

## Architecture and Human Behavior

### **Does Design Affect Our Senses?**

**By:**

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#### **Abstract**

Does design affect our senses? This may seem a simple question and therefore, it should have a simple answer. Almost all architects will say, yes it affects our senses, our moods, our emotions and our behavior. But, how many of these architects take this into consideration when they design? If really the built environment affects the user physically and psychologically, how many architects know about the human senses? How these senses function? What kinds of stimulus influence each sense and what kind of reaction or behavior should be expected accordingly?

This area of research has gripped a lot of architects to study the relationship between architecture and human behavior, in order to help them enhancing their designs and producing better qualities. Environmental psychology is an important research field that assists architects understanding more about their built environment.

This paper will try to address the importance of such relationship, and highlight the process of perception and behavior in the environment. It will discuss the main human senses, their stimuli and their influence on the human body physically and psychologically. It will also rank these senses from the most noticeable sense which is highly influenced by the surrounding environment to the least one.

#### **Key Words**

Architectural Environment, Human Behavior, Human Senses, Physiological Effects, Psychological Impact.

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## **Introduction**

Although it is a principal issue in any design process, only some researches have paid attention to the weight and the influence of the architectural environment over one's psychology, and the role of the built environment in people's lives. Furthermore, anthropological, sociological, and psychological researches have reduced some of the mysteriousness of human behavior but much remains unknown.

Architects who are responsible of designing the surrounding environments for all mankind should try hard to clarify more about the human-environment interface and thus about environmental design. They should respond to human needs and motivations and speculate their behaviors, not only the perceptual processes but also the emotional responses and actions. They should also learn more about the human senses and how they function for different stimuli. In other words, architects should design for the human senses.

Millicent Gappell found that a large number of replicable experimental and scientific records have confirmed the relationship between biological responses and human reactions to sensory stimuli. She says: "the data clearly demonstrates that the mind, brain, and nervous system can be directly influenced, either positively or negatively, by sensual elements in the environment."<sup>2</sup> This is true for both the natural environment and the built environment (the architectural environment).

## **Architectural Environment and Human Behavior**

Any definition or description of the environment has to be with reference to something surrounded by either nature or manmade. It is also said that "architecture is the third skin" of the human body, since the first skin is the real skin, which acts as the outer envelop and the filter of the body, then the clothes that act as the second skin, which is also considered as an insulation and filter. "So people's third skin would be the next layer out -usually the building they are in,"<sup>3</sup> which performs as the surrounded manmade environment. This kind of environment- the architectural environment- should fulfill the human needs and comply with the user requirements. However, "what architects create is a potential environment for human behavior; what a person uses and appreciates is his or her effective environment. The role of positive theory for the design professions is to enhance the ability of designers to predict what the effective environment of people will be when the built environment is configured in a particular pattern."<sup>4</sup>

The architectural environment, where the main life activities of any society take place, has a dominant and permanent influence on the user of this environment. Nevertheless, people do not only try to cope with their environment passively, but they modify it actively to match their needs by acting individually or collectively, "leading to characteristic interaction effects which vary over time, situations and persons." (Anette Sommer; the Responsibility of Architecture for the Lack of Responsibility).<sup>5</sup>

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<sup>2</sup> Gappell, 1991.

<sup>3</sup> Elyacoubi, 1999.

