

The impact of light in interior architecture Of Residential building

Sara Davarpanah

MS Architecture, Interior architecture Department, E.M.U, Famagusta, Cyprus

Abstract— Light creates a feeling of emotions. The origin of light is natural light, which is also known as daylight. There must always be space for natural light; even when people design artificial light, they will want it to look like natural light.

Light controls people's behavior and emotions. It can make people even happier. When people design light for space they need to put in position of people working in that space. Even lighting seems very functional. For example when people in the park, the streetlight and underground artificial light make people feel uncomfortable. But if it were natural light, people would feel comfortable. Users will create a new space from the feeling, which combines the comfort provided by natural light, and the users own feelings and emotions.

Main topic of this reseach is to study the emotional effects of lighting on space users using physiological and psychological measures. It is clear from literature that the choices of lighting of constructed spaces are not based on scientific facts, thus there is a need for a research that studies the impact of light on people using subjective and objective measures.

Key word : lighting, interior design, residential spaces

1. INTRODUCTION

Interior design concerns itself with more than just the visual or ambient enhancement of an interior space; it seeks to optimize and harmonize the uses to which the built environment will be put. Thus, in the words of the U.S. Bureau of Labor Statistics, it is "practical, aesthetic, and conducive to intended purposes, such as raising productivity, selling merchandise, or improving life style." Interior design is a practice that responds to changes in the economy, organization, technology, demographics, and business goals of an organization. As a human activity, interior design is centuries old. As a coherent profession identified by the label "interior designer," it is relatively recent. Many experts trace its beginnings to the early 20th century and the rise of interior decoration as a career separate from architecture. In the early decades, this practice focused largely on the residential area. By the 1940s, the terms "interior design" and "interior designer" were used primarily by those individuals providing services to a small but growing number of business clients. After World War II, nonresidential design—offices, hotels, retail establishments, and schools—grew in importance as the country rebounded economically. Interior design is generally divided into two categories, residential and contract or commercial. Today, interior design is becoming increasingly specialized as buildings and materials get more complex technologically and regulations and standards more demanding.

Interior design is a multi-faceted profession in which creative and technical solutions are applied within a structure to achieve a built interior environment that solves the customer's problems and links space to business strategies and goals. These solutions are functional, enhance the quality of life and culture of the occupants, and are aesthetically attractive. Designs are created in response to and coordinated with the building shell, and acknowledge the physical location and

social context of the project. Designs must adhere to code and regulatory requirements, and encourage the principles of environmental sustainability. Interior design can also influence the choice of real estate that will address the organization's needs through the architecture and design elements. The interior design process follows a systematic and coordinated methodology, including research, analysis, and integration of knowledge into the creative process, whereby the needs and resources of the client are satisfied to produce an interior space that fulfills the project goals.

Humans are affected both psychologically and physiologically by the different spectrums provided by the various types of light. These effects are the less quantifiable and easily overlooked benefits of daylighting. Daylighting has been associated with improved mood, enhanced morale, lower fatigue, and reduced eyestrain. One of the important psychological aspects from daylighting is meeting a need for contact with the outside living environment (Robbins 1986).

According to Dr. Ott (Ott Biolight Systems, Inc. 1997a), the body uses light as a nutrient for metabolic processes similar to water or food. Natural light stimulates essential biological functions in the brain and is divided into colors that are vital to our health. On a cloudy day or under poor lighting conditions, the inability to perceive the colors from light can affect our mood and energy level. Dr. Liberman (1991) also mentioned that light plays a role in maintaining health:

"When we speak about health, balance, and physiological regulation, we are referring to the function of the body's major health keepers; the nervous system and the endocrine system. These major control centers of the body are directly stimulated and regulated by light, to an extent far beyond what modern science...has been willing to accept".

