrant flowers you planted in front of the window with a breeze coming from the outside and you can feel it through the smell even if you do not have visual contact at that moment.

Water, which we can define as the source of life, is also one of the design elements that help reduce the stress of people, improve health conditions and work performance. The factors that make us so attracted to water are also because it appeals to our different senses. We can come into contact with water by seeing, hearing, touching, and even tasting [3]. In interior design, it is possible to experience water with ornamental ponds, aquariums, artificial wetlands, fountains and sometimes just drops of rain on the window.

Each design element atmospherically makes a different contribution to the interior. When water as a design element is supported by artificial lights, plants, and materials, giving us the opportunity to experience the interior in a different way. With the different use of the water element, it is possible to create a calm interior atmosphere, as well as a more interactive and livelier atmosphere.

Vegetation as another design element, is perhaps the first design element that comes to mind when it comes to bringing nature indoors. As one of the clearest strategies to invite nature in, the use of plants, is one of the design elements also contribute to stress reduction and physical health improvement. In the context of design, the use of plants in clusters, single or dispersed forms is one of the factors that affect the interior atmosphere and perception in different ways. The ecological context of the plant species is also important on the way to make a biophilic design in plant use. Using local plants instead of exotic species in the design is also valuable in terms of ecological and sustainable design [3].

Just like a furniture design, there are certain design criteria in planting design. As it can be seen in the Fig. 1, the main headings of these criteria are the same in both designs, divided into three as colour, texture and form. However, while the colour criterion in a furniture design is *"hue, tone or brightness and saturation or intensity"*, when it comes to planting design, the colour criteria change to; *"autumn colours, the colour of leaves, bark, flowers and fruit*." Since plants change colour in every season it is important to be able to see further in the design process. In terms of texture design, when designing an object, *"visual, nature of the surface and tactile"* are the design criteria, while *"leaf, tree and branch"* are the criteria in planting design. When it comes to form, for a furniture or an object design the criteria are separated as *"Inorganic or human-made, three-dimensionality and organic or natural"*. On the other hand, for planting design *"Natural hedgerow, geometry, being formal or informal, height, width, length"* are among the criteria in the design process (Fig. 1). Furthermore, for planting design, plant species, location, season, function and maintenance are among the influencing factors on the design decisions [33].

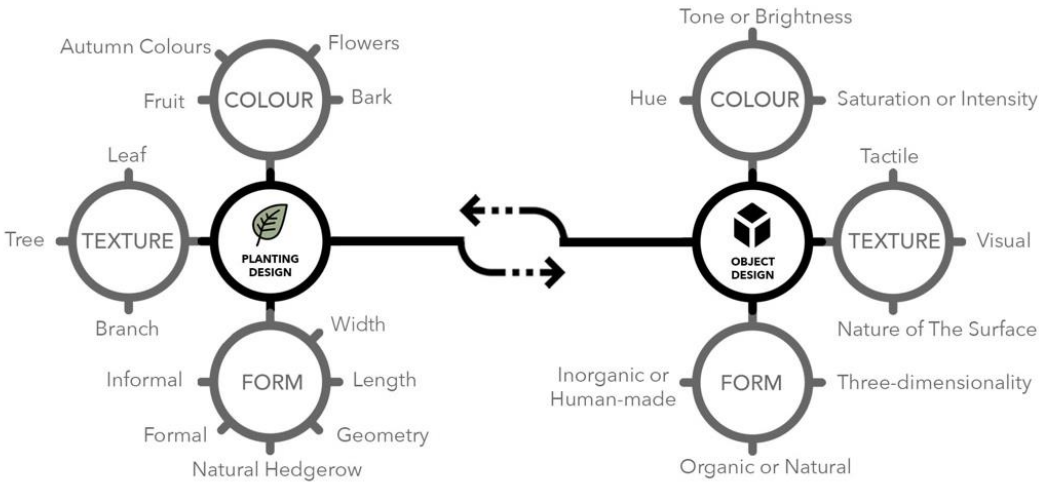

Fig. 1. *Planting and Object Design Criteria, Similarities and Differences Diagram*[1]

[1] *The diagram in Fig.1 is based on information taken from Holden and Liversedge's book, "Landscape Architecture, an Introduction, (2014)." [33]*

