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# The Characteristics of Urban Forests as Restorative Environments with the use of the Perceived Restorativeness Scale: focusing on the Hongneung Experimental Forest, Seoul, South Korea

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**Key words**: Psychological restorativeness, Residential area, Therapeutic space, Use patterns

**Abstract**: The aim of this empirical study of Hongneung Experimental Forest (HEF) was to determine how urban forests in residential areas are being used as restorative environments. A survey (n = 232) based on the Perceived Restorativeness Scale was conducted to analyse how each element of the scale differed based on the user's characteristics and to identify the relationship between use patterns and psychological restorativeness. Analysis showed that HEF played a role as a restorative environment in a residential area. The extent of stay received the highest score (6.35), followed by being away (5.97), fascination (5.59), and compatibility (5.47), whereas legibility (4.81) received a relatively low score. The differences in psychological restorativeness based on sex, age, visit frequency, and duration of stay were statistically significant. In particular, the psychological restorativeness for housewives and the elderly was greater than that for men. The greater the frequency of regular visits (e.g., 1~2 times per year), the more likely the visitor will stay for approximately 3h. In the midst of social demand for the restorative environments of urban forests that are accessible and available in everyday life, this study is significant in that it examined the effectiveness of urban forests as restorative environments and presented empirical directions from the visitor's perspective for the planning of urban therapeutic spaces. However, there is a limit to generalizing the psychological restorativeness of urban forests with just the HEF as an example; therefore, future research is warranted to comparatively analyse various spaces.

## 1. INTRODUCTION

Many studies have shown that the natural environment has a positive effect on human health by promoting physical activity (Lovell, 2016), enhancing social cohesion (Maas et al., 2009), and improving physiological and psychological resilience (Hartig et al., 2003; Park et al., 2010). For example, children living in inner-city neighbourhoods with larger and more trees reported superior health-related quality of life (Kim, J.-H., Lee, & Sohn, 2016). Based on these benefits, there is a growing interest in the planning of natural environments to promote human health (European

Commission, 2014; World Health Organization, 2006), such as with the "Healing Gardens" and "Therapy Forests" of the various "Prescription Trails" throughout the USA, the "Forest Therapy" bases and roads in Japan, and the "*vitapacours*" in Switzerland.

To promote human health, the Korea Forest Service has created therapy forests to utilize the healing power of nature that are now operated at 51 sites as of 2018. These therapy forests are equipped with convenience facilities, visitor centres, meditation spaces, and healing forest trails, first established in 2008. The purpose of a therapy forest is to enhance the body's immunity and to utilize various environmental factors in the forest to improve health. Most therapy forests are located outside of cities in natural environments characterized by high tree density and clean air, and various studies have shown that visiting a forest can help cure diseases and promote health (Cho, Lee, & Kim, 2014). However, these therapy forests are not widely available to urban residents on a daily basis; there is growing interest in the creation of restorative environments for urban forests that are more readily available (Kim, H. L., 2014; Kim, J.-H., Lee, & Sohn, 2016).

Visiting an urban forest has been shown to reduce stress and improve the psychological and physiological health of urban residents to the same degree as spending time in nature (Hartig, 2011; Hauru et al., 2012; Tzoulas et al., 2007). Hence, active discussions continue to identify the effects of environmental factors of urban forests on human health and wellbeing (Carrus et al., 2013; Carrus et al., 2015; Van Den Berg, Hartig, & Staats, 2007). Examples include the effects of psychological restorativeness (Tomao et al., 2018) depending on the forest stand structure in urban forests and how the scenery in urban forests can maximize psychological restorativeness (Hauru et al., 2012). In addition, Stigsdotter et al. (2017) identified eight different perceived sensory dimensions of forest environments in urban areas (i.e., serenity, nature, species richness, space, prospect, and refuge, as well as social and cultural factors) associated with the promotion of health, as described by the "Supportive-Environment Theory." Based on these perceived sensory dimensions, many studies have investigated the effects of the physical environment and elements of urban forests with the use of the Depression Anxiety Stress Scale.

The purpose of this study is to examine the effectiveness of urban forests as restorative environments and provide an empirical direction from the user's perspective for the planning of urban therapeutic spaces in the context of discussions about the accessibility of urban forests in daily life. To understand empirically how urban forests are being used as restorative environments, this study 1) analysed how psychological restorativeness functions in urban forests and how functions differ depending on the user's characteristics, and 2) assessed the characteristics of an urban forest as a restorative environment in relation to specific restorative functions.

