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Effects of Environmental Design Inspired by nature on Psychological and Physiological Responses of Clients in Medical Spaces

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ABSTRACT: Medical environments such as hospital waiting rooms can affect a client's anxiety level as well as psychological and physiological responses to his or her situation. The aim of this research was to evaluate the use of environmental design, specifically the design which incorporates elements of nature, in clinics and hospitals to decrease anxiety, blood pressure and pulse rates of waiting clients. Representations of nature and the natural environment are known to recover a dynamic union between an environment and its user, therefore the effects of environmental design on subjects' responses are measured and analyzed. In order to examine these hypotheses a sample of 145 people were chosen as subjects for the experiment. They were divided into control and experiment groups, both of which included males and females. The designed environment was applied for the experiment group which included elements of nature, green plants, sounds of waterfall and birds. Both control and experiment groups were pre tested and then post tested. The findings showed that being in the designed hospital's waiting room was clearly effective at decreasing a client's level of anxiety ($p< 0.001$), blood pressure ($p< 0.001$) and pulse rate (0.001). We propose that using an environmental design for medical treatment centers can reduce levels of anxiety in clients and can effectively foster a sense of wellbeing.

Key words: Natural Environmental Design,Waiting Anxiety, Blood Pressure, Pulse Rate

INTRODUCTION

Over the ages human habitat has changed from the natural environment to a predominantly urban environment. A significant problem with urban living is ever increasing levels of environmental pollution and the resultant tension that has caused trouble for its inhabitants' physical resilience and inner sense of well-being (Stigsdotter *et al.,* 2010; Brown *et al.,* 2009; Spanou *et al.,* 2012). In the context of the promotion of good health the term 'environment' refers to its physical, psychological and social characteristics (Han, 2009). According to the World Health Organization (WHO), in a definition (2004) based on environmental effects on human health, environmental psychology proposes solutions to human difficulties in environmental terms. Scientific research on the subject has shown that humans need the natural environment for good health and a closer relationship between humans and their environment results in a more developed sense of well being and promotes better ability in humans to adapt to their environments (Crooks and Agarwal, 2009).

Biophilia theory identifies nature as the gratifier of human beings' biological needs. Environmental psychology leads to protectoral psychology by an evolutionary process whereby the relationship between humans and environmental sustainability is considered essential in order for humans to promote a sustainable future (Clayton and Myers, 2009).

Stress itself leads to poor health and may hinder the recovery processes. Ulrich (2002) has suggested that stress in circumstances of medical treatment centers could be alleviated by exposure to an environment with natural characteristics (therapeutic landscape). The therapeutic effect of the natural landscape in an environment facilitates an individual's ability to recover and cope with stress, which in turn results in improved health (Weinstein *et al.,* 2009; Van den Berg *et al.,* 2007).

Kaplan (1995) in Attention Restoration Theory (ART) reports that environmental design that includes key concepts (being away, extent, fascination, and compatibility) is necessary to restore attention. These concepts include making various places, the presence of green materials, decreasing hard places and surfaces, encouraging environment design, decreasing factors that cause confusion and removing ambiguity about the principles of environmental design. This finally leads to 'Benson relaxation'

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processes in which memory turns to alpha, pulse rate, blood pressure and muscle contraction decrease (Change, 2008). Studies show that environmental design that uses natural elements has been effective in decreasing stress (Herzog and Strevey, 2008; Rappe, 2005). Furthermore, exposure to green plants has demonstrated fast physical improvement and decreased pain after surgery in hospitals as well as mental rest and increasing indirect attention (Park, 2002; Park *et al.,* 2004), children and their families adapt to the stress of a hospital environment and long term serves to increase the quality of clients' lives. Exposure to the natural environment is effective to increase adaptation, sense of security, positive emotion and to reduce feelings of indignation while increasing a sense of patience and tolerance.

Inspired by the ideas of Sigmund Freud, Lacan has had an enormous influence on numerous fields of study in humanities and social sciences about the relationship between landscape and hospitals, including waiting room spaces. The Foucaultian approach conversely, understands the subconscious, the gaze, and desire as socially constructed responses that are implicated in the disciplinary production of subjects. This is why Lacan aligns the 'Real' with anxiety, violence, and the paradoxes of painful pleasure, which he calls 'enjoyment' (Evans *et al.,* 2009).

