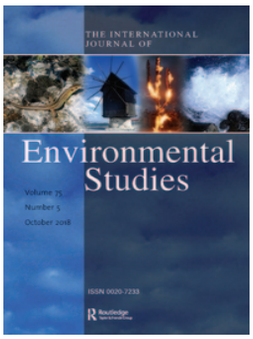

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Culture is new nature: comparing the restorative capacity of cultural and natural landscapes

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ABSTRACT

Is the cultural landscape a restorative environment for mental stress? What is the restorative potential of cultural landscape, compared to the natural landscape? And what factors determine the restorative potential of cultural or natural landscape? These questions have not been studied previously. To fill the gap the present study conducts an experiment to compare the restorative capacity of cultural and natural landscapes in China, and explores the driving forces of 15 landscape characteristics on the restorative quality of the two landscape types. The results show that there are no significant differences of restoration between cultural and natural landscape. The 10 photographs representing cultural landscape have a bigger standard deviation (lower consensus) of restorative capacity than the 10 photographs representing natural landscape. More water features and the flat terrain are the significant promoters for the restoration of cultural landscape. Abundant colours, which usually imply a higher diversity of plant species, are vital to enhance the restorative capacity of natural landscape.

KEYWORDS

Restorativeness; cultural landscape; natural landscape; design

Introduction

Background

As early as 70 years ago, the World Health Organization (WHO) defined health as 'a state of complete physical, mental and social well-beings and not merely the absence of disease or infirmity' [1]. According to the definition, mental health is an indispensable component of human health. Unfortunately, nowadays mental health problems are common worldwide. Even WHO predicts that, by 2020, mental disorder will become one of the two most important causes of illness [2]. In China, according to an investigation conducted in 2013, more than 30 million people are suffering from depression, but even worse is that depression and anxiety are widespread among urban residents [3]. Although numerous researchers have demonstrated that exposure to the environment with natural elements such as water, green plants and birdsong can reduce stress and benefit health [4–6], approaches to health promotion, prevention and care are still medically-oriented [7]. The mental health effects of environment have not been fully recognized and widely used to treat health problems.

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Literature review

Environmental psychology has a long tradition of research into the benefits of natural environments [8–10]. Researchers find that exposure to the natural environment increases subjective well-being [11], providing some immediate relief from the demands of city life through opportunities to renew cognitive resources and psychophysiological response capabilities [12–14]. Thus the natural environment is a kind of restorative environment. Restoration here can be defined as the process of recharging depleted cognitive capacity, which is negatively affected by prolonged directed activities or exposure to stress that produces mental fatigue [13]. Most researchers have focused on the difference between natural and urban areas. Their negative attitudes towards the urban environment fit well into the tradition of criticism of urbanism in general [15]. For example, van den Berg et al. [16] conclude that viewing the natural environment elicits greater improvement in mood and marginally better concentration than viewing the built environment; Tsunetsugu et al. [17] suggest that the physiological effects of viewing an urban *forest landscape* (lower diastolic blood pressure, higher parasympathetic nervous activity, lower sympathetic nervous activity and lower heart rate) imply a better restorative capacity than viewing unforested landscape (unforested, built environment).

In recent years, several researchers have tried to define the features of landscape possessing high potential to reduce stress. They offer valuable guidelines for health landscape design through comparing the health outcomes of exposure to different categories of environment. For example, Jiang et al. [18] conclude that higher tree coverage is much better for recovering from mental fatigue; Nordh et al. [5] claim that three landscape characteristics (higher coverage of grass, more trees and a bigger green area) influence the efficiency of restorative environment; and Völker and Kistemann [19,20] suggest that water is an important element for people's mental restoration. There is, however, no consensus on the specific features possessed by the restorative environments.

Aim of this study

The accumulated literature suggests that nature is much better than built environment for relieving mental stress. But the cultural landscape, much being the built environment, especially the traditional cultures such as the Great Wall, the Forbidden City in China, the pyramids in Egypt, the Acropolis in Greece, is the centre of many visits by tourists; and attracts government support for conservation and maintenance. Is the cultural landscape a restorative environment? To our knowledge, this has not been a research topic. Accordingly, this study attempted to understand the restorative quality of cultural landscape compared to that of natural landscape in the Chinese cultural context. Further, following the psychophysical method [21,22], we try to establish quantitative models between the landscape characteristics and restorative quality of the two landscape types, which aims to find reliable evidence to assist landscape design. The following research questions guide this study:

(1) What is the restorative potential of cultural landscape, compared to the natural landscape which has been demonstrated to be a restorative environment?
(2) What are the important attributes constituting the mental restorative quality of cultural or natural landscape?

Method

Photographs

Twenty landscape photographs were selected consciously by the authors, representing two landscape types: the cultural landscape and the natural landscape. Each type includes two subtypes: for the natural landscape, wilderness and urban green space; for the cultural landscape, modern landscape and traditional landscape. Ten photographs illustrate each landscape type and five photographs each subtype. The weather reflected on all photographs is rather similar, with clear to mostly clear skies, and all photographs were taken in summer. In addition, human beings are generally not present in the scenes photographed. Figure 1 shows samples of photographs.

