

ORIGINAL ARTICLE

Analysis of the Psychological Effects of Exposure to Different Types of Waterscape Facilities for Urban Green Space Planning

Hyun-Ju Jo^{*}, Jie-Ming Wang¹⁾

East Coast Life Sciences Institute, Gangneung-Wonju National University, Gangneung 25457, Korea

¹⁾*Department of Environmental Landscape Architecture, Graduate School, Gangneung-Wonju National University, Gangneung 25457, Korea*

Abstract

To create urban landscapes that take human emotion into consideration, the present study verified the psychological effects of artificial waterscape facilities on users, as these facilities significantly impact their psychological comfort. Data was collected using the SD scales and POMS of 60 male and 60 female participants after they watched a video of four waterscape facilities. Participants deemed the video clip of a fountain waterscape to be artificial and linked it with changeable images that increased their vigor. The video clip of waterfall stimulated various impressions (e.g., vital, liked, active, etc.) and changed participant' mood states by increasing their vigor and decreasing fatigue. The video clip of the pond yielded familiar impressions, produced less free images, and decreased tension among participants. Finally, the video clip of the stream stimulated quiet and comfortable images as well as reduced negative feelings of anger, confusion, and depression among participants. Furthermore, males experienced more positive effects than females, regardless of the type of waterscape facility. The study findings indicate that the four different waterscape facilities influenced participants' mood states. Additionally, the psychological effects differed by gender. The data suggest that landscape planners need to carefully consider their choice of waterscape facility when designing green spaces to ensure that the space is psychologically comforting to users.

Key words : Fountain, Waterfall, Pond, Stream, Profile of mood states, Semantic differential scales

1. Introduction

Given the increasing interest in health and the improvement of QOL, urban green spaces play a critical role because these are places that promote health and psychological well-being (Hartig et al., 1991; Hansmann et al., 2007). Scientific data have been accumulating in recent decades concerning stemming from interaction with urban green space

(Karmanov and Hamel, 2008; Hirose et al., 2010; Lee et al., 2011; Elsadek and Fujii, 2014)

Waterscape facilities in urban green space cultivate positive sentiments and create pleasant urban environment for users (Park, 2006). The aesthetics and pleasantness associated with water elements in urban parks increase the usage of and satisfaction with these parks. Waterscape are a unique feature of landscape design because unlike plants and

Received 19 August, 2016; **Revised** 3 September, 2016;

Accepted 7 September, 2016

***Corresponding author** : Hyun-Ju Jo, East Coast Life Sciences Institute, Gangneung-Wonju National University, Gangneung 25457, Korea
Phone : +82-33-640-2639
E-mail : hjo1011@gmail.com

The Korean Environmental Sciences Society. All rights reserved.
© This is an Open-Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

fixed landscapes, they create flexible shapes within the space and maximize the visual effects of the landscapes (Kim et al., 2007). Various types of waterscape facilities have been introduced in urban green space for those reasons.

Previous studies on waterscape facilities have provided theoretical considerations of traditional waterscapes (Sim and Kang, 1988; Lee and Kim, 2012). Case studies have focused on the locations where he place introduced water space (Nam and Kim, 2000), researchers also evaluated user satisfaction (Chin et al., 2003), maintenance conditions (Kang and Sim, 2010), waterscape planning (Park, 2000), and the design and characteristics of the bodies of water (Kim et al., 2007; Lee et al., 2008). These previous study have primarily analyzed the physical aspects of waterscape facilities and reviewed user satisfaction through comprehensive analyses. However, to fully appreciate the use and impact of waterscape locations, studies also need to concretely review the psychological effects of waterscape facilities on users.

Although urban green spaces consist of various landscape elements, the most of studies of physiological and psychological effects of green spaces have focused on plants (Hirose et al., 2010; Jo et al., 2013). Thus, the present study objectively verified the psychological effect that are produced in users after exposure to different type of waterscape facilities.