Keeping in mind that plants are living beings during the design process, it is important both to ensure continuity in design and to make a sustainable design. Using and positioning the plants, taking into consideration their needs such as water and light will allow both the capture of the desired atmosphere in the interior and the protection of design as it is. The textures, colours of the plants, whether they shed their leaves, the plants that can be used together, the appropriate growing conditions are all important factors in plant selection. It is possible to create a biophilic atmosphere in the space with the texture, colour, and smell of the selected plants. Indoor usage areas of plants also differ in terms of their contribution to the atmosphere. Indoor uses such as green walls, inner gardens, flowerpots are the most common ones. Also, indoor aquatic plants can be used in an artificial pools or ponds. Furthermore, it is possible to integrate the plants into the space by providing a visual connection from the outside landscape through the window.

In addition to being a design element in the design, plant, flower, and tree forms continue to exist as a source of inspiration for organic forms used in designs [23]. As well as being inspired by the plant's forms, they are used symbolically and by integrating into furniture with the use of their motifs, like animals. The use of artificial plants is also one of the design elements used indoors and inspired by nature and plants. Realistic plants that are accurately replicated, although they do not appeal to many senses like a real plant, visually contribute to the space.

Fire, on the other hand, is one of the design elements discovered at the very beginning of humanity and that led us to our origins. According to Vitruvius, the discovery of architecture is as basic as the discovery of fire and the language of communication, and he describes the presence of fire as an indicator of the beginning of people's life as a social community [18,19]. Experiencing fire indoors has a valuable position in creating a warm atmosphere. Although fire has the power to create anxiety by reminiscent of burning, it can give warmth to the environment as a part of the design with a controlled fireplace, candles, or fire barrels [3]. The fire element need not only be present to contribute to the environment, but it can also create an atmosphere of warmth in the interior by simulating fire with heat, colour palette and light.

Biophilic design elements influence human perception of interior space due to the mentioned atmospheric effects. The biophilic atmosphere filled with shapes, materials and symbols representing nature, stimulates positive responses. The used language of the surrounding nature "*can make people feel alive and human*" [8,9].

Human Factor and Biophilic Design

For the successful implementation of biophilic design in interior spaces, it is not only a design that meets the physical needs of the human being, but also have to contribute to the space atmosphere mentally and behaviourally. When examining the state of physical contribution, blood pressure, comfort and satisfaction and recovery state are seen to be the determining parameters. In addition to those physical improvements, the mental improvement results can be described as an increase in motivation, satisfaction, problem solving ability, creativity, and less anxiety and stress. On the other hand, when positive changes are examined in terms of behaviour, it can be described as able to overcome the problems better, improvement of skills, providing concentration better, increase in social skills and reduce aggressive behaviour is found [3].

According to the results of many researches, it has been found that indoor biophilic interventions affect blood pressure positively. Significant changes in heart rate are observed in places where windows, plants and natural materials are used, which provide daylight and natural views. This physical effect created by biophilic design elements directly affects psychological and mental functions such as stress control and concentration [10].

The healing effect of biophilic design on humans may be one of the most important positive results of this design strategy, which can be considered both physical and mental effect. At the beginning of time, healing techniques were applied with the help of nature. Nature sometimes contributes to human well-being and healing with the raw materials in medicines and sometimes the conditions it provides. In addition to the medicines of the period, the sound of water, music, fragrances, and examples of treatment by spending time in nature are seen in many healing centres in the Ottoman Empire and Ancient Greece. Although biophilic design has benefits such as lowering stress levels, helping people become more resistant to diseases and contributing to their recovery by changing the environment. As nature used as a healing factor throughout history, we see that today's healthcare professionals use the drugs first [14]. There are many examples and research can be found that relates nature with the healing process and wellbeing.

In 1984, environmental psychologist Roger Ulrich made a discovery. His study focused on the relationship between recovery from surgery and the natural appearance of the room, and with this experiment, it resulted in the finding that the recovery rate was higher in patients who stayed in rooms with nature view after surgery. As a result of the study, it was observed that the use of biophilic design in hospital rooms reduced the need for medication and improved behaviour during the recovery process [16]. As a result of this study, it was found that it has a measurable effect on the health and healing process of patients by only improving the quality of the aesthetic experience [17].

