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EFFECTS OF EVERGREEN TREES ON MENTAL RESTORATIVE QUALITY OF WINTER LANDSCAPES

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Highlights:

- mental restorative quality of winter landscapes with adding evergreen trees was evaluated;
- planting site of evergreen trees has a crucial impact on mental restoration;
- broad-leaved evergreen trees are the best in terms of mental restoration;
- moderate proportion of evergreen trees is the best for the landscape with water.

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Abstract. Compared with other seasons, winter usually has low mental restorative quality due to the lack of greenness. Reasonably adding evergreen trees to winter landscapes can improve the quality. However, what proportion, species and planting site of evergreen trees are better for mental restoration? To address this question, two original pictures (describing two landscape types) and 24 manipulated pictures (including three categories and four grades of proportion of evergreen trees) were collected, and 381 respondents were employed to score the mental restorative quality of each picture. The results revealed that planting evergreen trees in the landscape with water was more efficient in promoting mental restoration than planting them in the landscape without water. Adding broad-leaved evergreen trees was much better than adding coniferous trees and the mixture of the two. And, for the landscape with water, moderate proportion of evergreen trees possessed significantly higher mental restoration than low or high proportion.

Keywords: mental restoration, evergreen tree, landscape type, tree species, winter landscape.

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1. Introduction

A healthy city is a city that continuously creates and improves the physical and social environments through urban design or health policies until residents' health reaches a satisfactory level (Hancock & Duhl, 1986). Urban green spaces have been considered as one of the key environmental factors for a healthy city, which directly contributed to improve people's health physically and psychologically (e.g., Gascon et al., 2017; Picavet et al., 2016; Jiang et al., 2014) and(or) indirectly through alleviating numerous environmental issues with adverse effects on health, including urban heat islands (Bowler et al., 2010), air and noise pollution (Hartig et al., 2014), loss of biodiversity (Cornelis & Hermy, 2004) and urban waterlogging (Zhang et al., 2021; Lovell & Taylor, 2013). Urban green spaces are primarily covered by vegetation (Haq, 2011), in which each plant species has its own growth rhythm adapting to the climate and other environmental conditions at a site. Therefore, in temperate regions, seasonality is a typical feature of urban green spaces (Xu et al., 2022), which strongly influences their visual appearances (Wang & Zhao, 2020). Accordingly the mental restorative quality of the landscape should change with seasons (Paddle & Gilliland, 2016; Sonntag-Öström et al., 2015; Winthorst et al., 2020) due to the fact that people mainly perceive the restorative quality through vision (Park et al., 2011; Xu et al., 2018; Wang et al., 2019). Usually, a landscape has lower mental restorative quality in winter than in other seasons (Paddle & Gilliland, 2016; Wang & Zhao, 2020) because winter is often described as a leafless season and low productivity which can causes stress (Kaplan, 1995).

Seasonal Affective Disorder (SAD) is characterized by the annual recurrence of depressive episodes in winter followed by remission of depressive symptoms in other seasons (Praschak-Rieder & Willeit, 2003). Although the rigorous diagnostic studies reveal the prevalence rates of SAD of 0.4% in the United States (Blazer et al., 1998) and 1.7% to 2.9% in Canada (Levitt et al., 2000; Levitt & Boyle, 2002), epidemiological studies report the prevalence rates

as high as 10% (Magnusson & Partonen, 2005) due to the fact that undiagnosed cases are widespread in communities (Thompson et al., 2004), which makes it a significant health problem. Generally, the prevalence of SAD is higher in high latitudes (Levitan, 2007), but it is also widespread in mid-latitude areas (Sha et al., 2022). For example, although the prevalence rate of SAD across China is not yet clear, a case study showed that the incidence rate of SAD among female college students was 28.61% (Xu et al., 2020). Some experts believe that the shortage of daylight exposure is one of the reasons of SAD (Anderson et al., 2016). Mental health, however, can also be achieved by surrounding environments, including forests (Takayama et al., 2014), waterscapes (Nutsford et al., 2016), soundscapes (Medvedev et al., 2015), and animals (Zhao & Gong, 2022). A recent study concluded that, in winter, the presence of vegetated landscape was better than the brightness treatment for improving mental fatigue recovery (Hidalgo, 2021).