2. Materials and methods

2.1. Materials

Four waterscape stimuli were chosen to evaluate the psychological effect of exposing individuals to different types of waterscape facilities: a fountain, waterfall, pond, and stream (Fig. 1). These are typical artificial waterscape facilities that have been introduced into urban green spaces and have high user utility. After each waterscape facility was turned on, a portable video camera was used to make three-minute recordings. The video was presented to respondents so that they could hear the water sounds



Fig. 1. The four types of waterscape facilities that were recorded using a video camera for three minutes each and later presented to respondents.

and feel as though they had visited the waterscape facilities. The sound levels of the four waterscape facilities were measured at 58~72 dB (fountain), 64~75 dB (waterfall), 48~61 dB (pond), and 52~68 dB (stream); this is important because sound levels can influence the psychological impact.

2.2. Psychological measures

For the psychological evaluations, a profile of mood states (POMS) questionnaire and a semantic differential (SD) scale were used. The POMS questionnaire objectively evaluates subjective aspects of emotions and feelings. For the measurement of emotion, subjective aspects on emotion and feelings. The POMS questionnaire measures six kinds of standard feelings. In contrast, the SD scale only measures depression, and MAS only measures anxiety. The POMS questionnaire can measure the temporary state of a respondent according to their environment. The POMS questionnaire includes 65 words, and the shortened version includes 30 words (Kim et al., 2003). Subjects were asked to choose one of four scores (0~4) that ranged from “not at all” (0 score) to “very much” (4 scores) for each word that described an emotion or feeling. The words were divided into six areas: Tension-Anxiety (T-A), Depression-Dejection (D), Anger-Hostility (A-H), Vigor (V), Fatigue (F) and Confusion (C). In this study, the shorten version of the POMS questionnaire was given to respondents to evaluate the changes in their feelings and moods after watching a video of the four waterscape facilities.

The SD scale is a type of rating system that was designed by Osgood et al.(1957) to capture the connotative meaning of objects. It is used to survey respondents' subjective impressions or preferences toward stimuli. In the present study, 25 pairs of opposing adjectives were used, and each was evaluated on a 7-point scale. The adjective pairs were selected based on previous studies on landscape.

2.3. Study respondents and data collection

A total of 120 university students (60 males and 60 females, mean age 23.2 ± 2.2 , mean \pm SD) responded to the survey. After providing an overview of the study and explaining the purpose of the study, informed consent was obtained from the participants. The survey was conducted in a university classroom after lectures had ended. The respondents were asked to watch the video of the four waterscape facilities (i.e. three minutes of each waterscape facility) and to fill out the SD scale and the POMS questionnaire. The required respondent time was 20 minutes in total.

2.4. Data analysis

Data were obtained from the SD scale that compared the four types of waterscape facilities. The scores for each adjective pair were calculated, and the mean value of all the subjects' results were compared using Friedman's comparison of k samples. For data comparisons between males and females, the mean value of male and female scores were compared using the Wilcoxon signed-rank test.

Data were also obtained from the POMS questionnaire. Respondents' scores for each of the words were divided into six standards: T-A, D, A-H, V, F, and C. The sum of the scores for each standard was calculated, and the score was converted into a T-score using the POMS conversion table. The T-scores were then compared for the four waterscape facilities using Friedman's comparison of k samples. Additionally, male and female scores were compared using the Wilcoxon signed-rank test.

3. Results

3.1. Psychological evaluation results from the POMS questionnaire

Fig. 2 shows the POMS subscale results for the comparison of the four waterscape facilities. In the tension and anxiety subscale (a), the pond and stream