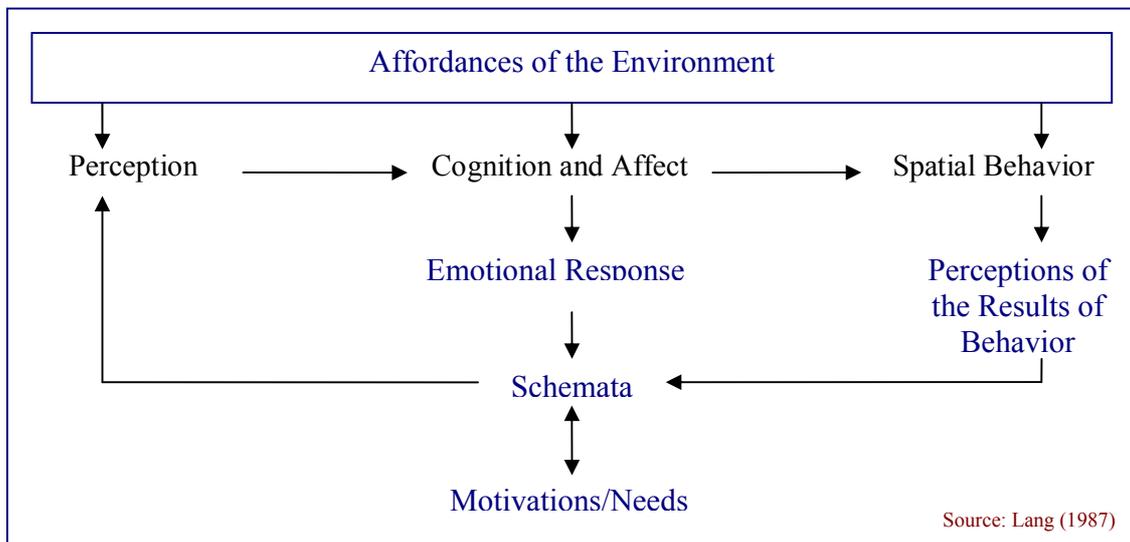
<sup>4</sup> Lang, 1987.

<sup>5</sup> Elyacoubi, 1999.

The surrounding environment is considered the context of behavior and reactions. “Our moods and behaviors are meaningful only if they can be understood in terms of their context.”<sup>6</sup> So, the relation between the surrounding physical environment and behavior is deep-rooted and interwoven. “Mary V. Knackstedt, in her recently published book, *Interior Design & Beyond*, elaborates on how designed interiors affect human behavior. She argues that interior designers have a moral responsibility to the future culture to design interior spaces that positively influence the quality of relationships between people and their social and physical environments.”<sup>7</sup>

So, the human behavior in any space has to be tested and carefully studied by designers in order to be taken into consideration during any future design process. To achieve that, designers have to understand the principle meaning of behavior through specialized scientific methods. In environmental psychology “a behavior is a definable unit of activity initiated by certain inputs and which generates certain outputs as a result of its activity.”<sup>8</sup> Psychology is defined as the systematic study of behavior and mental processes. The study of human behavior is considered to be the primary focus of much of the field of environmental psychology.

Any environment has potentials which offer for human experiences and behavior. The principle process concerning the interface between human and environment according to Jon Lang is shown in the following diagram.



**The Fundamental Processes of Human Behavior<sup>9</sup>**

<sup>6</sup> Bell, 1996.

<sup>7</sup> Lawrence, 2005.

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<sup>9</sup> Lang, 1987.

“Information about the environment is obtained through perceptual processes that are guided by *schemata* motivated by *needs*. These *schemata* are partially innate and partially learned. They form the linkage between *perception* and *cognition*. They guide not only the perceptual processes but also emotional responses (*affect*) and actions (*spatial behavior*), which in turn affect the *schemata* as the outcomes of behavior are discerned.”<sup>10</sup>

### **The Five Senses as Receivers and Gateways to the Human Mind**

The main function of our senses is to enable us to sense the world around us. “Our eyes see it, our ears hear it, our noses smell it, our mouths taste it, and these along with a few other senses provide us with most of the knowledge that we have about the world”<sup>11</sup>. This also occurs when we enter a new space and we begin to notice it, recognize it, and then evaluate it. This process of discovering affects our sensation in the space and influences our opinion about it. Intellectual designers realize this fact and take it into consideration in their designs. They design as if they are treating the different senses of the user: vision, hearing, smell and touch.

“The five senses are each gateways of healing. The eyes which give us sight are gateway to color healing; the ears which give us hearing are a gateway for music therapy; the sense of touch lends itself to massage; the sense of smell to aromatherapy and the sense of taste to our diet.”<sup>12</sup> Thus the surrounding environment has a massive effect on the user, mentally and physically. This results that the human behavior in an architectural space is considered a reaction to the effect of that space on the user and his/her senses.