## 2. RESTORATIVE ENVIRONMENTS

Restorative environments are defined as places that afford visitors the opportunities to recover from stress and otherwise renew personal adaptive resources needed to meet the demands of everyday life, such as the ability to focus attention (Kaplan, R. & Kaplan, 1989). The "Attention Restoration Theory" (ART) (Kaplan, R. & Kaplan, 1989) and "Psycho-Evolutionary Theory" (Ulrich, 1983) hold that natural green environments are especially beneficial for restoration. The ART proceeds from the idea that restorative

environments support and enhance the recovery of diminished capacity in directed attention through conceptual properties, especially *fascination*, *being away*, *extent*, and *compatibility* (Kaplan, R. & Kaplan, 1989; Sonntag-Öström et al., 2014). *Fascination* can take place in an environment that does not require the expenditure of mental effort and involves stimuli and processes of exploration; *being away* is the feeling, either psychological or physical, of being distant from daily routines and demands where directed attention capacity is used; e*xtent* is the capacity of an environment to provide for exploration and a sense of coherence, which refers to the ability to organize and structure a scene in the environment; and *compatibility* is the match between what a person wants to do, what the environment supports, and what the person is expected to do in the environment (Kaplan, S., 1995; Peschardt & Stigsdotter, 2013), provided that the individual's desires and what the environment provides are consistent (Hartig et al., 1997; Lee, S. H. & Hyun, 2003), and the richer the four factors, the more beneficial the restorative environment (Hartig et al., 1997).

To measure the self-perceived restorative potential of an environment, the "Perceived Restorativeness Scale" (PRS), as introduced by Hartig et al. (1997), is based on the four ART components and consists of a total of 16 questions that are graded with the use of a 7-point Likert scale. From a methodological perspective, the reliability and validity of the PRS have been confirmed in many studies (Hartig et al., 1997). For example, (Korpela & Hartig, 1996) used the 16 questions of the PRS with the Zuckerman Inventory of Personal Reaction Scale (ZIPERS), a measure of environmental stress that includes evaluations of the degree of positive effects, attentiveness, fear, and sadness based on a 5-point scale (Kim, H. L., 2014). Furthermore, Laumann, Gärling, and Stormark (2001) used 22 items of the Restorative Components Scale by modifying the PRS scale to five properties of "being away," separated into "novelty" and "escape," although the term "extent" was switched to "scope." Meanwhile, Herzog, Maguire, and Nebel (2003) proposed the use of the Perceived Restoration Potential, which is a modification of the PRS that consists of four factors: "openness," "visual access," "ease of movement," and "setting care." Han (2003) also studied the restorative environment using a short version of the Revised Restoration Scale (SRRS) that measures emotional, physiological, cognitive, and behavioural perspectives. In 2003, Lee, S. H. and Hyun (2003) translated the PRS into Korean and verified the usefulness of the scale through experimentation. Unlike the existing PRS, the Korean version of the PRS (K-PRS) consists of five properties and 26 items, as summarized in Table 1.

*Table 1*. Case studies of restorativeness scales

| Author | Scale | Properties |
|---|---|---|
| Korpela and Hartig (1996) | PRS (4) | Being away, fascination, coherence, compatibility |
| | ZIPERS (5) | Positive affect, sadness, attentiveness, anger/aggression, fear arousal |
| Laumann, Gärling, and Stormark (2001) | RCS[1)] (5) | Novelty, escape, scope, fascination, compatibility |
| Herzog, Maguire, and Nebel (2003) | PRS (4) | Being away, fascination, coherence, compatibility |
| | PRP[2)] (4) | Openness, visual access, movement ease, setting care |
| Han (2003) | SRRS (4) | Emotional, physiological, cognitive, behavioural |
| Lee, S. H. and Hyun (2003) | K-PRS (4) | Repose, fascination, coherence, legibility |

## 3. USE PATTERNS OF URBAN FORESTS

The study of one's preferences and perceptions of natural spaces has been emphasized for the management of urban forests and parks (Sterl, Brandenburg, & Arnberger, 2008), and there have been on-going analyses of the satisfaction and preference of urban forests. For example, Karanikola, Panagopoulos, and Tampakis (2017) analysed the user's preference and satisfaction regarding forest management, while Paletto, Guerrini, and De Meo (2017) analysed the user's preference for the degree of thinning for urban forest management. To deduce improvements to urban forests, Japelj et al. (2016) assessed the users' preferences of environmental elements, while Zhai, Baran, and Wu (2018) analysed differences in visitation patterns based on the motivation of the users using a Global Positioning System tracking device, and Zhang and Zhou (2018) analysed social media data to determine the effect of the location and accessibility of urban forests on visiting patterns. Many recent studies have investigated the effectiveness and planning of urban forests in residential areas from a therapeutic point of view. In this respect, Lanki et al. (2017) studied the relationship between urban green environments and human health, while Sonntag-Öström et al. (2014) conducted comparative analysis on perceived restorativeness, mood, attention capacity, and physiological reactions when visiting city and forest environments.

## 4. METHODS

### 4.1 Study Site

This study was conducted in the Hongneung Experimental Forest (HEF), located in Seoul, South Korea (Figure 1). The structure of the forest is preserved with various species of trees within the urban area and is acknowledged as "the first-generation arboretum" in Korea. Established in 1922, the HEF, covering 44 ha at the southwestern foot of Mt. Cheonjang (天藏山, 141 m), east of Seoul, was a historic site ("Hongneung" in Korean). In the past, the grave of Empress Myeongseong was located in this forest. The HEF consists of 12 theme gardens, including a coniferous garden, deciduous garden, medicinal plant garden, and five forest trails: the trail of the millennium forest, the empress' trail, the trail of forest adventure, the trail of Chenjangmaru, and the trail of the Munbae tree. Additionally, since 1993, the forest has been open on Saturdays and Sundays to increase the public's understanding of the importance of trees and forests, attracting 210,000 visitors per year (Choi & Kim, 2015).