In biophilic design, human factor is one of the design factors that should be considered in terms of designing according to "human scale" in addition to the state of healing and well-being. The human scale was defined as the most well-known human measurement systems, in Leonardo da Vinci's 1490 Vitruvian Man drawing and the Le Corbusier Modulor drawing (1948) [25]. The architectural space standards, in which the human body can adapt to the ideal ratio and the optimum dimensions are calculated in terms of use, are also available in the book "Neufert: Architects' Data" published in 1936 for the first time [27]. Spaces designed with this human scale and in a way that human beings can use in the most appropriate way help the designer in designing spaces that will be used without exceeding the limits, respecting the nature of the human. In the love for nature, which is the essence of biophilic space, it is possible to provide spaces in human scale without ignoring the factor that human beings are natural and a part of nature.

Sensorial Design Bases of The Biophilic Design

The senses, emotions, mind, culture, and physical-mental state of health develop according to our changing living standards and play an important role in experiencing the environment [22]. Every space that is designed or in its natural state reaches us through our senses. The senses guide us in perceiving space. If we did not have any of our senses, it would not be possible for us to define any space or visualize it in our minds. In fact, each element used has a sensory function. When a biophilic space is desired to be created, these design elements should be chosen in such a way that they describe nature to us through the senses.

When we look at building designs that have an important place in terms of architecture in the world, although landscape designs do not come to the fore as the primary, when examined in detail and architectural historian Grant Hildebrand's "*Biologically, we tend to like buildings and landscapes with prominent natural elements. When we can't really place ourselves in a natural environment, we make some effort to provide ourselves with substitutes. There is evidence that we like to have natural archetypes or simulations of them in our environment. The thing is, a building or the landscape does not resemble nature, some architectural scenes (eg, form and space, light and dark) fit an archetypal image of the natural world."* considered together with their words, we see that these architectural buildings that leave a mark on us are appreciated not because the buildings resemble nature, but because they provide us with the way of creating traces and scenes from nature that can appeal to all our senses [3, 21].

In this section, the sensory design elements are examined under the heading of five senses and how they contribute to the space through senses is analysed. Under the sense of "sight", visual connection to the nature, natural form and material was analysed, under "hearing" the sound of water and plants was examined, under "touch" the texture of plants and materials, and the feeling of fire and air, within the scope of "fragrance", the effect of the scents of nature on the design is processed and as the fifth sense, "tasting" is examined as a design element within the scope of edible plants and water as a life source. The relationship between Biophilic design elements (Fire, Plants, Water, Colour-Shape-Form Inspired by Nature, Animals, Natural Lighting, Ventilation, Natural Materials) and senses (Sight, Hearing, Touch, Smell, Taste) is shown in Fig. 2.

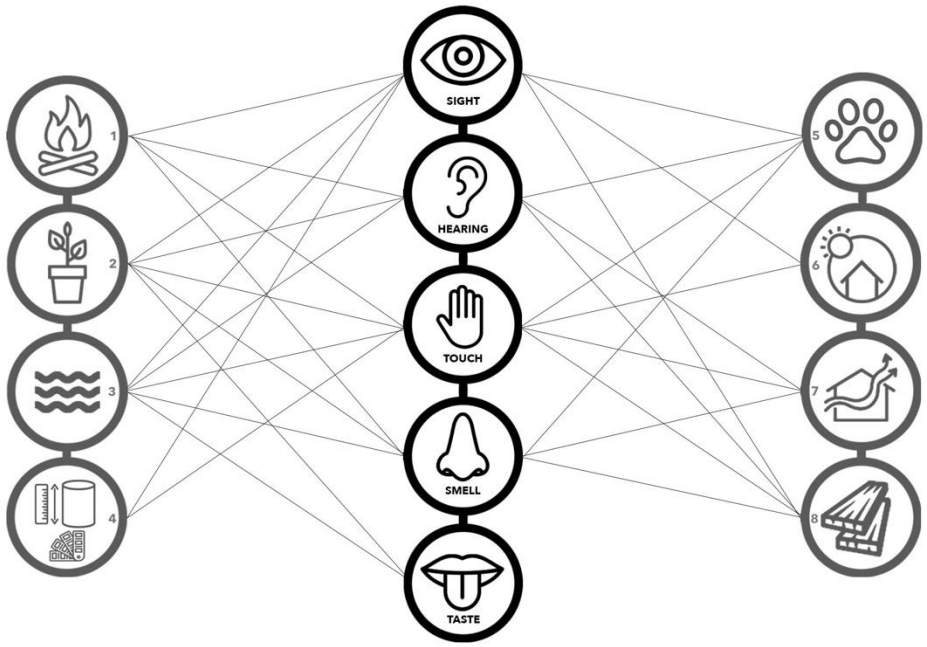

Fig. 2. *The Relationship Diagram of The Senses and Biophilic Design Elements (1.Fire, 2.Plants, 3.Water, 4.Colour-Shape-Form Inspired by Nature, 5.Animals, 6. Natural Lighting, 7.Ventilation, 8.Natural Materials)*