Numerous studies have evidenced that green spaces could benefit to promote mental health (e.g., Wang et al., 2018, 2019; Zhao et al., 2018; Du et al., 2021; Zhu et al., 2021). Vegetation, the important component of green spaces, has undergone extensive research in terms of the psychological restoration and mental health, but winter vegetation in urban settings has not been understood well in existing literature (Hidalgo, 2021). Winter vegetation possibly fall their leaves and fade green in temperate regions, which may be one of reasons for the low mental restorative quality in winter. Although Wang and Zhao (2020) indicated that greenness provided by evergreen trees was a promoter of mental restoration in winter, the authors also suggested that not all species of evergreen trees could have restorative potential. In summary, existing literature has not reached an agreement on the relationship between evergreen trees and mental restoration in winter, which creates a dilemma for designers and managers. In addition, the fine-scaled understanding of this issue, such as the species, species' mixture, proportion and planting site of evergreen trees in relation to mental restoration in winter, is so limited that we can not provide any clues to guide winter landscape design. To address these research gaps, this study aims to answer the following three questions and contribute to physical and psychological improvement of people's health.

(1) Can adding evergreen trees enhance the mental restorative quality of winter landscapes?

(2) Is the mental restorative quality of evergreen trees related to the planting sites (landscape types)?

(3) How do the categories and proportions of evergreen trees influence the mental restorative quality?

2. Materials and methods

2.1. Study area and photographic images

Xuzhou is a medium-sized city in eastern China with a temperate monsoon climate and distinct seasonal variations. It is cold in winter, and winter landscape is generally lacking in greenness due to the fact that local natural vegetation is deciduous broad-leaved plants. Two pictures taken in winter in Xuzhou were selected as the original pictures which described the common winter scenes of urban green spaces (Figure 1). The first picture presented the combination of vegetated landscape and waterscape with a moderate open space (called "landscape with water"), and in close range, the vegetation was all deciduous trees, with some evergreen trees in the distant view. The second picture presented the pure vegetated landscape with an open space (called "landscape without water"), and in close range, a withered yellow lawn dominated the landscape, while the mid shot featured a mixture of deciduous trees and some evergreen trees. There was no snow view in the two pictures because snow is rare in Xuzhou due to the fact that winter is the dry season, and it is not very cold, causing the snow to melt quickly (Xu et al., 2022).

Based on the two original pictures, three categories of evergreen trees (broad-leaved trees (represented by Privet tree (*Ligustrum lucidum*)), coniferous trees (represented by Cedar tree (*Cedrus deodara*)) and the mixture of Cedar and Privet trees), and four grades of proportion of evergreen trees (30%, 50%, 70% and 90%) were applied for each original picture using the photomontage simulation (Figure 1). This method has been evidenced to be reliable, and widely used in previous works (e.g., Paddle & Gilliland, 2016; Wang & Zhao, 2020; Zhao & Gong, 2022). The proportion of evergreen trees was calculated by dividing the area of evergreen trees by the area of all wood plants in the picture. Cedar and Privet are the two most popularly used species of evergreen trees in urban green spaces in Xuzhou, because they can adapt to the local environments and grow well. In total, 2 (landscape types) × 3 (Categories of evergreen trees) × 4 (grades of proportion of evergreen trees) + 2 (original pictures) = 26 images were collected. These images served as stimuli to evaluate their quality for mental restoration. Despite the fact that pictures can only convey visual information, thus are not fully reflecting the real landscape (Palmer & Hoffman, 2001), compared with the survey on situ, pictures have the advantages of fast progression, low cost (Zhao et al., 2013) and easy to compare multiple landscapes (Mashizi & Sharafatmandrad, 2023). Therefore, the method of using pictures as stimuli has been widely used in experience-based assessments (Nordh et al., 2009; Paddle & Gilliland, 2016; Xu et al., 2018, 2022; Mashizi & Sharafatmandrad, 2023).