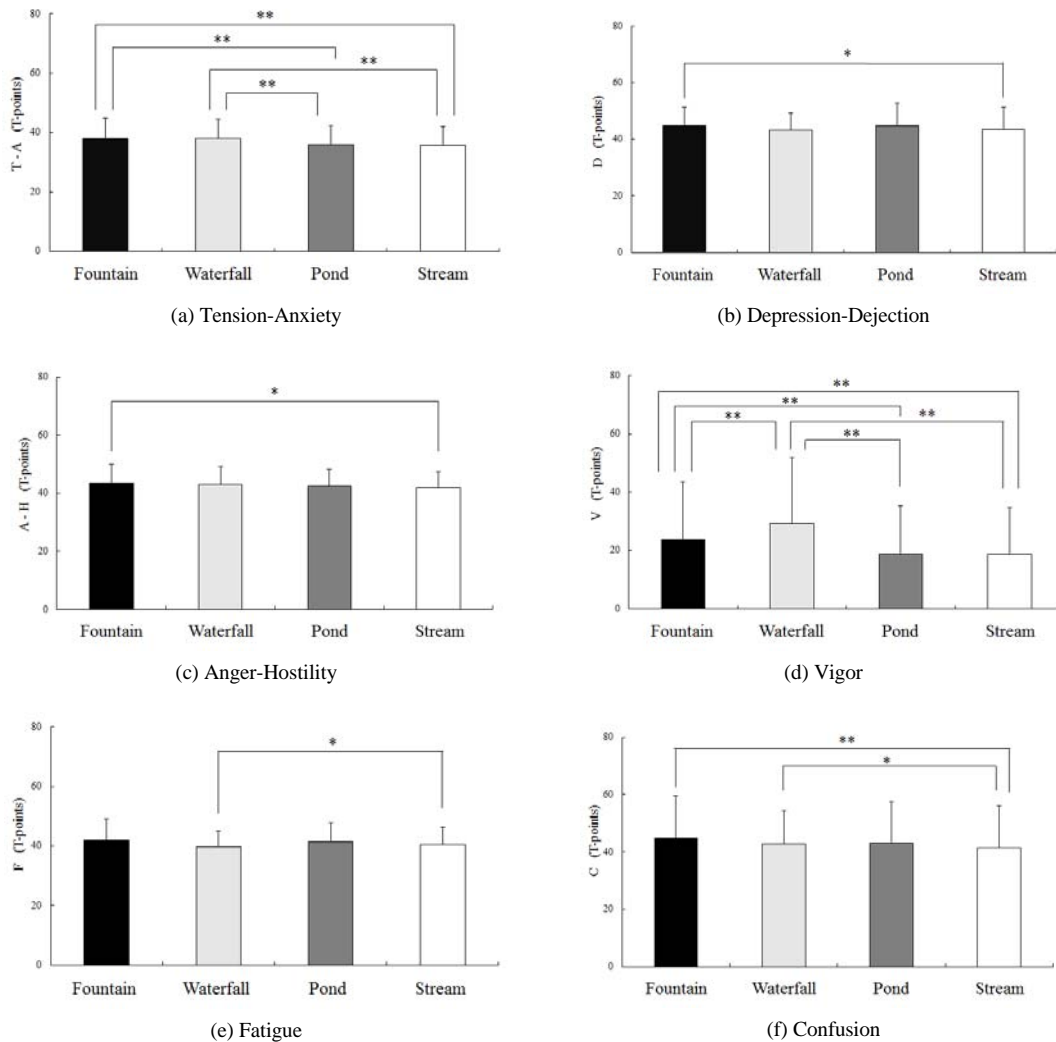


Fig. 2. POMS subscale results showing the observed differences for the four types of waterscape facilities (N=120).

had lower scores ($P < 0.01$, respectively) than the fountain and waterfall. Accordingly, exposure to the pond and stream decreased feelings of tension and anxiety among respondents. In the depression and dejection subscale (b) and the anger and hostility (c) subscale, the stream received lower scores than the fountain ($P < 0.05$). This shows that exposure to the stream reduced depressed and angry feelings more than exposure to the fountain for respondents. In the

vigor subscale (d), the waterfall had a higher score than the fountain ($P < 0.01$), pond ($P < 0.01$), and stream ($P < 0.01$); additionally, the fountain had a higher score than the pond ($P < 0.01$) and stream ($P < 0.01$).