Therefore, the concern of the architects is always to create an appropriate physical environment that helps the user and improves his physical and psychological condition. This fact made Hansard says: “We shape our buildings and afterwards our buildings shape us”<sup>13</sup>, and even more. Roger Ulrich, who is concerned with the effect of the built environment on the well-being of the user, agrees on that and says: “There is increasing scientific evidence that poor design works against the well-being of patients”<sup>14</sup> In this perspective, the central goal of architects and designers should be to improve wellness by creating physical surroundings that are “psychologically supportive” (Ruga, 1989).

The Gestalt School of Psychologists reveals the importance of the relationships between stimuli for the sense we make, and the context. “The most crucial property is that our experience of our environment is notably temporal and sequential”.<sup>15</sup> It is scientifically proofed that the visual perception for any built environment is influenced by the movement of the user in that environment and the acoustical level in it.<sup>16</sup> This makes the

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<sup>10</sup> Lang, 1987.

<sup>11</sup> Atkinson, 1996.

<sup>12</sup> Gimbel, 1993.

<sup>13</sup> Hansard, 1943.

<sup>14</sup> Ulrich, 1995.

<sup>15</sup> Canter, 1975.

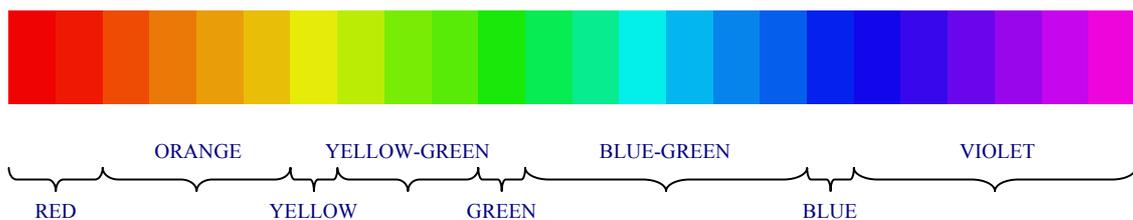
<sup>16</sup> Bishop, 1973.

architects deal with their designs with a great concern; they do not limit their interest to one sense and neglect all other senses. “As designers, we create physiological and psychological sets of relationships that have to do with all the senses.”<sup>17</sup>

### **The Visual Sense**

“Only vision, audition, and smell are capable of obtaining information that is at a distance from us (often vital to our survival), and of this group vision is the most finely tuned in the human species.”<sup>18</sup> For that, the visual sense is the most important sense between all other senses that affect the human behavior in any architectural space.

Every sense responds to a different kind of physical energy which acts as the main stimulus for that sense. As for vision, the physical stimulus is light, which is a fragment of an electromagnetic radiation/energy that originates from the Sun and the Universe, and also includes other forms of radiation. The eye of the Human beings is only sensitive to a bit of the wavelength field of the electromagnetic radiation, (400 – 700 nanometers). However, the visual system of humans does not distinguish all the light in this range the same, it turns it into colors.



**The Solar Spectrum**<sup>19</sup>

Within, this range which the human beings are sensitive, they can differentiate 150 hues. Though, if we consider that each hue can produce many different values of lightness and saturation, then it is estimated that there are more than seven millions colors which can be distinguished. Consequently, after realizing this fact, will designers neglect using colors in their designs?

### **The Effect of Light**

Although it is important for architects to understand how eye functions when perceiving light, the main interest to them is the analysis of light from an ecological and psychological perspective. Light has two basic types, radiant (direct light) and ambient (indirect light). The radiant light passes through the different media with varying degrees of interference, while the ambient light consists of the light reflected from the surfaces around us. Also, there is another classification which is of great significance of the designers that is the natural light and the artificial light.

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<sup>17</sup> Kellman, 1988.

<sup>18</sup> Atkinson, 1996.

<sup>19</sup> Ibid.

