

The Psychological Impacts of Interacting with Nature-Based Design

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ABSTRACT: Our modern society is filled with stressful stimuli that impact our daily lives, and lead to problems that eventually threaten our mental and psychological wellbeing. Expanding urban life and urbanizing people's interactions have drastically increased and resulted in more stressful circumstances. Unfortunately, the role of nature and nature-based design in our urban societies as an alternative in reducing the impact of unhealthy and stressful situations produced by our modern and urbanized life style has been neglected. Considering the fact that human beings are social creatures and their surroundings affect them both mentally and psychologically; hence, the study of psychological impacts of nature and nature-based design is both essential and necessary in our fast evolving urban societies. This research investigates nature-based design and the short-term observational impacts and benefits of urban societies' interaction with nature on different aspects of human psychology including perceived restoratives', mental health and vitality and creativity. The participants in the two sample groups observed two different urban areas. One was a building complex in Isfahan city center and the other was an urban park in Isfahan. In the end, the participants filled out a comprehensive psychological questionnaire assessing the effects environment on different dimensions of human psyche. Our results demonstrate that even short-term interaction with nature and nature-based designs had positive effects on one's psychological wellbeing, and therefore, our findings show that urban designs and architecture intertwined with nature were crucial in protecting and improving human mental health and wellbeing.

Keywords: *Interacting with nature, Psychological well-being, Psychological environment, Nature-Based Design.*

INTRODUCTION

Due to the innate tendency of human interaction with nature and the potential impacts of relationship with nature on human mind and body, man has always sought to create a logical and proper connection between the interior space and the external nature (Emami, 2014). Quality of urban environment contributes significantly to the public health. Elements within the urban environments, as well as green spaces, enable the people to cope well with stresses. These environments have beneficial effects on human health (Frumkin, 2001); but unfortunately, in the process of urban planning and architecture, abundant benefits of natural environments are not well considered on human health (Tyrväinen et al., 2005). In modern urban societies, acute and chronic stresses and inadequate restoration from stress are known as a growing problem that has along-

term impact on the health (McEwen, 1998). This indicates that stress management is a critical issue in maintaining health and a deterrent to stress-related diseases in urban societies. There are expensive works in the treatment of stress-related diseases, but few measures are performed to prevent these diseases. Recent studies have shown that green spaces in the city help reduce stress and improve public mental health (Björk et al., 2008; Hartig et al., 2003). Even looking at the picture of a natural space has positive effects on emotional and mental conditions compared to an urban environment (Hartmann & Apaolaza, 2010). It was shown in a study that positive emotions (focus, passion, and power) in citizens, who are exposed to the natural environment for more than 5 hours a month, are much more compared with people who were less or never exposed to it. New theories, such as Ulrich's stress

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recovery theory, have predicted that natural landscapes reduce stress, while environments dense with buildings and with little open and green spaces, delay the stress treatment (Velarde et al., 2007). In addition to the items listed, the positive effects of being in nature may be due to the effects of colors on humans. Colors evoke different emotional and cognitive effects. The red color that attracts more attention, leads to motivation and activation, and increases emotionality and vitality; it is a sign of aggression, anger and anxiety, while the green color which attracts less attention, has a relaxing effect (Kodama et al., 2010). Living and working in nature improve self-esteem and mood characteristics (Barton & Pretty 2010: 45). In terms of the relationship between man and environment, Andrew Brennan has also developed the ecological humanistic opinion, and believes that since we are part of nature, we must have relation with it to become a perfect man. He linked our identity with nature and knows it as the first step toward environmental ethics (Bell, 2003).

The aim of this study was to increase awareness about the impact of these kinds of environments and the importance of architectural design based on the interaction with nature, so we can use its benefits and impacts on life by recognizing it. In this study, we tried to use a measuring scale as short as possible, so ROS measurement method was used in similar studies (Korpela et al., 2008). In addition, vitality is a narrow sense but associated with the concept of healing (Ryan et al., 2010) and requires further study in different environments. Finally, there is more need to study the effect of environment not only on motivation of emotion and energy, but also on the development of character such as creativity (Newell, 1997).

The Interaction between Human and Nature from the Architectural View

With all its beauty and charm, nature provides two constraints to human:

A. Material constraints: Man cannot withstand all conditions and is forced to accept the separation from nature and referring to a different environment.

B. Theoretical constraints: Human's insight into the place of nature and its relation to human, sometimes defines it higher or lower than the level of human.

Both factors lead to the formation of different architectures and environments in the heart of nature. Various climatic types provide certain architectural characteristics. This factor is a criterion of identity in architecture and gardens of the world, and this aspect can be known as the super structural and physical layer of architecture identity. The second factor is hidden, because the reason for physical differences between the different architectures is searched in the difference of their viewpoint towards human. This layer can be introduced as the underlying and identity layer of architectural identity (Noghrekar, 2010).