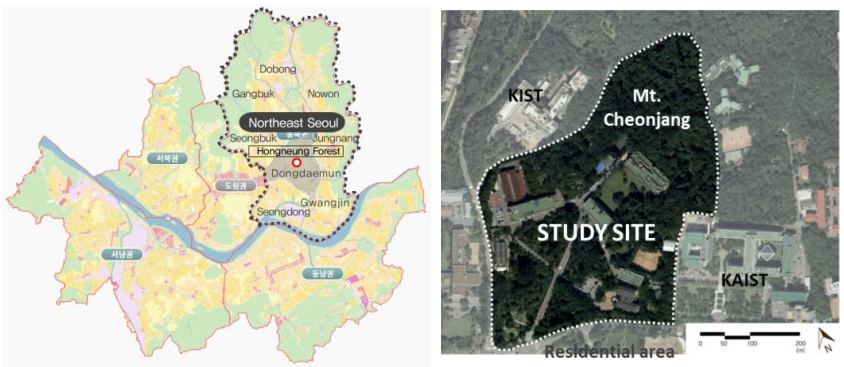


*Figure 1.* Study Site: Hongneung Experimental Forest

## 4.2 Survey

In this study, a visitor survey was conducted to elucidate the relationship between the visitor's characteristics and psychological restorativeness of urban forests. The survey consisted of three sections: demographic characteristics, visit characteristics, and the PRS.

### 4.2.1 Demographic and visit characteristics

Variables were chosen based on earlier studies on the use patterns of the HEF Forest (Jung, Lee, & Kang, 2014; Kim, W. H., Kim, & Moon, 2010; Sreetheran, 2017; Yoo, 2013; Bong, 1997). The variables included the visit purpose, visit frequency, duration of stay, type of companion, activity type, and type of transportation. In this study, the survey consisted of questions regarding demographic characteristics (i.e., sex, age, occupation, and residential area), as well as seven visit characteristics (i.e., visit experience, visit frequency, duration of stay, type and number of companions, activity type, and visit purpose; Table 2). The survey was conducted on May 5 and June 2, 2018 at the entrance of the HEF.

### 4.2.2 K-PRS (Korean version of the PRS)

To analyse the therapeutic functions of the HEF as a restorative environment, the K-PRS, consisting of translations of the items of the PRS, was adopted. Compared to the existing PRS, a 'legibility' factor was added, and the items were reorganized by the factors in the K-PRS. The reliability of the K-PRS has been validated. The scale added "legibility" to the 16 existing PRS items and ten new questions as measurements (Appendix 1) on a 7-point Likert scale (1 = not at all, 7 = very much). "Legibility" refers to the possibilities one perceives in an environment to maintain orientation and to obtain a sense of the surroundings as one proceeds further (Kaplan, R. & Kaplan, 1989). The sum of the scores of 26 questions were adopted as an overall score of the restorative environment, where a higher score indicates a greater perception of the restorative environment (Yoo, 2013).

### 4.2.3 Data analysis

Of a total of 240 submitted surveys, 232 (96.7%) were included for analysis, as eight responses with inconsistent or missing data were excluded. First, frequency analysis and descriptive statistics were used to determine the demographic and use patterns. In addition, the 26 items were verified against the results of the PRS survey through factor and reliability analyses. Additionally, the relationships between use patterns and psychological restorativeness with the property values of the PRS were identified using the *t*-test and analysis of variance.

*Table 2.* Survey items

| Variables | Items | Method |
|---|---|---|
| Demographic characteristics | Sex, age, occupation, residential area | Variables extracted from the research survey |
| Visit characteristics | Visit experience, visit frequency, duration of stay, type and number of companions, | |

| | | |
|---|---|---|
| | activity type, visit purpose | |
| Psychological restorativeness | Being away, fascination, coherence, compatibility, legibility | K-PRS (5 properties, 26 questions) |

# 5. RESULTS

## 5.1 Relationship between user characteristics and psychological restorativeness

### 5.1.1 Demographic characteristics and psychological restorativeness

The ratio of women was greater than that of men (56.9% vs. 43.1%, respectively), while those aged 50–69 years accounted for 56% of the visitors. For the residential area, most visitors were neighbourhood residents, while more than 70% resided in north-eastern Seoul, which included the neighbourhood area of the HEF. The most common occupations of the visitors were housewives (27.2%), followed by office workers and public officials (24.1%) (Table 3).

Regarding the relationship between demographic characteristics and psychological restorativeness, the difference in psychological restorativeness according to sex was statistically significant and that of women was much higher than that of men (132.32 vs. 125.42, respectively, $p < 0.006$). The psychological restorativeness according to occupation, especially for housewives and students, was significant, as that of housewives (137.03) was significantly greater than that of the other groups. Additionally, regarding age, the psychological restorativeness scores of visitors aged >50 years was greater than that of those aged 20–39 years.

