Perceptual effect of color use in patient rooms

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Abstract

Messages are conveyed to users through every element within the space. People receive these messages through sense organs. People and space interact constantly because of the way that they perceive and transmit space. People also establish their action boundaries, identify their motivational criteria, and feel a sense of belonging to the place they experience as a result of this interaction. In this way, the location, with all of its characteristics, influences the mental health of those who inhabit it. The colors chosen for patient rooms have a significant impact on the emotional and mental health of the patients, given the medical procedures and rehabilitation programs that they undergo. Patients' healing processes may vary based on the physical characteristics of the environment in which they are situated. Hospitals are intricate functional structures, so specific design requirements should be established by assessing every department independently. The purpose of this study is to determine how people's perception of spatial quality in general patient rooms where two adults stay during treatment is affected by the use of color. In the research method, adjective pairs were determined in line with spatial quality in order to reveal the perceptual effect of color variables in patient rooms. The survey technique was applied according to this experimental design. By simulating the patient room- which was proposed as the study area- in a digital environment with a one-to-one scale, the colors identified as the dependent variable in the study's methodology were visualized independently. The survey technique was employed to ask questions about the perceptual effect of colors on people who have experienced patient rooms by using adjective pairs based on the spatial quality level. The orange color used in patient room interior design was found to be eye-catching, communication facilitator, inviting, pleasing, encouraging, and sincere, while the blue color was found to be comforting and refreshing, based on data acquired from the survey, which was administered to 168 people in total. Many spaces in hospital buildings serve a variety of purposes, and the patients who use these spaces have a range of needs. For this very reason, it is advised that these hospital units be included in the interior design process utilizing information supported by empirical research, with each space being specially designed to meet its unique requirements and functions.

Keywords: hospital, patient room, spatial perception, color

1. Introduction

Space has a significant impact on how people act (Roth, 2006). Although space expresses its own qualities, the individual experiencing it displays behaviors by projecting their own emotions on it (Pallasmaa, 2018). People therefore require physical environments, or locations, that are associated with their memories and serve as reminders of important life events. Every location has a memory that sets it apart from the others. Because of this, space structures its distinct identity with its designer to prioritize human comfort (Tağrikulu, 2022). In this sense, space is an integral component of life on Earth.

Environmental elements in space are created and used by movements of an individual within it. The idea of spatial perception is revealed as the subject forms a connection with the surroundings and interacts with the space during this perception process. The formation of spatial perception is associated with an individual's experience of a place and their subsequent memory of that place as a result of that experience. Depending on how individuals move in space, this experience evolves and changes (Garip, 2009). A person becomes a user once they have visited any location. The perception of space is directly correlated with the number of times the user interacts with it. Using

a variety of mental images, the human mind constructs physical characteristics of the space and converts them into behavior during the process of spatial perception. These mental pictures also have the power to influence how people behave (Hasgül, 2011).

According to İzgi (1999), one of the most crucial components in the perception of space is visual perception. Color within the context of environmental factors are among the most fundamental elements influencing visual perception (Noraslı, 2022). People may experience different emotions or ideas in a space depending on the color of the various elements. Functioning elements and the overall quality of space have an impact on people's feelings and thoughts in addition to environmental elements like color. Because of this, assumptions about the purpose and use of location lead to psychological prejudice in individuals. This highlights the need for a distinct design strategy based on the characteristics of each space.

One type of building that needs a special design approach is a hospital. These are multifunctional, complex structures that house a variety of users, including patients, visitors, and medical professionals. As places where patients, injured people, and those who suspect a disease and want to have their health conditions checked are observed, examined, diagnosed, treated, and rehabilitated as outpatients or inpatients, hospitals are the type of organizations that are more functional and have the most complex structure compared to other structures of similar size (Eceoğlu, 2010). In this case, the user-oriented requirements for each hospital space are demarcated by its specific function. Scientific research should be conducted to identify these needs, and interior design procedures should make use of them.

The purpose of this study is to investigate how users' perceptions of space are affected by the colors used in patient room interior design. Although many studies have been conducted on the effect of color use in hospitals, the results are based on the general perception values that colors create on people. In addition, since hospitals are multifunctional structures, they consist of multiple spaces, each unit of which must be evaluated separately with color variables. In this context, the originality of the study is that the colors that will affect the psychology of the patients are examined specifically according to their spatial quality attributes, by going through a setup only for the patient room. Eight different adjective pairs, three distinct color variables, and spatial quality levels established during the study's management were used to create a survey system specifically. A survey that was administered to 168 persons who used the patient room yielded the data. The colors chosen for patient room interiors that influence users' perceptions were analyzed in accordance with the data. Significant differences were noted in each pair of adjectives, according to the findings. The data revealed that, in comparison to other color variables, orange was more eye-catching, communication facilitator, inviting, pleasing, encouraging and sincere. When compared to other color options, blue was discovered to be more comforting and refreshing.

1.1. Spatial Perception Depending on Human-Space Interaction

Humans mostly use their senses to perceive their surroundings. They exhibit their behavior in space according to emotional and thought state they perceive. Therefore, to the extent that they are able to perceive space, humans reveal their behavioral reactions. People and space interact as demonstrated by the way they perceive and respond when they enter a space that contains both functional and aesthetic elements. As a result, the central component of architecture- space- appears to have the ability to control people's emotions. Places and people are constantly interacting, according to Zevi (1990), who views space as "the leading actor of architecture" and architecture as "the art of creating space".

The idea of space has a long history that started in antiquity. Space keeps reinventing itself in this way, showing up in all of its forms and perceptual components. Ever since the beginning of time, humans have had difficulty surviving in hostile environments. So much so they were in danger of going extinct during this process. Men made the most of nature throughout this struggle, beginning with the tools it provided them in its raw form and gradually learning to shape them (Öztürk Çelebi, 2018). In the past, humans found refuge in naturally occurring structures like

caverns and tree holes, but with time, they started to modify these areas to suit their needs. Living spaces have evolved over the ages due to the intelligence that sets humans apart from other living things, and as a result, the concept of space from an architectural perspective has emerged.