Persian Garden

Persian garden is the manifestation of the interaction between

man and the surrounding nature, and indicates the rich civilization of Iran in the relationship between man and nature in the universe. The civilization offers distinctive achievements in the field of environment. The system of Persian garden includes a variety and different sizes from the smallest to the biggest urban garden and city garden. Persians have always been interested in building gardens in the yard and around the buildings. Arthur Pope also writes: garden is the most important favorite subject in Iran, because almost all Persian carpets express the concept of the garden (Shahcheraghi & Eslami, 2009). Perhaps the main memory of the homeland and the origin of Aryan people was the source of this interest. Human has lived in the lap of nature throughout history and has been developed and evolved by coexistence with it.

The quality of the natural environment is not limited to individuals' health, but it meets emotional and psychological needs, underlies the development and progression, forms the identity and extracts the different environmental experiences such as recreation, freshness and vitality, and restoration and reconstruction of the mind. Its absence brings worry, anger, helplessness, fear, panic, and pessimism. In line with his mental health, human is in special need of being close to nature and connection with it in different forms. The revival of the tradition of garden making is acceptable to the community; thus, it is necessary to achieve a true understanding of it. Constructing the Persian garden has a historical continuity, but is not something that is sealed in the distant past. Fading the Persian garden has happened in the contemporary era, but its collective memory is still alive in the minds of the Persians (Mehdi Nejad et al., 2016).

The Design based on Interaction with Nature

In the urban design and architecture, human-nature interaction is an important factor that should be focused, because today, sociologists, psychologists and psychiatrists believe that urban green spaces play a positive role in the health of citizens in addition to providing residential environmental health. In fact, green spaces play a role in providing a certain number of natural elements that are necessary for physical and psychological balance in people with varying backgrounds in addition to reforming the urban landscape. The suitable green space beside the built environments must be usable; it is a key element in the design (Tabaeian, 2015). Undoubtedly, green spaces and urban parks should be considered of the most basic factors of human and nature sustainability in today's urbanization. Table 1 shows the results of the theories; in its review, the effects of the design based on human-nature interaction on the mental health of healthy and sick people are remarkable. For example, designing a hospital where patients can interact with nature can shorten the period of hospitalization

Benefits of Interacting with Nature

There has always been an intimate relationship between nature and human. Understanding the benefits of interacting with nature is very important to preserve and improve human

Table 1: Interaction with the natural and building and scape, and their impact on health.

| Researchers | Comparison of landscapes | | Reports on the impacts on health |
|----------------|---|--|---|
| Ulrich,1979 | Natural Landscape: lands covered with vegetation including agricultural lands | | Improving health and reducing anxiety Increasing the positive factors and decreasing the triggers of fear |
| | Urban landscape: commercial landscape and industrial areas | | Increasing anguish, loss of precision |
| More,1981 | Prison | Agricultural lands and trees | Reducing stress compared to that prisoners who observed the prison grounds |
| | | Prison grounds | Prisoners who observed the prison grounds were in queues .of patients 24% more than those who saw agricultural lands |
| Ulrich,1984 | Hospital | Natural landscapes: trees | Short recovering after surgery in the hospital, less negative comments in the notes of the nurse's assessment, and using less strong sedative compared to patients who saw the .brick wall |
| | | Building brick wall | Long recovering after surgery in the hospital, more negative comments in the notes of the nurse's assessment, and using more strong sedative consumption compared to patients .who saw the natural landscapes |
| Hartig,2003 | Natural environment: View of tree/nature ((1600 hectares of vegetation and wildlife | | Less stress and improved mood: reduced level of stress/ lower blood pressure. Increased positive effects and reduced .anger and aggressiveness |
| | Without natural perspective/urban environments | | Increased blood pressure, reduced positive effects and in- creased anger and aggression |
| | With the average density of professional offices, and retail development | | |
| Grahn,1997 | School | School playground with a high rate of nature | Fewer days of disease for students, less attention problems, less concentration problems, improved motor function |
| | | School playground with a low rate of nature | More days of disease for students, more attention and concentration problems, lower motor function compared to students who played in the natural playground |
| Tylor,2002 | The number of windows with a view of (nature (on a scale from 0 to 4 | | Improved self-discipline in girls: 20% perspective was related to girls' self-discipline. There was no relationship to .the measurements performance in the boys |
| | For girls: lower self-discipline with less .view of green space | | |
| Heerwagen,1990 | Patients' Waiting Room | Paintings of nature scenes, distant mountains, sunset, clusters of trees and grassy (areas, paths (Mystery | Stress reduction: patients feel calmer and less stressful in a place with painted walls, compared to a simple waiting .room |
| | | White wall | Patients viewing a white wall had higher heart rate increase during the waiting period, they had less tranquility and more stress than the patients who observed the painting of landscape |

health, especially in a world where people go quickly toward urbanization ,e.g. evidences suggest that living near green spaces has many benefits for human health. With a proper design that interacts with the natural landscape, we can reduce many treatment costs and crime rates (Kenigeret al., 2013).

