

Persian Medicine

Light and color therapy: the role of light and color in architecture from the perspective of traditional Persian medicine

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Competing interests

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Abbreviations

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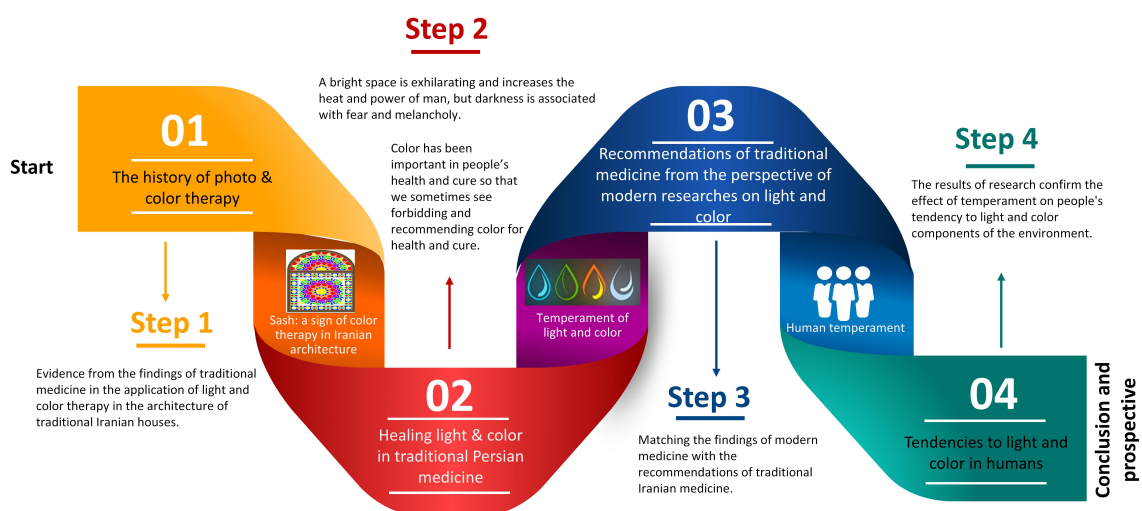
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Abstract

Some of the most important elements of healing architecture are light and color, which have been considered in diverse studies of environmental design for treatment and an effect on health. However, there is a lack of research in the field of the proportion of light and color with human differences. The goal of the present research is to provide a new perspective regarding the correlation between humans and the environment based on the philosophy of natural sciences in Iranian traditional medicine, with a focus on color and light to contrive an all-out balance of humans. The present article establishes a connection between traditional and modern medicine; it also indicates medical and health activists to draw their attention to the need for basic researches in traditional Iranian medicine to improve it based on scientific evidence as well as change the attitude of architects to design places based on people’s temperament (in traditional Persian medicine, temperament implies the same and new quality that results from the combination of the **four elements (fire, air, water, and earth are four essential constituents of human and non-human beings)** with each other and with their interaction in a composite body). This article is a descriptive method in a qualitative study that discuss elements of light and color from the perspective of traditional Persian medicine, after reviewing the history of color and light therapy. From the perspective of modern research, the study additionally discusses the effect of light and color on humans, the relationship of light and color with the temperament of people, and the effect of environmental color and light on people’s temperament. Notably, humans differ with regard to their characteristics and thus have different temperaments, which causes them to have different tendencies toward environmental factors. Qualitative data indicate the difference in the propensity of individuals to color and light according to a physical and psychological condition, and the effect of color and light on human temperament. Thus, the recommendations of traditional medicine can help present a proper pattern of design.

Keywords: light; color; health; architecture; traditional Persian medicine



Tradition

Light and color therapy has been used since centuries. The Egyptian civilization was the first to study color therapy based on the environment. In her master's thesis (2003) and while quoting Mary Anderson in *Color Healing: Chromotherapy and How It Works* (1975), Jo Edge has stated that the environment Egyptians created in their temples affected the healing of people and that they used sunlight to heal wounds. In addition, the ancient Iranians used color therapy based on light radiation. The importance of color from the point of view of Avicenna has been such that in writing the contents of materia in *The Cannon of Medicine* (1015 C.E.). In recent decades, a new concept of "healing architecture" has emerged as light and color are some of the most important elements of a healing environment and as the aesthetics in architecture have a profound effect on physical, mental, physiological, and overall performance.