Due to the fact that there were different areas of wood plants between the two original pictures, the same proportion of evergreen trees between the two pictures had different green view indexes which was defined as the area covered by greenery divided by the area of a picture (excluding the sky) (Yang et al., 2009). The green view index of each grade of proportion of evergreen trees for two landscape types was calculated (Table 1).

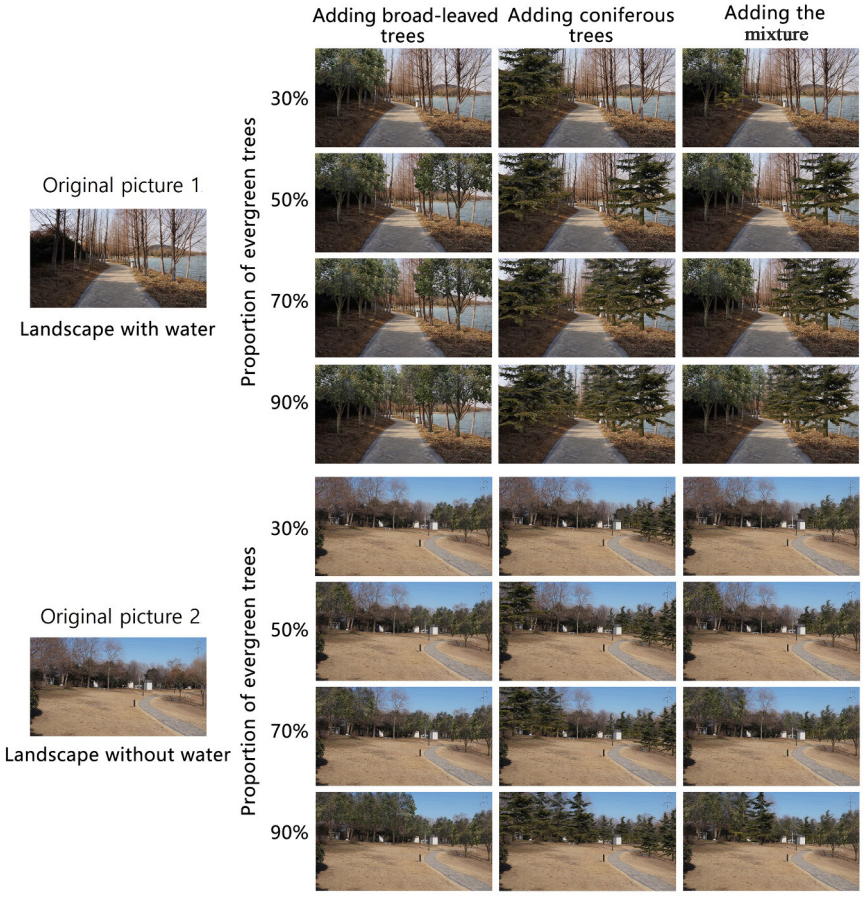

Figure 1. Original pictures and the images produced by photomontage technology

Table 1. Conversion between proportion of evergreen trees and green view index

Proportion of evergreen trees	Green view index	
	Landscape with water	Landscape without water
30%	16.4%	13.6%
50%	27.3%	22.7%
70%	38.3%	31.7%
90%	49.2%	40.8%

2.2. Mental restorative quality assessment

2.2.1. Measurement scale

The Short-version Revised Restoration Scale (SRRS) developed by Han (2003) consists of four dimensions, and each dimension contains two items. SRRS has been widely used to measure the mental restorative quality across various landscape types (Paddle & Gilliland, 2016; Xu et al., 2018; Memari et al., 2017) due to its simplicity and reliability. However, Zhao and Gong (2022) indicated that the two items in each dimension were similar in meaning, and the evaluations of the two items were usually interlocked, thus, the two items could be combined into one item, further simplifying SRRS. The authors named the new SRRS as revised SRRS. This study used the revised SRRS to measure the mental restorative quality of winter landscapes. Respondents were asked to imagine that they were in the scene presented by an image and select a scale for each item according to their perception on a 5-point scale (Table 2). All items of revised SRRS were accurately translated into Chinese because all respondents came from China, and they were proficient in Chinese.