In Table 2, types of urban environments, where humans can interact with nature, have been introduced. Tables 3 and 4 analyze the different types of human interaction with nature and positive effects on human beings. And the classification of indicators of care landscape on the health is shown on Table 5.

Table 2: Types of urban environments where humans interact with nature. (Source: The author based on Kenigeret al., 2013)

| Type | Example |
|--------------------|--|
| Indoor environment | Plants |
| Urban environment | Public green space Private green spaces such as gardens Roadside trees Plants |

Table 3: Types of human interaction with nature (Source: The author based on Kenigeret al., 2013)

| Type | Description | Example |
|-------------|---|---|
| Accidental | Experience of nature as a side event for another activity | Walking to work and driving Facing with plants inside buildings Facing with nature in the way of another activity |
| Intentional | Presence in nature as the main objective | Recreation, such as hiking, camping, wildlife viewing, adventure Horticulture or agriculture |

Table 4: The positive effects of interaction with nature (Source: The author based Kenigeret al., 2013)

| Type | Description | Example |
|---------------|--|--|
| Mental health | A positive effect on mental processes | Increasing the self-confidence Improving mood Reducing anger Mental health Reducing anxiety |
| Cognitive | A positive effect on cognitive ability | Reducing mental fatigue Improving academic performance Educational opportunities Improving the ability to perform tasks Improving the cognitive function in children Improving productivity |

Continuue of Table 4: The positive effects of interaction with nature (Source: The author based Keniger et al., 2013)

| Type | Description | Example |
|---------------|--|--|
| Physiological | A positive effect on physical functioning or physical health | Reducing stress |
| | | Lowering blood pressure |
| | | Reducing headaches |
| | | Reducing mortality from circulatory diseases |
| | | Faster restoration |
| | | Understanding Health |

Table 5: Classification of indicators of care landscape on the health (Source: Nili et al., 2013)

| Therapeutic landscapes characteristic | Researchers | Condition of characteristic in therapeutic landscapes | A report on the effect on health |
|--|------------------------------|---|---|
| Spatial variety | Grahn et al. (1997) | School playground with a high rate of green space | Reduced rate of disease / maximized concentration power / improved performances |
| | Hartig et al. (2003) | Presence of landscape of trees and nature | Reduced stress and improved behaviors and moods / lower blood pressure / reduced anger |
| Distributing green materials and medicinal herbs | Kaplan (1993) | A landscape with natural elements | Strong impact on satisfaction and restoration and improvement / reduced frustration / increased patience / life and overall health |
| | Lohr and Pearson-mims (2006) | An urban landscape with different forms of trees (round- cone) | Positive emotional response in urban areas with trees compared to urban spaces with inanimate objects / lower blood pressure / Positive emotional response to round and cone forms of trees |
| Distributing colorful flowers and plants | Otto son and Grahn (2005) | Garden with old fruits, a nature of variety of flower species | Increased power of concentration / positive impact on heart beats |
| | Tennessen & Imprich (1995) | Trees, grass, bush, and lake | Increased rate of direct attention |
| Encouragement to practice | Staats et al. (1997) | Landscapes of forest with different densities (path against cutting the path) | Increased pleasure / high availability / difference of response in high and low density |
| Reducing unfavorable environmental noise with the help of phone (sound) system | Diette et al. (2003) | Natural landscapes, meadow with the sound of nature | The pain of those who are exposed to nature and sound is significantly reduced |
| Minimizing ambiguity (readability) | Nakamura & Fujii (1992) | Fence | Using fence creates tranquility, it creates stress if it is made by concrete blocks |
| The rise of water in different species | Laum et al. (2003) | Natural environments, beach | Positive effect on heart beat |
| | Ulrich et al. (1991) | Natural landscapes, vegetables with water | Reduced anger and fear / rapid and complete recovery / decreased heart beat |

Elements of landscape architecture are full of different architectural approaches. The relationship between landscape and human health is very important in the researches at the global level and has become increasingly important. On the one hand, enjoying this landscape is a unique characteristic of human in the sense that human inherently tends to nature and finds peace of mind along with it. On the other hand, it can be clearly understood that architecture does not take steps only to

beautify the environment, but also it designs the landscape and natural elements in a way that can have a positive impact on the psyche of the individual. A review of researches on the impact of the natural environment on human shows that in addition to creating a sense of calm in the human, landscapes invite him to focus and think. The relationship between the human and environment and landscape provides the opportunity to experience with the help of the five senses; these senses are