Background

Historically, light and color therapy dates back to centuries ago [1]. The Egyptian civilization was the first to study color therapy based on the environment. In her master's thesis (2003) and while quoting Mary Anderson in *Color Healing: Chromotherapy and How It Works* (1975), Jo Edge has stated that the environments Egyptians created in their temples affected the healing of people and that they used sunlight to heal wounds [2, 3]. In addition, the ancient Iranians used a type of color therapy based on light radiation [4, 5]. The importance of color from the point of view of Avicenna has been such that while drafting the contents of material in *The Cannon of Medicine* (1015 C.E.), he used different colors to help readers better understand the content [6].

In recent decades, a new concept of "healing architecture" has emerged [7–9]. In this concept, the effect of designing a medical environment for reducing patient stay and the positive effect of nature on health are considered in three ways [7, 10–23]: (1) the effect of environment on mental health and for reducing stress [24–31] or the effect of green and blue spaces for improving health [32–38]; (2) the effect of the energy of environmental objects on humans [39]; and (3) the effect of outdoor activities on human physical health and the role of place design on physical activities [40] as people spend more than 90% of their life in buildings [41]. In addition, people's lives are influenced by communication with the environment through senses such as sight, and in this communication, light plays an important role [42, 43]. The role of color is also crucial because of its effects on the human mind [44–47]. Notably, light and color are some of the most important elements of a healing environment and aesthetics in architecture [48] and have a profound effect on physical, mental, and physiological well-being as well as the overall performance [49–51]. Therefore, the designer requires physiological and psychological knowledge that will help explore the effects of light and color on humans [52].

Previous studies have assessed either the aspects of light and color therapy and their application in common modern medicine therapies, or the use of color and light in the design of contemporary therapeutic environments regardless of individual human differences. Two aspects distinguish the present research from previous studies: the first is the study of light and color therapy from the perspective of traditional Iranian medicine and the second is the emphasis on people's temperament (in traditional Persian medicine, temperament implies the same and new quality that results from the combination of the four elements (fire, air, water, and earth are four essential constituents of

human and non-human beings) with each other and with their interaction in a composite body) and the differences in their tendencies to light and color due to individual differences. This research is a descriptive-analytical study that considers the relationship of color and light as architectural variables with human health as well as disease from the perspective of traditional Persian medicine. The primary question addressed in this study is as follows: what are the recipes in traditional Persian medicine regarding light and color in architecture and environment? Moreover, do people exhibit different trends to light and color with the different mental and physical conditions? This study has been conducted with the aim of establishing a connection between traditional and modern medicine researches and introducing environmental light and color from the perspective of traditional Iranian medicine, for future studies on the application of this science.

The history of photo and color therapy

Light is an important architectural parameter. Light exhibits different colors according to its wavelength [53], and therefore, light and color are two continuous elements [54]. In "*Color Harmony for Better Living*" (2002), Lambert has indicated the importance of color therapy in ancient civilizations [54]. Because it is an issue that has always been considered throughout history, phototherapy and chromotherapy have been used in Egypt, Greece, China, and India since 2000 B.C.E. [55, 56].

In 6 B.C.E., Orpheus was the first to utilize the vibrations of light and color as tools for treating patients, and in India, Acharya Charaka recommended light therapy. In 125 C.E., Apollonius studied the effect of light on emotions [57]. Avicenna (980 C.E.) used color as a way to diagnose disease, identify temperaments, and treat and maintain health [6]. In 1493, Paracelsus used the power of colored rays to heal patients [57]. In the 17th century, Janet used light rays to cure hysteria. In 1876, Pleasanton and Pancoast were the first to use blue light to stimulate the glandular system and red light to stimulate the nervous system [58]. In 1878, Dr. Babbitt described using a variety of colors to repair internal organs [59]. In 1908, Aura-Soma used colors to improve physical and mental well-being, and in 1945, Dr. Feindel introduced the use of green light to promote calmness [58]. Faber Birren, in several books and articles she began writing in 1928, suggested a range of colors for the interiors of hospitals and other environments [60]. In 1930, colored lights were employed to balance the nervous system, to accelerate learning, and for sedation before operation. In 1943, Max Luscher developed the Psychological Color Test [61]. In the rest, the presentation of color therapy books to Yale University in 1971 by Faber Birren, the use of various colors to cure the internal organs of the human's body in 1978, and the edition of chapter one of the complementary medicine book called *Color Therapy* in 2000 by Donnelly are counted as the latest studious findings in this field. In addition, in recent years in India, colors have been used to establish balance in human body using the traditional and ancient form of color therapy called Ayurveda [62].