A 1986 study by West as cited by Heerwagen (1986) evaluated the effects of light on health by evaluating prison inmates with different window views. He found that inmates with windows facing a meadow or mountains had significantly lower rates of stress-related sick calls than inmates with a view of the prison courtyard and buildings. Furthermore, inmates on the second floor had lower rates of stress-related sick calls compared with inmates on the first floor. Reasons for the differences in sick calls included a more expansive view from the second floor, which provided increased positive psychological benefits. Inmates on the first floor had added stress from lack of privacy because of visibility to passersby. Because natural views tend to produce positive responses, they may be more effective in reducing stress, decreasing anxiety, holding attention, and improving mood. Studies in 1979, 1981, and 1986 by Ulrich (Heerwagen 1986) support the effectiveness of natural views. Ulrich found that viewing vegetation and water through slides or movies is more effective in creating psycho-physiological recovery from stress than built scenes without water or vegetation. Also, individuals recovered faster and more completely from a stressful event when exposed to films of natural settings as opposed to urban scenes. Nature group subjects also had lower muscle tension, lower skin conductance, and higher pulse transit along with possibly lower blood pressure from these health differences. Furthermore, Ulrich reported more positive emotional states and wakeful relaxation states for people exposed to natural scenes.

The human eye functions at its best when it receives the full-spectrum of light provided by daylight (A Closer Look at Daylighted Schools 1998). Many fluorescent lights are concentrated in the yellow-green portion of the spectrum to obtain the most lumens per watt; this unbalanced, narrow spectrum limits the blue in the source, which leads to improper functioning of the eye. Therefore, the superior spectral content of natural light makes it the best light for the eye (Ott Biolight Systems, Inc. 1997a). Looking at what parts of the eye are affected by light helps to understand how it functions in different light sources:

Before the 1940s, daylight was the primary light source in buildings; artificial lights supplemented the natural light. In the short span of 20 years, electric lighting had transformed the workplace by meeting most or all of the occupants' lighting requirements. Recently, energy and environmental concerns have made daylighting a rediscovered aspect of building lighting design. The physics of daylighting has not changed since its original use, but the building design to use it has. Daylighting is often integrated into a building as an architectural statement and for energy savings. However, benefits from daylighting extend beyond architecture and energy. The psychological and physiological aspects of natural light should also be considered. The comforting space and connec-

"The human eye is a light-sensing system with a pupil and a photoreceptive medium called the retina. The retina contains two photoreceptors: rods and cones. Cones (which see photopic lumens or bright light) are responsible for day vision. Rods (which see scotopic lumens or dim light) are associated with night vision...Studies at UC Berkeley Laboratories by Dr. Sam Berman, senior scientist, have proven that pupil size and brightness perception at typical office levels are, in fact, strongly affected by rod activity within the retina of the eye.

Light reaching the retina of the eye is converted into electrical signals that are transmitted by the optic nerve. Most of these signals end up in the visual cortex of the brain and produce our sense of vision. However, some of the nerve fibers split off from the optic nerve soon after leaving the eye and send signals to the suprachiasmatic nucleus, which is the area of the brain where the main clock for the human body resides (Light, Sight, and Photobiology 1998).

2. Literature review

2.1. What is light?

Light is the soul of architecture design. Light allows us to see, to know where we are and what around us. Beyond exposing things to view and feel, light models those objects to enhance visual and to help us define the physical world. Nothing would be visible without light, light also makes it possible to express and show to the mind's eye things that eludes the physical one. Light helps us redefine the relationships of people with the environment and with themselves. It is divided into natural light and artificial light (Benedetti, F.; Colombo, C.; Barbini, B.; Campori, E.; Smeraldi, E).

Natural light is a gift of nature. Civilized man learns to use artificial light sources which free him from total dependence on daylight, we also learn to appreciate the value of daylight and become aware of its special advantages.

Artificial light is seeing both during the day as well as after dark. It is made by human. It is very useful when lack of natural light.

tion to the environment provided to building occupants provide benefits as significant as the energy savings to building owners and managers.

This paper summarizes the benefits that different wavelengths of light have on building occupants. Daylighting has been associated with higher productivity, lower absenteeism, fewer errors or defects in products, positive attitudes, reduced fatigue, and reduced eyestrain.

