University of North Carolina Asheville
Journal of Undergraduate Research
Asheville, North Carolina
May 2019

The Effects Of Urban Vegetation On Stress Recovery

Julia Diesel, Brenna Tull, and Clayton Gaar
Environmental Studies Department
The University of North Carolina Asheville
One University Heights
Asheville, North Carolina 28804 USA

Faculty Advisor: Dr. Dee Eggers

Abstract

Previous studies indicate that viewing nature, urban green spaces, and urban vegetation, as opposed to urban environments with no vegetation, aids in stress recovery from physical and mental stress. Specifically, these studies have shown that as the proportion of vegetation in a given view increases, recovery time from stressors decreases. The positive effects of green space are not limited to immersion experiences, but have been found when vegetation is viewed through images, videos, or windows. This study explored the physiological impact of varying percentages of green space in the urban environment on recovery from minor stressors. Participants experienced a standard minor stressor (i.e., Stroop, sequential subtraction, or simple computer game) and then viewed an auto-advancing PowerPoint slideshow. This was repeated three times with 0%, 40%, and 70% of vegetation in the visual field of urban environments. During the experiment, subjects were connected to monitors measuring muscle tension (EMG), brain activity (EEG), skin conductance (EDA), respiration, skin temperature, and pulse (BVP), each of which is an indicator of stress/relaxation. The goal of this research was to contribute to the literature supporting the restorative effects of vegetation in urban areas and identify which percentage best supports recovery. Although other studies have investigated recovery with varying levels of vegetation in the visual field, this study was unique in that it used a combination of six physiological measures. Due to time constraints, there was a small sample (n=23) and analysis was conducted only for skin temperature and skin conductance. While the results were not statistically significant, the trends were consistent with published literature. These trends may become significant with a larger sample size. Future research could build upon this study by utilizing a sample size of at least 50 participants. The results of this, and similar studies, inform urban planning and landscape design, public health, and environmental psychology.

1. Introduction

Although the health benefits of nature contact are receiving increasing attention from researchers and health officials, the idea that contact with nature can have restorative effects on the human mind and body is not a new one. As the prominent American landscape architect and urban planner Frederick Law Olmsted argued in his writings in the late 19th century, nature seems to have inherent relaxing and restorative qualities that can and should be utilized to alleviate the common stresses associated with modern urban life[1]. While such intuitive beliefs based on personal experience provided the initial justification for the designation of many national parks and "beautification" of American cities, empirical evidence for nature benefits is imperative if we are to strengthen the argument for the inclusion of more natural spaces in urban areas.

1.1 Benefits from Direct Nature Contact *in situ*

The literature on the benefits of nature contact has been greatly expanded in recent decades in terms of both empirical evidence and theoretical explanations for such benefits. The benefits of experiencing nature in situ have been well documented, especially in the context of wilderness trips and outdoor recreational activities[2,3,4,5]. However, Ulrich

points out that it is difficult to distinguish between the benefits resulting from the recreational activity itself and those resulting from simply being in nature[6]. More recently, progress has been made in making this distinction and there is a growing body of literature suggesting that simply being in nature can be a restorative experience in and of itself. A study comparing recovery from mental fatigue between wilderness vacationers, urban vacationers, and stay-at-home vacationers showed that those who spent time in nature recovered the most from attentional fatigue[7]. A later experiment that compared stress recovery for subjects who took a walk in either a nature preserve or an urban setting showed that subjects who walked in the nature preserve recorded lower blood pressure and experienced increased positive affect and decreased negative affect[8]. Finally, a study examining recent nature visits and restoration found that visits to more natural environments created a trend toward greater restoration than did visits to urban environments[9].