In traditional Persian medicine, the effect of light and color on individual health and treatment is of particular importance. In the Vendidad, an Avesta scripture (141 B.C.E. to 224 C.E.), sunlight is indicated for its use as an antiseptic [63]. Ibn Rabban Tabari in *Ferdous al-Hekmah fi al-Tibb* (2nd century AH (Anno Hegirae; lunar calendar)) has mentioned the effect of colored stones for the treatment of diseases such as epilepsy as well as for abortion [64]. In addition, chapter 34 of *Pahlavi Narration*, drafted in 3 AH, was devoted to the healing properties of colored beads [65]. Rhazes (3 AH) in *Al-Hawi* discussed light reflection in the pupil and the change in pupil size according to incident light intensity [66]. Avicenna (4 AH) introduced the concept of using the color of body organs as a tool to diagnose diseases and demonstrated the relationship between temperature and physical condition of the body. He was the first to state that the use of wrong color aggravates the disease and to demonstrate the use of different colors to treat many eyes and mental illnesses [6]. In 5 AH, Alsuwaidi stated that colors have their temperament and thus affect

mood [67]. In addition, Nasser al-Hokama in 13 AH identified the need for lighting spaces to maintain health [68]. In the last century, Nabipour stated that openings and windows with colored glass can help treat patients with skin diseases and those with high fever [69]. In an article, Alireza Ahmadian concluded that direct sunlight reflected on the windows of homes or workplaces can also be used as a type of light therapy to treat seasonal affective disorders [70].

Healing light: the effect of light on human

From a doctor's perspective, residence is considerably important and plays a significant role in human health. In addition, the role of natural light as the most favorable light form cannot be denied [71]. In his book titled *The Healing Sun*, Dr. Hobday reiterates Vitruvius's findings regarding architecture, i.e., the architect must choose healthy places for buildings and the design of buildings should be exactly such that it prevents diseases [72]. In 1 B.C.E., Vitruvius was the first to consider the quantitative and qualitative aspects of daylight [73]. In the present times, this recommendation is being considered in a more detailed manner [74]. Therefore, considering daylight is a fundamental starting point.

The traditional Persian medicine recommends building houses in a

proper form by indicating the dimensions and direction of window placement for ensuring adequate daylight in the building to reduce the harm caused by weather in a city that has unhealthy weather [6, 75]. Nasser Al-Hakma has stated the importance of good lighting in homes and the relationship between light and health: "The house in which the sun would not shine, the physician would come. Therefore, wide and high doors should be built for the room through which sunshine can reach all parts of the room easily, and there be no dark spots." [68]. Clearly, traditional Iranian buildings, especially houses in warm and dry areas, have implemented this recommendation in the best manner using elements such as sashes, doors, and windows (three-door, five-door, or seven-door) as well as belvedere skylight (Figure 1).

From the point of view of traditional medicine, all universes have temperaments. Therefore, each part of the human body also has a temperament [76], and when this is not in a moderated state, a person will fall sick. Light has a warm and dry temperament and imbibes energy and induces movement. A dark environment leads to the deposit of melancholy in the brain, its more coldness, and the exit from its natural state. A bright space is exhilarating and increases the heat and power in humans. Based on this, doctors have recommended such type of architecture for bathrooms [77–80] (Figure 2).