SIGHT

1. Use of Natural Colour and Light

Colour perception is one of our senses that is directly related to our emotions. At different times of the day, we perceive colours of different shades with different light angles. Man's relationship with colour is defined by the hour-to-hour hue of light and the colours of natural elements such as plants, animals, and rocks. The psychological effects of colour are based on the origin of humanity in the ages when colour perception was formed [14]. The ability to perceive colour is a sensory feature. Colour receptors in our eyes, these channels that send signals to the brain, are directly linked to our emotions. Our perception of colour has evolved from red to blue under natural light. As a result, the shades of colours are in a linear relationship with the light. The colour of every object in nature changes according to the incoming light as well as on surfaces [15].

The reason why colours are an effective factor on human perceptions in design is that they have a function that has been transmitted to us through our genetic codes, which has influenced the survival of our ancestors, and enables them to locate food, resources, and water. *"People are interested in bright floral colours, rainbows, beautiful sunsets, shimmering water, blue skies and other colourful features of the natural world"* [23]. For this reason, using colour palettes from nature is an effective way for designers to create spaces that people will be satisfied in.

The use of colour is one of the important design elements that contribute to the perception of space atmospherically. Colours that have symbolic and psychological factors on people should be integrated into the space as a design method. The fact that the colours of natural materials are at the forefront creates a biophilic atmosphere, but if artificial materials are used to complete the design, the use of a natural colour palette and the symbolic reflection of nature in these materials will complete the desired atmosphere [23]. In addition to having a sensory effect on its own, colour has the feature of having a place in the human's memory and creating an atmosphere with the colour palette it is used together. Every colour is a part of nature and is observed in nature. The most important thing in a biophilic design process is to construct the harmony and balance of colours as if painting a landscape, and to make the user feel in relation to the created space and nature.

2.Use of Natural Form and Material

2.1. Natural Form

Curved forms appear in every point of nature, and it can even be said that a straight line is difficult to find in nature. The phenomenon of curvature and nature originates from the living and lifelike nature that human beings experience in their environment, which comes from its essence, again to the perception codes. We are emotionally satisfied with curves that have a symmetrical and natural balance through our neurological response mechanisms. On the other hand, gravitationally, unstable curves can be perceived as disturbing [14]. The observation of the forms and shapes seen in nature by our ancestors can be observed because of the need for shelter [18].

Biophilia reflects the sensory response of humans to natural elements in their environment. However, biophilic design is sometimes confused with Biomimicry. Biomimicry can also be used in architecture with shapes that do not reflect or directly

reference nature with inspiration from nature. For example, the fractal lattice in an animal or plant anatomy can be used as a source of inspiration in biomimicry and used in the arrangement of materials in the design of the building facade. However, an abstract nature phenomenon in this dimension may not contribute to the state of well-being by not expressing nature to it sensually, since it is not a symbol that people can easily perceive. For a design to be biophilic, it is not enough to take reference only from nature, at this point, its distinction can be sensed by the senses and contributing to human well-being, the criteria can reveal the difference between the two design methods [14]. The biological and geological forms known as *"biomorphology"* and *"geomorphology"*, which are the source of inspiration for designs, is also one of the frequently used methods in biophilic atmosphere design [23].

2.2. *Material*

We are connected to nature through the materials, designs we choose and the location we are in [13]. When the atmospheric contribution of material selection to biophilic design is examined, we see that the use of minimally processed materials such as wood and stone contributes to the natural feel of the space. However, it is not enough just to be unprocessed for material selection. It provides a biophilic contribution to the space by connecting the spirit of the location with locality, climate, and culture using local materials. In addition to the contribution of localness to the atmosphere, it is another important dimension that the natural, ecological and supply is made from approximately 1000 kilometres of environment [2].