1.2 Benefits from Viewing Nature *ex situ*

If there are clear benefits from experiencing nature in situ, what about benefits from an indirect form of nature contact, such as viewing nature through windows or pictures of nature? This question has far-reaching implications for modern urban inhabitants whose lifestyles prevent them from being able to visit natural spaces, whether due to lack of time or lack of readily available access to such environments. Can an office worker receive the same benefits, or even a substantial proportion of the benefits, from viewing nature through her office window as she would taking a walk through a park or a nature preserve? Can a student better handle the stress of exams if there are pictures of nature in the school buildings? A wealth of empirical evidence suggests that the answer to both of these questions is "yes."

1.2.1 views through windows

Viewing nature through windows has been proven to provide restorative benefits in a variety of real life settings. In a study of hospital patients recovering from surgery, Ulrich found that patients with windows overlooking trees rather than buildings experienced faster and less painful recovery during their hospital stays[10]. Kaplan and Kaplan found that office workers with views of trees and flowers reported lower levels of job-related stress, higher levels of job satisfaction, and less illnesses and headaches than those who could see only built structures from their windows[11]. A similar study linked natural views to the ability to cope with job stress and less intention to quit[12].

1.2.2 simulated views (i.e., pictures, murals, and videos)

Much of the research into the restorative benefits of viewing nature has been conducted by showing subjects simulated views of nature in the form of slides or pictures. These experiments, carried out in controlled laboratory settings, have consistently produced results indicating that viewing natural scenes is more restorative than viewing urban scenes. Research into the restorative value of nature paintings has also been conducted. A study of patients in a dental office found that hanging a mural depicting a natural landscape significantly reduced patients' feelings of anxiety[13]. In Felsten's study of restorative views in a campus setting, students rated nature murals higher in perceived restorative value than actual views of nature through windows[14]. These findings suggest that paintings of nature can provide restorative benefits in the absence of windows with views of nature.

Simulations of nature views in the form of videos have also been explored. In a 1991 study, Ulrich showed nature and urban scenes to subjects following a stressful video on workplace accidents, but used video simulations of nature and urban settings for the recovery condition instead of slides[6]. The results were consistent with previous findings, showing greater stress recovery for subjects viewing nature scenes than did urban scenes. The rapidity of the stress recovery for those who viewed nature scenes suggested that even small amounts of brief nature contact may provide significant restorative benefits for stressed individuals. Parsons *et al.* showed video simulations of drives through varying amounts of "nature-… or artifact-dominated" areas in an attempt to examine the effects of different roadside environments on stress recovery and stress immunization[15]. They found that subjects who viewed the artifact-dominated drives exhibited higher levels of stress than did those who viewed nature-dominated drives. Participants who viewed nature-dominated drives also experienced faster stress recovery and greater immunization to future stressors. Despite this strong evidence, other studies have shown less decisive results. Ziesenitz and Kromker found no difference in attention restoration and stress recovery between groups of participants who walked through a park or watched a video or computer simulation of the same walk through the park[16]. However, a comparison of physiological recovery from stress between participants who viewed nature through a window and those who viewed the same nature scenes on an equally sized plasma screen showed that the plasma screen did not provide the same

restorative benefits as the view through the window[17].These conflicting findings suggest that further research needs to be aimed at deciphering the effects of nature contact method (e.g., in situ versus ex situ, window views versus monitor simulations, still versus moving images) on stress recovery.