Space is the void that permits people to act and, to some extent, separates them from their surroundings (Hasol, 1993). While being the focus of numerous studies, space is portrayed in various ways. Hence, while Von Meiss (2013) claims that space's external forms are constrained by spatial elements and that there is a void in the space that is filled from the inside, Zevi (1990) defines space as a void that exists, is lived in, and is limited by structural elements.

Research on the integrated relationship between architecture and the concept of space has always been ongoing. In certain studies, space has been categorized and examined in terms of architecture. The relationship between space and its perception dimension was established by Norberg Schulz (1974), who also classified the various forms of space into five categories: pragmatic space, existential space, perceptual space, cognitive space, and abstract space. On the other hand, Gür (1996) defined space as the location of an individual or a group and talked about how space is classified into five categories based on Norberg Schulz's classification: useful space, symbolic space, existential space, architectural structural space and abstract geometric space.

The incorporation of space into human life is a crucial aspect of architecture. Thus, Ching (2002) claimed that space surrounds us constantly and that human activity can occur anywhere in its volume. According to Ching, architecture will also emerge when space starts to be encircled, shaped and arranged by elements that are grouped together. However, Kuban (2016) emphasized the significance of the concept of space in terms of architecture, saying that this unique void- which is expressed as space- is what distinguishes architecture from other building actions and how architecture shows its effect by separating the living and the user from the natural life.

The way people perceive space makes it more valuable and selective. The concept of space has malleable meanings due to the spiral relationship that exists between its physical attributes and the emotional and intellectual behavior patterns of life's functional process. Through the use of their senses, humans experience and comprehend space by connecting it to one another. The space is experienced with all of its messages, but objects only acquire meaning when humans are able to categorize or interpret the information gathered through the senses. The effect of the objective environment on the sensory organs is what causes sensation, which is the first step in the perception process. (Aslan et al., 2015; Erkan Yazıcı & Çakıcı Alp, 2017). According to Leland (2006), perception is employed to value the pleasure that architecture provides. This value has to do with how one views and understands the information gleaned from sensation.

Reacting to physical stimuli can help one establish balance and achieve harmony with their surroundings. To exhibit this harmony, one must be able to identify and comprehend their surroundings (Aydıntan, 2001). The process of organizing sensory data to give objects or events around us meaning is called perception. Individuals interpret the stimuli by giving them personal meaning after this process (Siegel, 2006; Smith, 2002). Associating, thinking, and other cognitive processes all involve perception, which varies based on an individual's cognitive structure (Goldstein, 2010).

Certain types of perception influence how space is perceived by concentrating on the senses of sight, touch, hearing and smell. Visual perception is the most significant of these. The sense of sight is the most fundamental that influences perception since it provides the majority of the information that is gathered from the surroundings. Those who experience the space perceive color, light, texture and form as elements of spatial stimulation through their visual sense. The ear becomes more noticeable when vision blurs or completely disappears. Since there are many different ways to perceive space, senses like hearing, smell and touch either greatly influence or contribute to this perception (İzgi, 1999).

A person's mental process of perception can influence how they perceive space, paving the way for the fact that space is conceptualized in the mind while the person perceives it, as the brain is

capable of multitasking. By creating spatial relationships, one can also conjure up imagined spaces (Wang et al., 2007). Humans generate and assess environmental cues through mental movement, combining existing knowledge with new information to form formation processes (Garip, 2009). The idea of spatial perception is revealed by the way that perception interacts with space by creating a connection between people and their surroundings.

Spatial perception is a formation that is connected to a person's memory of the place through experience via the creation of various images, the human mind converts the physical characteristics of space into behavior during the process of spatial perception. According to Gollodge (1999), these brain-formed images have the capacity to influence people's behavior. People experience the space and engage with their perceptions in this way, directly connecting with their present psychological states.

1.2. Color Factor in Space

Depending on how it is used in the space, color, one of the key elements affecting readability, can have an impact on people's psychological states (Carpman & Grant, 2016). The Optical Society of America's Colorimetry Committee defined color as the spatial or transient characteristics of luminous energy that are produced by stimulation of the retina in the eye and are perceived by an observer through visual perceptions (Hardeberg, 1999).

When light strikes an object, it can reflect, refract, absorb or transmit the light. Color is defined as the image that appears in the eye when the light strikes an object, reflects off of it and sends sensory information to the brain (Güller, 2007). An in-depth examination of the physiological definition of color- which is essentially the result of light waves entering the eye- reveals that color is created when light strikes an object, reflecting the majority of the colors the object contains because of its molecular makeup while absorbing the remaining colors (Tepecik, 2002).

The perception of color requires a second light source, where the reflected light enters the eye's retina, and the change in incoming light during absorption or reflection determines the color's perception (Özdemir, 2005). As a result, color is the impression that light waves have on a person as they enter their eyes and reflect off of objects. This effect is a physical phenomenon that happens due to the strength of light. Color formation is directly influenced by light intensity, which varies based on our surroundings and results in a range of colors and tones. As a result, the balance of colors is flawless in nature (Göker Paktaş, 2018).

The way that color is symbolized in nature is usually through natural analogies. For example, the color red is associated with fire, warmth and energy, while the color blue is associated with the sea, which is associated with coldness and serenity (Heschong, 2002). There is no universally accepted theory regarding the psychological effects of colors on humans; however, colors are classified into two categories based on their psychological impact and intensity. These categories are influenced by factors such as gender, culture and geography. Warm colors are found on the red and orange side of the line connecting yellow and purple, and cold colors are seen on the green and blue side. This is true when full yellow and full purple are positioned opposite each other on the color wheel (Hidayetoğlu, 2010).

Warm colors, such as orange, red, and yellow, evoke feelings of coziness and dynamism in human psychology. They are vivid, provocative, and ostentatious, with long wavelengths that strike the retina first due to high vibrations. Colors that convey a sense of calmness or coolness are known as cool colors. This group mostly consists of green, purple and blue tones. Shades of purple and green in this color family typically lead to contradiction. Green and purple are created by combining two warm and cold colors in a specific ratio because they are intermediate colors. As a result, blue is the only color in the cold color group that has an entirely cold effect. Cool hues are used in hospitals to soothe patients and slow down metabolism. Cleanliness is evoked by cool blue and green tones. These hues often have a more receding and stagnant effect because they appear on the retina of the eye later than other colors. They give the impression that the volume they are in is wider and larger because of these slow effects and their backward appearance (Güngör, 2005).