*Table 3.* Demographic characteristics and psychological restorativeness

| Variables | | N | % | Psychological restorativeness | *t*-value/*p*-value F-value/*p*-value | post test results |
|---|---|---|---|---|---|---|
| | Total | 232 | 100 | - | - | - |
| Sex | male | 100 | 43.1 | 125.42 | −2.753/0.006** | *t*-test |
| | female | 132 | 56.9 | 132.32 | | |
| Age, years | 20–29 (a) | 35 | 15.1 | 118.43 | 10.528/0.000** | a,b < d,e (Scheffe test) |
| | 30–39 (b) | 36 | 15.5 | 118.86 | | |
| | 40–49 (c) | 31 | 13.4 | 127.94 | | |
| | 50–59 (d) | 58 | 25.0 | 136.64 | | |
| | >60 (e) | 72 | 31.0 | 134.63 | | |
| Resid-ential area | Dongdaemun-gu (neighbourhood) | 61 | 26.3 | 134.38 | 2.021/0.112 | - |
| | North-eastern Seoul | 116 | 50.0 | 127.09 | | |
| | Others in Seoul | 40 | 17.2 | 128.08 | | |
| | Outside of Seoul | 15 | 6.5 | 129.67 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Occu-pation | Employee/public official (a) | 56 | 24.1 | 128.46 | 6.744/ 0.000** | d < e (Sche-ffe test) |
| | Professional (b) | 25 | 10.8 | 127.12 | | |
| | Self-employed/business (c) | 38 | 16.4 | 126.08 | | |
| | Student (d) | 29 | 12.5 | 115.38 | | |
| | Housewife (e) | 63 | 27.2 | 137.03 | | |
| | Unemployed/others (f) | 21 | 9.1 | 136.48 | | |

**$p$< 0.01

As a result of the understanding of the relationship between the attributes of the groups that reached statistical significance through cross-tabulations, most housewives had the highest rates of psychological restorativeness and most were aged 50–59 years (28.8%) or 60–69 years (30.3%) (Figure 2).

Based on the results of this study and demographic characteristics, urban forests play a very important role in the psychological restorativeness of middle-aged women. In an earlier study, "leisure" was identified as a key determinant of happiness and quality of life of middle-aged women (Kim, M. S. & Han, 2006). Thus, this study identified the importance of recreational and leisure activities in nature among middle-aged women.

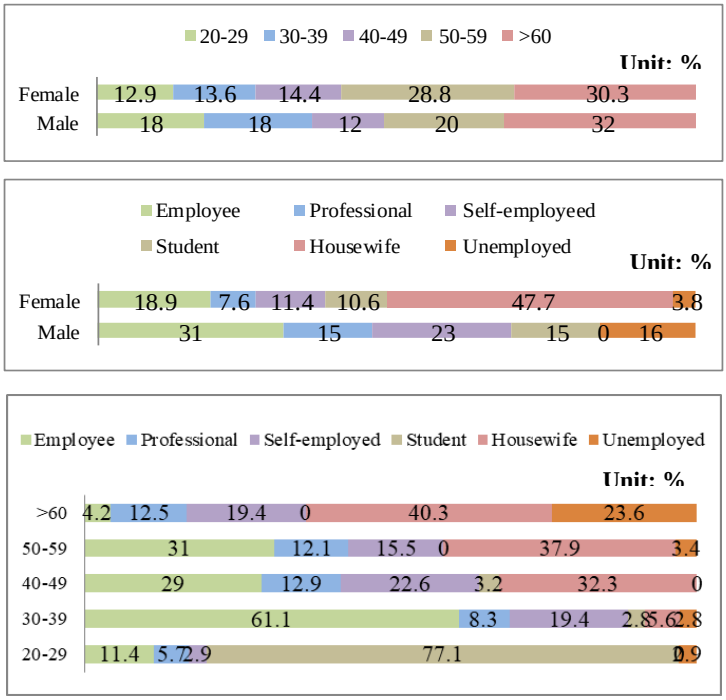


*Figure 2*. Cross analysis of demographic characteristics

### 5.1.2 Use patterns and psychological restorativeness

Regarding use patterns, most of the visitors had previous visit experiences (55.6%) and usually visited once or twice a year (35.8%). The most common purposes for the visit were nature appreciation (34.5%), walking and exercise (28.9%), and relaxation (24.6%). Almost half (47%) of the visitors stayed for 1–2h, followed by 2–3h (24.1%). Additionally, the most frequent visits were mainly by two people (40.9%) with family members or relatives (53.9%) (Table 4). Overall, 2–3 family members visited for hiking, walking, and scenic views for about 2h, so the HEF functions as a typical urban forest in a residential area.

Regarding the relationship with restorativeness, regular visitors were more likely to have a sense of psychological recovery than first-time visitors, which is in line with the findings of an earlier study (Grahn & Stigsdotter, 2003), which reported that stress is lowered with a greater frequency of visits. An earlier study claimed that restoration occurs over vastly different amounts of time (Kaplan, R., Kaplan, & Ryan, 1998). In this study, the extent of psychological restorativeness varied depending on the duration of stay, as visitors who stayed for 3h had the highest mean score (139.61).