Medical centers and policlinics are stressful places for clients. They have been attributed to causing feelings of anxiety while waiting to see a Doctor which compound(s) the problems related to illness and pain (Gesler *et al.,* 2004; Tanner, 2002). Using images of the natural environment in medical centers and hospital waiting rooms serves to influence clients and doctors by directing their attention to art and nature. The reality of the experience in a medical waiting environment is often one of anxiety, aggression and contradiction caused by the pressure of pain. Here, it is possible to change this human psychological conception by using the waiting room environment as a stimulant (Foucault, 2007). Also, it is possible to trigger these emotions by attention to images of the natural environment in waiting rooms. Using natural elements causes positive responses in these environments. Subjects exposed to representations of the natural environment had lower scores for indignation, aggression, and fear than those in urban environments (Evans *et al.,* 2009).

The presence of artwork based on the natural environment in hospitals may benefit (the) health care providers as much as the patients who gaze on it, thus challenging us to think carefully about who actually benefits from the presence of nature in the waiting room. By utilizing the principles of environmental psychology, it is possible, with the use of appropriate architectural practice to maintain a constant environment in the recommended style. It is also pertinent to mention that interior design and environmental design can affect mental status, attitude and behavior of people in these situations (Van den Berg *et al.,* 2007). The present research has investigated the effect of environmental design by natural elements on decreasing a waiting patient's anxiety, blood pressure and pulse rate. The hypothesis of this study was that exposure to an environment designed with principles of nature can be effective at controlling anxiety and stress often induced by waiting in medical centers, but will also have an effect on systolic and diastolic blood pressure readings and pulse rates. This experiment demonstrated that these environmental factors had different influences on male and female clients and those with a history of anxiety.

MATERIALS & METHODS

The method of this study was semi-experimental with pre test and post test groups and a control group. The sample of patients was chosen from clients of Khatam-Alanbia Hospital in Tehran, it included 145 subjects, 76 females (a control group of 37 and a group of 39 for the experiment), and 69 males (a control group of 35 and a group of 34 for the experiment). The subjects were between 20 to 45 years of age (33.5, on average). The subjects were chosen from the clients of the hospital by incidental voluntary sampling at determined times The subjects were pre tested and then post tested by exposure to the designed environment for about 20 to 45 minutes. In this short period of time, the effects of environment and environmental factors on waiting anxiety and blood pressure were tested. The designed environment was filled with green plants, there were views of forests and cane fields with a short water fall with the natural and gentle sounds of falling water in the pond and the quiet sound of finch, and a bower made from natural materials with a wooden bamboo chair.

The method of the study was the subjects' responses to the researcher's waiting anxiety test questionnaire whose reliability had been tested on 100 clients from medical clinics. The validity of the test was measured at 0.83 by Cranach's α (alpha). This 20-item test evaluated 3 anxiety conditions; psychological, physiological and behavioral. It was based on the Spielberger Test Anxiety Inventory (STAI). The anxiety scale is in the continuum of the spectrum from high to low. This questionnaire had been used for the past 20 years in various studies as a common test to evaluate anxiety. Moreover, subjects' anxiety was measured with two scales (STAI & Waiting Anxiety Scale). The concurrence in patients of anxious

waiting and a history of anxiety was 0.86 in this study. Using a parametric statistical method of multiple regressions of the demographic data and anxiety a shpylberger scale mode criterion, the variable of (anxious waiting) was compared between the two groups in terms of having or not having a history of anxiety. To find a meaningful relationship between the variables discussed above, the ANOVA method was employed. The results demonstrated that there was a correlation between indicators of anxiety induced by waiting and general anxiety, gender and education. However, no correlation was found between waiting with anxiety index family, job and disease. Table 1 shows the findings of the effect on clients with a history of anxiety measured by STAI. Table 1 also shows that previous anxiety levels affected the waiting anxiety indices, with 99% confidence level. Therefore, null hypothesis is refused and the researcher's hypothesis is confirmed ($p< 0.01$).

The tool used to measure blood pressure and pulse rate (included measurements of the two levels systolic, diastolic) was a digital manometer BMG 4906 model that is padlocked on the wrist of right hand and after a round of client rest; the readings are registered while the person is motionless. To be more precise, the readings were taken again using a mercuric manometer and the two readings compared in order to gain more accuracy (Harrison, 2000).