2.2. Wavelengths of Light

Electrical light sources include cool white fluorescent, incandescent, energy-efficient fluorescent and full-spectrum fluorescent lighting. Each type has a different level of energy consumption. However, the most important factor affecting build-

ing occupants is the different spectrums of light that each source produces. Different wavelengths or spectral distributions of light have different effects on the human body. Most electrical light sources lack the spectral distribution needed for complete biological functions, although full-spectrum fluorescent lighting does come close to that of natural light (Hathaway, et al. 1992).

Cool white fluorescent lights are concentrated in the yellow to red end of the visible light spectrum. Incandescent lamps, similarly, are concentrated in the orange to red end of the spectrum. In comparison, energy-efficient fluorescent lighting is typically concentrated in the yellow to green portion of the spectrum. These three light sources lack the blue portion of the color spectrum (Lieberman 1991), which is the most important part for humans and is best provided by natural light. Full-spectrum fluorescent lighting is the electrical light source that has a spectrum of light most similar to natural light because it provides light in the blue portion of the spectrum.

Daylight provides a better lighting environment than cool white or energy-efficient fluorescent electrical light sources because "daylight...most closely matches the visual response that, through evolution, humans have come to compare with all other light" (Franta and Anstead 1994). The majority of humans prefer a daylight environment because sunlight consists of a balanced spectrum of color, with its energy peaking slightly in the blue-green area of the visible spectrum (Lieberman 1991). According to Hathaway, et al. (1992), natural light also has the highest levels of light needed for biological functions:

The photobiologic action spectrum of greatest importance to humans ranges from 290 to 770 nanometers. Skin reddening and vitamin D synthesis occurs in the range of 290 to 315 nanometers. Tanning or pigmentation of the skin and reduction of dental... [Cavities] occurs in response to band light in the band from 280 to 400 nanometers. Vision is the most sensitive to light in the 500- to 650- nanometer range (yellow-green light). Billirubin degradation occurs in response to light in the 400- to 500-nanometer range (blue light) (Hathaway, et al. 1992).

2.3. Light in the Interior Design

Beauty receives its meaning from the beam of light otherwise it is meaningless in darkness. The light, whether superficial or mystical, makes beauty eye-catching and makes the color and other beauties of the object to attract the eyes. Hence, discussions about light have a special status in the aesthetics and art related considerations. Architecture is one of the sciences and arts in which the role of light can be considered and a detailed discussion about taking advantage of the natural light is provided in this science. Lighting devices are also attended to as the sources of artificial lighting. Light is one of the components in the architecture and is discussed

along with other elements and concepts such as structure, space regularity, materials, color, etc. Architecture is the accurate and stunning artistic play of a collection of artificial objects under the light. Each environment has two faces taking into account the role of lighting and varying amounts of light during day and night link these two faces together. Lighting has given special meaning and sense to the life and architecture in each period. Light can be used variously for conveying specific meanings and purposes. For example, a specific point can receive emphasis with the creation of a pore and directing light toward it or it is possible to make a spiritual atmosphere with the gentle movement of light (SeyedSadra, 2009).

Human dependence on light is undeniable. Light has a direct effect on the human psyche. Researchers believe that as the human contemplates on the healthy diet for his body, he should provide enough and appropriate light for his soul as well. If this requirement is neglected, it would cause many of the unpleasant effects on the psyche. This effect does not solely depend on the amount of light but also the kind of the ambient light must be taken into account. For example, even if white and blue lights have been sufficiently dispersed in the library environment, they may bring a sense of despair and depression for the person. Lighting of the library environment can bring a variety of emotions such as peace, joy, happiness, depression, fear, anxiety, anger, and other similar emotions. That is why humans have a sense of happiness in a specific place with particular lighting and has a sense of depression with another kind of lighting at the same place. The effects of light on the structure of the objects also demands attention. Light is an efficient means to achieve many of the desired visualgoals. For example, with the application of a specific light or a purposeful combination of several types of artificial lighting, it is possible to make some parts of an object hollow or protuberance. Although, it is obvious that all these changes are visual tricks, it seems that the object has structure changes as a result of the great impact of such lighting. As the light is effective in terms of restructuring the visual appearance of objects, it has significant effect on changing the physical condition of the environmental and its architectural features (Azem, 2007).