Natural light from the sun is considered to be the best source of light for the human health physiologically and psychologically. Antonio F. Torrice clarifies that “when we are surrounded by natural outdoor light, there’s an equal balance of each of the colors of the spectrum in our bodies.”<sup>20</sup> The human system evolved under the influence of the sun - light spectrum to which particular light-sensitive and light-modulated organ systems are specifically adapted.

“It has been proved scientifically that the cases of depressions are much more (about 200%) during the autumn and winter season than during the spring and summer season. After several researches, psychologists found that light is the main reason behind that.”<sup>21</sup> It also enhances the visual perception in the environment for both form and color, and provides a pleasant feeling. In the same time, designers can overcome the negative effect of glare and heat through different architectural treatments externally and internally.

Light does not only have a psychological effect on humans but also has a physiological effect. “Full-spectrum light provides prophylactic control of viral and staph infections and produces significant improvements in physical working capacity by decreasing heart and pulse rate, lowering systolic blood pressure, and increasing oxygen uptake.”<sup>22</sup> Therefore, designers have to respect light and its effect in their designs. It became not only a source for visual functioning in the environment, but also a stimulus for the senses physically, mentally and emotionally.

So, for architects light adds dynamic qualities to their architecture, extends patterns, forms and designs into the dimensions of time. In addition to that, the mixture between light and shade generate contrasts, helps distinguishing between different planes and creates texture to surfaces.<sup>23</sup>

### **The Effect of Color**

Colors are essential in our lives. Without it we can not discriminate the surrounding environment and perceive its dimension and components. “The color is not important in itself. What is vastly more important is the response to it.”<sup>24</sup> However, without our ability of perceiving colors we lose our capability of realizing the difference of forms, surfaces and components of any space. Therefore, color is one of the major design elements that affects functional, physiological, and psychological aspects.

“There is some evidence to suggest that light of different colors entering the eye can indirectly affect the center of emotions in the hypothalamus, which in turn affects the pituitary gland. This master gland controls the entire endocrine system, including the thyroid and sex glands, and so controls the harmonic levels of this system and the moods

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<sup>20</sup> Torrice, 1988.

<sup>21</sup> Elyacoubi, 1999.

<sup>22</sup> Gappell, 1991.

<sup>23</sup> Elyacoubi, 1999.

<sup>24</sup> Riley, 1995.

consequent upon them.”<sup>25</sup> And that what concerns the architects, the fact that colors have influence on the psychological condition of the user of their spaces. But not only colors have psychological effects on the user, they also have physiological outcomes.

“Color strongly influences human emotions and physiology. Red stimulates the sympathetic nervous system, increases brain wave activity, and sends more blood to the muscles, thus accelerating heart rate, blood pressure, and respiration. Blue triggers the parasympathetic nervous system and is credited with a tranquilizing effect.”<sup>26</sup> Architects also believe that color has a great effect on perception. Warm colors seem to advance and cool colors to recede. With the use of cool colors, time is underestimated, weights seem lighter, objects seem smaller, and rooms appear larger. The opposite is true for warm tones. Thermal comfort is also affected by color; people feel cooler in cool-toned rooms and warmer in warm-toned rooms, although the actual temperature may be the same.

### **The Auditory Sense**

Both the visual sense and the auditory sense are considered the key senses for perceiving and understanding the environment. Atkinson says: “along with vision, audition is our major means of obtaining information about the environment.”<sup>27</sup> Also, there is a strong bond between these two senses. “Hearing is influenced by the intensity of illumination, . . . , visual attention is improved when noise level is reduced.”<sup>28</sup> Dallas Smith has an opinion about these two stimuli and the relationship between them, he says: “If there is a visual environment that is displeasing, one can close one’s eyes. However, it is very difficult to shut out the sound environment. In fact, closing one’s eyes can make one even more sensitive to the sound environment.”<sup>29</sup>

The audition stimulus is the sound wave which is a wave of pressure changes. The sound is created from the movement of any object. When it moves, it pushes the molecules of air in front of it. In return, these molecules push other molecules and then return to their original position. This is the way the sound wave is transmitted through the air. These alternating pressures cause the eardrum to vibrate, and then the eardrum transmits these vibrations through the structures of the middle and inner ear to the basilar membrane in the cochlea.

