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The influence of indirect nature experience on human system

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ABSTRACT

A growing number of studies have shown that contact with nature contributes enhancing positive psycho-physiological effects. This study experimentally compared the effects of direct and indirect contact with nature on psychological and physiological affect, respectively. Thirty university students participated in this experiment. The results of this study indicated that indirect nature experience also provided positive psychological and physiological effects, except for parasympathetic nerve activity. The results of the present study would support the effectiveness of virtual nature for people who cannot easily access real nature in order to improve psychological benefits.

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Contact with nature; psycho-physiological effects; virtual nature; forest therapy; health benefits

1. Introduction

According to biophilia (Wilson 1984) and human evolutionary (Ulrich 1981) theories, humans have spent many thousands of years adapting to the natural environment, yet have only inhabited urban ones for relatively few generations (Maller et al. 2006). However, the world has become an urban society, with a vast number of people becoming alienated from the traditional people–nature relationship. The modern urban continuous, distracting stimuli can impede people's abilities to focus on significant issues or to achieve relaxed states (Kaplan 2001; Kim et al. 2017). Viewing nature is considered one approach to promoting balance and harmony in the modern urbanite's life.

Ulrich et al. (1991) argued that a person's initial response to an environment is affective. They believed that the initial affective response to an environment shapes the cognitive events that follow, leading to sustained attention, higher levels of positive feelings, and reduced negative or stress-related feelings (Valtchanov et al. 2010). The growing number of studies supported Ulrich and his colleagues' argument and evidenced that viewing natural scenes contributes to reducing stress, provides more positive psycho-physiological effects on human systems, and may facilitate recovery from illness (Shin et al. 2012; Bang et al. 2017; Lee 2017). Cross-cultural studies also indicate that visual exposure to natural scenes improves moods, reduces stress, and provides optimal physiological activation (Han 2010; Shin et al. 2011; Honold et al. 2014; Song et al. 2015; Bang et al. 2017; Lee 2017).

The accumulating evidence of the beneficial effects of viewing nature prompts an important question: can restorative environments be created and customized to promote a health benefit and help people who have difficulties visiting or spending time in real nature? In the modern society, not everyone can access nature easily. In particular, people with disabilities, senior citizens, and those with other illnesses cannot freely seek out natural settings. For these populations, replicating the restorative effects of nature may be achievable using indirect nature experiences.

This study experimentally compared the effects of direct and indirect contact with nature (i.e., virtual nature experience) on psychological and physiological affect, respectively. To our knowledge, this comparison of direct and indirect nature experience and their differential impacts on psycho-physiological affect, respectively, has not been investigated experimentally.

2. Material and methods

2.1. Participants

Thirty university students aged between 18 and 27 (21.2 ±1.7) years, participated in this experiment. Anyone with a current or recent history of endocrine, neuropsychiatric, salivary gland or acute/chronic pain disorders, or who was using certain disqualifying medicines, was excluded from participating. Before the experiment, the participants were fully informed about the aims and procedures involved. After briefing about the experiment, the participants signed an agreement to take part in the study. The study was approved by the Institutional Review Board of the Chungbuk National University (CBNU 201609-BMSB-366-01) and conducted in accordance with committee's regulations. Participants came to the laboratory one at a time by scheduled appointments over the course of 8 weeks.

2.2. Experimental design

To compare the effects of direct and indirect nature experience on psychological and physiological influence, two sets of experiments were conducted. A nature setting located near the Chungbuk National University campus in Cheongju, South Korea was selected for the effect of direct nature experience. The nature area was flat, bright and well-managed with mostly pine trees (Figure 1). Physiological and psychological effects of indirect nature experiences were measured in a laboratory with an artificial climate maintained at 25°C with 50% relative humidity (Figure 2).

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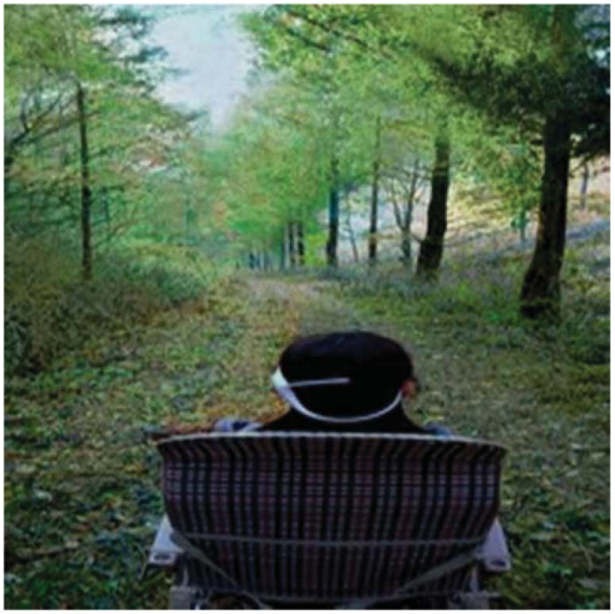

Figure 1. Study area for investigating the effect of direct forest experience.