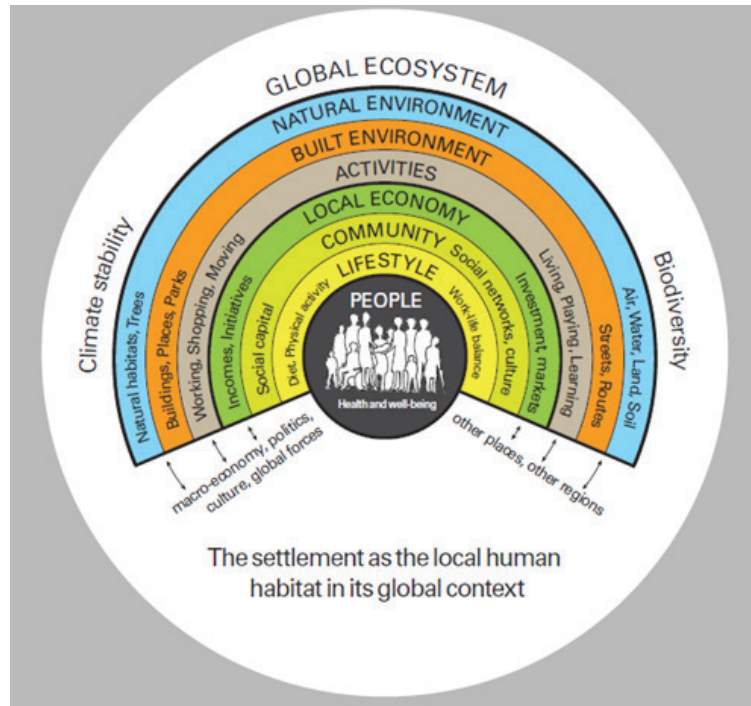


Fig.1: Settlement health map (Source: Barton & Grant, 2006)

also in the nature. However, the senses are purposefully ordered in the healing sights. Axes of the healing landscapes awaken sense(s) of the audience, and finally bring all five senses into balance (Nili et al., 2013).

Environmental Stress

Stress is literally a Latin word, which occurs when a person feels s/he is in a threatening condition (Tabaeian, 2015). The settlement health map shows how human health and wellbeing depend on not only genetics but also the conditions of life. It is very clear that the natural environment and landscape are very important and effective compared to other factors. Places encourage human to activities and also contemplation and relaxation; so it should be somewhere safe, attractive and easily accessible. These are necessary infrastructure components for a society, which is very important for the construction and planning of settlements.

Objectives

The main objective of this study was to evaluate the psychological impact of human interaction with nature investigated with the short-term observation of two different urban environments: a building environment in the city and an urban green space. In a more specialized way, the aim of the study was to investigate the effects of human-nature interaction including observation and walking, on the power of perception, mental vitality, spirit, and creativity of people. Our hypothesis

is that all dependent variables such as restoration, vitality and positive spirit have stronger de-stress effect in natural environments or environments that interact with nature. Our guess is that the negative moods of individuals' spirits are reduced in green environments while they are increased or remained unchanged in building environments (downtown).

MATERIALS AND METHODS

Place of Study

Participants were exposed to one of the two different environments located in the city of Isfahan; these environments include an urban park and an urban building environment in the city center.

Mellat Park, located at Mellat Boulevard near the Sio-Se-Pol Bridge, is a park in the city of Isfahan founded in 1967 with an area of over 18 thousand square meters. The area is adjacent to the Zayandeh Roud River, which is the largest river in the Central Persian Plateau. Mellat Park is a green area with flowerbeds, water elements, many of trees and grass, and has recreational amenities including spaces for exhibition, sports, couches and a stage for live music performances. This place is usually used year-round for outdoor recreation and sports. During the study, participants first saw the park and then went for a stroll along recreational trails (Fig. 2).

Bozorgmehr Street was the place of control for building environment in the city center. In this experiment, participants saw the square in the main street while sitting. Then, to stroll



Fig. 2: Isfahan Mellat Park



Fig. 3: Isfahan Bozorgmehr Street

along a sidewalk, they commute to the shopping center and traffic (Fig. 3).

Sampling

Questionnaire was used in this study to collect data. To measure the effects of green space on reducing stress in the above locations, the questionnaire was responded. Questionnaires were distributed among 55 patients, randomly distributed among 40 subjects (they observed only one place), and 15 of them have observed both environments. Participants were 28-65 year old non-smokers, 21 of which were male.