*Table 4*. Use patterns and psychological restorativeness

| Variables | | n | % | Psychological restorativeness | *t*-value/*p*-value *F*-value/*p*-value | Post test results |
|---|---|---|---|---|---|---|
| | Total | 232 | 100 | - | - | - |
| Visit experience | Visit | 129 | 55.6 | 133.03 | 3.350/0.001** | *t*-test |
| | Non-visit | 132 | 56.9 | 132.32 | | |
| Visit frequency | None (a) | 103 | 44.4 | 124.73 | 6.234/0.000** | a < b (Scheffe test) |
| | Once a week (b) | 14 | 6.0 | 145.43 | | |
| | Once a month (c) | 45 | 19.4 | 130.53 | | |
| | Once or twice a year (d) | 70 | 30.2 | 132.16 | | |
| Major visit purpose | For appreciating nature | 80 | 34.5 | 131.28 | .853/0.493 | - |
| | For a rest | 57 | 24.6 | 129.75 | | |
| | For a walk or exercise | 67 | 28.9 | 128.94 | | |
| | For the education | 16 | 6.9 | 125.81 | | |
| | For other reason | 12 | 5.2 | 121.50 | | |
| Duration of stay, h | <1 (a) | 45 | 19.4 | 122.58 | 7.479/0.000** | c > a,b (Scheffe test) |
| | 1–2 (b) | 109 | 47.0 | 126.93 | | |
| | 2–3 (c) | 56 | 24.1 | 139.61 | | |
| | 3–4 (d) | 15 | 6.5 | 134.27 | | |
| | >4 (e) | 7 | 3.0 | 117.86 | | |
| Companion type | Family and relatives | 122 | 52.6 | 131.21 | 1.886/0.114 | - |
| | Friends or couple | 62 | 26.7 | 127.95 | | |
| | Alone | 36 | 15.5 | 127.28 | | |
| | Group (club, community) | 10 | 4.3 | 118.50 | | |
| | Other | 2 | 0.9 | 150.00 | | |
| Number of companions | 1 (alone) | 36 | 15.5 | 127.28 | 1.189/0.315 | - |
| | 2 | 90 | 38.8 | 127.43 | | |
| | 3 | 50 | 21.6 | 133.30 | | |
| | >4 | 56 | 24.1 | 130.21 | | |

$^{**}p < 0.01$ $^{*}p < 0.05$

According to Figure 3, the results of cross-tabulations with the variables of visit experience, visit frequency, and duration of stay, which were statistically significant, those who had previously visited had typically visited once or twice a year ($n$ = 70) with the most common duration of 1–2h ($n$ = 64). Regardless of the visit frequency, the duration of stay was similar for 1–2h, but a number of first-time visitors stayed for only >1h ($n$ = 27). Yoo (2013) and Hansmann, Hug, and Seeland (2007) found that a longer stay in urban forests was associated with greater psychological restorativeness because of the greater exposure to scenic nature (Yoo, 2013).

In this study, the longer the duration of stay, the greater the psychological restorativeness, and in particular, a visit of 3h was identified as the optimal retention time. However, it is not easy to generalize from only this forest as an example, thus further in-depth studies are warranted to discern the effect of the duration of stay.

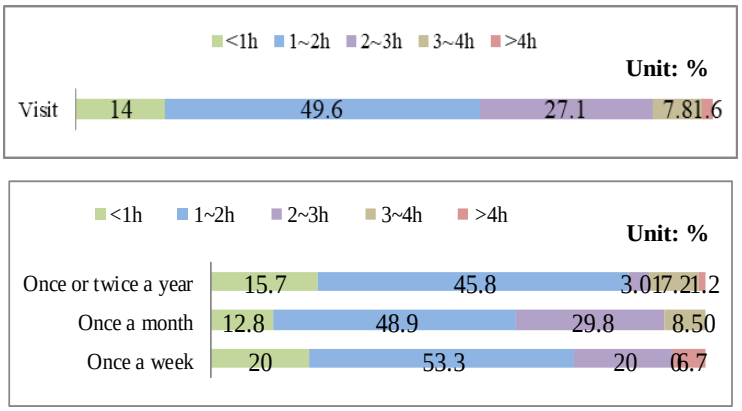


*Figure 3.* Cross analysis of use patterns

## 5.2 Measuring PRS

### 5.2.1 Visitor's psychological restorativeness

To test the validity of the PRS, factor and reliability analyses of each question item were performed. Based on principle component analysis with varimax rotation, the items were divided into five factors (e.g., total cumulative score of the K-PRS = 71.47%). However, three items (#5: Coming here helps me to obtain relief from unwanted demands on my attention; #11: This place is boring; and #13: There is nothing worth looking at here) were deleted because of low reliability. Without these three items, factor analysis was conducted in the same way as with the existing K-PRS. Thus, the same factors were used. To understand the reliability of the PRS as a measurement tool, the items all have a Cronbach-α of >0.7. Thus, the factors included for the PRS of the HEF were being away, fascination, coherence, compatibility, and legibility (Table 5).

