

Small Public Urban Green Spaces for Mental Restoration

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Small public urban green space (SPUGS) was defined as urban public spaces which did not exceeding 5,000 m² in size with vegetation and their own entrance. Exposure to SPUGS has been demonstrated to have mental benefits for older adults. However, studies on identifying the objective environmental features of SPUGS and their effects on mental restoration for older adults remain limited. The research results showed that: (1) Both the green view index, and the boundary enclosure had a strong impact on the mental restoration of older adults; (2) The colorfulness index showed the strongest relationship with the vitalizing effect. (3) Sky view factor and, number of seats only influenced the ROS score, while the results of revitalization suggest that large areas of water should be avoided. (4) Physiological Equivalent Temperature (PET) was also confirmed to have negative effects on the psychological health of seniors in autumn.

Keywords: small public urban green spaces (SPUGS) ; mental restoration ; environmental features ; thermal comfort ; older adults

1. Background

Higher exposure to urban green spaces (UGS) is associated with longevity ^[1], the enhancement of physical activity ^{[2][3][4]}, social connection ^[5], and the relief of stress-related illnesses such as depression ^{[6][7]} in older adults, especially if they are situated close to their homes ^[8]. Most existing studies have focused on larger green spaces (e.g., city parks, riverside green spaces, and forests); however, smaller UGS in high-density areas have recently received more attention ^{[9][10][11]}. Karin Peschardt et al. ^[12] defined small public urban green spaces (SPUGS) as public spaces not exceeding 5000 m² in size with some vegetation and their own entrance. Studies have reported on the vital role of SPUGS in promoting residents' mental and physical health ^[13]. Based on the Attention Restoration Theory (ART) ^[14] and the Stress Reduction Theory (SRT) ^[15], SPUGS is primarily used for "socializing"—the act of meeting for social purposes—and "rest and restitution"—the process of restoration from mental fatigue ^{[12][16]}. However, research on SPUGS is still too limited to be translated into concrete design strategies that are appropriate for older adults' own unique physiological characteristics. Moreover, most studies have been conducted in Western contexts ^[17].

Tokyo's efficient UGS system makes it livable and accessible for its high-density aged population; therefore, the way in which the SPUGS environmental features influence older adults differs from its effects in a Western context. What can and should be done by landscape designers so that SPUGS meet the requirements of and improve older adults's mental health? Which of the environmental features of SPUGS have an impact on the older adults' mental restoration outcomes? What is the impact of each related variables? These questions require immediate attention, particularly in high-density Asian countries.

2. Environmental Features in SPUGS

Studies have attempted to identify the specific objective variables of UGS that influence the psychological improvement of older adults. The accessibility of SPUGS has been a critical issue ^[18]. The distance from one's home to the green space in the neighborhood is related to the psychological stress recovery benefits for the older adults, especially those from a low socioeconomics class ^{[19][20]}. Euclidean distance and self-reported walk time have been commonly applied in studies ^{[21][22]}. Natural features attract people to outdoor activities and thus, promote their psychological well-being. Nordh and Ostby ^[16] found that natural components such as "a lot of grass/plants" and "water features" in small urban parks can promote opportunities for restorative experiences. Research on the plantings in UGS has been divided into three layers: "ground cover," "eye-level green," and "tree canopies" ^{[13][23]}.

Furthermore, the restorative benefits of "green ground cover" and "eye-level greenness" in pocket parks have been confirmed to be the opposite of those of large UGS for mental promotion ^[13]. The "green view index", an indicator of eye-

level visibility of green vegetation [24][25], could represent the actual feelings of green space users in environmental research and public health studies [26][27]. The spatial form design of UGS may influence how participants perceive and interact with the space and, thus, may affect their mental health [28][29].

Chen et al. [30] observed that spatial transparency and spatial enclosure were significantly correlated with older people's moods in poor-quality residential areas. The width of the adjacent street and the average height of surrounding buildings in small-scale street corner spaces also impact the frequency of seniors' communication behavior, thus affecting their mental well-being [31]. Meanwhile, Chen and Zhang [32] demonstrated that a space's layout, aesthetic, and recreational services influenced study participants' appraisals of their pleasure, arousal, and control.

The Environmental Assessment of Public Recreation Spaces tool (EAPRS) [33] and the Neighborhood Green Space Tool (NGST) [11] have been used in various studies. Both of them emphasized the importance of the quality of UGS facilities (e.g., paved and unpaved trails, tables, benches, cafés, playgrounds). In relation to microclimate features, thermal comfort has been observed to be significantly correlated with psychological restoration outcomes using physiological equivalent temperature (PET) and predicted mean vote (PMV) [34][35] in roadside and forest scenes. However, with the degeneration of thermal sensation in older adults [36], the mental restoration of objective environmental features can vary with age, resulting in the restoration benefits having different effects. Moreover, most of the research perspectives have been relatively singular. How to systematically present the effect of the different dimension features in SPUGS on the mental restoration benefits of older adults remains a problem that needs to be solved.

3. Mental Restoration of Older Adults

Experimental evidence shows that visiting or seeing natural elements alleviates attentional fatigue and emotional stress [37][38][39][40]. The Restoration Outcome Scale (ROS) can be widely used to investigate restorative emotional and cognitive outcomes in a given environment [34][41][42]. ROS is confirmed to be reliable in evaluating the participant's relaxation, attention, and calmness when exposed to nature and green spaces [40]. With regard to mental responses in SPUGS, the self-reported vitality restoration score was considered to be the result of contact with nature in parallel with the ROS. Subjective vitality is related to mental status [43][44][45].

In contrast to low energy states (e.g., relaxation), it reflects high energy states (aliveness, energy available for self) and is positively related to mental [44] and physical health [46]. Subjective vitality enables older adults to maintain a physically and socially active life, which can delay physical and cognitive decline associated with aging [47]. Several studies conducted in different countries and locations have reported that the presence of outdoors or natural environments provides better vitality experiences [42][1]. Based on these studies, it seems that SPUGS have the potential to be areas for subjective vitality recovery.

4. Research Conclusions

- Participants aged over 70 were more likely to gain revitalization benefits from the SPUGS. When the older adults remained in the SPUGS for more than 30 minutes, the ROS and self-reported vitality restoration scores increased significantly. Companionship was found to exert an influence on the psychological benefits gained during visits to the parks, which supports previous studies;
 - The sky view factor strongly affected the older adults' restorative effects. The boundary enclosure and green view index have a significant impact, which suggests that shrubs and trees should be combined to provide older adults with a greater sense of enclosure and security, as well as offering a more appropriate level of greenness. The green view index should be about 0.4. Spaces with a proper number of seats are more inclined to provide psychological recovery benefits;
 - The vitalizing effects were significantly affected by the colorfulness index, green vision rate, water features, road paving, boundary enclosure, and aspect ratio. Older adults can benefit from vitality recovery when visiting SPUGS through the perception of aesthetic and space edge protection. In addition, water features should be avoided in SPUGS;
 - PET was confirmed to have negative, direct effects on the restorative benefits of older adults within the range of 5°C-20°C. The relationship was more prominent in older respondents with a PET of more than 16°C.
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