Study Time

The study has been done in mid-spring (May 2016) when nature is green and parks have many visitors. All the experiments were conducted at 6 pm after an ordinary working day for volunteers.

Study Materials

During the experiment, several psychological criteria were used to measure the feeling of restoration, vitality and spirits of the participants. We used two methods to measure their restoration experiences (Kaplan & Kaplan, 1989). These measures are the Restoration Outcome Scale (ROS) and Perceived Restoratives Scale (PRS). ROS has 6 items, 3 items reflect on tranquility (I feel relax and powerful, I feel calm, I am willing and eager to perform everyday tasks), one item reflects on focus restoration (I feel I can focus and be conscious), and two items reflect the ability to erase the thoughts (I can forget all my worries, my thoughts are pure and carefree).

For PRS, two measures of PRS Gen1 and PRS Incon2 were applied. General restoration includes 12 items. (Avoiding, for example: Spending time here was as a break in the daily routine tasks of my life.), motivation (for example: It has many fascinating features.), and collaboration (for example: This is consistent with my personality). Incoherence contains 4 items

(for example: It is a hectic place). Spirits of individuals were evaluated by measuring positive and negative affects (panas3) (Watson et al., 1988). Positive affects were calculated through 10 items showing the positive impact, high levels of energy, full focus, motivation, and interest; while negative affects were calculated through 10 items indicating negative impact, stress, distress, and different scenarios of unwillingness (nervousness, discomfort and guilt). Report of perception of having energy and feeling so alive were measured with four visual scales of energy and vitality e.g., I'm feeling so alive. I have energy and spirit (Ryan & Frederick, 1997). Creativity measurement includes four items that are provided according to the objective of this study (e.g., I have several new ideas. So, I feel creativity by spending time outside). All the psychological items were measured using Likert scale from 1 (not at all) to 7 (completely) (Tyrväinen et al., 2014).

Testing Process

Participants were divided into groups of four individuals; participants were guided to see each location only once (Mellat Park and Bozorgmehr Street in Isfahan). Participants were asked not to talk during the test in order to minimize the effects of social relationships. Participants then completed the first questionnaire. The first phase was to observe the location for 15 minutes. Participants then completed the second questionnaire. After observation, they walked for 20 minutes by the guidance of the researcher so that all groups move in the same path and at a slow pace. All tracks were already known. After the

walk, participants were going to the seats, and completed the third questionnaire after sitting for 3 minutes. During all tests, weather was variable from mostly sunny to cloudy.

RESULTS AND DISCUSSION

Analysis of the scale

Levels of PANAS POS, SVS4 and ROS had a significant positive relationship in all areas. There was no special connection between the PANAS POS and PANAS NEG. As can be seen, positive affects have a significant direct connection with the public restoration, vitality and outcome of restoration and creativity, while having an inverse relationship with incoherence. Negative affects have an inverse relationship with general restoration, vitality, and restoration outcome, while having a direct relationship with incoherence. In all cases, there was no significant relationship between negative affects and creativity. About vitality (SVS), environment had a significant effect on the actual amount of vitality. The effect of park was significantly more than the city. Also, time had a major effect on the actual amount of joy and vitality during the test. The results showed that the inner vitality scores in the park increase after a long period of time, while it is decreased in the city. (See interaction in Fig.4)

All positive and negative feelings at the beginning and end of the study were measured by the Positive and Negative Affect Scale (PANAS). This indicates that people experience more positive affects after seeing the green space (see Fig.5), and place was significantly effective for negative affects. The

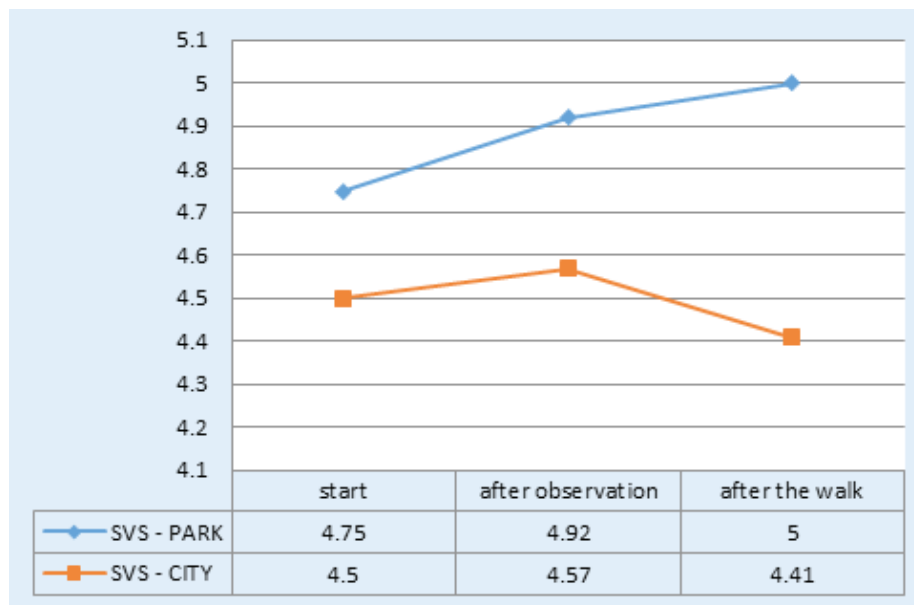


Fig.4: The impact of green space and building space on human vitality.