These results show that the waterfall promotes vigorous feelings more than the other waterscapes and that the fountain can change mood animatedly. In the fatigue subscale (e), there was a significant

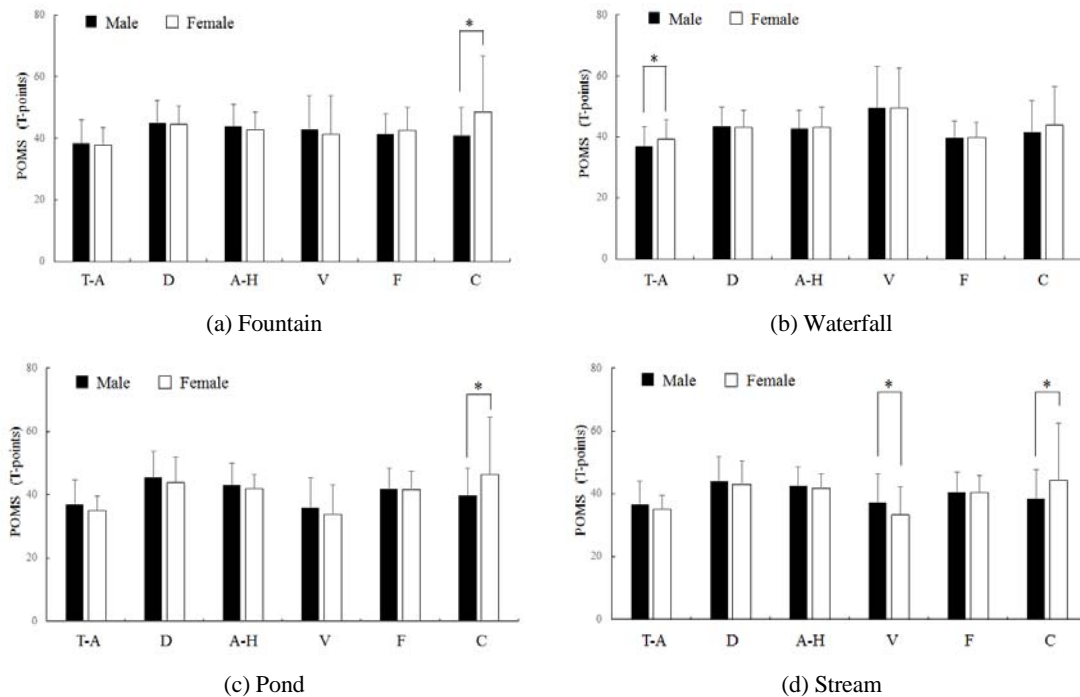


Fig. 3. The POMS subscale results: observed differences between male (N=60) and female (N=60) subjects in response to the four waterscape facilities.

difference between the findings for the waterfall and stream: the waterfall had a lower score than the stream ($P < 0.05$). This indicates that the waterfall decreased feelings of fatigue. In the confusion subscale (f), the stream had a lower score than the fountain ($P < 0.01$) and waterfall ($P < 0.05$). Accordingly, exposure to the stream reduced feelings of confusion among respondents. In short, each waterscape facility produced psychological effects by changing the mood states of respondents: 1) the fountain increased vigor, 2) the waterfall increased vigor and decreased fatigue, 3) the pond decreased tension, and 4) the stream decreased anger, confusion and depressed feelings.

Mood state changes between male and female respondents were compared. In response to the fountain (a) and pond (c) waterscapes, males had

lower confusion scores than females ($P < 0.05$). In response to the waterfall (b) waterscape, males had lower tension and anxiety scores than females ($P < 0.05$). In response to the stream waterscape, males had higher vigor scores ($P < 0.05$) but lower confusion scores than females ($P < 0.05$). Accordingly, the results indicate that the male respondents had more positive feelings, such as increases in vigor or reductions in tension and confusion, than female respondents in response to all the waterscape facilities (Fig. 3).

3.2. Psychological evaluation results from the SD scales

In short, the findings revealed that exposure to each waterscape facility produced specific impressions in respondents. First, the waterfall created various positive impressions, such as like, active, vital,