Not all sounds in the environment have negative effects on the human beings; some sounds have positive effects on both the psychological and the physiological status. Music for instant, (not all kind of music) could decrease the level of blood pressure, reduce the heart beat of the listener and minimize the production of some stimulus hormones. As well, it could reduce the suffering from pain and increase the feeling of

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<sup>25</sup> Varley, 1980.

<sup>26</sup> Varley, 1980.

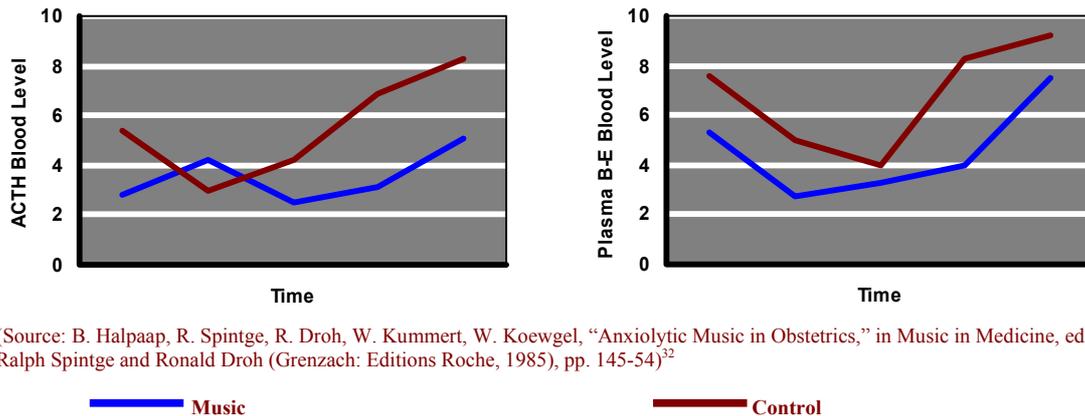
<sup>27</sup> Atkinson, 1996.

<sup>28</sup> Putsep, 1981.

<sup>29</sup> Mazer, 1992.

relaxation and comfort.<sup>30</sup> James D. Burnett confirms that some researches and studies measured the physical effect of the positive sounds in the nature.<sup>31</sup>

A study was done by a group of researchers on the effect of music on blood pressure levels during childbirth labor over a 24-hour day. A significant effect was found for the use of the music, representing an amazing stress-reducing effect. This can be shown by the following two diagrams:



(Source: B. Halpaap, R. Spintge, R. Droh, W. Kummert, W. Koewgel, "Anxiolytic Music in Obstetrics," in Music in Medicine, eds. Ralph Spintge and Ronald Droh (Grenzach: Editions Roche, 1985), pp. 145-54)<sup>32</sup>

### The Effect of Noise

Commonly, the most logical or expected effects of exposure to noise is the hearing-impaired or hearing loss. However, noise has more damaging effects on the auditory sense. "Auditory trauma, besides producing generalized stress reaction, produces physiological changes in blood capillary structure, impeding the flow of red blood cells and constructing the vascular channels. This can cause high blood pressure, heart disease, and ulcers."<sup>33</sup>

As a result, noise is considered one of the most commonly known stressors, in surveys related to environmental psychology, of what people like and do not like in their neighborhood or community. In these surveys and parallel studies it was found that frequent exposure to noise is linked with severe and chronic diseases. Most of these researches have highlighted that noise may be the main cause of a variety of physiological changes that may contribute to these diseases. Other surveys discovered that high level of noise can also lead to the increase in arousal and stress (e.g. Cohen et al., 1986; Glass & Singer, 1972)

<sup>30</sup> Abdel Moneim, 2000.

<sup>31</sup> Burnett, 1997.

<sup>32</sup> Mazer, 1992.

<sup>33</sup> Gappell, 1991.