*Table 5.* Factor and reliability analyses

| Items | Fascination | Being away | Coherence | Compatibility | Legibility | Communality | Eigen value | Variance explanation (%) | Cronbachα |
|---|---|---|---|---|---|---|---|---|---|
| 7 | 0.794 | 0.134 | 0.008 | 0.186 | 0.204 | 0.725 | 3.653 | 15.884 | 0.886 |
| 8 | 0.762 | 0.202 | 0.111 | 0.177 | 0.084 | 0.673 | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 9 | 0.734 | 0.233 | 0.074 | 0.164 | 0.140 | 0.645 | | | |
| 6 | 0.671 | 0.311 | 0.009 | 0.253 | 0.146 | 0.632 | | | |
| 10 | 0.551 | 0.405 | 0.124 | 0.205 | 0.117 | 0.539 | | | |
| 12 | 0.535 | 0.179 | 0.192 | 0.333 | 0.177 | 0.497 | | | |
| 2 | 0.294 | 0.836 | 0.114 | 0.147 | 0.114 | 0.833 | | | |
| 1 | 0.206 | 0.827 | 0.098 | 0.210 | 0.084 | 0.786 | 3.426 | 14.896 | 0.906 |
| 4 | 0.257 | 0.760 | 0.194 | 0.197 | 0.151 | 0.743 | | | |
| 3 | 0.329 | 0.721 | 0.086 | 0.276 | 0.143 | 0.733 | | | |
| 16 | 0.118 | 0.135 | 0.906 | 0.072 | 0.025 | 0.859 | | | |
| 15 | 0.075 | 0.087 | 0.896 | 0.073 | 0.033 | 0.822 | 3.198 | 13.906 | 0.899 |
| 14 | 0.121 | 0.042 | 0.847 | 0.017 | 0.017 | 0.734 | | | |
| 17 | −0.014 | 0.137 | 0.821 | 0.056 | 0.059 | 0.699 | | | |
| 20 | 0.305 | 0.172 | 0.006 | 0.784 | 0.269 | 0.811 | | | |
| 19 | 0.226 | 0.119 | 0.033 | 0.778 | 0.217 | 0.719 | | | |
| 22 | 0.372 | 0.191 | 0.062 | 0.734 | 0.226 | 0.768 | 3.173 | 13.798 | 0.880 |
| 21 | 0.277 | 0.364 | 0.152 | 0.642 | 0.195 | 0.682 | | | |
| 18 | 0.083 | 0.466 | 0.096 | 0.622 | −0.007 | 0.620 | | | |
| 25 | 0.055 | 0.151 | 0.071 | 0.129 | 0.869 | 0.802 | | | |
| 26 | 0.121 | 0.194 | 0.052 | 0.146 | 0.834 | 0.772 | 2.988 | 12.990 | 0.863 |
| 24 | 0.176 | 0.060 | −0.008 | 0.167 | 0.827 | 0.746 | | | |
| 23 | 0.333 | −0.004 | 0.035 | 0.216 | 0.665 | 0.600 | | | |

Duration of stay had the highest score (6.35), followed by being away (5.97), fascination (5.59), and compatibility (5.47), while legibility (4.81) had a relatively low score (Table 6).

Visitors achieved a sense of psychological restorativeness because the urban environment is a very calm and quiet place upon entering [extent]. Visitors also experienced psychological restorativeness by taking a break from their daily routines and being absorbed in nature [being away]. In addition, the attention of the visitors is drawn to many interesting things, such as admiring the landscape [fascination]. However, the score of "legibility" was low, suggesting that it is necessary to develop suitable facilities and guidance programs.

*Table 6.* K-PRS Mean and SD

| Factor | | Questionnaire | Factor loading | Mean | | SD |
|---|---|---|---|---|---|---|
| Fascination | 7 | My attention is drawn to many interesting things. | 0.794 | 5.41 | 5.59 | 1.457 |
| | 8 | I would like to get to know this place better. | 0.762 | 5.55 | | 1.367 |
| | 9 | There is much to explore and discover here. | 0.734 | 5.52 | | 1.393 |
| | 6 | This place has fascinating qualities. | 0.671 | 5.63 | | 1.289 |
| | 10 | I would like to spend more time looking at the surroundings. | 0.551 | 5.92 | | 1.187 |
| | 12 | The setting is fascinating. | 0.535 | 5.49 | | 1.453 |
| Being away | 2 | Spending time here gives me a good break from my day- | 0.836 | 6.00 | 5.97 | 1.181 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | to-day routine. | | | | |
| | 1 | Being here is an escape experience. | 0.827 | 6.08 | | 1.185 |
| | 4 | Being here helps me to relax my focus on getting things done. | 0.760 | 6.10 | | 1.106 |
| | 3 | It is a place to get away from it all. | 0.721 | 5.70 | | 1.304 |
| | 16 | There is a great deal of distraction. (reverse) | 0.869 | 6.41 | | 0.971 |
| Coherence | 15 | It is a confusing place. (reverse) | 0.834 | 6.34 | 6.35 | 1.081 |
| | 14 | There is too much going on. (reverse) | 0.827 | 6.31 | | 1.120 |
| | 17 | It is chaotic here. (reverse) | 0.665 | 6.34 | | 1.151 |
| | 20 | I have a sense that I belong here. | 0.784 | 5.17 | | 1.475 |
| | 19 | I can do things I like here. | 0.778 | 5.16 | | 1.569 |
| Compatibility | 22 | I have a sense of oneness with this setting. | 0.734 | 5.46 | 5.47 | 1.410 |
| | 21 | I could find ways to enjoy myself in a place like this. | 0.642 | 5.82 | | 1.198 |
| | 18 | Being here suits my personality. | 0.622 | 5.73 | | 1.408 |
| | 25 | It is easy to find my way around here. | 0.869 | 4.83 | | 1.771 |
| | 26 | It is easy to see how things are organized. | 0.834 | 5.05 | | 1.570 |
| Legibility | | | | | 4.81 | |
| | 24 | I could easily form a mental map of this place. | 0.827 | 4.49 | | 1.814 |
| | 23 | There are landmarks to help me get around. | 0.665 | 4.86 | | 1.631 |