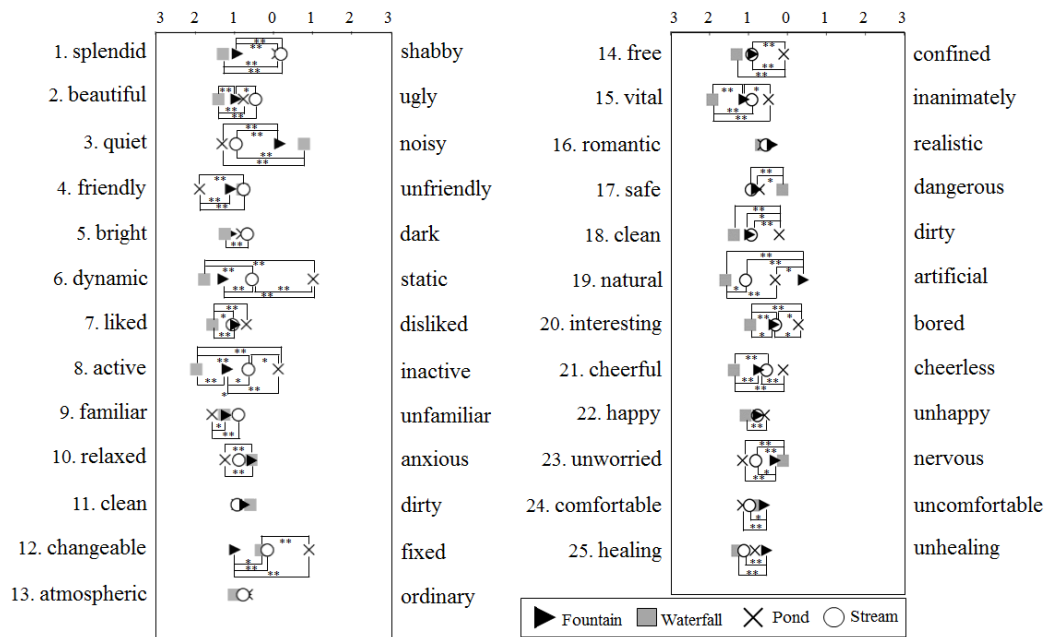


Fig. 4. SD results showing the observed differences for the four types of waterscape facilities (N=120).

natural, and cheerful. Second, the pond produced somewhat negative impressions, such as being less clean and less free than the waterfall; however, it was the most familiar image to respondents. Third, exposure to fountains caused respondents to select the most artificial and changeable images. Finally, streams produced quiet, comfortable impressions in respondents (Fig. 4).

The SD results were compared for male and female respondents (Fig. 5). In response to the fountain, males produced higher scores than females for splendid and atmospheric images (a). In response to the waterfall, females found that the waterfall sound was noisy, while males found that the waterfall stimulated safe, clean, relaxed, and atmospheric images (b). Also, males found that the pond had a safer image (c) and the stream had a more active image (d) compared to female respondents. Accordingly, the results showed that male respondents had more positive impressions of the four waterscape facilities

than female respondents.

4. Discussion and conclusion

In this study, we investigated psychological responses to four types of waterscape facilities and measured these responses using two verbal scales of SD and POMS. The results indicated that although the fountain was perceived to be artificial, it was associated with changeable images and increased vigor among respondents. Exposure to the waterfall positively altered mood states like vigor and decreased negative feelings like fatigue; it also produced various positive image impressions, like vital, like, and active. The pond was perceived as familiar but was associated with fewer free images decreased tension. Finally, respondents associated the stream with quiet and comfortable impressions; it also reduced the negative mood states of anger, confusion, and depression.