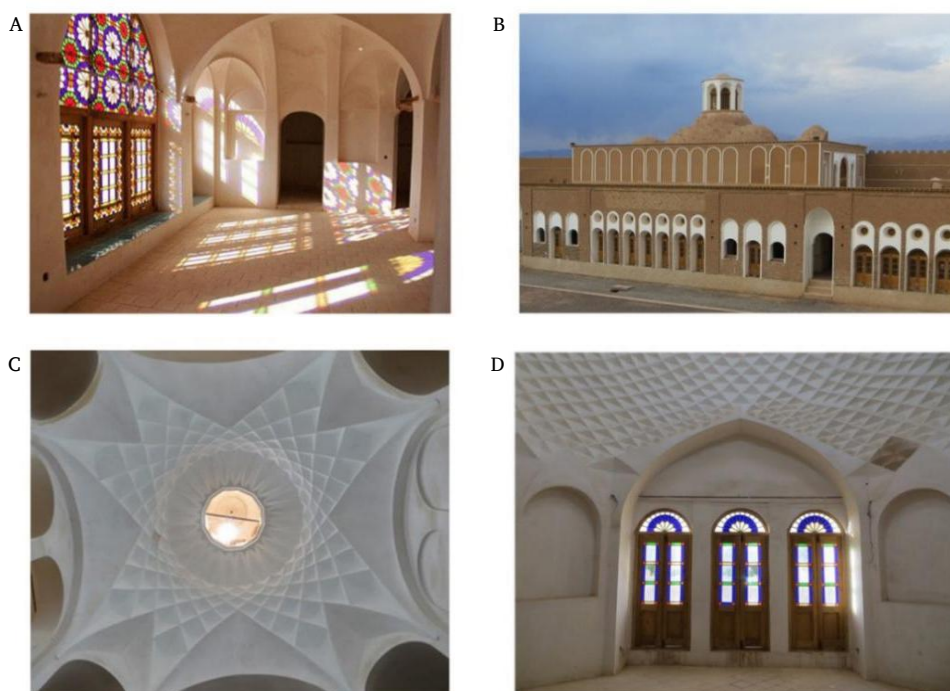


Figure 1 Lighting in Haj Agha Ali's house (Rafsanjan). A, sash window; B, the facade of the belvedere, door and window; C, the view under the belvedere; D, the three-door interior view. Source: this photograph was taken by Vahideh Rahimi-Mehr at Rafsanjan city in Kerman Province, Iran, in November 2017.

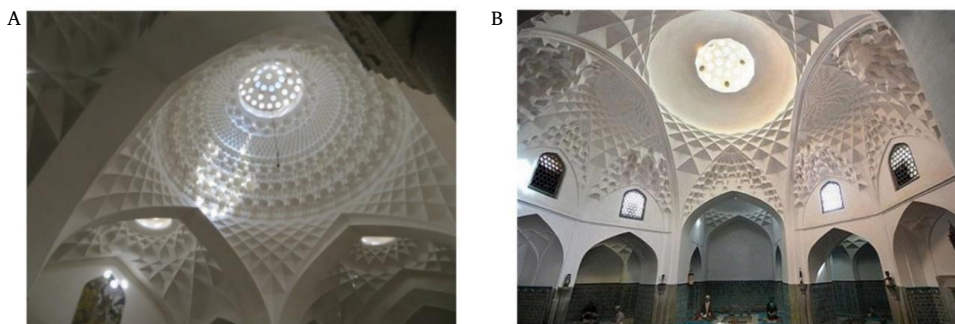


Figure 2 Lighting in Kerman bathrooms. A, the glass house of Ibrahim Khan bathroom; B, the glass house of Ganjali Khan bathroom. Source: this photograph was taken by Vahideh Rahimi-Mehr at Kerman city in Kerman Province, Iran, in September 2017.

In traditional medicine-based phototherapy, the intensity of incident light is considerably important. Accordingly, physicians have recommended the amount of light that should be received based on different physical and mental conditions (Figure 3). (1) Balancing space light is essential in curing warm meningitis (a severe headache because of warm swelling in the thin curtain or cortex of the brain) [81]. (2) Looking at strong lights is disadvantageous, e.g., staring at glitters can cause eye injuries [82] or stimulate epilepsy [82]. (3) In some cases, light intensity can cause diseases such as snow blindness [82]. (4) Reducing light intensity is sometimes important to cure diseases, e.g., using darkness for treating diseases such as conjunctivitis and cataract or unilateral facial paralysis (for which Avicenna recommended a dark house) [82]. In addition, light induces pain in patients with certain diseases and is therefore forbidden, e.g., for patients with headache [82].

The healing color: the effect of the environment’s color on humans

During Hippocrates lifetime, physicians believed that colors have a suitable effect on the development or improvement of diseases, which facilitated the initiation of using colors for treatment [83]. In traditional Persian medicine, color has been deemed important to improve health and cure diseases; thus, we sometimes witness forbidding and recommending color for improving health and curing diseases (Figure 3). Examples of avoiding color to maintain health are as follows: not using dark (black) colors in the environment as it leads

to the congestion of melancholy humor or not using white colors to avoid diseases such as snow blindness [82]. Examples of forbidding colors for treatment include the prohibition of watching red color among patients with diseases such as nosebleed [6] and hemoptysis [82] owing to the stimulation of blood and increased bleeding [82]; the prohibition of looking at whiteness and light by patients with conjunctivitis [82]; and preventing coloring doors and walls to cure meningitis [82]. Happy colors have been recommended to maintain health; e.g., Rhazes states that beautiful pictures with colors such as yellow, red, green, and white mixed in a proper ratio are suitable for curing melancholy eczema and for reducing the symptoms of psychosomatic diseases [84].

In traditional Iranian architecture, there are several examples of the use of happy color combinations (Figure 4). Colors have also been recommended for the treatment of diseases, e.g., using red color in the treatment of pediatric strabismus. Avicenna has recommended putting a red object near the ear beside the squint eye for reducing strabismus in some cases [82]. In addition, the use of black and green colors in the environment has been recommended to cure conjunctivitis. In addition, it is recommended that the patient’s mat and environs be black or green; moreover, during the disease, the patient should hang a black cloth on his face to see black and during recovery, he should hang a blue one. It is also recommended that the patient’s abode be dark [82]. Another example is for treating snow blindness, for which it is recommended that the patient looks at green and blue items and that a black item is always in the front of his eyes [82].