2.4. Impact of light on human

Sunlight is the form of natural lighting which nurtures most living things. Photo-synthesis (the ability of plants to use sunlight in manufacturing food) and phototropism (the tendency of plants to grow towards light) are two light-related processes that are well understood. The effects of light in vision are also well understood. Non-visual effects of light on students are not so well understood. Some of the known or suspected effects of light on people are discussed in later sections of this review but before such a discussion takes place, it is useful to

discuss the nature of sunlight.

When sunlight passes through a raindrop, a rainbow is formed. Sunlight passing through a prism produces the same effect. While sunlight appears to be "white" light, the rainbows produced by raindrops or prisms suggest that sunlight contains many colors. The range and intensity of these colors is referred to as the spectrum of sunlight. Sunlight reaching the earth's surface consists of energy in wavelengths ranging from 300 nanometers (nm) to 825 nanometers (Thorington, L., Parascondola, L., and Cunningham, L., 1971, p. 34). For the most part vision is a response to light energy reflected from objects in wavelengths ranging from 400 nm to 770 nm. Wavelengths shorter than 400nm fall into the ultraviolet range while wavelengths longer than 770 nm are more readily sensed as heat (infrared). Between 440 nm and 770 nm the energy intensity of sunlight is quite uniformly distributed.

Aside from enabling vision, natural light has some interesting effects on animals and people. Some of these effects are physiological and some are psychological. The scopes of these effects are highlighted by Dantsig N. M., Lazarev, D. N., and Sokolov, M. V. (June 1967, p. 225). Who say:

"If the human skin is not exposed to solar radiation (direct or scattered) for long periods of time, disturbances will occur in the physiological equilibrium of the human system. The result will be functional disorders of the nervous system and a Vitamin D deficiency, a weakening of the body's defenses and an aggravation of chronic diseases".

Wurtman, R. J., and Neer, R. M., (1970) report that:

The indirect effect of light about which most information is available is, of course, vision. Retinal responses to environment alighting also mediate an expanding list of endocrine hormonal effects. These include control of pubescence, ovulation, and a large number of daily rhythms.

2.5. Natural Light in the residential Settings

Natural light is an important factor in designing residential environments with desired quality and has a significant effect on people's conscious and unconscious memory. Moreover, the ultraviolet radiation of daylight is one of the elements in causing the natural rhythm of the body's biological systems. Studies have shown that students and scholars have significantly better performance in the settings that enjoy natural light. The use of natural light is significantly effective in saving the electronic energy and has direct influence on the quality and quantity of the standard environment such as the degree of temperature and humidity (Sami Azar, 1997). In general, natural light (daylight) is discussed in terms of the quantity and quality. Although the use of natural light is well known to the human beings from the past and architects today take advantage of it with the utilization of skylights and windows, the quantity of daylight was ignored by the designers up to the beginning of the twentieth century and even to the middle

of it when the human invention of artificial lighting was a pioneer in the field of architectural design at that time.

2.6. Artificial Light in the residential Settings

As in most cases in the residential settings a combination of natural and artificial light is used, it is better to utilize the fluorescent lights with semi-direct (with perforated pages), uniform, or multiple light distribution. In this case it is better to have the rows of lights perpendicular to the rows of teaching boards and desks. Furthermore, taking into account the local light shedding on the teaching board seems necessary.

3. Research methodology

a. Case study

Target population included Residents of residential complexes who are with bachelor degree or higher. According to Cochran formula, the least sample size of 357 patients was obtained.

b. Research and material

Present study in terms of objective is application. Its application is propose emotional effects of lighting on space users using physiological and psychological measures in order to improving their quality environment. The study in terms of research is "analytical-descriptive". Data collection method was library and survey. Also, SPSS Technique has been used. So, at first questionnaire was prepared. At finally, talent analyzed hypothesis. The hypotheses are:

- Hypothesis 1: looks light in architectural spaces of perception and human behavior is effective.
- Hypothesis 2: Looks understand the architectural space with natural light quality has a direct relationship.