average effect showed that people have less negative feelings in the park compared to city. Considering the average effect of time, people had less negative feelings at the end of testing compared to the beginning (see Fig.6).

Perceived restorativeness in all three locations was measured by PRS, which was divided into two criteria: PRS Gen (This place has a fascinating quality), and PRS Incoh (Here is a hectic place). We are also interested in evaluating the impact of interventions on creativity using creativity criterion. The

amount of creativity in the park was higher compared to the city (Fig.7).

Important interaction between time and space during the experiment showed that participants feel better in different ways depending on the time and place. Interaction suggests that there are significant differences between the park and the city. This means that participants will feel better after 15 minutes sitting in the green space, and even longer stay at these locations will increase the feeling (Fig.8).

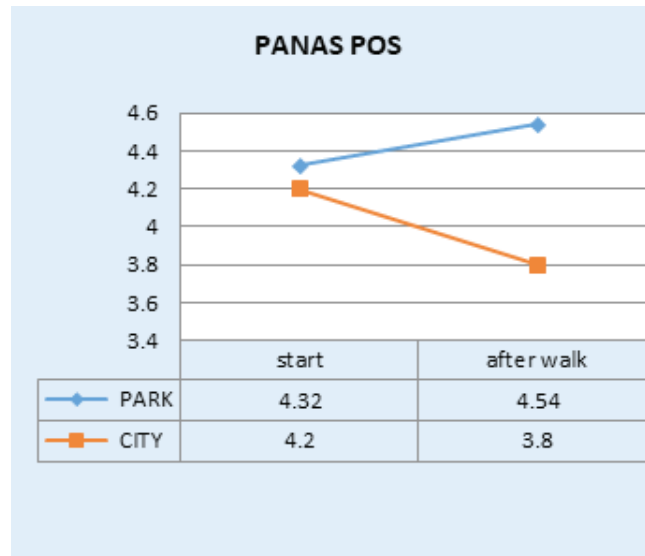


Fig.5: The impact of green space and building space on positive affects

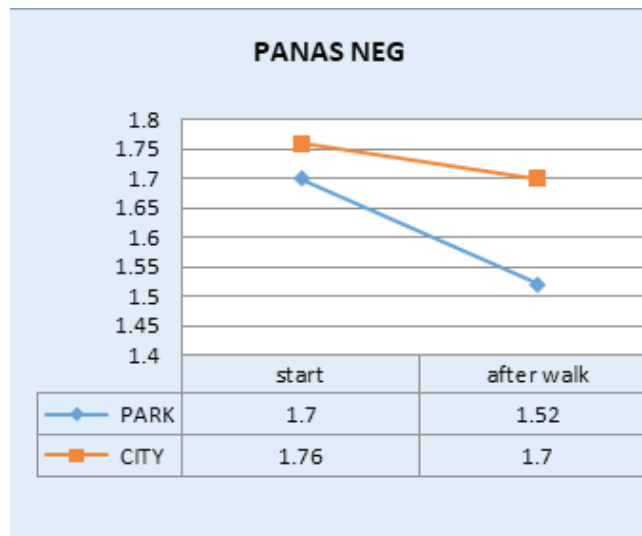


Fig.6: The impact of green space and building space on negative affects

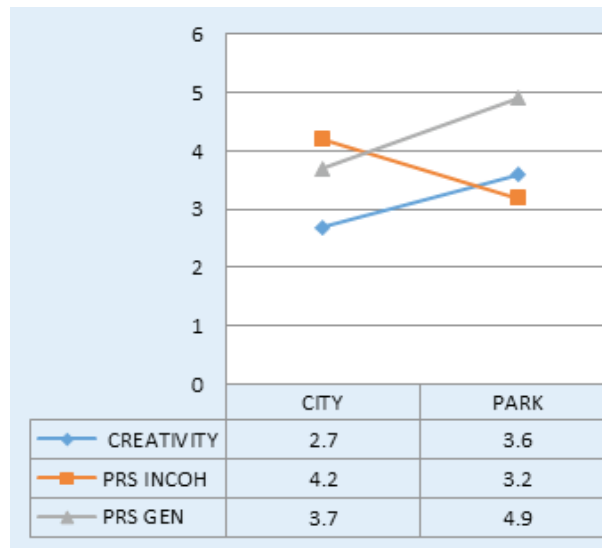


Fig.7: The impact of urban green space and building space on PRS Gen, PRS Incoh, and creativity.