2.3. Heart rate variability

Heart rate variability (HRV) was measured as the periods between consecutive R waves (R–R intervals) in an electrocardiogram recorded with a portable electrocardiograph (Canopy 9 plus, IEMBIO). The low frequency (LF; 0.04–0.15 Hz) band and the high frequency (HF; 0.15–0.40 Hz) band were measured. The HF power was suggested as reflect parasympathetic nervous activity (Kobayashi et al. 2012).

2.4. Semantic differential method

The participant's emotional impact was investigated using a modified semantic differential (SD) method (Osgood et al. 1957). This SD method contains items and each item has a pair of adjectives, such as "comfortable–uncomfortable."

Figure 2. Laboratory for investigating the effect of indirect forest experience.

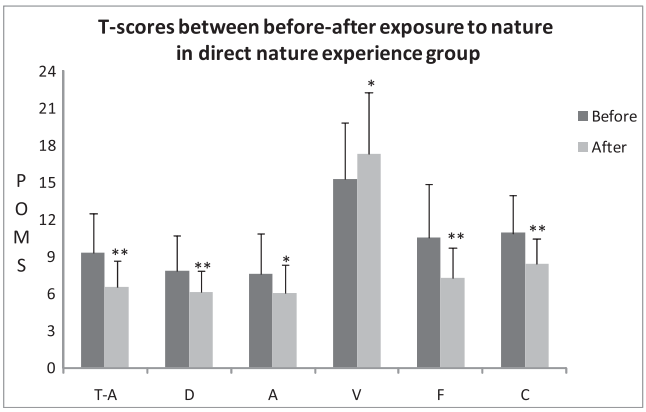

Figure 3. Mood improvement after direct nature experience.

2.5. Profile of mood state (POMS)

The POMS is a commonly employed, factor-based and analytically derived scale to measure psychological distress. In this study, the Korean version of POMS was employed to measure each participant's six mood states, such as tension and anxiety (TA), depression (D), anger and hostility (A-H), vigor (V), fatigue (F), and confusion (C).

3. Results

3.1. Direct and indirect nature experience and mood state

To investigate the effect of mood states from direct and indirect nature experiences, participants' mood states were measured before and after exposure to nature experiences. As can be seen from Figures 3 and 4, there were significant differences in t-scores in both direct and indirect nature experience groups. Specifically, in the direct nature experience group, participants' tension and anxiety (TA) (t = 4.65; p = .000), depression (D) (t = 2.86; p = .008), fatigue (F) (t = 3.70; p = .001), and confusion (C) (t = 4.64; p = .000) were significantly improved at $p \leq 0.01$ level after exposure to nature. On the other hand, anger (A) (t = 2.10; p = .044) and vigor (V) (t = 2.18; p = .038) were improved at $p \leq 0.05$ level after exposure to nature. Interestingly, in the indirect nature experience group, all moods significantly improved at $p \leq 0.01$ level after exposure to virtual nature [tension and anxiety

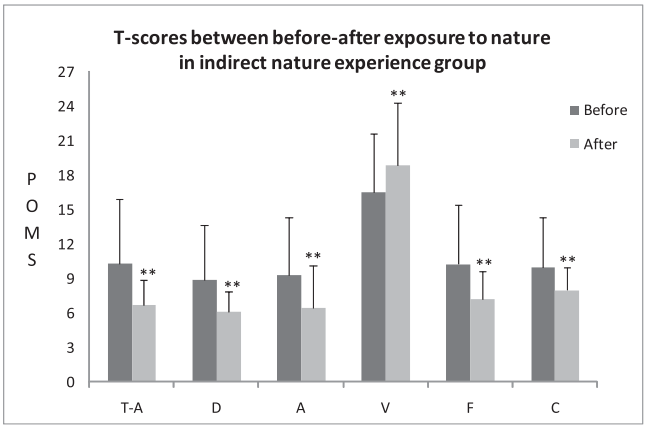

Figure 4. Mood improvement after indirect nature experience.

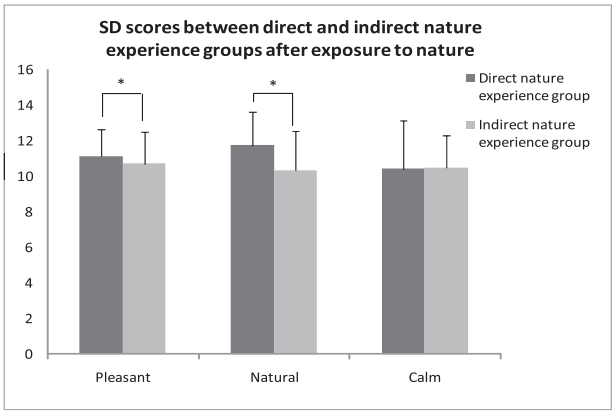

Figure 5. Differences in SD scores between direct and indirect nature experiences.