The use of materials is associated with many senses in space, such as touch and sight. In a space designed to create a biophilic atmosphere, the use of natural materials is as important as material compatibility. The first place to be inspired when designing this material palette should be nature itself. Both the colour balance and texture balance in nature guide the designer in the design process. "Material experience" is an expression of human experience through material. It is human nature to give meaning to materials or an object. These meanings are the experiences we have with them, through the observations and experiences. Knowing that glass is fragile, and stone is hard depending on our experience with these materials [32].

Plants are also perceived and used as a design element serving different senses in the space. Perception through contact is one of them. Plants are considered as a material in design. While being evaluated as material, it should not be forgotten that plants are alive, and they should be used by constructing a design to meet their natural needs. This factor is also of great importance for the design to be sustainable. As mentioned in the title of *"Design Elements That Affects Interior Atmosphere"*, the design process and the factors affecting the planting design are like the design process of an object but vary according to the characteristics of the plants. While considering plants as materials, unlike furniture design, "*plant type, location, seasonal characteristics, function and care*" are as important criteria as "*form, colour and texture"* (Fig 1.) [33]. The compositions made with plants can be positioned next to structural elements or water elements, and endless design variations can be created by supporting variables such as flooring material, pool types and location [33]. The choice of plants, the choice of materials will change the feel of each variable composition and will help create a different sensory environment for the user.

3.Use of Visual Connection to The Nature (Window - Outdoor Framing)

Windows are an important architectural element that provides our visual relationship with the exterior. Architectural conceptions, geographical conditions and design decisions vary with their location, dimensions, and shapes in the space. They are openings that connect us from the interior to the exterior through our visual sense and the evolution of this architectural element is also important while exploring the sensorial relation of the design elements and biophilia.

As Walter Gropius stated in "New Architecture and Bauhaus", with the emergence of new materials, traditional construction raw materials in post-industrial revolution buildings were replaced by new materials such as steel, concrete, and glass. With the integration of materials into architecture, it has also changed the architectural perception and thus it has been possible to create wide openings that allow them to be interact with nature in designs [34]. In the age of industrialization, people leave their lives in the village and settle in the city to find a job, which brought them away from nature. This process, which can be described as the opposite of biophilic, forced people to live in places without ventilation, comfort, windows and isolated from nature, followed the production of new materials, and with these new materials, it started with creating wide openings to return to nature.

When a research on "Designing Nature in the Daily Spaces of Childhood" is examined, it is seen that interacting between indoor and outdoor spaces is a necessity to create a healthy space for children. As a solution, it is recommended to have large windows in the interior, and to design an interior garden or a glazed botanical garden in places with cold climates [30,31]. This research also shows that having large windows that relates user to the exterior is increase the life quality of the user.

On the other hand, when the view from window is considered as a design element, with landscape design, it is possible to change the landscape seen outside when viewed from the interior through a composition change, design decision. A properly designed environment can achieve the best view of the user and affect the direction of view while blocking unnecessary sounds at the same time. By positioning the plants according to their height and texture, the desired direction as a vista for the person to look can be provided by the designer.

HEARING

The sound itself has the healing effects of the presence as well as the visuals of the water itself. Every sound of nature coming from outside is reflected inside as an element that will affect the atmosphere. The patter of a light rain, the sound of the sea waves, the sound of the waterfall, the sound of birds singing, the sound of the leaves are just a few examples of the music from nature. Water and plant sounds each vary according to natural conditions and material types. Just as the sound emitted by the rain differs according to its intensity, the feeling it creates in the interior changes the atmosphere in the environment. For those who have trouble sleeping, nature sounds, or white noise playlists are techniques used as sleep therapy, and this technique uses the power of sounds to change mood and atmosphere. According to studies, it has been observed that listening to nature sounds or wearing headphones to prevent sounds from the environment, especially in hospitals, helps improve sleep quality in patients [23,27].

Under the conditions of modern life, every single electrical device in our living spaces creates a solid barrier between us and nature, without really understanding what we hear. Almost all electrical devices make a fan noise, and this noise can start to come to us after

a while as the sound of increasing bills and has the potential to create additional stress on us [23].