Numerous color tones are discernible and observable to the human eye. Owing to the wide range of color tones, descriptive parameters including color type, value, saturation and mixtures are required to accurately classify and choose a color that has been requested or specified by someone else. Because color tones vary so much, they are treated using descriptive criteria. The criteria that are most frequently used are color type, value and saturation.

Type is a classification that varies based on the color's wavelength and gives the color its name, such as red, green or blue. The color's tone is determined by the value. It displays the amount of light reflection, or how light or dark a color is (Ulaş, 2002). One criterion that relates to the color of the light is saturation. White is equivalent to the total absence of color in this sense. Highly saturated colors do not contain white. To put another way, colors have a high saturation level when they are bright, pure and vibrant (Sema, 2006).

The eye is drawn to a color combination with strong contrast. Combining visually appealing elements can lead to misunderstandings. (Doğu & Erkip, 2000). People can interact with their surroundings through color because of its physiological and psychological effects. Color is a useful tool for designing places that are aesthetically pleasing, functional and symbolic because it conveys information about the surrounding area. As a result, color is used intentionally when incorporated into a design (Müezzinoğlu, 2018).

Primary colors and strong colors like red, yellow, and blue can initially seem emphatic but eventually wear people out and make them tense. Yellow is a color that promotes spiritual development, but because it reflects aging and jaundiced skin tones, care should be taken when using it in hospital buildings. The use of tones between yellow and green ought to be avoided because they are associated with bodily fluids (Leibrock, 2000).

Green is a comforting color that makes us think of nature, so making it the primary color in operating rooms helps keep surgeons' eyes from getting tired from staring at body tissue. Because the color blue is associated with peace and relaxation, it lowers blood pressure, which helps treat neurological conditions. Spaces requiring a high degree of visual sensitivity, quiet, and concentration should be designed with green and blue hues (Marberry, 1997).

Protecting patients' physical and mental well-being through the use of color can enhance healing environments. It ought to support medical diagnosis, therapy, and recovery initiatives. Consequently, color expression should be considered when choosing the right lighting. Hospital hallways, patient rooms, and exam rooms should adhere to general color guidelines, but designers should prioritize creating the "ideal home" atmosphere over maintaining a "corporate appearance" (Mahnke, 1996). When used correctly, colors can also provide social support by reducing stress levels (Kocaoğlu et al., 2020). The correct choice of colors used also affects people's actions and orientation (Kalantari et al., 2021; Al Sharaa et al., 2022). In this context, it is important to choose colors to increase the comfort level of users (Long et al., 2021).

Numerous studies have examined the combined effects of color and light, which have a natural power that can influence a person's soul. When it comes to using color in architecture to create a healing space, it is crucial to use it properly. In this way, color influences patients as an element of architectural design. It is anticipated that hospitals with well-chosen interior designs will facilitate faster patient recovery and give both patients and medical personnel a greater sense of space (Khaleghimoghaddam, 2023).

1.3. Hospital and Patient Rooms

The World Health Organization (WHO) defines hospitals as inpatient institutions that provide health services that can be grouped as observation, diagnosis, treatment and rehabilitation, and where patients receive long or short-term treatment. In the Inpatient Treatment Institutions Operation Regulation, on the other hand, hospitals are characterized as institutions where patients, injured people, and those who suspect a disease, want to have their health conditions checked,

birth givers, are observed, examined, diagnosed, treated and rehabilitated as outpatients or inpatients (Eceoğlu, 2010).

There have been notable changes in hospital structures with the advancement of medicine. Houses of worship were utilized for patient care even though religious beliefs and medical science were once understood in tandem (Ergenoğlu & Aytuğ, 2007). Medical and therapeutic institutions have evolved and improved with time. Due to the diversity of diseases, urbanization, population growth, differences in lifestyles, and advancements in medical technology, hospital structures have changed over time (Tipi, 2007).

The pavilion system was introduced to hospital buildings as a result of the diseases that followed the continental wars that broke out in Europe and America in the 1850s. Patient beds were set up along a long corridor in this system. Due to advancements in building technology and the adoption of the pavilion system, which covered enormous areas, the Monoblock system started to be implemented in the 1900s. Depending on their capacity and land size, these hospitals are now designed using both vertical and horizontal planning strategies (Aydın, 2009). With the advancement of technology and medicine, health campuses are becoming more and more prominent. Health campuses aim to address all needs through their services and look for solutions to illnesses (Ayan, 2019). These hospital building types are campus layouts that cater to sizable regions with various settlement patterns.

Patients, companions, and medical staff are among the many and diverse users found in hospitals, which house numerous units. Personnel and units in hospitals that differ in terms of service delivery may also differ based on the services rendered (Aydın, 2001). Hospitals are classified into five categories based on the services they offer: training and research hospitals, general hospitals, special branch hospitals, district hospitals, and day hospitals. District hospitals are medical facilities that offer admission and treatment services to patients. In cases where patients need more advanced testing and care, they stabilize patients and refer them appropriately. Day hospitals are the ones that were built either inside or in conjunction with hospitals and offer daily outpatient examination, diagnosis, and treatment services (Aydın, 2009). Private branch hospitals are facilities where patients with specific demographic traits and unique health problems are observed, examined, diagnosed, treated, and rehabilitated. In contrast to general hospitals, which are physical establishments where national health services are offered to the public with all equipment and specialties, regardless of age and gender. Training and research hospitals are private, general medical facilities that conduct research, provide education, and train specialists and subspecialists (Ayan, 2019).

Hospitals are categorized into three groups based on regional distribution: regional hospitals, secondary regional hospitals, and local hospitals. Within this framework, regional hospitals are defined as 500–1000-bed hospitals, as well as medical centers or university hospitals that house various types of medical research labs and educational establishments. Regional hospitals classified as second-degree, having between 100 and 500 beds, are designed to offer complete medical care. Local hospitals are medical facilities with between 30 and 100 beds that offer special care and surgical services as needed (Aydın, 2009).