(TA) (t = 4.17; p = .000), depression (D) (t = 3.81; p = .001), anger and hostility (A) (t = 3.74; p = .001), vigor (V) (t = 2.85; p = .008), fatigue (F) (t = 4.12; p = .000), and confusion (C) (t = 3.16; p = .004)]. The results indicate that those who had nature experiences either directly or indirectly obtained positive mood states.

3.2. Semantic differential (SD) method

Figure 5 compares the effects of emotional impact between direct and indirect nature experiences. Among the three emotional impact categories, there were significant differences in "pleasant" (t = 2.39; p = .020) and "natural" (t = 2.60; p = .012). However, in the "calm" category, no significant difference was found (t = –.111; p = .912). The results of the SD comparison indicate that participants who had a direct nature experience felt higher pleasant and natural feelings than those who had an indirect nature experience.

3.3. Parasympathetic nerve activity

The results of analysis to compare the natural logarithm of HF component, which is known as an estimate of parasympathetic nerve activity, between direct and indirect nature experiences are shown in Figures 6. As can be seen from Figure 6, there were significant differences in mean HF values between before and after in the direct nature experience group (t = 3.57; p = .001). However, in the indirect nature experience group, no significant difference was found between before and after experiences (t = 0.97; p = .336).

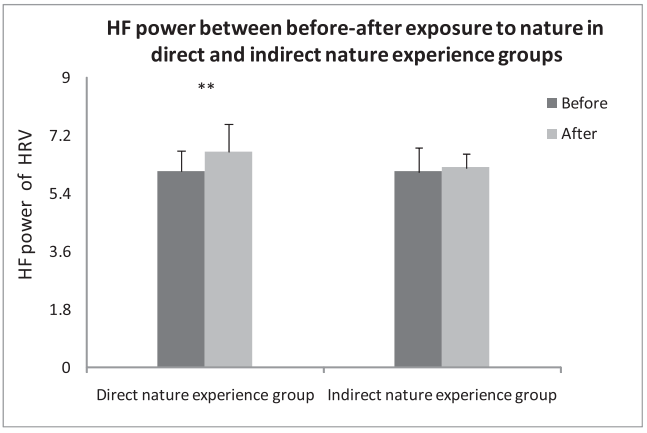

Figure 6. HF changes after nature experiences.

4. Discussion

Contact with nature has been evidenced to enhance psycho-physiological effect positively (Shin et al. 2012; Beil and Hanes 2013; Bang et al. 2017; Lee 2017). The present study was performed to compare the psycho-physiological effects of direct and indirect nature experience. Although some previous studies (Ulrich 1984; Valtchanov et al. 2010; McAllister et al. 2017) have reported positive impacts of indirect nature experiences, very few studies have reported the impacts of comparison between direct and indirect nature experiences.

The results of this study indicate that indirect nature experience provided positive psychological and physiological effects as direct nature experience did, except parasympathetic nerve activity. The findings in this study are consistent with the Kaplan and Kaplan (1989) Attention Restoration Theory (ART) that nature provides human restoration. The findings also are in line with Ulrich's argument that contact with nature provides positive physiological responses.

The present study results indicated that exposure to virtual nature can produce significant improvement in affective states. Modern technology in virtual reality (VR) would allow for the complete customization and creation of restorative environments (Valtchanov et al. 2010). The results of the present study would support the effectiveness of virtual nature for people who cannot easily access real nature. People with disabilities, patients, inmates, and workers in remote areas are in urgent need of experiencing nature to obtain positive psycho-physiological benefits. The present study can provide strong justification for providing virtual nature.

The findings of the present study indicate that even brief, virtual nature experience can enhance affect, and emphasizes the necessity of indirect nature experience for special populations who cannot easily access real nature. The experimental constructs employed in this study may have some limitations that can be addressed by future research. Relatively small sample size and a homogeneous group in this study may limit its statistical power. Further research should consider including more participants from diverse populations. Especially, studies with large numbers of participants from different population groups may generalize the results of this study. Although the physiological measure did not show a significant difference in HRV response between before and after exposure to indirect nature, the measures on psychological effects suggest that a large variety of content needs to be made available in order to achieve compatibility with a large number of people. Duration of exposure to indirect nature and content of nature may cause the insignificant difference in HRV. Further research with different content of nature, different duration to exposure and different population may be needed to confirm the findings of this study.

5. Conclusion

This study investigated the psycho-physiological effects of direct and indirect nature experiences. The results of this study showed that exposure to real and virtual natural environment appears to be beneficial to participants' moods and feelings. However, exposure to the real natural environment tends to be more beneficial in physiological response (parasympathetic nerve activity) than exposure to virtual nature.

Disclosure statement

No potential conflict of interest was reported by the authors.

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