TOUCH

1. Use of Texture

Materials are not only perceived visually but also; we experience them by the sense of touching. Landscape areas created inside or outside the building encourage the development of imagination, exploration, and problem-solving skills due to their diversity, texture, and detail. The texture of natural materials has organic and curved structures compared to objects created by human beings; this form nurtures the sense of exploration [23]. The feature of natural materials that make people wonder is because each natural material is different from each other. A piece of oak or a shell is not the same. Although it has a perfect ratio, each natural element is a material to be discovered. This state of discovery also helps people to get away from stress by allowing their mind to divert elsewhere [22]. The fact that we find ourselves rolling our hands around the texture of a wooden table while immersed in a thought, and this behaviour takes our stress, is an example of this behaviour.

The texture of the material not only affects the atmosphere of the space with its naturalness, but also every material used in the interior contributes to the atmosphere with its effect on acoustics. For example, materials such as fabric absorb sound, mirrors, glass, or marble can reflect the sound and these texture differences change the direction of reflection of the sound. Changing acoustics in the interior creates a direct difference in the "perception of space" by directly affecting the quality of hearing [28].

Texture also has an impact on the perception of scale, shape, position, and distance. It is possible to change the perception of space visually by creating a difference in textures as well as colours and light. According to research by Wang at al., [29], a room with a textured wall is perceived smaller than a non-woven room of the same size, the perception of rough or clear patterned textures, such as wooden walls, correlates with the distance of the person in the space, and creates different textural effects. The meaning that the texture of the material evokes to the user is also the factors that affect the width perception.

2. Use of Air and Fire

Fire and air are perhaps the most powerful design elements transferred from the essence of human beings to this day. Without air and warmth, we cannot survive. When we consider them as a design element, the common feature of these two important elements is that we can feel them without seeing them. We do not need to see that we are close to fire or the wind hitting our faces, we get this information through our skin. Although fire is used as a visual element in the design and symbolically adds warmth to the space, inspired by its colours, it is the fire that we feel through touch that gives the atmosphere the real warmth.

On the other hand, although the air, is not seen like fire but it is a design element that can be used in many ways by providing correct ventilation in the space. With the design of the air flow, it is possible to direct the smell of the sea, newly mown grass, smell of the soil from the outside, while the unwanted smells can be directed out by positioning the building and the windows correctly. Providing the correct ventilation system with the position of the building and the windows is have great importance not only in terms of sensory but also in terms of sustainability. The most important factor for human health in the places we live in is that the air is quality to be clean and homogeneous [23].

SMELL

Every object has a unique smell. These distinctive scents allow us to understand what they are without seeing them. The smell of freshly cut grass, the smell of the soil after the rain, the smell of flowers are just examples of the natural scents carried inside the space by an air flow from the outside. Since each scent has a different effect on people in relation to their own past memories, these scents of nature, which are behind these memories, often have an impact on people. For this reason, man-made products such as candles, incense, room fragrances that artificially bring fragrances to the space aim to revive the feelings of people and add character to the space by trying to reflect the scents of nature [23, 30].

The use of scent as a nature therapy is one of the design techniques that are also used in biophilic design and appeal to the sense of smell. Nature therapy through scent is applied in the following steps. First, the stress state is detected, with the aim of restorative effect, scents such as forest, flower scent are smelt, although there are differences according to individuals at this point, psychological rest and improvement in the immune system are a result of these stages. The aim is to achieve physiological relaxation and to achieve this without medical treatment. In studies related to odour; Aromatic oils such as orange, rose essence, fragrances of herbs with medicinal value such as perilla herb oil, have been tested in the interiors of structures made of different building materials and their positive effects have been observed [35].

TASTE

1. Use of Edible Plants (In Grown Vegetables, Herbs)

Plants and flowers are not only beautiful but also a source of food for people. Humans had evolved throughout history to understand and discern plants as food visually and mentally [24]. Plants play an important role in people's lives as a symbol of food and life, as well as reminders of nature. This inherent fear of hunger, the desire to grow their own food, is the basis for many people's desire to settle outside of the city and grow their own fruit and vegetables. Although this is the basis of the need and love for plants, the presence of plants in living spaces has the potential to increase people's comfort, health, and performance, even if they are not consumed as food [23].