Table 2. Revised Short-version Revised Restoration Scale

Dimension	Item	Scores
Emotional	How do you describe your emotions when viewing the image?	Very depressed = 1; depressed = 2; average = 3; good natured = 4; very good natured = 5
Psychological	How do you describe your psychological response when viewing the image?	Very nervous = 1; nervous = 2; average = 3; relaxed = 4; very relaxed = 5
Cognitive	Are you interested in the scene presented by the image?	Not at all = 1; poor = 2; fair = 3; interested = 4; very interested = 5
Behavioral	Would you like to visit the scene presented by the image?	Not at all = 1; poor = 2; average = 3; much = 4; very much = 5

2.2.2. Survey procedure and respondents

Palmer (1990) revealed that respondents preferred significantly summer scenes over autumn scenes when the evaluation was conducted in spring, but when evaluating in summer, the preference ratings did not differ. Therefore, the evaluation period can influence the respondents' perception of the landscape. To avoid the bias caused by the evaluation period, the mental restorative quality of 26 images was surveyed in December 2022 which was in line with the season of the scenes in the images. During December 2022, COVID-19 pandemic was fast spreading in China because Chinese government untied its strict epidemic control policies at the beginning of December. To protect respondents from infection, online surveys were conducted to collect the data. The 26 images were randomly divided into six groups in which 1–4 groups included four images, and the 5th and 6th group included five images to avoid the possible fatigue of respondents. The six groups of images were made into six questionnaires which were initiated by six postgraduate students from China University of Mining and Technology, respectively. The questionnaires were released through WeChat, a very popular social app in China, and participants were encouraged to share them with their friends. The six initiators and participants were told not to send the questionnaires to the persons under 18 years old. Finally, a total of 381 respondents participated in these surveys, in which 367 respondents were valid. The valid response rate was 96.3%. Invalid questionnaires included that all images were given the exactly same score for all items. The invalid questionnaires were excluded from further analysis. The demographic variables of valid respondents are presented in Table 3.

Generally, there were more females than males among the respondents, and young people (18–35 years old) with higher education (college or higher) dominated the respondents, which could be possibly explained by two facts. One, the six postgraduate students who initiated the online surveys are young people (22–28 years old), and their friends are more likely to be similar to them in age and education level. Two, middle-aged and older people are less to use WeChat than young men. They have a lower chance to be involved in the surveys.

2.3. Data analysis

The average value of four items listed in the revised SRRS of each respondent was calculated for each image, and the median of data was used as the mental restorative quality of an image. Followed by Shapiro Wilk's and Levene's test, the data of mental restorative quality conformed to the normal distribution ($W = 0.944$; $p = 0.165 > 0.05$), and also passed the homogeneity of variance test ($L = 0.312$; $p = 0.541 > 0.05$). Therefore, Mann–Whitney U-test and Kruskal-Wallis H-test were conducted to examine the significance of the effects of landscape types, and categories and proportions of evergreen trees on mental restorative quality of winter landscapes. The stepwise multiple linear regression analysis was employed to explore the relationships between mental restoration scores and landscape type, category of evergreen trees, proportion of evergreen trees and green view index.

3. Results

3.1. Reliability

The internal reliabilities of mental restoration scores of six groups of images were calculated. Cronbach's alpha was 0.899, 0.898, 0.879, 0.840, 0.932, and 0.947 for the six groups, respectively. The results revealed very good internal reliabilities of mental restorative evaluations for all groups according to the criteria built by Landis and Koch (1977).