4. Discussion

So, in this section of paper were studied indicators and hypothesis. The hypotheses are:

- Hypothesis 1: looks light in architectural spaces of perception and human behavior is effective.
- Hypothesis 2: Looks understand the architectural space with natural light quality has a direct relationship.

4.1. Analyzing data

First hypothesis: looks light in architectural spaces of percep-

tion and human behavior is effective.

Relationship between sensory perception and light (Pearson test)

In this hypothesis two variables that have an impact hypothesis, can be chosen. for example, the first variable X sensory perception and human behavior and the second variable Y of light. That is the premise on which we intend to investigate the correlation between these two variables together to prove it. Therefore, assuming normal distribution of data to study their correlation with Pearson test will be discussed.

Correlation			
		Natural Light quality	Understand architectural space
Natural Light quality	Pearson Correlation	1	0.470**
	Sig. (2-tailed)		.000
	N	217	217
Understand architectural space	Pearson Correlation	0.470**	1
	Sig. (2-tailed)	.000	
	N	217	217

** . Correlation is significant at the 0.01 level (2-tailed).

Table 1: The correlation in the first hypothesis test

Correlation			
		Perception and human behavior	Light
Perception and human behavior	Pearson Correlation	1	0.342**
	Sig. (2-tailed)		.000
	N	217	217
Light	Pearson Correlation	0.342**	1
	Sig. (2-tailed)	.000	
	N	217	217

** . Correlation is significant at the 0.01 level (2-tailed).

The correlation coefficient is 0.342 in this case positive. The value favorable for solidarity. The correlation with the amount of P (Sig. (2-tailed)) is provable. Note that to test the hypothesis that a correlation must statistic value (Sig. (2-tailed)) should be less than 0.01 is the correlation between two variables is accepted. So we can say that between perception and human behavior and of light in the design and interior, there is a positive relationship.

Scnd hypothesis: Looks understand the architectural space with natural light quality has a direct relationship.

Relationship between understand architectural space and natural light quality Pearson correlation test.

In this hypothesis, two variables that have an impact hypothesis can be chosen, for example, the first variable X understanding of architectural space and the second variable Y is the quality of natural light. The second variable is the first variable to take effect. That is the premise on which we intend to investigate the correlation between these two variables together to prove it.

Table 2: The correlation in the scnd hypothesis test

The correlation coefficient is 0.470 in this case positive. The value favorable for solidarity. The correlation with the amount of P (Sig. (2-tailed)) is provable. Note that to test the hypothesis that a correlation must statistic value (Sig. (2-tailed)) should be less than 0.01 is the correlation between two variables is accepted. So we can say that between perception and human behavior and of light in the design and interior, there is a positive relationship.

Conclusion

As mentioned in the article, light is one of the most influential factors in residential space. Proper light in addition to provide visual light is effective on the personality, sprit and person. One of the important principles in the design of residential spaces is to provide visual comfort which is possible through providing enough light in the room and other environments. This issue in addition to providing visual comfort for students is very effective in creating productivity. Providing visual comfort for children and adults and beginners is of particular importance. Maintaining eye health and vision, reducing nerve fatigue and finally the desired effect on the quality of area among the positive effects of appropriate light in residential space. Sometimes with very simple and practical measures such as the true reflection of environment, natural and artificial lighting, creating luminous environment according to its function the lighting of bed room can be increased. As a result, light is one of the most effective factors in increasing residential productivity and through adjusted light best result can be obtained for residential environment.