Various design solutions for growing indoor vegetables and herbs and integrating edible plants into the interior are presented by the designers. Some of these design examples include the green wall mechanisms and growing plants in pots that is used since ancient times. As an alternative to classical flowerpots, pot mechanisms integrated into kitchen modules, self-fertilizing and even self-watering technologies have been developed today. With these methods, it will be possible to make a small-scale agriculture from tomato to basil in the living area. While appealing to all the senses, an activity that will provide closeness with the earth will also be included in the space. In this way, the sensory communication with the space will be increased by tasting the product that the user grows inside of the living space.

2. Use of Water as a Life Source

It is examined that water have a sensory relationship with human, but more than seeing, hearing, and smelling the water there is also another sensory relationship with the human

that can be related with taste. Man needs water to survive, and the assurance of being close to water is perceived as an assurance that there is enough water around him to drink and survive [14]. This attraction can be traced back to our ancestor's effort to find habitats close to water sources. The underlying reason for the positioning of all settlements close to water stems from this phenomenon. Even if the water is not drinkable, being close to water, provides an additional comfort indoors. This information, transmitted by genetic codes, affects human well-being even though we can reach water much more easily in modern living conditions [11,14].

RESULTS AND DISCUSSION

Humans use their senses to explore the world they live in. They look around, observe, touch their surroundings, and sense material differences, hear sounds, smell the environment, and do all of these at the same time [32]. The presence of these mixed senses creates an atmosphere in the space. The main purpose of Biophilic design concept is to assimilate the space-human-nature relationship within the man-made environment and to ensure the theme of the relationship in the interior by evaluating each physical, mental, and psychological factor.

In this article, the relationship between man and nature, which is the basis of biophilic design, is examined by analysing the sensory, physical, and mental properties of human. Every element in the space appeals to the senses, and every experience obtained through these elements and senses creates an atmosphere perception in the human mind. The study was shaped as shown in Fig. 3, to examine the relationship between senses, atmospheric space perception and biophilic design elements, and how these design elements make a perceptual difference in the interior atmosphere.

To analyse the effect of biophilic design elements on atmospheric perception in space, firstly, the term biophilia and biophilic design, was studied both to identify biophilic design elements, to get to the basis of the relationship between human and nature and to examine the foundations of biophilia from our ancestors to this day. At this stage, information about humans, the way of life of our ancestors and the relationship with nature was obtained by perceiving the basics of biophilia and analysing the genetic codes that man passed from generation to generation. Elements that serve to find direction and sometimes survive in the foundations of humanity were evaluated under the title of biophilic design.

Then the biophilic design elements, which were clarified in the first stage, were examined one by one in the second stage, and how they were used in the interior to affect the atmospheric design was revealed by examining the relation between this thematic space and human. In the third stage, the relationship between biophilic design and human factor in design was examined. It has been demonstrated and supported by the results of other studies, that the biophilic design affects the mental and physical health of the human being. In addition to being handled in terms of health, it was also evaluated within the framework of human scale and biophilic space perception. In the last phase, our five senses, which enable us to perceive the space, are processed by associating biophilic design elements in detail under the subtitles of "Sight, Hearing, Touch, Smell, Taste" (Fig 2.) In this way, it has been analysed with which senses each element is perceived in the space and how these design elements contribute to atmospheric perception.