1.3 Amount of Vegetation

While several studies indicate that viewing nature-only scenes is more restorative than viewing urban only scenes, there is also reason to believe that restoration is influenced by the proportion of vegetation or natural space in a setting compared to the proportion of urban space in the setting. A number of studies have shown that the restorative value of a scene with both natural and urban elements increases as the proportion of natural space increases. For example, in one study students rated urban scenes with prominent green space more restorative than scenes depicting only urban space, but rated them less restorative than scenes depicting only nature[18]. Similarly, in Felsten's study on the restorative value of views of both natural and urban elements from windows and murals, student ratings of perceived restorativeness tended to increase as the amount of natural space in the view increased[14]. A third study found that perceived restoration increased as the natural makeup of the environmental image increased, regardless of whether or not the individual was familiar or unfamiliar with the setting[19]. Additional support for this idea is seen in Velarde *et al.,* a study which examined the health effects of viewing nature[20]. The results of this study support the concept that the more natural space present in an individual's work or living area, the better their health and the higher they rate their restoration[20]. However, a contrasting finding resulted from a study comparing student stress recovery using three categories of slides: countryside (nature), urban with vegetation, and urban without vegetation[21]. According to self-reported affect ratings, students reported that the slides depicting urban scenes with vegetation were more restorative than both the countryside and the urban slides. This result suggests that vegetation in an urban setting may have a greater impact on psychological recovery than merely the total amount of green space in a setting. These conflicting findings indicate further research is needed to understand perceived restorativeness of urban-vegetation versus vegetation-only settings.

1.4 Physiological Measures of Stress Recovery

To answer the question of which environments promote and which environments work against stress recovery, it is important to define clearly the concept of stress. For the purposes of this study, the definition of stress used is "the process by which an individual responds… physiologically... to a situation that challenges or threatens well-being"[22]. Specifically, physiological responses are characterized by heightened autonomic arousal and consist of cardiovascular, muscular, and neuroendocrine changes in the body[6,23].

While stress is associated with negative changes in physiological processes, stress recovery "involves numerous positive changes... in levels of activity in physiological systems"[6]. Symptoms of stress and restoration can manifest in three response modes - psychological, physiological, and behavioral - suggesting that the most successful investigation into the environmental effects on restoration will involve a "multi-modal combination of measures"[6].

Several studies have included in their design a physiological component in order to examine stress responses manifested primarily in the form of autonomic arousal[6,7,8,15]. The results of these studies indicate that natural environments foster more rapid and complete recovery than do urban environments. For example, Ulrich *et al*. used pulse transit time (PTT), skin conductivity response (SCR), and muscle tension (EMG) as stress measures and used heart period (HP) as an indicator of the ability to direct attention[7]. Subjects who viewed nature experienced a faster and greater decrease in autonomic arousal, as indicated by the stress measures, as well as a greater ability to direct attention (intake) than did those who viewed urban environments. In their simulations of various driving environments, Parsons *et al*. compared changes in SCR, EMG, electrocardiogram (EKG), and blood pressure among subjects who viewed natural and built roadside environments[15]. Subjects who viewed the natural roadside environments experienced greater stress recovery and immunization to future stress than did subjects who viewed built roadside environments. Hartig *et al*. compared post test heart rate and blood pressure means between subjects who walked in natural and urban environments, but found no significant difference between group means, likely due to the delayed timing of data collection[7]. However, in a later study, blood pressure declined faster for subjects sitting in a room with a view of trees through the window than for those sitting in a windowless room[8]. In the same experiment, subjects who then took a walk through nature showed lower mean blood pressure during the walk than did subjects who took a walk in an urban setting.

2. Methodology

Our study uses physiological measures to assess stress recovery over the course of three stressors and three recovery periods.

2.1 Participants

Participants were recruited via in-class and email announcements. Inclusion criteria for this study was based on status as UNC Asheville students, faculty, staff, and alumni. A total of 23 subjects completed the study over the course of nine days. Each participant was briefed on informed consent, which detailed what to expect during the experiment. There were no known risks, but individuals were encouraged not to participate if they had a latex allergy. Subjects could benefit by understanding what types of urban environments best promote stress recovery for them, individually. Each participant was assigned a random number so that their data was not associated with their identity.

2.2 Procedures

2.2.1 survey

Following completion of informed consent, a six question survey was administered to gather preliminary information relevant to the study. Questions included participants age, major, year in school, self-reported stress level, primary visual environment from ages 4-17 (i.e., urban, suburban, forest, farmland, rural, desert, other), and if they had used a stimulant on the day of participation.