When designing buildings, emphasis is placed on construction and maintenance costs. However, real people will be working in these buildings, so consideration should be given to their psychological and physiological well-being. The improved health of building occupants benefits employers and building owners because of improved performance. With properly installed and maintained daylighting systems, natural light has proved to be beneficial for the health, productivity, and safety of building occupants. Natural light helps maintain good health and can cure some medical ailments. The pleasant environment created by natural light decreases stress levels for

office workers. Productivity increases with the improved health of workers, and with better productivity comes financial benefits for employers. Students also perform better with natural light. Across the nation, studies have shown students in daylight rooms achieve higher test scores than students in windowless or poorly lit classrooms. Along with better test scores, student health also improves from the increase in vitamin D intake. Students have fewer dental cavities and grow more under full-spectrum lighting. Daylighting also benefits retail stores because of more even light that provides better color rendering. Customers stay in stores longer and employees can identify items faster with better lighting. In health care facilities, natural light improves patient recovery rates and allows for proper vision for the elderly in assisted living facilities. Hospital staff also benefit from the natural light because of the amiable environment. Patients will be more at ease when staff is in a better mood, and the staff will be calmer when patients have improved recovery. Productivity increases in industrial environments because of improved color rendering and the better quality of light provided by natural light. Also, safety is increased with better lighting conditions. The use of daylighting decreases utility costs and improves the well-being of building occupants. The effects of natural light on building occupants should be an important consideration for building design because studies have shown the strong influence light has on people in many different environments. Daylighting can provide satisfaction for both building occupants and owners.

.REFERENCE

- i. Azem, P., (2008). Buildings and library equipments, management and planning, library publication, Tehran.
- ii. Bertman, T. "Creating Comforts: Companies Weave Employees' Needs into Thoughtful Design Plans." <http://www.bizsites.com/1997/MJ97/facilitydesign.html>. Accessed July 13, 2001.
- iii. Benedetti, F.; Colombo, C.; Barbini, B.; Campori, E.; Smeraldi, E. (February 2001). "Morning Sunlight reduces length of hospitalization in bipolar depression." Vol. 62, No. 3; pp. 221–223.
- iv. Heerwagen, J.H. (1986). "The Role of Nature in the View from the Window." 1986 International Daylighting Conference Proceedings II. November 4–7, 1986; Long Beach, CA; pp.430–437.
- v. Hathaway, W.E.; Hargreaves, J.A.; Thompson, G.W.; Novitsky, D. (1992). A Study In to the Effects of Light on Children of Elementary School Age—A Case of Daylight Robbery. Alberta: Policy and Planning Branch, Planning and Information Services Division, Alberta Education.
- vi. Hathaway, W.E.; Hargreaves, J.A.; Thompson, G.W.; Novitsky, D.; "A Summary of Light- Related Studies." A Study into the Effects of Light on Children of Elementary School Age—A Case of Daylight Robbery; Bright Light Enterprises On-Line. <http://www.vitalight.com/articles/alberta2.htm>. Accessed June 11, 1998.

- vii. Heerwagen, J.H.; Johnson, J.A.; Brothers, P.; Little, R.; Rosenfeld, A. (1998). "Energy Effectiveness and the Ecology of Work: Links to Productivity and Well-Being."
- viii. Liberman, J. (1991). Light Medicine of the Future. New Mexico: Bear & Company Publishing.
- ix. "Light, Sight, and Photobiology." Lighting Futures; Vol. 2, No.3. http://www.lrc.rpi.edu/Futures/LF_Photobiology/index.html. Accessed June 11, 1998.
- x. Johnson, M. (July 17, 2001). Electronic Mail from University of Minnesota-Twin Cities Civil Engineering student.
- xi. Ott Biolight Systems, Inc. (October 1997a). "Ergo Biolight Report." California: Ott Biolight Systems, Inc.
- xii. Robbins, Claude L. (1986). Daylighting Design and Analysis. New York: Van Nostrand Reinhold Company; pp. 4-13.
- xiii. SeyedSadra, (2009). Architecture, colour and human: the atmosphere, physics and chemistry color, lighting and color effects on humans and other topics, publications of thought, Tehran
- xiv. Sami Azar, A., (1997), dynamism and creativity in organizing educational spaces, the Office of Research and Development Research and equipping schools, new school magazine.
- xv. Thorington, L., Parascondola, L., and Cunningham, L. (1971). "Visual and Biologic Aspects of an Artificial Sunlight Illuminant" . Journal of the Illuminating Engineering Society , 34.
- xvi. Wurtman, R. J., and Neer, R. M. (1970). Good Light and Bad. The New England Journal of Medicine , Vol. 282, No. 7