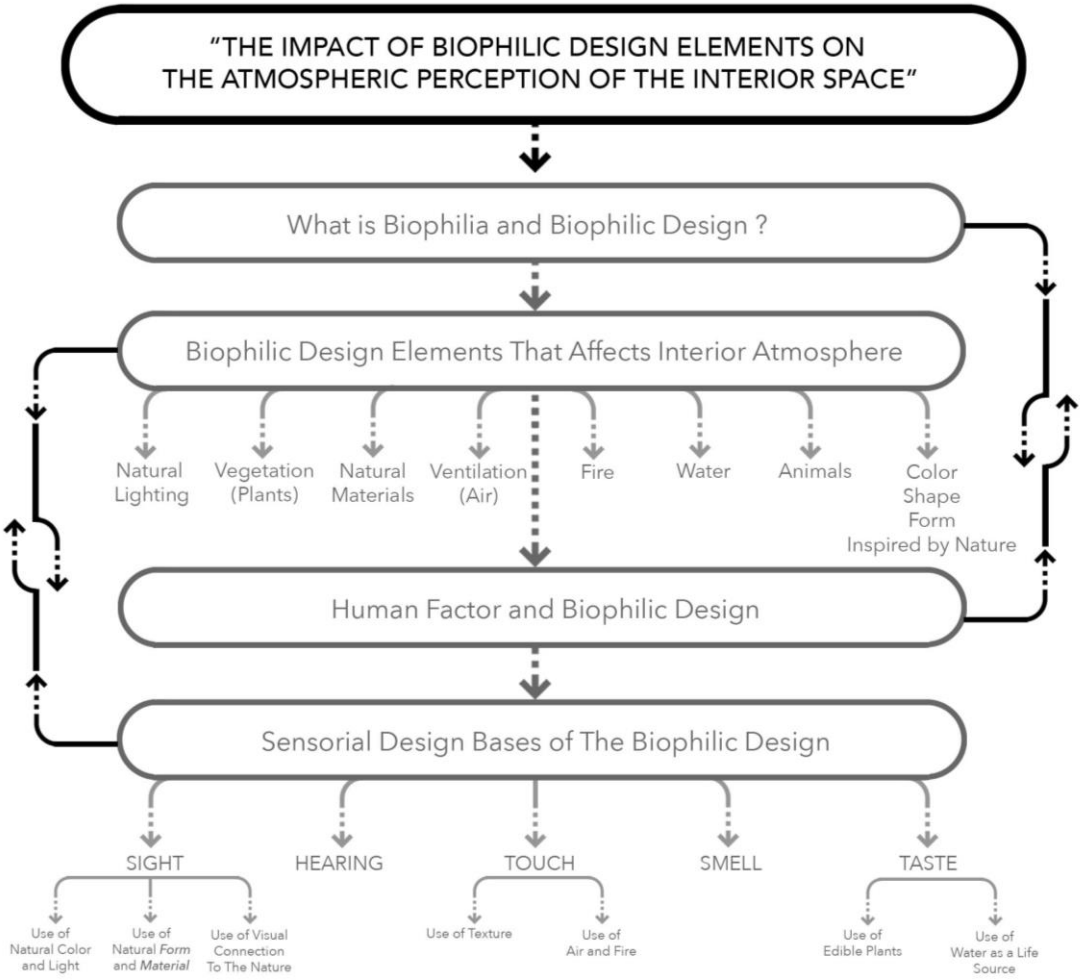

Fig. 3. *Article Research Stages Flow and Relationship Diagram Between Titles*

CONCLUSION

The emerging biophilic design area is growing rapidly today. This article analyses human-nature connection that originated in evolution, together with human senses, space and perception and aim to relate the biophilic design elements and their affect to atmospheric perception of the space through senses.

Used to be the nature itself was the habitat of the human beings but in the modern life buildings take its place and that is how the need to going back to the essence start to appear and create the need for reintegrating the nature to the habitat that turns into concrete boxes. If we assume the beginning of urbanization as the rise of the industrial revolution, we come to the knowledge that only 0.01% or maybe less of the time that has passed since the beginning of humanity has passed in the modern environment [35]. This means that since the moment humanity was formed, more than 99.99% of its life has been spent in nature. Looking back on the history of mankind, considering the fact that he has spent major part of his life in the nature since its formation, it is an inevitable result that man longs for nature and when he feels himself in nature both psychological and mentally improvement is seen. As a result of the post-modern evolution of man, "Biophilic Design"

and the term "Biophilia", which forms the basis of this design method, enlighten, and comes as a solution to the problems that is caused by being away from the nature.

This article shows that biophilic design elements are based on the source of humanity, our ancestors' experience with nature, and the genetic codes transmitted to us through them. As "Biophilia" refers to the emotional bonds humans have with other living organisms. In the modern world, people need these design elements to feel psychologically and mentally comfortable. Like every design element, these biophilic design elements are perceived by the human being through the senses and create an atmosphere in the space. The forms and applications of the design elements of a biophilic atmosphere, determined as Fire, Plants, Water, Colour-Shape-Form Inspired by Nature, Animals, Natural Lighting, Ventilation and Natural Material, have been analysed in comparison with the senses.

Quoting from a sentence by landscape architect Ian McHarg is perhaps the most concise explanation to define the relationship between nature and human in the context of biophilia. *"The problem of man and nature is not one of providing a decorative background for the human play, or even ameliorating the grim city: it is the necessity of sustaining nature as a source of life, milieu, teacher, sanctum, challenge and, most of all, of rediscovering nature's corollary, of the unknown in the self, the source of meaning."* [3,12].

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