3.2. Overall evaluations on mental restorative quality

The medians of mental restoration scores of 26 images are presented in Figure 2. The results showed that, for the

Table 3. Demographic statistics of respondents

Questionnaires		First	Second	Third	Fourth	Fifth	Sixth	Total respondents
Respondents		63	95	50	63	45	65	381
Valid respondents (%)		61 (96.8%)	91 (95.8%)	47 (94.0%)	61 (96.8%)	44 (97.8%)	63 (96.9%)	367 (96.3%)
Gender	Male (%)	29 (47.5%)	39 (42.9%)	16 (34.0%)	27 (44.3%)	13 (29.5%)	24 (38.1%)	148 (40.3%)
	Female (%)	32 (52.5%)	52 (57.1%)	31 (66.0%)	34 (55.7%)	31 (70.5%)	39 (61.9%)	219 (59.7%)
Age	<18 (%)	0 (0.0%)	3 (3.3%)	1 (2.1%)	2 (3.3%)	0 (0.0%)	4 (6.3%)	10 (2.7%)
	18–35 (%)	59 (96.7%)	54 (59.3%)	46 (97.9%)	58 (95.1%)	31 (70.5%)	41 (65.1%)	289 (78.7%)
	36–60 (%)	2 (3.3%)	31 (34.1%)	0 (0.0%)	1 (1.6%)	9 (20.4%)	16 (25.4%)	59 (16.1%)
	>60 (%)	0 (0.0%)	3 (3.3%)	0 (0.0%)	0 (0.0%)	4 (9.1%)	2 (3.2%)	9 (2.5%)
Education	High school or lower (%)	1 (1.6%)	30 (33.0%)	2 (4.3%)	1 (1.6%)	7 (15.9%)	19 (30.2%)	60 (16.4%)
	College (%)	57 (93.5%)	54 (59.3%)	27 (57.4%)	37 (60.7%)	32 (72.7%)	29 (46.0%)	236 (64.3%)
	Postgraduate (%)	3 (4.9%)	7 (7.7%)	18 (38.3%)	23 (37.7%)	5 (11.4%)	15 (23.8%)	71 (19.3%)

landscape with water, 70% and 90% coniferous trees, and 90% the mixture did not improve the restorative quality, while the other treatments enhanced the mental restorative quality of winter landscapes. For the landscape without water, 30% broad-leaved trees, 30% and 50% coniferous trees, and 70% and 90% the mixture did not improve the restorative quality, while the other treatments enhanced the mental restorative quality. The median of restoration score (3.5) of the landscape with water was higher than the median (3.0) of the landscape without water. Mann–Whitney U-test showed that there were significant differences in mental restorative quality between the landscape with and without water (U = 237280.000; Z = −7.827; p < 0.001). The addition of evergreen trees resulted in an increase in mental restoration scores, with a median of 0.50 for the landscape with water, and 0.25 for landscape without water. This was calculated by subtracting the restoration score of an original image from the median of restoration score of corresponding images with evergreen trees added.

3.3. Effects of proportions of evergreen trees on mental restorative quality of winter landscapes

The medians of mental restoration scores of four grades of proportion of evergreen trees across two landscape types are presented in Figure 3, which showed that, for the landscape with water, 50% and 70% evergreen trees possessed the highest mental restorative quality, and 90% possessed the lowest; for the landscape without water, 50%, 70% and 90% evergreen trees was equal in terms of mental restorative quality, higher than 30%. Mann–Whitney U-test revealed that adding evergreen trees significantly improved the mental restorative quality of winter landscape with water (U = 4321.500; Z = −2.040; p = 0.041), but not significantly improved the mental restorative quality of winter landscape without water (U = 14958.000; Z = −0.772; p = 0.440).

3.4. Effects of evergreen categories on mental restorative quality of winter landscapes

The medians of mental restoration scores of three evergreen categories across two landscape types are presented in Figure 4. Regardless of landscape types, compared with coniferous trees and the mixture, adding broad-leaved trees was the most effective way for enhancing the mental restorative quality in winter. Kruskal-Wallis H-test revealed that there were significant differences in mental restorative quality among three evergreen categories for both the landscape with water (H = 7.962; p = 0.019) and the landscape without water (H = 7.031; p = 0.030), suggesting that category of evergreen trees was a critical factor for the improvement of the mental restorative quality in winter.