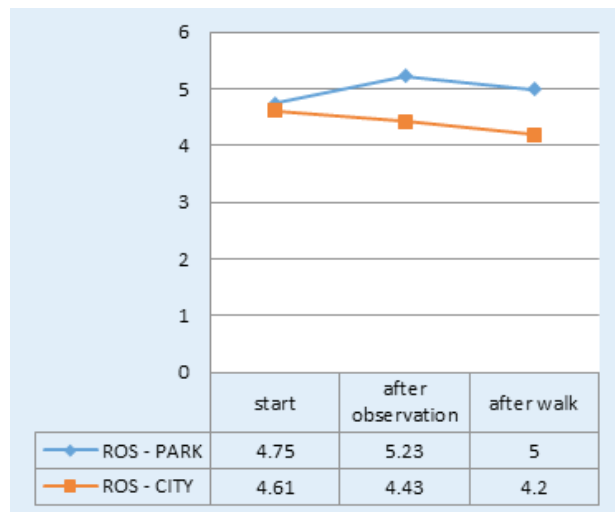


Fig.8: The impact of urban green space and building space on ROS.

CONCLUSIONS

In this study, we examined the impact of short-time observation of different urban environments on the human spirit, i.e., comparing building environment with green spaces. The effect of interaction with nature in the environment accessible by people and in situations close to real life is investigated. Using different psychological interventions, the effects of two different environments on restoration, vitality, spirit and creativity were evaluated. The study hypothesis approved the enhanced restoration feeling, joy and positive affects in the

green area, and their reduction in urban areas. In addition, sense of creativity was increased in green environments; the findings also confirm that the feeling of restoration after a short period of observation of nature is considerable. However, increased vitality in green space, with the interaction of time and space, was created only after a bit of a walk, and the presence of more than 15 minutes in nature is necessary to create vitality. Findings of the articles and research showed that urban green spaces play a positive role in the health of citizens in addition to providing environmental health; and people's exposure to

nature in places such as hospitals, educational and cultural centers, and prisons, has a positive and healing performance, and leads to restoration and enhanced creativity. Hence, we conclude that appropriate urban and architectural design based on interaction with nature, which is easily accessible for residents, has a positive impact on the human psyche and spirit, and improves the performance of the urbanization activities.

ENDNOTES

1. General Restoratives subscale
2. PRS Incoherence
3. The Positive And Negative Affect Scale
4. Subjective Vitality Scale