RESULTS & DISCUSSION

The findings have shown the effect of exposure to the aforementioned environment on waiting anxiety, systolic and diastolic blood pressure and pulse rate indexes in both males and females of both the control and experimental groups. Averages for the experimental group were lower than that of control group, as shown in Table 2.

The Tables show the differences between waiting anxiety and systolic and diastolic blood pressure indexes for both male and female clients of the control and experimental groups. In order to examine differences in the two groups, variation analysis was used.

As variation analysis results show in Table 3, F was equal to 18.139 between both control and experimental groups. Therefore, with 99% confidence level, being exposed to the designed environment affected a subject's pulse index and (indicated by decrease) better than in the control group (f=18.139, $d.f.$=1,144, $p< 0.01$). The results also show that F in waiting anxiety index of both genders as not significant. Therefore the difference between genders was not significant for heart beat index since group and gender relation F was not significant. Our findings also demonstrated that the design of clinic and hospital waiting environment by natural elements could decrease the client's waiting anxiety according to the principles of environmental psychology that is in step with the findings of Brown *et al.* (2009), Chang *et al,* (2008) and Park (2002) as well as Park *et al.* (2004). A study on 35 females and 56 males (Park, 2009) under surgery showed that exposure to the inside of a hospital with designed environment, decreased anxiety levels in comparison to the control group. Considering the fact that the waiting anxiety index shows higher records for patients with a history of anxiety, it can assumed that previous anxiety has an influence on waiting anxiety index by increasing it, in other words there is a high probability that anxious people with type A personalities will be more anxious in a waiting situation than other personality types. In this study, it has been demonstrated with 99% confidence level that the waiting anxiety variable changed and had observable decreases by exposure to the designed environment (as compared with control group that did not experience this environment). The other findings of this study show that there was no significant difference to waiting anxiety between male and female clients in the environment based on natural elements, contrary to the findings of Han (2009) which showed that a designed environment had more effect on women than on men.

The differences between male and female clients of both control and experimental groups exposed to the designed environment are shown in the systolic blood pressure index. Variation analysis method was used to study the differences of two groups in this index. As the information in Table 4 shows, the results of variation analysis (F), 19.145 between the control and experimental groups in systolic blood pressure index, is significant. Therefore, with 99% confidence level, exposure to the designed environment affected the subject's blood pressure index, demonstrated by lower blood pressure levels than those in control groups (f=19.145, $d.f.$=1,144, $p< 0.01$). Furthermore, the results of Table 4 show that F was equal to 7.075 between two groups of males and females as represented by the systolic blood pressure index, which seems significant. So, with 99% confidence level, exposure to the designed environment had a different effect in each group between males and females on the subject's systolic blood pressure (f=7.075, $d.f.$=1,144, $p< 0.01$). From the results of the systolic blood pressure index it can be assumed that the effect of the designed environment was higher for female patients than for male patients. Moreover, findings from the experiment show that the effect of the designed environment was

Table 1. the effect of former anxious background on person's waiting anxiety index

Waiting anxiety	Mean	S. d.	Mean error	t	D. f.	Sig.	N
With background	23.8077	8.65457	0.81188	2.942	144	0.001	73
Without background	15.0769	6.58906	1.48834				72

Table 2. Variant descriptive on indexes

Indexes	group	mean	S. d.	group	mean	S. d.
waiting anxiety	control	23.80	6.52	Experiment	16.80	5.90
Systolic blood pressure	control	129.11	11.98	Experiment	117.25	11.46
Diastolic blood pressure	control	77.21	8.2	Experiment	74.10	6.51
pulse rate	control	86.11	9.78	Experiment	77.20	7.99

Table 3. The results of Variation analysis in waiting anxiety

indexes	recourse	Square addition	Degree of free	Square average	F	Significant
waiting	Corrected model	850.1250	3	325.12	8.202	0.001
anxiety	Within group	31455.205	1	31455.205	894.051	0.001
	group	698.210	1	698.210	18.139	0.001

Table 4. The results of variation analysis in blood pressure

indexes	recourse	Square addition	D. f.	Square average	F	Sig.
Systolic blood	Corrected model	5875.9830	3	1485.328	8.625	0.001
pressure	Within group	1579884.433	1	1579884.433	7282.922	0.001
	Group	3145.083	1	3145.083	19.145	0.001
	Gender	1306.151	1	1306.151	7.075	0.007
Diastolic blood	Corrected model	177.9930	3	60.508	1.558	0.290
pressure	Within group	435553.216	1	435553.216	7005.404	0.001
	Group	82.108	1	82.108	1.566	0.123