2.2.2 measures

Participants were first connected to a respiration belt, which was placed around the lower ribs, over their shirt. Two sensors were placed on the index and ring finger of the non-dominant hand to assess skin conductance (EDA), which is a measure of perspiration on the pads of the fingers. Then a BVP monitor was taped to the middle finger of the non-dominant hand to measure heart rate. On the same finger a monitor was placed under the tape to measure skin temperature. A latex EMG pad was then placed along the trapezius muscle to measure muscle tension. Finally, three EEG sensors were connected to the center top of the head and both earlobes to measure brain activity. This involved cleaning each site with alcohol, exfoliating with NuPrep gel to increase conductivity, and connecting each sensor with Ten20 conductive paste. These leads were connected to a ProComp Infiniti biofeedback encoder and data was recorded using BioGraph Infiniti software. Following connection to each of the monitors, impedance mode was used to assess the quality of the EEG reading.

2.2.3 experiment sequence

Three minor stressors were used throughout the experiment: a Stroop test, a sequential subtraction task, and a simple computer game. These stressors were paired with a set of auto-advancing images, each of which lasted approximately three minutes. The Stroop test was paired with a PowerPoint containing 0% urban vegetation, sequential subtraction with 40% urban vegetation, and the computer game with 70% urban vegetation. Although the pairing between the minor stressor and PPT remained consistent with each participant, the order of the stressors was varied.

The experiment began with a baseline period in which the participant relaxed with their eyes closed for 30 seconds, followed by 30 seconds with their eyes open. Immediately after the baseline period they began their first minor stressor, each of which lasted for one minute. They then viewed the corresponding PowerPoint and were asked to focus on the images, immerse themselves, and relax. This process was repeated two more times with the remaining stressors and PowerPoints. At the conclusion of the study, participants were given the opportunity to ask any questions and view their physiological data.

3. Data

3.1 Results

Due to time constraints on the availability of testing equipment, we focused on skin conductance and skin temperature and were unable to analyze other measures (i.e., BVP, respiration, EMG, and EEG).

Skin conductance is the best physiological indicator of stress, increasing as stress increases. Skin conductance, measured as EDA, was found to increase with each subsequent stress task of the experiment, regardless of the stressor type. Following this trend, skin conductance decreased during each recovery period, regardless of the quantity of urban vegetation. The results for skin conductance also indicate that as vegetation increased, so did the differences between the maximum stress and maximum recovery between tasks. The greatest average stress reaction for skin conductance was observed during the computer game stressor; however, subjects varied on which minor stressor was the greatest stressor for them.

We assessed recovery by calculating the difference between maximum stress during the stress tasks and maximum recovery that took place during each slideshow. The greatest differences occurred between the computer game and the 70% vegetation slideshow, which was expected based on previous research into the restorative benefits of increasing quantities of vegetation. See table below for average skin conductivity differences.

Skin Conductivity: Maximum Previous Stress to Maximum Recovery			
Percent Vegetation	0%	40%	70%
Max Previous Stress to Max Recovery Difference	4.90	6.51	7.12

Skin temperature was the second physiological measure we assessed. The results showed large variations between participants in baseline skin temperature. This is most likely due to individual physiological differences. Skin temperature was found to decrease during each stressor, but increase with each new stress task over the duration of the experiment, regardless of the order of stressors. We speculate that this was due to the warm temperature of the enclosed space in which the experiment took place. The greatest decreases in skin temperature were observed during the sequential subtraction stressor. The maximum recovery for skin temperature was observed during the 40% vegetation slideshow.

Prior to beginning research, we speculated that sequential subtraction would be the greatest stressor. We found this to be true for the majority of participants. We paired the math stressor with the 40% vegetation slideshow under the assumption that the high level of stress induced by sequential subtraction would potentially mask the recovery effects of the 0% and 70% vegetation images.