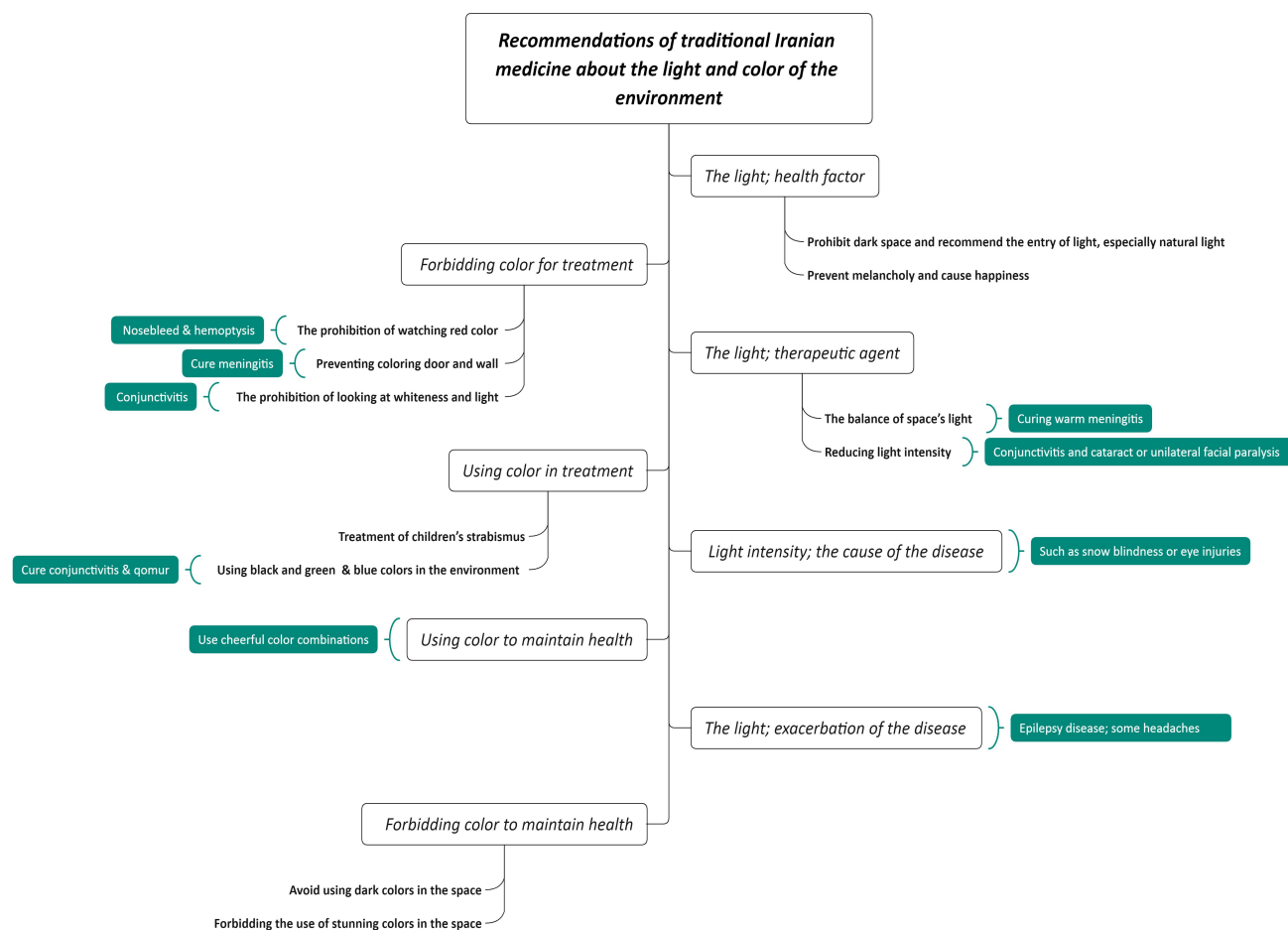


Figure 3 Summary of traditional Iranian medicine recommendations regarding the use of light and color in the environment