Table 5. The results of variation analysis in Pulse rate

indexes	recourse	Square addition	D.f.	Square average	F	Sig.
Pulse rate	Corrected model	1499.89	3	501.99	5.012	0.001
	Within group	578522.22	1	578522.22	4999.97	0.001
	group	1478.5433	1	1478.54	14.990	0.001
	gender	4.012	1	4.012	0.031	0.543

not significant for systolic blood pressure index in relation to gender, as group and gender relation F was not significant. Other findings of this study related to the effect of exposure to this environment on systolic blood pressure index of both controls and experimental groups' averages had no difference for males and females. As the information included in Table 4 shows, the results of variation analysis, F was 1.566 (Table 4) between both control and experimental groups in diastolic pressure index that is not significant with d.f. 1 and 144 on a scale of 0.123. Therefore, alternate hypothesis is refused and null hypothesis is confirmed. Based on these findings, this designed environment did not affect a client's diastolic blood pressure index showing there was no meaningful difference between the groups (control and experimental) or between males and females. Then, the difference of systolic blood pressure index was examined for male and female clients in both the control and experimental groups.

The variation analysis method was used to evaluate pulse rates. difference in both groups is shown in the pulse rate index. As Table 5 shows, the results of variation analysis indicating that F is equal to 14.99 in both control and experimental groups in pulse rate index seems significant. So, with 99% confidence level, exposure to the designed environment affects a subject's pulse rate index, showing decreased pulse rate in the group that were experimented comparing to the control group (f=14.99, $d.f.$=1,144, p< 0.01). The findings of this present research, as demonstrated by the systolic blood pressure index and pulse rate, show that the design of the clinic's waiting environment using representations of nature decreased the client's systolic blood pressure and pulse rate. Other research supports the outcome of this study Park (2002), Change *et al.* (2008), Han (2009) and Herzog *et al.* (2008) investigated the effect of inner physical site design on people having surgery to induce a decrease of blood pressure; the findings of Change *et al*. (2008) showed that it decreased students' heart beat and blood pressure and mental frequencies decreased while watching images of the natural environment. But the research also showed that the effect of environmental design on the systolic blood pressure of males and females patients was different. The findings of the present study showed that the effect of exposure to this environment, as verified by the systolic blood pressure index for women in the study was more than for men and there was an observable decrease in female systolic blood pressure. In other words, the findings of this study indicated that natural environment design in the waiting room had no influence on clients' diastolic blood pressure (it should be taken into consideration that the range of diastolic blood pressure variance is less than systolic and generally it remains constant) but as there is no research in this field, the assertion needs to be studied further.

CONCLUSION

The constructed environment was built on principles of environmental design that specifically used representations of nature in natural environmental design enabling clients to distance themselves from anxiety that can stem from being in challenging places such as clinics and hospitals. The waiting room in a clinic or hospital is an environment that induces stress and anxiety. There is an association between the natural environment and hospital design; an intersection of beauty, nature and technology. Using principles of environmental psychology in these environments led to a waiting period when a subconscious sense of peace and calm was experienced. The purpose of this paper has been to rationalize why it is that we observed so much environmental design in hospital waiting rooms while undertaking fieldwork in this space by designing with theoretical frameworks, and in doing so critically engaging with the therapeutic landscape concept. According to Tanner (2002), the waiting room is a complex 'space of public display' that through its design exposes some of our deepest assumptions, or perhaps more accurately our deepest illusions, about ourselves and our bodies. It is the therapeutic landscape of small scale of gardens in waiting rooms in Tehran hospitals such as that used in this research that is viewed by

care providers and administrators as a space in which to appeal through visual and other stimulation to the desires of people in those places.

In the experiment presented above, it has been posited that the presence of the natural environment in a hospital may benefit health care providers as well as patients, thus challenging us to think carefully about who benefits from the presence of nature in the waiting room. Putting nature on display in the waiting room diverts occupants' thoughts away from the 'Real' while simultaneously reinforcing it. Views of the natural environment when incorporated in to environmental design serve to immerse people in feelings and sensations of calm, relaxation, escape, and even pleasure in a way that shifts attention away from the very real 'goings on' within the hospital at large. The main limitation of this study was to gain access to the studied samples and lack of financial equipment and suitable locations for designing medical environments in Tehran.

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