3.2 Statistical Analysis

While mean recovery times varied as expected for skin conductance, no statistically significant differences were found for skin conductance or temperature. This was expected due to the small sample size, n = 23 we were able to test during the two weeks we had access to testing equipment. ANOVA of skin conductance results indicated statistically significant differences for 0% and 70% vegetation; however, the data violate the assumption of equal variances. When unequal variances are taken into account, the difference in means is not statistically significant. Sensitivity analysis suggests that if the sample size were slightly more than doubled, the results would have been statistically significant. This suggests that further studies should include a minimum n = 50.

4. Conclusions

4.1 Implications for Urban Planning and Landscape Design

This study, and similar research, bring attention to the anthropogenic values of green space. Knowledge of this could help to incentivize action to protect existing green spaces, and to increase the implementation of green space in urban areas. Informed urban design has the ability to positively impact human stress levels, and, in the future, city planners, architects, and landscape designers should increase their focus on urban greening. Incorporating elements such as windows in offices, schools, and hospitals with views of plentiful urban parks and tree-lined streets is one such example. In addition, interior designers should use more images of nature in their designs. Investigation of other benefits derived from urban vegetation (e.g., ecosystem services, savings on energy bills, air purification, reduced noise pollution) could be the subject of further research in this field, but discussion of these topics is beyond the scope of this project.

4.2 Implications for Public Health and Environmental Psychology

An extensive report by the American Psychological Association in 2017 linked stress to decreased cognition and a variety of mental and physical health problems, such as depression, cardiovascular disease, and cancer[24]. The same report included an American Institute of Stress estimate of costs from stress-related injury and sickness, employee absence and turnover, decreased productivity, and other stress-related impacts that exceed $300 billion per year in the United States[24]. These numbers indicate the need for stress reduction, as high levels of stress are not only costly to society, but can have negative effects on the individual as well. Although increased levels of urban greenery are not obviously related to reduction in stress-related costs, research has found that greater urban greenery has many positive impacts on stress levels and overall well-being, and can therefore decrease these costs. In the future, to combat the effects of stress on individuals and society, urban green space should be increased and given greater importance and consideration in design decisions.

5. Acknowledgments

The authors would like to thank UNCA alumnus and Undergraduate Research Scholar, Clayton Gaar for the excellent foundational work on this project in his paper, “Nature Contact and Restoration.” The authors would also like the thank Dr. Dee Eggers and Dr. Connie Schrader for their mentorship and support of this research project.

6. Endnotes

1. Olmsted, F. L. (1865). The value and care of parks. Report to the Congress of the State of California. [Reprinted in R. Nash, Ed., (1976). The American Environment. Reading, MA: Addison-Wesley, pp 18-24.]

2. Driver, B. L. (1976). Quantification of outdoor recreationists' preferences. In B. Smissen & J. Myers, Eds., Research: Camping and Environmental Education, HPEP Series No. ll. University Park, PA: Pennsylvania State University, pp 165 187.

3. Knopf, R. C. (1987). Human behavior, cognition and affect in the natural environment. In D. Stokols & I. Altman, Eds., Handbook of Environmental Psychology (2 Vols). New York: John Wiley, pp 783-825.

4. Schroeder, H. W. (1989). Environment, behavior, and design research on urban forests. In E. H. Zube & G. T. Moore, Eds., Advances in Environment, Behavior, and Design, New York: Plenum, Vol. 2, 87-117.

5. Shaffee, N., & Shukor, S. F. A. (2018). THE EFFECT OF NATURAL SETTINGS ON STRESS REDUCTION.

6. Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A. & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology, 11*, 201–230.

7. Hartig, T., Mang, M., & Evans, G.W. (1991). Restorative effects of natural environment experience. *Environment & Behavior, 23*, 3-26.