In addition to hospital buildings, the current hospital design approach strives to create environments where service providers and recipients can meet all of their needs, including lodging, childcare, entertainment, social activities, and shopping. This approach also incorporates patient- and user-oriented designs and explains the emergence of health campuses that provide services across wide geographic areas. Consistent with the human-centeredness principle, hospital care units are increasingly adopting a patient-centered approach rather than a care-centered (Ergenoğlu & Aytuğ, 2007). The human-centered design approach in patient rooms has been made clear by this circumstance.

Depending on the patient's condition and the number of visitors, patient bedrooms have different action areas and sizes. Seven categories can be used to group patient rooms: general,

disabled, infected, psychiatric, maternity, suite, and children's patient bedroom. Depending on the user group, different design elements are applied in each patient room. Generally speaking, based on the purpose and activities of a modern patient room, the areas can be divided into four sub-spaces: the first is the area where the patient lies down and where the bed is situated; the second is where staff performs care actions; the third is the area where companions perform sitting and resting actions; and finally the area where the patient performs cleaning actions (Aksoy & Aydın, 2022).

Function, adaptability, space, safety, aesthetics, and efficiency are factors that influence the standard of care and recuperation in the patient room. Physically and psychologically, the patient room needs to provide the following: seclusion from other patients when needed, companionship from other patients when appropriate, cleanliness, security, the feeling of being cared when assistance is needed, privacy, quiet, and the freedom to move around the room. Access to showers and baths, proper and sufficient lighting, ease of use of bed and TV remote controls, phone, nurse call sign, sufficient and accessible space for personal belongings, guest accommodations, outside visibility, and aesthetically beautiful surroundings are all examples of encouraging elements (Sungur Ergenoğlu & Tanrıtanır, 2013).

Because these factors have a positive impact on patients' healing processes, thorough literature research on these factors and global knowledge of technological and digital advancements have made it possible for qualified practices to be used widely. Future patient room designs must be adaptable enough to accommodate various disease treatments in terms of both space and technology. The needs are identified by means of an integrated study of the technological structure and building design; consequently, among the design inputs are the creation of visually appealing space layouts that minimize the potential for physical and psychological harm to patients and their relatives, as well as the development of patient-centered, flexible patient care models (Aksoy & Aydın, 2022).

In addition to demarcating the hospital's capacity, patient rooms are the primary factor influencing architectural form and character. The primary design factors that should be taken into account in patient-centered room designs are color, texture, lighting, noise control, view, and ergonomic furniture (Stoufer, 2000). The design elements utilized in patient rooms and their relationships to one another are rather significant in the context of space and human interaction, according to the patient-centered design approach, which takes into account the rehabilitation process, psychological state, morale, and motivation of patients receiving inpatient treatment.

2. Method

According to the patient-centered design approach, the research investigated how people perceive the colors used in patient rooms. Thus, the following is the research hypothesis: "Perceptual evaluations differ depending on the colors used in patient room design." In line with this questioning, an experimental design was created. Accordingly, a survey technique was applied with color variables determined by limiting adjective pairs that reveal spatial quality.

In this sense, a double patient room at Konya City Hospital was chosen as the study area. The survey technique was employed in the research method to obtain data. As independent variables, orange (R:191; G:120; B:56), blue (R:72; G:102; B:164), green (R:88; G:150; B87) and gray (R:150; G:150; B:150) colors were used. Studies on the use of color in healthcare buildings have shown that while red has an exciting effect, it raises blood pressure, so it is not advised to be used in treatment areas with the exception of Alzheimer's patients. (Marberry, 1997). Red is not included in the study's purview in this context. Although yellow color increases spiritual development, it was not included in the scope of the study because it reflects aging and jaundiced skin tones and caution should be taken when using it in hospital buildings (Leibrock, 2000).

Previous studies that evaluated spatial perception and were found to be valid and safe (İmamoğlu, 2000; Başkaya et al., 2006; Yıldırım et al., 2007; Çağatay et al., 2017; Müezzinoğlu et al.,

2021) were used to identify the adjective pairs regarding the perceptual effect of colors. A total of eight different adjective pairs and a five-stage semantic differentiation scale ranging from positive to negative were employed: eye-catching - distractive, communication facilitator-communication hinderer, invitatory - repellent, pleasing - unpleasing, encouraging - passivating, comforting - discomforting, formal-sincere, refreshing-boring.

Three-dimensional images were created in four different ways, as illustrated in Figure 1, based on the colors chosen for the survey application. All physical conditions, including the size, scale and spatial organization of the patient rooms experienced by the participants, were kept the same. The 40m2 work area was digitally modeled at to produce the visuals. Not every surface of the wall was painted in the designated colors. The wall surfaces' colors were limited to white and employed as emphasizing pieces. The wall surfaces that users see the most in the entrance and lying positions were used as references in the three-dimensional patient room visualizations that were produced.
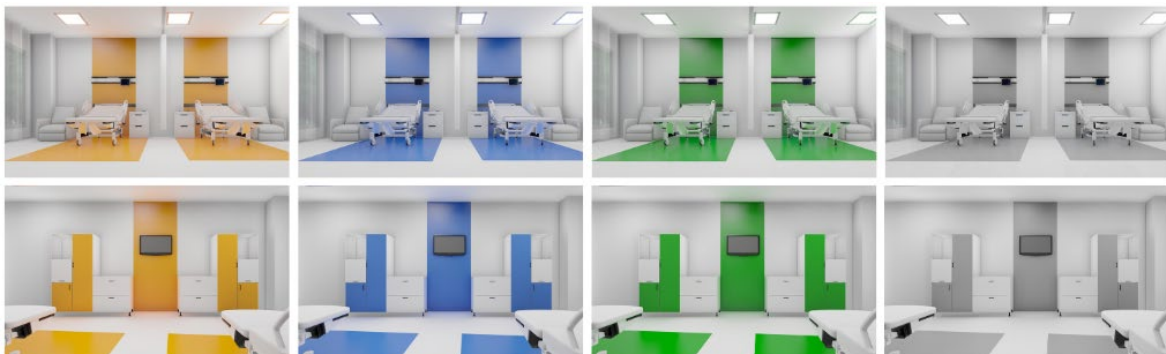

Figure 1 Visuals used in the survey application

A total of 168 persons who visited the patient room completed the survey that was created in accordance with all of these data. People using public patient rooms participated in the survey. The survey was approved by the scientific ethics committee, and participant consent was acquired. The SPSS 18 software was utilized for the analysis of the survey data. The data from the normal distribution were subjected to the ANOVA test, which is used for parametric data. The analyses ascertained to have significant differences as a result of this test were compared with the Tukey test.