### 5.2.2 Psychological restorativeness depending on visit frequency and duration of stay

Depending on the visit frequency, regular visitors achieved greater psychological restorativeness than the first-time visitors (Table 7). The four factors of the PRS (i.e., fascination, being away, compatibility, and legibility) showed distinction. The greater the visit frequency, the more easily the visitor appreciated the space [legibility]. Additionally, regular visitors gave high marks to the "fascination" factor, suggesting that the greater the visit frequency, the more visitors wish to explore and discover nature. The visitors continue to visit because it is well-matched between what an individual wants to do and what the environment provides (Hartig et al., 1997) [compatibility]. It is understood that psychological restorativeness increases in the process of feeling the attraction of nature and satisfying one's desire to explore the forest. Urban forests are relatively accessible, as compared to therapy forests, which are located outside of cities in Korea. To enhance the effectiveness of urban forests as restorative environments, it is

necessary to continue providing visitor opportunities through the development of programs that encourage regular visits.

*Table 7.* Psychological restorativeness based on visit frequency

| Variables | Visit frequency | Mean | SD | *F*-value/*p*-value | Post test results |
|---|---|---|---|---|---|
| Fascination | None (a) | 31.94 | 6.176 | 4.191/0.007** | a < b (Scheffe test) |
| | Once a week (b) | 37.27 | 4.682 | | |
| | Once a month (c) | 33.85 | 6.450 | | |
| | Once or twice (d) | 34.29 | 6.273 | | |
| Being away | None (a) | 23.14 | 4.121 | 2.812/0.040* | - |
| | Once a week (b) | 26.27 | 2.890 | | |
| | Once a month (c) | 23.77 | 4.488 | | |
| | Once or twice (d) | 24.28 | 4.235 | | |
| Coherence | None (a) | 24.97 | 4.241 | 1.047/0.372 | - |
| | Once a week (b) | 26.27 | 1.870 | | |
| | Once a month (c) | 25.15 | 4.433 | | |
| | Once or twice (d) | 25.82 | 3.089 | | |
| Compatibility | None (a) | 25.94 | 5.993 | 3.644/0.013* | a < b (Scheffe test) |
| | Once a week (b) | 30.47 | 5.027 | | |
| | Once a month (c) | 27.74 | 6.099 | | |
| | Once or twice (d) | 27.99 | 5.336 | | |
| Legibility | None (a) | 17.55 | 5.784 | 8.053/0.000** | a < b > c,d (Scheffe test) |
| | Once a week (b) | 23.80 | 5.348 | | |
| | Once a month (c) | 21.11 | 5.134 | | |
| | Once or twice (d) | 19.11 | 5.356 | | |

**p < 0.01 *p < 0.05

Next, the study found that psychological restorativeness differed with the duration of stay. In the case of urban forests, a duration of stay of 3h was the most appropriate time for visitors to enjoy various activities and to appreciate the fascination of the forest. In particular, there were differences in the factors of fascination, being away, and compatibility (Table 8). The duration of stay factor had an immediate effect due to the contrast in environmental change, fascination, being away, and compatibility. Together, these factors were associated with an increased restorative effect through activities in the forest. An optimal activity time in consideration of the restorative effect is very important in the planning of urban forests; thus, further research is needed to validate these results.

*Table 8.* Psychological restorativeness according to duration of stay

| Variables | Duration of stay, h | Mean | SD | *F*-value/*p*-value | Post test results |
|---|---|---|---|---|---|
| Fascination | <1 (a) | 31.47 | 6.309 | 6.730/0.000** | c < a,b,e (Scheffe test) |
| | 1–2 (b) | 32.90 | 6.175 | | |
| | 2–3 (c) | 36.71 | 5.228 | | |
| | 3–4 (d) | 34.40 | 5.124 | | |
| | >4 (e) | 28.71 | 9.069 | | |
| Being away | <1 (a) | 22.40 | 4.484 | 5.340/0.000** | c > a,b (Scheffe test) |
| | 1–2 (b) | 23.39 | 4.517 | | |
| | 2–3 (c) | 25.73 | 2.825 | | |
| | 3–4 (d) | 25.33 | 3.200 | | |
| | >4 (e) | 23.00 | 4.000 | | |
| Coherence | <1 (a) | 24.13 | 3.859 | 2.382/0.052 | - |
| | 1–2 (b) | 25.32 | 3.649 | | |
| | 2–3 (c) | 26.14 | 4.078 | | |
| | 3–4 (d) | 26.00 | 3.566 | | |
| | >4 (e) | 27.29 | 1.113 | | |
| Compatibility | <1 (a) | 26.11 | 4.955 | 8.589/0.000** | c > a,b,d,e (Scheffe test) |
| | 1–2 (b) | 26.53 | 5.923 | | |
| | 2–3 (c) | 30.25 | 4.333 | | |
| | 3–4 (d) | 29.27 | 5.120 | | |
| | >4 (e) | 20.14 | 9.547 | | |
| Legibility | <1 (a) | 18.47 | 5.337 | 1.396/0.236 | - |
| | 1–2 (b) | 18.79 | 5.777 | | |
| | 2–3 (c) | 20.77 | 5.853 | | |
| | 3–4 (d) | 19.27 | 5.663 | | |
| | >4 (e) | 18.71 | 5.707 | | |