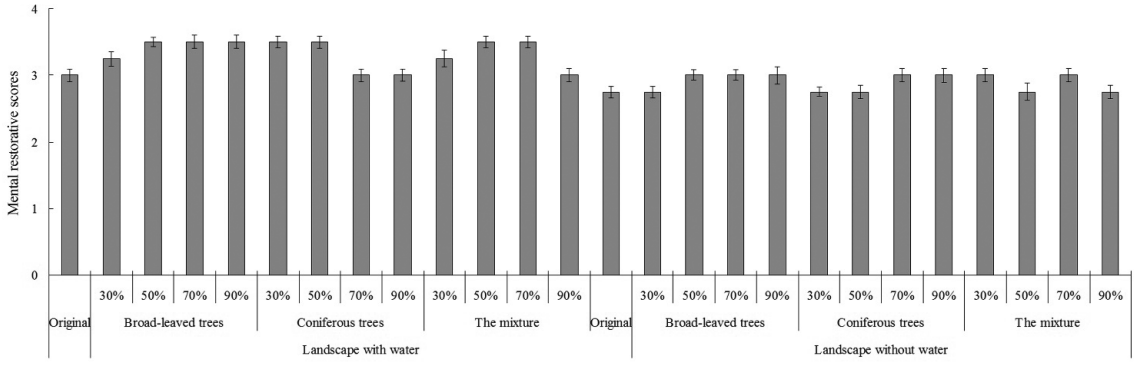

Figure 2. Medians of mental restoration (± standard error) within respondents of 26 images

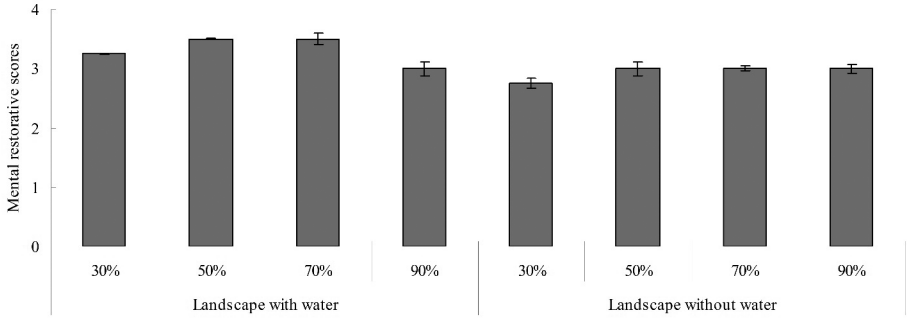

Figure 3. Median of mental restoration (± standard error) of four grades of proportion of evergreen trees across two landscape types

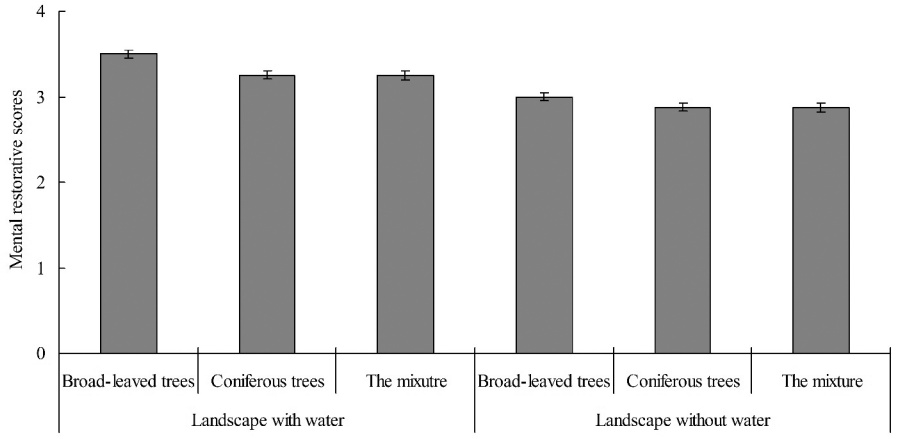

Figure 4. Medians of mental restoration (± standard error) of three evergreen categories across two landscape types

3.5. Driving force of landscape types, categories of evergreen trees, proportions of evergreen trees and green view indices on mental restorative quality of winter landscapes