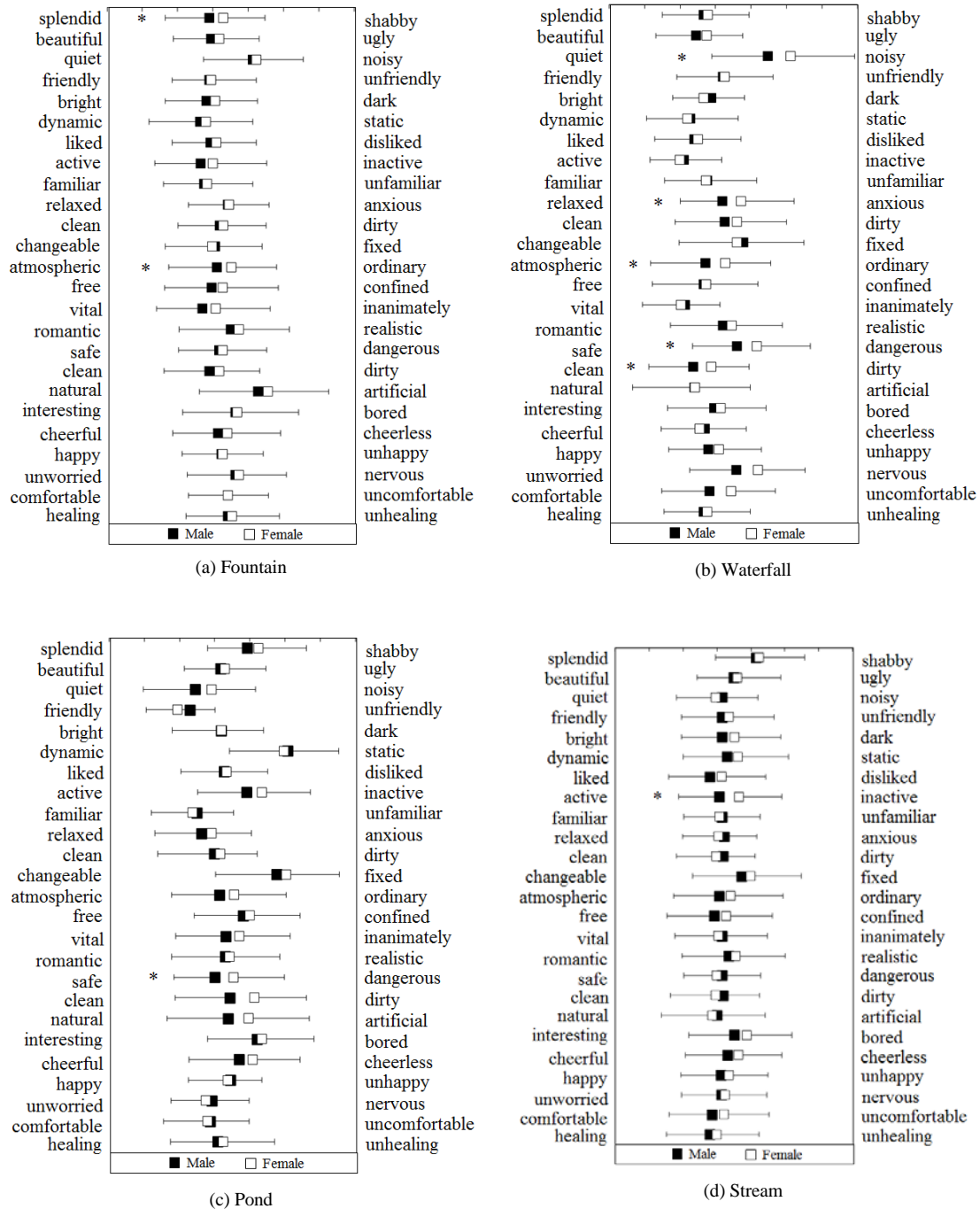


Fig. 5. SD results of the observed differences between male (N=60) and female (N=60) subjects in response to each of the four waterscape facilities.

The results from the SD scale and the POMS questionnaire indicate that although respondents responded with different images depending on the type of waterscape facility, viewing waterscape facilities can have positive psychological effects like enhancing positive mood states and reducing negative mood states. Exposure to the different waterscape facilities can influence mood changes. For example, vital, changeable, and active images increase vigorous feelings, whereas quiet and familiar images decrease feelings of tension and anger. In comparing genders, the findings from the SD scale and POMS questionnaire showed similar tendencies. Males positively changed their mood states more often than females according to the POMS results, and males provided higher scores than females concerning positive images according to the SD scale results. The results show that regardless of the type of waterscape facility, the psychological effects may differ according to gender. These results are consistent with those of previous studies documenting the physiological and psychological effects are different between genders. For example, Hirose et al.(2010) studied the physiological and psychological effects by vision and touch of three different turf grasses. The results showed male and female had different impressions of turf grasses by vision and touch. Elsadek and Fujii(2014) also reported male and female had different psycho-physiological effects by showing different responses of cerebral region.