**$p < 0.01$ *$p < 0.05$

## 6. DISCUSSION

The aim of this empirical study of the HEF was to determine how urban forests in residential areas are being used as restorative environments. It also identified differences in psychological restorativeness based on the visitors' characteristics.

Extent of stay received the highest score (6.35), followed by being away (5.97), fascination (5.59), and compatibility (5.47), while that of legibility (4.81) was relatively low. In relation to the extent of stay, visitors reported that the greatest psychological restorativeness was due to the very calm and quiet space of the HEF, even though the forest is located in the middle of the city with adjoining roads. However, regarding "legibility," visitors reported psychological fatigue because of the difficulty in navigating the HEF.

The differences in psychological restorativeness according to sex, age, visit frequency, and duration of stay were statistically significant. In particular, the psychological restorativeness for housewives and the elderly

was greater than that of men, and with a regular frequency of visitation of 1–2 times per year, with a duration of stay of about 3h.

The HEF is a restorative environment in a residential area that offers an important therapeutic space, especially for housewives (Lee, H. J. et al., 2019). Middle-aged women reported stress associated with the negative social perception that full-time housewives are worthless and unprofessional. Additionally, the menopausal symptoms of loss, conflict, and crisis start to occur, which can influence physical and psychological changes (Stewart & Ostrove, 1998). To overcome these negative attributes, the female responders reported a desire to engage in activities to improve health and happiness with the goals of time management and personal growth. In the case of Koreans, they continued to participate in the Forest Experience Program to meet their needs (Kim, B. S., Kim, & Lee, 2013).

Additionally, regular visitation was correlated with a better therapeutic effect. Also, continuous visits to urban green spaces can reduce the frequency of negative emotions and increase the opportunity for positive emotions, leading to a feeling of happiness in daily life (Hong et al., 2019). As restorative environments, urban forests should provide opportunities for continuous visits by developing regular programs and attractive contents. Furthermore, in earlier studies, “being away” was identified as the most important factor prompting visits to the HEF. However, the factors of extent of stay, fascination, and compatibility also received high scores. These restorative characteristics of urban forests are generally different from those of typical forests.

The results showed that a stay of 3h was the most suitable amount of time to experience the fascination of the forest and take a break from daily life, which was one of the most significant results of this study, in accordance with the results of the earlier studies that a longer duration of stay is associated with superior psychological restorativeness (Yoo, 2013). To maximize psychological restorativeness, it is necessary to develop 3h trails and to diversify programs. However, further research is needed to objectively support a suitable duration of stay.

In the midst of social demand for the restorative environments of urban forests that are accessible and available during everyday life, this study is significant in that it examined the effectiveness of urban forests as restorative environments and presented empirical directions from the visitor’s perspective for the planning of urban therapeutic spaces. However, there is a limit to generalizing the psychological restorativeness of urban forests with just the HEF as an example, thus future research is warranted to comparatively analyse various spaces.

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## APPENDIX: K-PRS

| Factor | | Questionnaire |
|---|---|---|
| Being away | 1 | Being here is an escape experience. |
| | 2 | Spending time here gives me a break from my day-to-day routine. |
| | 3 | It is a place to get away from it all. |
| | 4 | Being here helps me to relax my focus on getting things done. |
| | 5 | Coming here helps me to get relief from unwanted demands on my attention. |
| Fascination | 6 | This place has fascinating qualities. |
| | 7 | My attention is drawn to many interesting things. |
| | 8 | I want to get to know this place better. |
| | 9 | There is too much to explore and discover here. |
| | 10 | I want to spend more time looking at the surroundings. |
| | 11 | This place is boring. (reverse) |
| | 12 | The setting is fascinating. |
| Coherence | 13 | There is nothing worth looking at here. (reverse) |
| | 14 | There is too much going on. (reverse) |
| | 15 | It is a confusing place. (reverse) |
| | 16 | There is a great deal of distraction. (reverse) |
| | 17 | It is chaotic here. (reverse) |
| Compatibility | 18 | Being here suits my personality. |
| | 19 | I can do things I like here. |
| | 20 | I have a sense that I belong here. |
| | 21 | I can find ways to enjoy myself here. |
| | 22 | I have a sense of oneness with this setting. |
| Legibility | 23 | There are landmarks to help me get around. |
| | 24 | I could easily form a mental map of this place. |
| | 25 | It is easy to find my way around here. |
| | 26 | It is easy to see how things are organized. |