REFERENCES

- Emami, S. (2014). Architecture along with nature; architecture education space interaction with nature to meet the psychological needs of students at two universities in Isfahan. *Manzar Magazine*, 24, 14-17.
- Bell, S. (2003). *Landscape: Pattern, Perception and Process*. (B. Aminzadeh, Trans.). Tehran: University of Tehran.
- Shahcheraghi, A., & Eslami S. G. (2009). Rethinking of Persian Garden Architectural Order in Persian Garden – Carpet with Emphasis on the Environmental Ecological Perception Theory. *Quarterly Scientific-Research Goljaam*, 9, 63-85.
- Tabaeian, M. (2015). *Man and the environment: psychological approach to architecture and urbanism*. Isfahan: Islamic Azad University Isfahan Khorasgan.
- Mehdi Nejad, J., Zarghami, I., & Sadat, S. A. (2016). The relationship between man and nature in the Persian gardens from the perspective of Islamic architecture. *Naghsh-e-Jahan Quarterly*, 1, 27-41.
- Noghrekar, A. (2010). *An Introduction to Islamic identity in architecture*. Tehran: Payam Sima Publication.
- Nili, R., R., & Soltanzadeh, H. (2013). The reflection of landscapes healing characteristics in the pattern of Persian garden. *Bagh-e-Nazar journal*, 23, 65-74.
- Barton, J., & Pretty, J. (2010). What is the best dose of nature and green exercise for improving mental health: A multi-study analysis. *Environment Science & Technology*, 44, 39-47.
- Barton, H., & Grant, M. (2006). A health map for the local human habitat. *Journal of the Royal Society for the Promotion of Health*, 126(6), 252-253. doi:10.1177/1466424006070466
- Bjork, J., Albin, M., Grahn, P., Jacobsson, H., Ardo, J., & Wadbro, J. (2008). Recreational values of the natural environment in relation to neighbourhood satisfaction, physical activity, obesity and wellbeing. *Journal of Epidemiology & Community Health*, 62(4). doi:10.1136/jech.2007.062414
- Frumkin, H. (2001). Beyond toxicity human: Health and the natural environment. *American Journal of Preventive Medicine*, 20, 234-240.
- Grahn, P. M., Artensson, F., Lindblad, B., Nilsson, P., & Ekman, A. (1997). *Stad and Land*, 145 (in Swedish).
- Hartig, T., Evans, G. W., Jamner, L. D., Davis, D. S., & Gärling, T. (2003). Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology*, 23(2), 109-123. doi:10.1016/s0272-4944(02)00109-3
- Hartmann, P., & Apaolaza-Ibañez, V. (2010). Beyond savanna: An evolutionary and environmental psychology approach to behavioral effects of nature scenery in green advertising. *Journal of Environmental Psychology*, 30(1), 119-128. doi:10.1016/j.jenvp.2009.10.001
- Heerwagen, J. (1990). The psychological aspects of windows and window design. In Selby, R. I., Anthony, K. H., Choi, J., & Orland, B. (Eds.), *Proceedings of the 21st Annual Conference of the Environmental Design Research Association*. EDRA, Oklahoma City, 269–280.
- Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective*. Cambridge: Cambridge University Press.
- Keniger, L. E., Gaston, K. J., Irvine, K. N., & Fuller, R. A. (2013). What are the benefits of interacting with nature?. *International journal of environmental research and public health*, 10(3), 913–935. doi:10.3390/ijerph10030913
- Kodama, T., Morita, K., Doi, R., Shoji, Y., & Shigemori, M. (2010). Neurophysiological Analyses in Different Color Environments of Cognitive Function in Patients with Traumatic Brain Injury. *Journal of Neurotrauma*, 27(9), 1577-1584. doi:10.1089/neu.2009.1119
- Korpela, K. M., Ylén, M., Tyrväinen, L., & Silvennoinen, H. (2008). Determinants of restorative experiences in everyday favorite places. *Health & Place*, 14(4), 636-652. doi:10.1016/j.healthplace.2007.10.008
- McEwen, B. S. (1998). Protective and Damaging Effects of Stress Mediators. *New England Journal of Medicine*, 338(3), 171-179. doi:10.1056/nejm199801153380307
- Moore, E. O. (1981). A Prison Environments Effect on Health Care Service Demands. *Journal of Environmental Systems*, 11(1), 17-34. doi:10.2190/km50-wh2k-k2d1-dm69
- Newell, P. B. (1997). A Cross-Cultural Examination of Favorite Places. *Environment and Behavior*, 29(4), 495-514. doi:10.1177/001391659702900403
- Ryan, R. M., & Frederick, C. (1997). On Energy, Personality, and Health: Subjective Vitality as a Dynamic Reflection of Well-Being. *Journal of Personality*, 65(3), 529-565. doi:10.1111/j.1467-6494.1997.tb00326.x
- Ryan, R. M., Weinstein, N., Bernstein, J., Brown, K. W., Mistretta, L., & Gagné, M. (2010). Vitalizing effects of being outdoors and in nature. *Journal of Environmental Psychology*, 30, 159-168.
- Taylor, A.F., Kuo, F.E., & Sullivan, W.C. (2002). Views of nature and self-discipline: evidence from inner city children. *Journal of Environmental Psychology*, 22, 49–63.
- Tyrväinen, L., Ojala, A., Korpela, K., Lanki, T., Tsunetsugu, Y., & Kagawa, T. (2014). The influence of urban green environments on stress relief measures: A field experiment. *Journal of Environmental Psychology*, 39, 1-9.
- Tyrväinen, L., Mäkinen, K., & Schipperijn, J. (2007). Tools for mapping social values of urban woodlands and other green areas. *Landscape and Urban Planning*, 79(1).
- Tyrväinen, L., Pauleit, S., Seeland, K., & de Vries, S. (2005). Benefits and uses of urban forests and trees. In K. Nilsson, T. B. Randrup, & C. C. Konijnendijk (Eds.), *Urban forests and trees in Europe: A reference book* (pp. 81e114). Springer Verlag.
- Ulrich, R.S. (1979). Visual landscapes and psychological wellbeing. *Landscape Research*, 4, 17–23.

Ulrich, R.S. (1984). Effects of Healthcare Environmental Design on Medical Outcomes, 49-59.

Velarde, M.D., Fry G., & Tveit M. (2007).Health effects of viewing landscapes- landscape types in environmental psychology. *Urban Forestry and Urban Greening* , 6, 199-212.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS Scales. *Journal of Personality and Social Psychology*, 54, 1063-1070.