It is not only the physiological effect of noise that could be seen on the human being, there is also the psychological effect. There are some evidences that noise can make people more emotionally reactive. These evidences are concluded from studies linking noise with hormones associated with emotions and psychological status. “Consistent with this, research has shown that noise sensitivity is related to annoyance at varying levels of noise and is associated with psychological disorders and mental health (e.g., Bullen et al., 1986; Iwata, 1984; Job, 1988; Stansfield, 1992).”<sup>34</sup>

### **The Smell Sense**

Although it is not considered one of the higher senses like the visual and the auditory senses, “smell is one of the most primitive and most important of the senses.”<sup>35</sup> This sense is more developed by other species. All species including human beings use this sense to help them in the survival in the environment. It helps in detection of spoiled food or escaping gas. Differing from other senses, smell has a direct route to the brain.

Not only, by the visual sense, can people identify their personal spaces, but also by the smell that is related to their spaces they can define them. These smell qualities of any space provide it with special characteristics that differentiate it from all other spaces. Lawrence found that “a space physically defined by partitions to assure privacy, for example, may be perceived more communal when penetrated by unwanted sounds and smells.”<sup>36</sup>

The smell stimuli are the molecules given off by a substance. These molecules move through the air and stimulate the olfactory receptors located in the nasal cavity which helps the person to discriminate between the different aromas. Usually, one can discriminate 10’000 to 40’000 different smells. However, women generally do better than men.

### **The Effect of Aromachology**

Aromatic consultant John Steele highlighted the therapeutic benefits of environmental fragrance. He said: “Perhaps the most notable example of stress reduction using fragrance in medical setting is at the Sloan Kettering Memorial Hospital, the world’s largest private institution devoted to cancer research.”<sup>37</sup> Steele discussed more benefits of using fragrance on the psychological status of the patient.

This is also the case for the normal person. Nice smells in any environment, provides a pleasant atmosphere and an encouraging environment to work and thus increase productivity. While, bad smells create an expelling environment and force the user to leave, which causes critical influences on productivity and efficiency.

Ray A.P. Anderson and Rex Anderson in their article (RTO Design for the Senses) mentioned 10 ways to dress up any store. The first advice was to “trigger customer senses

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<sup>34</sup> Bell, 1996.

<sup>35</sup> Atkinson, 1996.

<sup>36</sup> Lawrence, 2005.

<sup>37</sup> Ruga, 1997.

with a pleasant aroma from candles or sprays”<sup>38</sup>. This shows how it is valuable and useful to stimulate the smell sense of the user and use it as an encouraging tool to increase the qualities of the environment.

### **The Touch Sense (The Skin)**

When the architect designs a space, he/she must put into consideration the climatic conditions of this space. Researches have proved that the human behavior in any space can be affected by the abnormal levels of heat, cold and wind. The human skin is the sense that is responsible for that kind of stimulus and that the human body needs special degrees for these different stimuli to be in the comfort zone. When the human body is in uncomfortable zone it behaves abnormal.

“Traditionally, touch was thought to be a single sense. Today, it is considered to include three distinct skin senses, one responding to pressure, another to temperature, and the third to pain.”<sup>39</sup>

Many studies had shown that there is a strong relation between the ambient temperature of any space and the behavior of the user inside this space. Any activity is going to be enhanced at first when the temperature is being raised and then it gets worse. Also there is strong evidence that there is a relation between heat and aggression.<sup>40</sup> Temperature is not the only stimulus that affects the human behavior, but also the barometric pressure and altitude has a tremendous effect on it too.

Temperature effect includes both physical and psychological components. The main physical component is the heat degree in the surrounding environment. One psychological component is centered on the internal temperature of the human body, the core temperature (deep body temperature), which affects the mood and the feeling of stress.

### **The Effect of the Touch Sense**

Some studies found that therapeutic massage has great effect on the physiological and psychological status of the person. It improves appetite, enhances well-being and mood, reduces stress and decreases pain.<sup>41</sup>

For architects and interior designers the most related issue to the touch sense is the selection of materials they use. Every material has a different touch and thus a different effect. Anderson mentioned some ideas that could be applied to enhance a room from furniture arrangements to background effects. He talked about different materials used for tabletops and the feeling linked to that. “Tabletops of wood give warmth to room. Tabletops of glass make a room appear larger. Tabletops of marble or stone give a feeling

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<sup>38</sup> Anderson, 2005.