3. Findings

The reliability of the data obtained from the study was analyzed with Cronbach's Alpha. According to Cronbach's Alpha reliability analysis, the coefficient value varies between 0-1; between 0.00-0.40 the scale refers to be unreliable, 0.40-0.60 is considered low reliability, 0.60-0.80 is quite reliable, and 0.80-1.00 highly reliable (Tavşancıl, 2005). Accordingly, the reliability analysis coefficient of the research was found to be 0.940 and its internal consistency is thus highly reliable.

Normal distribution of the data depends on the skewness and kurtosis values being between ±3 (Shao, 2002). According to the normality analysis results of the scales, it is observed that the values have a normal distribution. As stated in Table 1, the skewness and steepness coefficients of the expressions related to the scale for each adjective pair are as follows: Skewness coefficient for Eye-catching - Distractive adjective pair = -0.113, and steepness coefficient = -1.173, Skewness coefficient for Communication Facilitator- Communication Hinderer adjective pair = -.015 and steepness coefficient = -1.085, Skewness coefficient for Invitatory- Repellent adjective pair = .017 and coefficient of steepness= -1.246, coefficient of skewness= -.081 and coefficient of steepness= -1.134 for the adjective pair Pleasing-Unpleasing, coefficient of skewness= -.063 and coefficient of steepness= -1.174 for the adjective pair Encouraging-Passivating. , Skewness coefficient for Comforting - Discomforting adjective pair = .012 and steepness coefficient = -1.070, Skewness coefficient for Sincere - Formal adjective pair = -.093 and steepness coefficient = -1.356, and

Skewness coefficient for Refreshing-Boring adjective pair scale = -1.356. -0.021 and steepness coefficient = -1.312.

Table 1 Normal Distribution of Color Variables by Adjective Pairs

Adjective pairs	Skewness value		Kurtosis value	
	Statistics	Standard deviation	Statistics	Standard deviation
Eye-catching-Distractive	-,113	,094	-1,173	,188
Communication facilitator-Communication hinderer	-,015	,094	-1,085	,188
Invitatory-Repellent	,017	,094	-1,246	,188
Pleasing-Unpleasing	-,081	,094	-1,134	,188
Encouraging-Passivating	-,063	,094	-1,174	,188
Comforting-Discomforting	,012	,094	-1,070	,188
Sincere-Formal	-,093	,094	-1,356	,188
Refreshing-Boring	-,021	,094	-1,312	,188

The results of the single-factor analysis of variance are indicated in Table 2. Accordingly, there is a significant difference at P<0.05 level in the scores given to the adjective pair 'Eye-catching – Distractive' according to colors (F (3,668) = 49.686; P= .000). Reviewing the multiple comparison Tukey test results showing which two groups the differences originate from, orange (M= 3.64; SD= 1.20), blue (M= 3.46; SD= 1.22), green (M= 3,07; SD= 1,39) and gray (M= 2.14; SD= 1.07) are observed to have a difference between the answers given to the adjective pairs. Orange color is the most eye-catching color while blue seems more eye-catching than gray and green.

There is a significant difference at the P<0.05 level in the scores given to the adjective pair 'Communication Facilitator - Communication Hinderer' according to colors (F (3,668) = 48.939; P =.000). Looking at the results of the multiple comparison Tukey test showing which two groups the differences originate from, orange color (M = 3.49; SD = 1.12), blue color (M = 3.30; SD = 1.13), green color (M=3,00; SD= 1,19) and gray color (M= 2.04; SD= 1.29) are observed to have a difference between the answers given to the adjective pairs. While the color orange is the most communication-facilitating color compared to gray and green; gray is the most hinderer. Blue color, close to orange color, seems to facilitate communication.

There is a significant difference at the P<0.05 level in the scores given to the adjective pair 'Invitatory-Repellent' depending on the colors (F (3,668) = 67.837; P= .000). Looking at the results of the multiple comparison Tukey test showing which two groups the differences originate from, orange color (M= 3.52; SD= 1.24), blue color (M= 3.27; SD= 1.20), green color (M= 2,92; SD= 1,19) and gray color (M= 1.19; SD= 1.16) are observed to have a difference between the answers given to the adjective pairs. While orange is the most invitatory compared to gray and green, blue is more invitatory than gray and green.

It seems that there is a significant difference at the P<0.05 level in the scores given to the adjective pair 'Pleasing-Unpleasing' depending on the colors (F(3,668) = 114.905; P= .000). Considering the multiple comparison Tukey test results showing which two groups the differences originate from, orange color (M= 3.67; SD= 1.07), blue color (M= 3.33; SD= 1.15), green color (M= 3,20; SD= 1,06) gray color (M= 1.66; SD= 1.01) are observed to have a difference between the answers given to the adjective pairs. While orange is the most pleasing, blue is more pleasing than gray and green.

A significant difference can also be observed at the P<0.05 level in the scores given to the adjective pair 'Encouraging-Passivating' depending on the colors (F(3,668) = 115.620; P= .000).

When we look at the multiple comparison Tukey test results showing which two groups the differences originate from, orange color (M= 3.70; SD= 1.12), blue color (M= 3.26; SD= 1.20), green color (M= 3,16; SD= 1,04) and gray color (M= 1.61; SD= 0.98) are observed to have a difference between the answers given to the adjective pairs. The color orange is most encouraging while blue is more encouraging compared to gray color.

There is a significant difference at the P<0.05 level in the scores given to the adjective pair 'Comforting-Discomforting' depending on the colors (F (3,668) = 61.219; P= .000). Considering the results of the multiple comparison Tukey test showing which two groups the differences originate from, orange color (M = 3.27; SD = 1.10), blue color (M = 3.54; SD = 1.21), green color (M= 3,05; SD= 1,20) and gray color (M = 1.94; SD = 1.12) are observed to have a difference between the answers given to the adjective pairs. The color blue is the most comforting color. Orange is comforting compared to gray color. Green color has a more comforting effect than gray color.