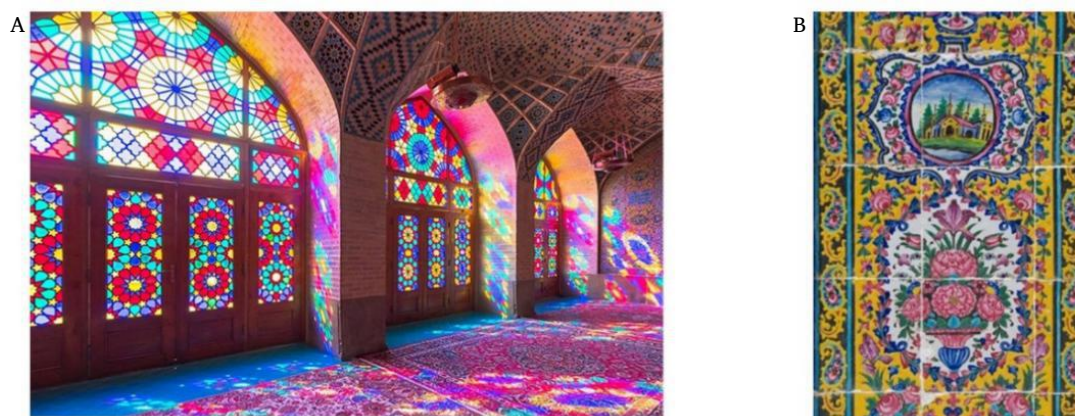


Figure 4 Combination of happy colors in Nasir-ol-Molk Mosque, Shiraz. A, sash; windows of Orosi; B, the sample titles. Source: this photograph was taken by Vahideh Rahimi-Mehr at Shiraz city in Fars Province, Iran, in July 2018.

Recommendations of traditional medicine from the perspective of modern researches on light and color therapy

Doctors emphasize on exposure to environmental light to maintain health and prevent few physical, mental, and psychological diseases. Such disorders can arise from the proliferation or lack of light and exposure to particles, toxic materials, X-ray and other ionizing radiations, and heat. E.g., the lack of light or darkness causes problems such as involuntary rotation of pupil [85], as in nystagmus disease (characterized by abnormal eye movements) that mine workers usually report when exiting from the mine. As a result, their eyes sense that the objects are vibrating for few seconds after exiting from the mine. This event can involve one or two eyes. Avicenna has explained the reasons for the inability to see and the effect of light as follows: “It is possible that the power of sight decreases because of staring a lot at a certain thing. For example, staying in darkness and not seeing light for a long time tightens sight’s essence and then leads to excessive thinness.” [82].

Some neuropsychological diseases such as schizophrenia and dementia are related to the lack of light. Jurjani, the physician from 5 AH, introduced coldness as a reason for these diseases and stated that darkness affects the development and aggravation of these diseases. Thus, he recommends a bright living environment to cure such patients [81]. He also advises that to cure cold meningitis (characterized by prolonged and deep sleep and lack of muscle movements, consciousness, and senses) the patient should sleep in a bright house during the entire course of the disease [81]. Owing to the warm temperament of light, it is difficult for humans to sleep in light environments. This is why people choose a dark environment while sleeping as melatonin regulates the hormone and the 24-hour pattern of the body’s operation and responses. The release of melatonin is stimulated by darkness and repressed by light. Therefore, it helps in regulating sleep and wakefulness in humans [86].

Till date, numerous quantitative and qualitative studies have assessed the effect of color and light on the health of human body and soul, and findings from all studies confirm the influence of environmental light and color on humans. Few studies have proved that environment’s light can penetrate the mammalian skull, and if its amount is enough, it can activate photoelectric cells inside the brain tissue [87]. In addition, several types of studies have demonstrated the effect of sunlight on few cardiovascular diseases. Sunlight is the main source of vitamin D, and a lack of this vitamin causes diseases such as cardiovascular diseases. For example, a study assessing the relation between vitamin D and venous thromboembolism in 29,518 women over 11 years demonstrated that the risk of this disease in women sufficiently exposed to the sun was 30% lower than that in women who were not exposed to the sun [88]. A research has also shown that adequate exposure to the sun and use of supplementary vitamin D can be a good choice for preventing and treating patients with coronary

artery [89].

In addition to eye injuries and vascular diseases, several mental and psychological problems can arise owing to a lack of exposure to light. Light has a direct effect on the functioning of internal brain parts. In addition, several studies have demonstrated the optimal effect of light on psychological health and human behavior as well as on the promotion of physical and mental conditions [90]. Some psychologists believe that the range of exposure to the light has a positive psychological effect on controlling the boarding system of the body [91, 92] and some types of depression, such as seasonal depression occurring in autumn and winter owing to reduced exposure to light [93] that decreases brain melatonin levels. Based on this evidence, “light therapy” was introduced to treat such conditions as exposure to the complete light spectrum or increasing light intensity induces melatonin production in the brain [94]. A recent study revealed that the use of appropriate lighting helps women relax in the delivery room [10]. In addition, the lack of natural daylight can lead to neural system disorders, loss of energy, exhaustion, tendency to self-seclude, and metabolism disorders [95].