Although the effects of landscape types, evergreen categories and proportions of evergreen trees on mental restorative quality have been examined one by one, the effects of one factor on mental restoration possibly depended on other factors. For example, whether adding evergreen trees could significantly improve the restorative quality or not possibly depended on the landscape types. In addition, the two landscape types had the same proportion of evergreen trees, but different green view indices (Table 1), implying that, possibly, the differences in mental restorative quality between the two landscape types were caused by green view index, instead the waterscape. Therefore, it is necessary to explore the comprehensive effects of the four factors on mental restorative quality, and their order of driving forces. Regression analysis can undertake this task (Zhao et al., 2013). Using mental restoration scores as dependent and the dummies of landscape types (landscape with water = 1; landscape without water = 2), the dummies of categories of evergreen trees (broad-leaved tree = 1; the mixture = 2; coniferous tree = 3), the proportions of evergreen trees, and green view indices as independents, stepwise multiple linear regression analysis revealed that landscape types and the categories of evergreen trees were the two reliably negative predictors of mental restorative quality (Table 4). This result indicated that landscape types were the most important factor in the improvement of mental restorative quality of winter landscapes, and categories of evergreen trees were the second important factor; while proportions of evergreen trees and green view indices had no impact on the mental restorative quality of winter landscapes.

4. Discussion

4.1. The relationship between landscape types and mental restorative quality in winter

A number of studies have evidenced that waterscape (blue space) was a positive element of healing environments (Pasanen et al., 2019; White et al., 2013; Nutsford et al., 2016; Finlay et al., 2015), and associated with better mental wellbeing (Völker et al., 2018), supporting our finding that the mental restorative quality of the landscape with water is higher than of the landscape without water. The present study also concludes that increased restoration score (0.50) caused by adding evergreen trees for the landscape with water was higher than that (0.25) of the landscape without water. This result can be explained by the findings of Fairchild et al. (2018) who suggested that visitors had greater perceived stress reduction in blue space with higher biodiversity, implying that the combination of water and vegetation is a multiplying accelerator for the mental restoration.

Table 4. Significant predictors for mental restorative quality of winter landscapes emerging from stepwise multiple linear regression analysis

Dependent	Independent	Unstandardized Beta	Standardized Beta	T	Sig.	Collinearity statistics	
						Tolerance	VIF
Mental restoration scores (R^2 = 0.659; adjusted R^2 = 0.617)	(constant)	3.769		36.405	0.000		
	Landscape types	−0.294	−0.733	−5.683	0.000	1.002	0.998
	Categories of evergreen trees	−0.082	−0.335	−2.596	0.017	1.002	0.998

4.2. The relationship between categories of evergreen trees and mental restorative quality in winter

This study indicates that broad-leaved evergreen trees are much better than coniferous evergreen trees and the mixture of broad-leaved and coniferous evergreen trees in terms of mental restorative quality. This result can be possibly explained by three aspects. One, in mid-eastern China, broad-leaved forests are more popular than coniferous forests, thus the respondents are more familiar with broad-leaved trees. The familiarity preference hypothesis suggests people's preference for the biome types that they are accustomed to through personal experience (Lyons, 1983), and this hypothesis was evidenced by recent studies (Hami & Tarashkar, 2018). There is evidence that highly preferred landscapes can promote mental restoration (Nordh et al., 2009; White et al., 2010; Wang & Zhao, 2020). Two, ecologists suggest that, generally, the productivity of forests distributed in high latitudes is lower than that of forests in low latitudes (Gillman et al., 2015). Therefore, compared with coniferous trees (mainly distributed in high latitudes (Olson et al., 2001)), broad-leaved trees (mainly in middle and low latitudes) provide more food to feed human. Mental restoration can be achieved through human perception of adequate resources (Kaplan, 1995). Three, Privet tree (representing the evergreen broad-leaved tree) used in this study is a native plant species, while Cedar tree (representing the evergreen coniferous tree) is an exotic species. A review article indicated that most existing studies showed a positive influence of native plants on biodiversity (Berthon et al., 2021) which can predict the mental restorative benefits (Wood et al., 2018).