A significant difference appears in the scores given to the adjective pair 'Sincere-Formal' according to colors at the P < 0.05 level (F (3,668) = 142.112; P = .000). Considering the results of the multiple comparison Tukey test showing which two groups the differences originate from, orange color (M = 4.09; SD = 1.04), blue color (M = 2.98; SD = 1.33), green color (M=3,36; SD= 1,09) and gray color (M=1.59; SD= 1.06) are observed to have a difference between the answers given to the adjective pairs. While orange is the sincerest color, green is found to be more sincere than blue and grey.

There is a significant difference at the P<0.05 level in the scores given to the adjective pair 'Refreshing-Boring' depending on the colors (F (3,668) = 103.877; P= .000). Looking at the results of the multiple comparison Tukey test showing which two groups the differences originate from, orange color (M= 3.50; SD= 1.16), blue color (M= 3.52; SD= 1.26), green color (M= 3,23; SD= 1,27) and gray color (M= 1.57; SD= 1.03) are observed to have a difference between the answers given to the adjective pairs. Blue color seems to be the most refreshing color while orange has an effect close to the color blue, but it is more refreshing than green.

Table 2 Single-Factor Analysis of Variance ANOVA Test

Adjective pairs	Orange		Blue		Green		Grey		ANOVA		
	M	SD	M	SD	M	SD	M	SD	df	F	Sig.
Eye-catching-Distractive	3,64	1,20	3,46	1,22	3,07	1,39	2,14	1,07	3,668	49,686	,000
Communication facilitator-Communication hinderer	3,49	1,12	3,30	1,13	3,00	1,19	2,04	1,29	3,668	48,939	,000
Invitatory-Repellent	3,52	1,24	3,27	1,20	2,92	1,19	1,79	1,16	3,668	67,837	,000
Pleasing-Unpleasing	3,67	1,07	3,33	1,15	3,20	1,06	1,66	1,01	3,668	114,905	,000
Encouraging-Passivating	3,70	1,12	3,26	1,20	3,16	1,04	1,61	0,98	3,668	115,620	,000
Comforting-Discomforting	3,27	1,10	3,54	1,21	3,05	1,20	1,94	1,12	3,668	61,219	,000
Sincere-Formal	4,09	1,04	2,98	1,33	3,36	1,09	1,59	1,06	3,668	142,112	,000
Refreshing-Boring	3,50	1,16	3,52	1,26	3,23	1,27	1,57	1,03	3,668	103,877	,000

Note: M: Mean value. SD: Standard deviation. High value indicates positive answers. Sig.: ANOVA analysis result is significant at *p<0.05 level.

According to the findings obtained from the analysis, the color orange is evaluated as more eye-catching, communication facilitator, invitatory, pleasing, encouraging and sincere while the color blue is found to be more comforting and refreshing. According to the analysis, it is seen that there exist significant differences in all adjective pairs. In this context, the hypothesis "Perceptual evaluations differ depending on the colors used in patient room design" is supported.

4. Conclusion

One of the most fundamental needs of humankind has always been the concept of space, which has existed from ancient times. In this particular context, one of the most potent factors influencing people's comfort level is space. Each space gains meaning by being designed for its purpose, which aims to increase comfort levels and positively impact people's lives with new insights.

In addition to people's innate capacity for perception, the physical components of the environment convey messages to its users, and people and the environment are constantly interacting. People establish their action boundaries, identify their motivational criteria, and feel a sense of belonging to the place they experience as a result of this interaction. In this way, the location, with all of its characteristics, has a direct impact on the mental health of those who occupy it.

Human and space interaction is influenced by a variety of factors, including people's demographics, social and cultural contexts, and the cognitive and perceptual effects of space. Depending on their illness, people's thoughts and feelings may also be included in this situation. In this regard, it is crucial that the designs used in patient rooms are made with the users of the space in mind.

People perceive and manage their emotions in different ways depending on the color of the walls, which sends a clear visual message to everyone in the room. As a result, the use of color, which is regarded by the place's nature as one of its environmental factors, distinguishes that location. Extended periods of time spent in patient rooms expose people to the perceptual effects of the colors used in the room. The psychological well-being and developmental trajectory of inpatients may be impacted by this circumstance as they undergo treatment.

The aim of the study was to determine the perceptual effect of the colors used in patient rooms of multifunctional hospitals on patients. For this purpose, in the context of the experimental setup created by using color variables and adjective pairs, data based on spatial quality affecting the psychological state of the patients were obtained as a result. The study found that people's perceptions are affected by the colors used in patient room interior design suggesting that orange and blue colors have advantageous effects. According to the results, the perceptual effect of the colors used in patient rooms is as follows:

• According to the findings obtained from the analysis, orange color; It was evaluated as remarkable, communication facilitator, inviting, happy, encouraging and sincere.

• The color blue was found relaxing and refreshing by the people who participated in the research.

• Although green and gray colors are preferred in themselves, they did not provide significant differences according to adjective pairs.

These findings align with those of previous research, including Hidayetoğlu (2010), Müezzinoğlu et al. (2021), Akçaova (2022), and Noraslı (2022). This demonstrates how people's perceptions of color are influenced and how they create parallel impressions in spaces used for various purposes.

Every color has a different psychological impact, and every space has a different purpose. Sometimes, because of the way the place operates, people might feel pressured by it. The perception that the operating room and the outpatient clinic evoke, for instance, might be different from one another. It is not reasonable to assume that the colors chosen for patient rooms will have the same psychological impact in other areas of hospital buildings, given the variety of spaces within. In this research, a standard two-person adult patient room was determined as the sample area and study results were obtained on these limitations. This work: It can also be developed by testing it in the rooms of hospitals in different structures such as public hospitals, private hospitals, children's hospitals. In this instance, it ought to be advised that the colors chosen for each space's design be taken into account independently and supported by research from scientific sources.

References

Akçaova, A. (2022). *Stadyum soyunma odası tasarımında kullanılan çevresel faktörlerin sporcu motivasyonu ve performansına etkisinin incelenmesi – Konya Büyükşehir Belediyesi Stadyumu*. Doktora Tezi, Lisansüstü Eğitim Enstitüsü, KTO Karatay Üniversitesi, Konya.