8. Hartig, T.,Evans,G.W., Jamner, L.D.,Davis, D., & Garling,T. (2003). Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology, 23*, 109–123.
9. White, M. P., Pahl, S., Ashbullby, K., Herbert, S., & Depledge, M. H. (2013). Feelings of restoration from recent nature visits. *Journal of Environmental Psychology*, *35*, 40-51
10. Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science, 224*, 420-421.
11. Kaplan, R. & Kaplan, S, (1989). The Experience of Nature. New York: Cambridge University Press.
12. Leather, P., Pyrgas, M., Beale, D., and Lawrence, C. (1998) Windows in the workplace. *Environment and Behavior, 30*, 739–763.
13. Heerwagen, J. H. (1990). Psychological aspects of windows and window design. In R. I. Selby, K. H. Anthony, J. Choi & B. Orland, Eds., Proceedings of the 21st Annual Conference of the Environmental Design Research Association. Oklahoma City: EDRA, pp 269-280.
14. Felsten, G. (2009).Where to take a study break on the college campus: An attention restoration theory perspective. *Journal of Environmental Psychology, 29*, 160–167.
15. Parsons, R., Tassinary, L.G., Ulrich, R.S., Hebl, M.R., Grossman-Alexander, M. (1998). The view from the road: Implications for stress recovery and immunization. *Journal of Environmental Psychology. 18*, 113–139.
16. Ziesenitz, A., & Kromker, D. (2008, July). Is virtual nature equally restorative as ‘‘physical’’ nature? An experimental comparison study. Paper presented at the International Association for People-Environment Studies Conference, Rome, Italy.
17. Kahn, P. H., Jr., Friedman, B., Gill, B., Hagman, J., Severson, R. L., Freier, N. G., et al. (2008). A plasma display window? – The shifting baseline problem in a technologically mediated natural world. *Journal of Environmental Psychology*, *28*, 192–199.
18. Herzog, T. R., Maguire, C. P., & Nebel, M. B. (2003). Assessing the restorative components of environments. *Journal of Environmental Psychology, 23*, 159–170.
19. Carrus, G., Lafortezza, R., Colangelo, G., Dentamaro, I., Scopelliti, M., & Sanesi, G. (2013). Relations between naturalness and perceived restorativeness of different urban green spaces. *Psyecology*, *4*(3), 227-244.
20. Velarde, M. D., Fry, G., & Tveit, M. (2007). Health effects of viewing landscapes–Landscape types in environmental psychology. *Urban Forestry & Urban Greening*, *6*(4), 199-212.
21. Honeyman, M. (1990). Vegetation and stress: a comparison study of varying amounts of vegetation in countryside and urban scenes. Paper presented at the National Symposium on the Role of Horticulture in Human Well-being and Social Developments, Washington
22. Baum, A., Fleming, R. & Singer, J. E. (1985). Understanding environmental stress: strategies for conceptual and methodological integration. In A. Baum & J. E. Singer, Eds., *Advances in Environmental Psychology*, *5*, 185-205.
23. Korpela, K., & Hartig,T. (1996). Restorative qualities of favorite places. *Journal of Environmental Psychology, 16*, 221-233.
24. American Psychological Association, APA Working Group on Stress and Health Disparities. (2017). *Stress and health disparities: Contexts, mechanisms, and interventions among racial/ethnic minority and low-socioeconomic status populations*. Retrieved from http://www.apa.org/pi/health-disparities/resources/stress-report.aspx

7. References

American Psychological Association, APA Working Group on Stress and Health Disparities. (2017). *Stress and health disparities: Contexts, mechanisms, and interventions among racial/ethnic minority and low-socioeconomic status populations.* Retrieved from http://www.apa.org/pi/health-disparities/resources/stress-report.aspx

Baum, A., Fleming, R. & Singer, J. E. (1985). Understanding environmental stress: strategies for conceptual and methodological integration. In A. Baum & J. E. Singer, Eds., *Advances in Environmental Psychology*, *5*, 185-205.

Carrus, G., Lafortezza, R., Colangelo, G., Dentamaro, I., Scopelliti, M., & Sanesi, G. (2013). Relations between naturalness and perceived restorativeness of different urban green spaces. *Psyecology*, *4*(3), 227-244.