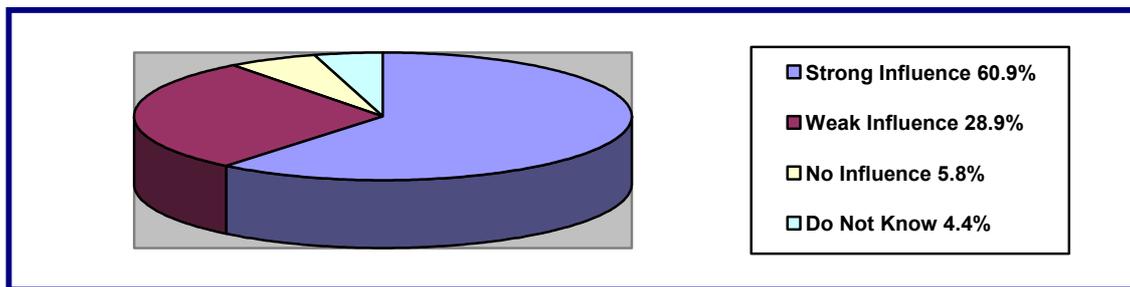
<sup>39</sup> Atkinson, 1996.

<sup>40</sup> See Bell, 1996 for more information. PP. 202-206.

<sup>41</sup> Ruga, 1997.

of quality.”<sup>42</sup> Also he said “If you use woodwork (paneling) in a room, the room will feel warmer and more comfortable.”<sup>43</sup>

Therefore, the materials used in any space have a noticeable effect on the user, the differences between the materials from the degree of hardness and softness, rigidity and flexibility, lightness and heaviness, etc. All these various specifications influence the design decisions of the architect. This fact was proven in a survey on the effect of the finishing materials used in the psychiatric healthcare buildings in Egypt on the mental health of the psychiatric patients.



(Source: Abdel Moneim, Walid, 2000, p. 318)<sup>44</sup>

“In conclusion, the behavioral evidence as well as knowledge of receptors and pathways show that the processing of a proximal stimulus such as touch is no more straightforward than the processing of distal information such as that provided by light.”<sup>45</sup>

### Concluding Remarks

As an outcome of this paper, we conclude these important remarks:

- The natural environment is considered the main source of many human experiences: radiant and ambient light, temperature, sounds, odors, and mechanical contacts. The way designers organize their built environment affects all these stimuli.
- It can be concluded, that what a user does and why, and the thoughts and feelings that accompany those actions, are linked somehow to interactions with the designed environment.

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<sup>42</sup> Anderson, 2005.

<sup>43</sup> Ibid.

<sup>44</sup> Abdel Moneim, 2000.

<sup>45</sup> Halliday, 1992.

- Our senses act as receivers and gateways to our minds and bodies. Therefore, they receive any stimulus from the surrounding environment and influence our minds and bodies, physically and mentally.
- Architects must deal with their designs with a great concern; they must not limit their concern on one sense and neglect all the other senses. They have to deal with all the senses equally.
- A visual environment with a variety of colors and shades is a good way of achieving desirable interest and stimulation for a more pleasant and productive space.
- In combination with other stressors, noise and unwanted sounds have adverse effects on physical and mental health. While nice fragrances have positive effects on reducing stress.
- Changes in air pressures associated with weather patterns can have harmful effect on human beings. While therapeutic massage has positive affects on the physiological and psychological status.
- The materials used in any designed space have a considerable effect on the user's perception and feeling and thus, the user's behavior.
- Architects should be in a contentious research and do more efforts to feed back their knowledge about how the user of their designed environment reacts and behave.
- The benefits of these researches are plenty and varied such as employee productivity, product marketability, and improving the responses of the users and their connected behaviors.

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