Aksoy, E., & Aydın, D. (2022). Hastane tasarımlarının geçmişten günümüze değişiminin hasta odaları üzerinden incelenmesi. *Bodrum Journal of Art and Design*, *1*(2). 221-240.

Al Sharaa, A., Adam, M., Amer Nordin, A. S., Alhasan, A., & Mundher, R. (2022). A user-centered evaluation of wayfinding in outpatient units of public hospitals in malaysia: ummc as a case study. *Buildings*, *12*(3), 364.

Aslan, A., Aslan, E., & Atik, A. (2015). İç mekânda algı. *İnönü Üniversitesi Sanat ve Tasarım Dergisi*, *5*(11), 139-151.

Ayan, G. S. (2019). *Yeni nesil sağlık yapılarının mekân dizim yöntemi ile incelenmesi: İstinye Üniversitesi Hastanesi Liv Hospital Bahçeşehir ve VM Medical Park Pendik Hastanesi örneği*. Yüksek Lisan Tezi, Fen Bilimleri Enstitüsü, Süleyman Demirel Üniversitesi, Isparta.

Aydın, D. (2001). *Genel hastanelerde teknolojik gelişmelerin bina ihtiyaç programına etkilerinin araştırılması*. Doktora tezi, Selçuk Üniversitesi, Fen Bilimleri Enstitüsü, Konya.

Aydın, D. (2009). *Hastane mimarisi, ilkeler ve ölçütler*. TMMOB Mimarlar Odası Konya Şubesi Yayını, Entegre Matbaacılık, İstanbul.

Aydıntan, E. (2001). *Yüzey kaplama malzemelerinin iç mekân algısına anlamsal boyutta etkisi üzerine deneysel bir çalışma*. Yüksek Lisans Tezi, Fen Bilimleri Enstitüsü, Karadeniz Teknik Üniversitesi, İstanbul.

Başkaya, A., Wilson, C., Ozcan, Y. Z., & Karadeniz, D. A. (2006). Study in reestablishing the corporate identity of a post Office institution with genderrelateddifferences in perception of space. *Journal of Architecturaland Planning Research*, *23*, 43-59.

Carpman, J. R., & Grant, M. A. (2016). *Design that cares: planning health facilities for patients and visiors*. American Hospital Publishing, Chicago.

Ching, F. D. K. (2002). *Mimarlık biçim, mekân & düzen*. (Gizem Parlak, Çev.). Nobel Yayınları, İstanbul.

Çağatay, K., Hidayetoğlu, M., & Yıldırım, K. (2017). Effects of colors used for corridor walls of high schools on perceptual evaluations of students. *Hacettepe University Journal of Education*. *32*(2), 466-479.

Doğu, U., & Erkip, F. (2000). Spatial factors affecting wayfinding and orientation: a case study in a shopping mall. *Environment and Behavior*. *32*(6), 731-755.

Eceoğlu, A. (2010). *Değişen kullanım ihtiyaçları karşısında hastane giriş mekânlarının şekillenmesi*. Sanatta Yeterlik Tezi, Fen Bilimleri Enstitüsü, Mimar Sinan Güzel Sanatlar Üniversitesi, İstanbul.

Ergenoğlu, S. A., & Aytuğ, A. (2007). Sağlık Kurumlarında Değişen Paradigmalar ve İyileştiren Hastane Kavramının Mimari Tasarım Açısından İrdelenmesi. *Yıldız Teknik Üniversitesi Mimarlık Fakültesi E-Dergisi*, *2*(1), 44-63.

Erkan Yazıcı, Y., & Çakıcı Alp, N. (2017). Duyuların mekânsal deneyimi şekillendirmesi: Sagrada Familia Kilisesi. *Art-e Sanat Dergisi*, *10*(19), 55-77.

Garip, E. (2009). *Büyük mağazalarda tüketici mekânsal davranışının mekânsal dizim çerçevesinde irdelenmesi*. Doktora Tezi, Fen Bilimleri Enstitüsü, İstanbul Teknik Üniversitesi, İstanbul.

Goldstein, E. B. (2010*). Encyclopedia of perception*. Sage Publishing, New York.

Gollodge, R. G. (1999). *Wayfinding behavior: cognitive mapping and other spatial processes*. Johns Hopkins University Press, USA.

Göker Paktaş, M. (2018). İç mimarlıkta rengin mekân algısı üzerindeki etkisi. *Journal of Interdisciplinary and İntercultural Art*, *3*(6), 137-144.

Güller, E. (2007). *Sağlık yapılarında renk olgusunun özel dal hastaneleri hasta yatak odası örneklerinde araştırılması*. Yüksek Lisans Tezi, Fen Bilimleri Enstitüsü, Dokuz Eylül Üniversitesi, İzmir.

Güngör, İ.H. (2005). *Görsel sanatlar ve mimarlık için temel tasar*. Esen Ofset, İstanbul.

Gür, Ş. Ö. (1996). *Mekân örgütlenmesi*. Gür Yayıncılık, Trabzon.

Hardeberg, J. Y. (1999). *Acquisition and reproduction of colour images; colorimetric and multispectral approaches*. PhD Thesis, Ecole Nationale Superieure des Tecummunications, Paris.

Hasgül, E. (2011). *İç mekânda yön bulma: büyük ölçekli binalarda inceleme.* Yüksek Lisans Tezi, Sosyal Bilimler Enstitüsü, İstanbul Teknik Üniversitesi, İstanbul.

Hasol, D. (1993). *Ansiklopedik mimarlık sözlüğü*. YEM Yayın, İstanbul.

Heschong, L. (2002). Daylighting and human performance. *ASHRAE Journal*, *44*(6), 65-67.

Hidayetoğlu, M. L. (2010). *Üniversite eğitim yapılarının iç mekânlarında kullanılan renk ve ışığın mekânsal algılama ve yön bulmaya etkileri*. Doktora Tezi, Fen Bilimleri Enstitüsü, Gazi Üniversitesi, Ankara.

İmamoğlu, C. (2000). Complexity, liking and familiarity: architecture and non-architecture turkish students' assessments of traditional and modern house facades. *Journal of Environmental Psychology*, *20*, 5-16.

İzgi, U. (1999). *Mimarlıkta süreç kavramlar ilişkiler*. YEM Yayın, İstanbul.