Driver, B. L. (1976). Quantification of outdoor recreationists' preferences. In B. Smissen & J. Myers, Eds., Research: Camping and Environmental Education, HPEP Series No. ll. University Park, PA: Pennsylvania State University, pp 165 187.

Felsten, G. (2009).Where to take a study break on the college campus: An attention restoration theory perspective. *Journal of Environmental Psychology, 29*, 160–167.
Hartig, T.,Evans,G.W., Jamner, L.D.,Davis, D., & Garling,T. (2003). Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology, 23*, 109–123.
Hartig, T., Mang, M., & Evans, G.W. (1991). Restorative effects of natural environment experience. *Environment & Behavior, 23*, 3-26.
Heerwagen, J. H. (1990). Psychological aspects of windows and window design. In R. I. Selby, K. H. Anthony, J. Choi & B. Orland, Eds., Proceedings of the 21st Annual Conference of the Environmental Design Research Association. Oklahoma City: EDRA, pp 269-280.
Herzog, T. R., Maguire, C. P., & Nebel, M. B. (2003). Assessing the restorative components of environments. *Journal of Environmental Psychology, 23*, 159–170.
Honeyman, M. (1990). Vegetation and stress: a comparison study of varying amounts of vegetation in countryside and urban scenes. Paper presented at the National Symposium on the Role of Horticulture in Human Well-being and Social Developments, Washington
Kahn, P. H., Jr., Friedman, B., Gill, B., Hagman, J., Severson, R. L., Freier, N. G., et al. (2008). A plasma display window? – The shifting baseline problem in a technologically mediated natural world. *Journal of Environmental Psychology, 28*, 192–199.
Kaplan, R. & Kaplan, S, (1989). The Experience of Nature. New York: Cambridge University Press.
Knopf, R. C. (1987). Human behavior, cognition and affect in the natural environment. In D. Stokols & I. Altman, Eds., Handbook of Environmental Psychology (2 Vols). New York: John Wiley, pp 783-825.
Korpela, K., & Hartig,T. (1996). Restorative qualities of favorite places. *Journal of Environmental Psychology, 16*, 221-233.
Leather, P., Pyrgas, M., Beale, D., and Lawrence, C. (1998) Windows in the workplace. *Environment and Behavior, 30*, 739–763.
Olmsted, F. L. (1865). The value and care of parks. Report to the Congress of the State of California. [Reprinted in R. Nash, Ed., (1976). The American Environment. Reading, MA: Addison-Wesley, pp 18-24.]
Parsons, R., Tassinary, L.G., Ulrich, R.S., Hebl, M.R., Grossman-Alexander, M. (1998). The view from the road: Implications for stress recovery and immunization. *Journal of Environmental Psychology. 18*, 113–139.
Schroeder, H. W. (1989). Environment, behavior, and design research on urban forests. In E. H. Zube & G. T. Moore, Eds., Advances in Environment, Behavior, and Design, New York: Plenum, Vol. 2, 87-117
Shaffee, N., & Shukor, S. F. A. (2018). THE EFFECT OF NATURAL SETTINGS ON STRESS REDUCTION
Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science, 224*, 420-421.
Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A. & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology, 11*, 201–230.
Velarde, M. D., Fry, G., & Tveit, M. (2007). Health effects of viewing landscapes–Landscape types in environmental psychology. *Urban Forestry & Urban Greening*, *6*(4), 199-212.
White, M. P., Pahl, S., Ashbullby, K., Herbert, S., & Depledge, M. H. (2013). Feelings of restoration from recent nature visits. *Journal of Environmental Psychology, 35*, 40-51.
Ziesenitz, A., & Kromker, D. (2008, July). Is virtual nature equally restorative as ‘‘physical’’ nature? An experimental comparison study. Paper presented at the International Association for People-Environment Studies Conference, Rome, Italy.