4.3. The relationship between proportions of evergreen trees and mental restorative quality in winter

Despite the fact that the greenery in the environment has been evidenced to play an important role in promoting health (Akpinar, 2016; Ward Thompson et al., 2012), the present study concludes that moderate proportion of evergreen trees (50% and 70%, see Figure 3) is much better to promote mental restoration than low or high proportion for the landscape with water. The high proportion of evergreen trees can block visitors' view, leading to decrease of openness of the landscape, in contrast, the low proportion increases the openness (Figure 1), implying that the moderate proportion of evergreen trees leads to half-open spaces which has been evidenced to be preferred over close and open spaces (Tveit, 2009), then inducing a higher mental restoration (Nordh et al., 2009; Wang & Zhao, 2020). However, the landscape without water does not follow this pattern. The reason may be that the landscape is more open, and even adding 90% evergreen trees just creates a half-open space (Figure 1).

4.4. Practical application

The present study indicates that landscape type is the most important factor to determine the mental restorative quality of winter landscapes. In practice, landscape architects should first focus on landscape design, such as preserving or creating water bodies in the landscape (Korpela et al., 2010). Then, the category of evergreen trees should be carefully selected according to local environmental conditions. In temperate regions, broad-leaved evergreen trees are encouraged to plant in urban green spaces. At last, the proportion of evergreen trees in the landscape should ensure to generate half-open spaces.

4.5. Limitations and future research

In the real world, it is impossible to find the appropriate places where include the landscapes possessing the proportions of evergreen trees distributed in equal difference sequence and conforming to the three categories of evergreen trees with exactly the same background. However, there are some differences between pictures and real landscapes. Pictures just represent the visual landscape characteristics, the characteristics dependent on other senses, such as the temperature, humidity, smell, sound and texture in the landscape are overlooked or indirectly perceived through sense's association of visual landscapes. Furthermore, pictures only describe static landscapes, while visitors usually watch the scenery when walking in a real environment. These differences probably weaken the applicability of the results.

This study concludes that evergreen trees can enhance the mental restorative quality of urban green spaces in winter if we can select the appropriate species of evergreen trees and control the proportion of evergreen trees in the landscape. Evergreen trees, however, grow in a place all year round, arising the question: "how do they actually impact on the functions of green spaces in other seasons?" Answering this question is not the aim of this study, but it is very important in practice. Therefore, exploring the effects of species, proportion and planting site of evergreen trees on mental restorative quality in a whole year will provide practical clues to guide the design and management of urban green spaces. This inspires a future study.

Urban green spaces include many types, and, in temperate regions, broad-leaved or coniferous evergreen trees also include many species. The present study, however, only uses two types of landscape (with and without water) and two species of evergreen tree (Privet and Cedar tree), which possibly produces bias. Therefore, designers and managers should exercise caution in any attempt to generalize the results and apply them in practice. If the landscape types and evergreen tree species used in this study are replaced by other types and species, respectively, or a study includes more landscape types and evergreen tree species, will it lead to different conclusions? This question inspires future research.

5. Conclusions

This study explores the effects of evergreen trees on the mental restorative quality of winter landscapes, which aid us to answer the three questions proposed by this study.

"Can adding evergreen trees enhance the mental restorative quality of winter landscapes?" Not always, it is dependent on landscape types, evergreen tree species and proportions of evergreen trees.

"Is the mental restorative quality of evergreen trees related to the planting sites (landscape types)?" Yes, adding evergreen trees to the landscape with water is better than to the landscape without water in terms of mental restoration.

"How do the categories and proportions of evergreen trees influence the mental restorative quality?" Adding broad-leaved evergreen trees are much better than adding coniferous evergreen trees and the mixture of broad-leaved and coniferous evergreen trees; moderate proportion of evergreen trees has higher mental restorative potential in winter than low or high proportion for the landscape with water.

This study also finds that landscape types (planting sites) are the most important factor to determine the mental restorative quality of winter landscape, flowed by the categories of evergreen trees.

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Disclosure statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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