Research in recent decades has confirmed the recommendations by traditional medicine regarding light intensity and avoiding looking at dazzling lights in some diseases (such as epilepsy) as well as regarding emphasis on darkness to treat few eye diseases. In line with this, currently, looking at consecutive pictures of TV or computer monitor with a high color contrast (especially black, white, blue, and red) is harmful to patients with epilepsy [96–98]. Numerous studies have proven the effect of darkness for the treatment of neurological diseases such as migraine [99] and several eye diseases [100, 101] and have suggested the efficacy of eye pads in diseases such as lazy eye and cataract [102].

In addition to light therapy, color therapy is considered a branch of complementary medicine. Studies have demonstrated the effect of colors on mind, behavior, and physical and intellectual balance and on inducing happiness, depression, peace, or impatience in humans [103, 104]. Today, scientific and physiological studies have proved that colors can induce physical responses such as upregulate or downregulate blood pressure or alter heartbeat, induce perspiration, induce the respiratory system, and even stimulate the models of brain waves [56, 105]. An appropriate color of the environment leads to peace and satisfaction. On the contrary, an inappropriate color causes mental stress, psychosis, and altered health in humans. Atypical and dark spaces induce unwanted depression and mental stress [106], which confirms the recommendation of traditional medicine to avoid using dark colors in spaces. In addition, modern research has suggested that certain colors should be avoided or used in hospital rooms; for example, dazzling colors should be avoided in patient rooms [107], cold colors should be avoided for patients with high blood pressure and those with anxiety, and red should be avoided for patients with epilepsy [6] as red stimulates the neural system,

particularly the sympathetic branch [61]. Thus, the red color stimulates cerebral waves as well as creates appreciable muscle traction and increases blinking frequency [87]. On the other hand, red light maximizes visual accuracy, which explains its use in airplane console and in the control room of ships and submarines [87]. Another study demonstrated that the combination of happy colors could increase the attractiveness of the space as well as its energy and vitality [108], which is in line with the recommendations of medicine of using an appropriate color combination to reduce melancholia.

From the point of view of doctors practicing traditional Iranian medicine, body color is a function of the body's humor [109] (e.g., skin color, hair color, tongue, and the color seen in a dream) and can be used to diagnose various diseases [110–113]. In addition, colors affect this humor from outside the human body. Thus, the experts of this science suggest that patients should use different colors along with other treatment methods, e.g., using blue color to reduce blood pressure, sciatica, headache, diabetes, colon irritation, and constipation; eating red fruits to cleanse the blood and form new blood; and using green color to relax and relieve anxiety and treat patients with heart diseases. In addition, several books on traditional medicine have recommended the use of plant, human, and animal images (with happy coloring) on the walls of bathrooms to treat body weakness [77–84]. Implementations of these recommendations can be seen in the traditional baths of Iran that are known as the common chapter of architecture and medicine [114] (Figure 5).

Tendencies toward light and color in humans

Traditional Persian medicine is constitutional and mixed with Greece philosophy empiricism that has provided valuable remedies based on a thousand-year-old experience of using light and color as important variables in architecture. This empiricism contains two theoretical and practical parts and two inseparable parts of physical and spiritual medicine [115–117]. This empiricism believes that maintaining the body's balance constitutionally means maintaining health, and when the body is out of this balance, it leads to a diseased state.

As factors such as color and light induce different satisfaction levels in humans, it is possible to design the environment by complete mental and temperamental recognition to satisfy people [118]. According to traditional medicine, humans have different temperamental and behavioral characteristics based on their temperament. It seems that these diverse physical and mental features contribute to their differing trends to various indexes of architecture in different temperamental groups. People with every temperament tend to have internal balance. For example, people with warm temperaments show less trend to heat and warm environments than cold environments. Therefore, architectural arrangements can be made based on the trends of these temperamental groups. These trends are caused by the effect of color and light on human temperament. The article "Investigating the relationship between human temperament and environmental color: a cross-sectional-analytical study in Kerman city." published in the

Journal of Complementary Medicine in 2020, examined the relationship of wall and ceiling colors in 144 residential units with the temperament of housewives; the results indicated the effect of environment colors on the temperament of residents [119]. In addition, recent studies have confirmed the tendency of people to light and color based on their temperament. In two studies conducted by Dadras et al. in the traditional medicine clinic of the University of Tehran in 2015 and 2017, the relationship between temperament differences and patient's tendency to color and light was examined.