To reduce confounding variables, the participants of the study was controlled as university students. Accordingly, the effect found in this study might not be generalizable to certain populations. Further studies are needed to test outcome with a wider range of participants and methodology.

The study findings suggests that urban landscape planners need to consider waterscape facility types when they plan urban green space to ensure that they create psychologically comfortable places for users.

REFERENCES

- Chin, K. H., Choi, M. B., Rho, J. H., 2003, A study on user's satisfaction of water space design in interior landscape architecture space, *Journal of the Korean Institute of Landscape Architecture*, 31(1), 23-33.
- Elsadek, M., Fujii, E., 2014, People's psycho-physiological responses to plantscape color stimuli: A pilot study, *International Journal of Psychology and Behavioral Sciences*, 4(2), 70-78.
- Hartig, T., Mang, M., Evans, G. W., 1991, Restorative effects of natural environmental experience, *Environment and Behavior*, 23, 3-26.
- Hansmann, R., Hug, S., Seeland, K., 2007, Restoration and stress relief through physical activities in forest and parks, *Urban Forestry & Urban Greening*, 6(4), 213-225.
- Hirose, S., Jo, H. J., Tonogi, H., Fujii, E., 2010, Experimental study on physiological and psychological responses by vision and touch of turf grass, *Journal of Landscape Architecture in Asia*, 5, 231-236.
- Jo, H. J., Rodiek, S., Fujii, E., Miyazaki, Y., Park, B. J., Ann, S. W., 2013, Physiological and psychological response to floral scent, *HortScience*, 48(1), 82-88.
- Kang, H. M., Sim, W. K., 2010, Urban and historic landscapes: Co-housing complex problems and improve the direction of hydroponic facilities, *Proceedings of the Korean Landscape Architecture Conferences*, 170-173.
- Karmanov, D., Hamel, R., 2008, Assessing the restorative potential of contemporary urban environment(s): Beyond the nature versus dichotomy, *Landscape and Urban Planning*, 86(2), 115-125.
- Kim, E. J., Lee, S. I., Jeong, D. U., Shin, M. S., Yoon, I. Y., 2003, Standardization and reliability and validity of the Korean edition of profile of mood states (K-POMS), *Sleep Medicine and Psychophysiology*, 10(1), 39-51.
- Kim, J. P., Kim, Y. S., Lim, W. H., 2007, An analytical study of the design and characteristics of water bodies in urban parks - A case study of urban park in Gyeong-nam -, *Journal of the Korean Institute of Landscape Architecture*, 35(2), 25-36.
- Lee, G. J., Choi, A.Y., Song, B. H., 2008, Characteristics analysis of the design factors followed by present

- techniques of waterscape facilities in the apartment complex, *Journal of Korea Institute of Ecological Architecture and Environment*, 8(4), 11-18.
- Lee, H. L., Kim, S. R., 2012, Water landscape displaying techniques of traditional gardens between China and Korea-With Soswaewon and ZhuonzhengYuan, *Journal of Korea Institute of Traditional Landscape Architecture*, 30(4), 1-13.
- Lee, J. Y., Park, K. T., Lee, M. S., Park, B. J., Ku, J. H., Lee, J. W., Oh, K. O., An, K. W., Miyazaki, Y., 2011, Evidence-based field research on health benefits of urban green area, *Journal of the Korean Institute of Landscape Architecture*, 39(5), 111-118.
- Nam, S. H., Kim, Y. K., 2000, A study on the water space in Woeam-ri Folk village, *Journal of the Korean Institute of Landscape Architecture*, 18(1), 60-69.
- Osgood, C. E., George, J. S., Tannenbaum, P. H., 1957, *The measurement of meaning*, Urbana, University of Illinois Press.
- Park, C. Y., 2000, Design of Unam-Ji waterfront park, *Journal of the Korean Institute of Landscape Architecture*, 28(4), 117-124.
- Sim, W. K., Kang, H., 1988, Symbolic meaning and landscaping value of Yong-ji(reflecting pond) in Korea old Buddhist temples, *Journal of Korea Institute of Traditional Landscape Architecture*, 2(7), 249-276.