Kalantari, S., Tripathi, V., Kan, J., Rounds, J., Mostafavi, A., Snell, R., & Cruz Garza, J. (2021). Evaluating the impacts of color, graphics, and architectural features on wayfinding in healthcare settings using EEG data and virtual response testing, *Journal of Environmental Psychology*. *79*. 101744.

Khaleghimoghaddam, N. (2023). Understanding the interplay of light, color, and interior design in helathcare spaces. *Journal of Design for Resilience in Architecture & Planning*, *4*(2), 219-231.

Kocaoğlu Aslanoğlu, R., Ulusoy, B., & Olguntürk, N. (2020). *Color in Hospitals*. Encyclopedia of Color Science and Technology Publisher: Springer, Berlin.

Kuban, D. (2016). *Mimarlık kavramları*. YEM Yayın, İstanbul.

Leibrock, C. (2000). *Design details for health: A guide to making the most of interior design's healing potential*. Wiley, New York.

Leland, R. M. (2006). *Mimarlığın öyküsü, ögeleri ve anlamı*. (Ergün Akça, Çev.). Kabalcı Yayınevi, İstanbul.

Long, R., Shang, X., Cao, H., & Li, J. (2021). *Emotional Experience Design of Medical Working Space Based on Color Semantics*. In: Shin, C.S., Di Bucchianico, G., Fukuda, S., G ve BSim , YG., Montagna, G., Carvalho, C. (eds) Advances in Industrial Design, AHFE 2021, Lecture Notes in Networks and Systems, vol *260*.

Mahnke, F. H. (1996). *Color, enviroment and human response*. New York: Van Nostrand Reinhold.

Marberry, S. O. (1997). Healthcare design. Wiley, New York.

Müezzinoğlu, K., Hidayetoğlu, M.L., & Yıldırım, K. (2021). The The effects of light color temperatures on students' perceptual evaluations in design studios. *Color Research and Application*, *46*(5), 1-13.

Müezzinoğlu, M. K. (2018). *Eğitim mekânlarında kullanılan renk ve ışığın öğrencilerin fonksiyonel ve algısal değerlendirmeleri üzerindeki etkileri*. Doktora Tezi, Fen Bilimleri Enstitüsü, Selçuk Üniversitesi, Konya.

Noraslı, M. (2022). *Şehir hastanelerindeki sirkülasyon sisteminin yön bulmaya etkilerinin mekân dizimi ile incelenmesi: Konya şehir hastanesi örneği*. Doktora Tezi, Lisansüstü Enstitüsü, KTO Karatay Üniversitesi, Konya.

Norberg Schulz, C. (1974). *Existence, space and architecture*. Praeger Paperbacks, Connecticut.

Özdemir, T. (2005). *Renk kavramı ve konut iç mekânında tasarıma etkileri*. Sanatta Yeterlilik Tezi, Fen Bilimleri Enstitüsü, Mimar Sinan Güzel Sanatlar Üniversitesi, İstanbul.

Öztürk Çelebi, G. (2018). Tarih öncesi dönemlerde iletişim. *Etkileşim*, *1*(2), 142-157.

Pallasmaa, J. (2018). *Tenin gözleri: mimarlık ve duyular*. (Aziz Ufuk, Çev.). YEM Yayın, İstanbul.

Roth, L. (2006). *Mimarlığın öyküsü: öğeleri, tarihi ve anlamı*. Kabalcı Yayıncılık, İstanbul.

Sema, T. (2006). *Mimarlık ve renk kavramı*. Yüksek Lisans Tezi, Fen Bilimleri Enstitüsü, Mimar Sinan Güzel Sanatlar Üniversitesi, İstanbul.

Siegel, S. (2006). *Which properties are represented in perception?* (T. Gendler, J. Hawthorne, Ed.). Perceptual Experience. Oxford University Press, Oxford.

Smith, A.D. (2002). *The problem of perception*. Harvard University Press, Cambridge.

Stoufer, J. (2000). Integrating human centered design principles in progressive health facilities. *Design & Health*, 258-292.

Sungur Ergenoğlu, A., & Tanrıtanır, A. (2013). Genel hastanelerde kullanıcı memnuniyeti açısından hasta odalarında mimari mekân kalitesinin irdelenmesi: Gaziantep ilinde bir alan çalışması. *Megaron*, *8*(2), 61-75.

Tağrikulu, R. (2022). *Yeniden işlevlendirilen mekanlarda katmanlaşan belleğin örnekler üzerinden incelenmesi*. Yüksek Lisans Tezi, Lisansüstü Eğitim Enstitüsü, İstanbul Kültür Üniversitesi, İstanbul.

Tavşancıl, E. (2005). *Tutumların ölçülmesi ve spss ile veri analizi*. Nobel Yayınları, Ankara.

Tepecik, A. (2002). *Grafik sanatlar, tarih, tasarım, teknoloji*. Detay Yayınları, Ankara.

Tipi, Ç. B. (2007). *Tıp fakültesi hastanelerinin erişebilirlik, kullanışlılık ve kullanıcı memnuniyeti kapsamında değerlendirilmesine yönelik bir yöntem önerisi*. Doktora Tezi, Fen Bilimleri Enstitüsü, Gazi Üniversitesi, Ankara.

Ulaş, B.G. (2002). *İç mekân renk düzenlemeleri*. Yüksek Lisans Tezi, Fen Bilimleri Enstitüsü, Mimar Sinan Güzel Sanatlar Üniversitesi, İstanbul.

Von Meiss, P. (2013). *Elements of architecture: from form to place tectonics*. EPFL Press, Lozan.

Wang, J., Zhu, Q., & Mao, Q. (2007). *The three-dimensional extension of space syntax*. 6th International Space Syntax Symposium içinde (ss.1-16). İstanbul, Türkiye.

Yıldırım, K., Akalın Başkaya, A., & Celebi, M. (2007). The effects of window proximity, partition height, and gender on perceptions of open-plan offices, *Journal of Environmental Psychology*, *27*(2), 154-165.

Zevi, B. (1990). *Mimariyi görmeyi öğrenmek*. (Demir Divanoğlu, Çev.). Birsen Yayınevi, İstanbul.

Resume

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