The results of both studies showed a significant relationship between temperament and tendencies [120, 121]. In the first study, which examined the relationship between color and tendency, the results showed that people's interest in a particular color did not lead to the choice of that color and that people, according to their temperament, tended to choose a color that helped moderate their temperament [120]. The results of the second study showed that people with a warm temperament were inclined to light more than those with a cold temperament and preferred happy colors [121]. In other words, the tendency of warm-tempered people to light does not lead to them choosing a bright or sunny space. These people choose an environment with less light or shade to reduce the warmth of their body temperature to balance their temperament. Alternatively, people with depression who, according to traditional medicine, have a cold temper tend to darken due to the effect of depression on them but choose a bright space and use sunlight for their treatment.

Conclusion and prospective

The current research aimed to assess the effect of the environment's light and color on humans from the perspective of traditional Persian medicine. Environmental factors such as color, light, and others' behavior can affect the brain to a greater extent and other organs to a lesser extent, through the brain. Of all factors, color and light are more controllable and are counted as the main indexes in architecture. Apparently, according to recommendations of the traditional medicine, light and color may not exhibit identical characteristics in all individuals. For example, the color that is suitable for a person with eye disease can be inappropriate for a patient with mental disorder, and this is where the temperamental conditions of people can help the architect choose the color and light of the environment. For example, the recovery of people who have diseases due to the brain's coldness, such as depression, can be accelerated by designing an environment with appropriate light and warm colors like orange.

Thus, it seems that lighting and coloring the environment can be affected by the temperamental roots of people, and individuals watch different lights and colors based on their temperamental conditions or abstain from a particular light and color. Of note, it should be considered in therapeutic centers that one of the ways to recognize a patient's condition is the color of his face. Therefore, the light and color of the environment should be chosen in a way such that the patient's face shows its real color, which will help doctors and nurses easily recognize the disease.

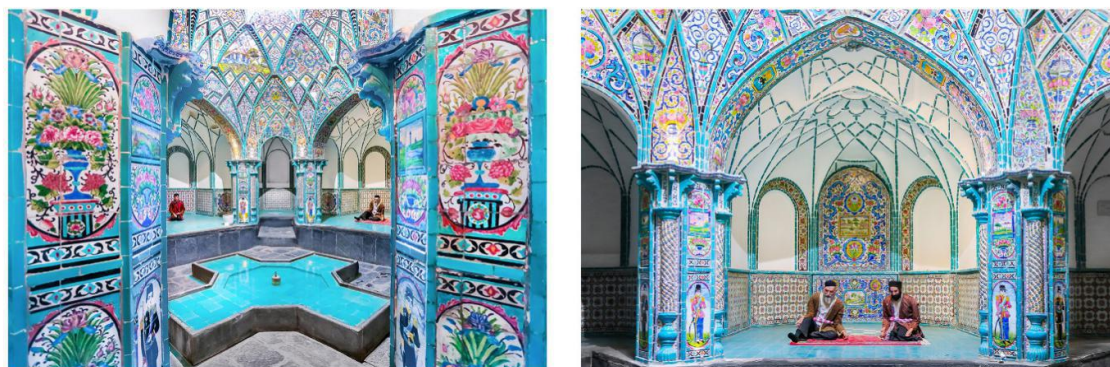


Figure 5 Four seasons bath bathroom tiles, Arak. Source: this photograph was taken by Hosein habibi Nejhad at Arak city in Markazi Province, Iran, in April 2019.

Meanwhile, architects and designers should expose their audience to suitable lights and colors based on temperamental conditions (in health and disease) and prevent the use of physical features that disagree with audience temperament. If this rule is not followed, watching unsuitable colors can induce diseases among people residing in the building. Resolving this matter is easier in homes and treatment centers; this is because in homes, each person's room can be designed in line with his temperament, and in treatment environments, it is possible to provide a color according to the patient's temper by designing partitions in different colors and considering special colors for each bedridden part. However, in environments with people who have different tempers, architects should use the combination of warm and cool colors or moderate colors such as green.

Compared with the past, people today spend most hours of their life in porch spaces during the day, providing the possibility of exposure to suitable and natural light. Thus, it would be a desirable idea to choose a color based on people's temperament to promote life quality and improve their health, contentment, and efficiency. Choosing an appropriate color implies selecting colors that induce a person's temperance based on the situation and performance of the place. Creating such facilities requires the prediction process to be clear and requires adopting guarded plans while presenting policy and strategic decisions, programming, designing and compiling practical solutions, and finally executing in addition to the belief in its useful results. This issue reveals the importance of recognizing mechanisms and relations dominated in these processes and knowing their management. Based on the aforementioned cases and findings, the environment's light and color can cause a disease, preserve health, or cure a disease. Moreover, if the design of the environment is associated with the knowledge of temperaments, such an environment will be associated with exceptionally good results.

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