To highlight the features of the four subtypes of the landscape, each picture expresses the symbolic components of the subtype. The traditional cultural landscape has the elements of ancient architecture such as classical pavilion, stone tablet, ancient rampart, etc. The most obvious feature of modern cultural landscape is that outstanding landmark in Figure 1(A). The difference between wilderness and urban green space is mainly reflected in the intensity of human interference. In the urban green space, there are signs of human endeavour to create an environment similar to the natural environment. In the wilderness, there were no or few signs of human presence.

Figure 1. Photograph samples of two landscape types (A and B representing cultural landscape, C and D natural landscape).

Measurement of perceived restorative capacity

Restorative scale

In order to compare the restorative capacity of cultural and natural landscape, quantitative methods should be introduced to measure the restorative quality. This study used the short-version revised restoration scale developed by Han [23] to achieve this goal. This restoration scale has been widely used by recent researches [24,25]. The sum of emotional, physiological, cognitive and behavioural dimensions which were described by 8 items was regarded as restorative quality. For each photograph, the participants evaluated the extent to which they agreed mostly with the given statement on a nine-point scale (1 = not at all; 9 = completely).

Procedure

Collecting data by an on-line survey is cheaper and easier than collecting data by the traditional method of face to face interview. Researchers have used the on-line questionnaire successfully and obtained reasonable results in studies related to landscape assessment [26,27]. In the present study, we made an internet questionnaire and conducted the survey from July to August 2017. When the participants opened the webpage, they could find a description 'Imagine you are in these scenes that you are viewing. How will you describe your response? Please give your selection for each item.' The order of the 20 images on the webpage is randomly assigned. After watching an image, the participants should select a number according to a nine-point scale for each item. Snowball sampling was applied to invite participants initiated by the first author. Finally 459 valid questionnaires were collected. Since the questionnaire was written in Chinese, all respondents are Chinese.

Landscape characteristics measurements

The aim of restorative environment research is to improve the restorative capacity. Prominski [28] suggests that scientific evidence in the field of design should be translated into design guidelines in an accessible and understandable way. In this study, 15 landscape characteristics were picked out by referring to the characteristics identified in the literature [29–31] and analysing the characteristics of landscapes studied (Table 1). We attempted to establish quantitative models for the landscape characteristics and restorative quality, and expected to find reliable evidence to guide landscape design aiming to increase the potential for relieving the mental fatigue of users.

In order to reduce the bias of the score of each landscape characteristic, we invited five postgraduates with a major in landscape architecture to rate the 15 landscape characteristics of all photographs according to the criteria shown in Table 1. The average value of five evaluations was calculated as the final score of each characteristic.

Statistical analysis

The mean value of all respondents' evaluations for each item listed in the restorative scale was calculated. The mean value of all items was used as the restorative quality of a photograph. At first, interclass reliability of restorative scores was tested using SPSS (Statistical Package for Social Science) 17.0 software. The analysis of variation (ANOVA) was used to compare

Table 1. Measurement scale of landscape characteristics.

Landscape characteristic	Scores			
	0	1	2	3
Number of landscape elements	Only one element	Two elements	Three elements	Four elements
Visual scale		Closed space	Semi-open space	Open space
Number of colour	One	Two	Three	Four
Percentage of land covered by vegetation	No vegetation	< 35%	36–70%	71–100%
Type of land vegetation	No vegetation	Grasses or (and) shrubs	Only trees or tree with grass	Mixed vegetation
Naturalness of land vegetation	No vegetation	Orderly configuration	Semi-natural configuration	Natural configuration
Growth status of plant	No vegetation	Bad	Moderate	Good
Percentage of land covered by water	No water	< 35%	36–70%	71–100%
Naturalness of water	No water	Orderly	Semi-natural	Natural
Accessibility of water	No water	Difficult to access	Neutral to access	Easy to access
Water quality (by visual observation)	No water	Bad	Moderate	Clear
Percentage of water covered by aquatic plants	No water	< 35%	36–70%	71–100%
Type of bank	Hard wall as bank	Shortly hard bank	Semi-natural bank	Natural bank
Ratio of building in the photo	No building	< 35%	36–70%	71–100%
Type of topography		Almost flat	Slightly undulating	Much more undulating

the restorative quality between cultural and natural landscape. Then, correlation analysis and stepwise multiple linear regression analysis were conducted to explore the effects of landscape characteristics in providing the restorative quality.

Results

Reliability

The interclass reliability of mental restorative scores for the two landscape types was calculated, respectively. Cronbach's Alpha for the cultural landscape was 0.841, for the natural landscape 0.892. If the Cronbach's Alpha > 0.801, it is almost perfect [32]. Thus, the results showed good internal reliabilities of restorative quality for both landscape types.

Comparison of the restorative quality between cultural and natural landscape

Figure 2 shows the restorative qualities and the four components of two landscape types. Although, based on the mean scores, the natural landscape (mean score = 6.28) was slightly better for relieving the mental stress of respondents than the cultural landscape (mean score = 6.10), the one-way ANOVA showed that there was no significant difference between them (p = 0.442). But 10 pictures of cultural landscape produce a higher standard deviation (SD = 0.596) of restorative scores than that (SD = 0.427) of natural landscape. Thus, the restorative potential of cultural landscape was much more dependent on its quality. Among the four components of restorative qualities, only the physiological response was significantly different between the two landscape types (p = 0.012), which means that a

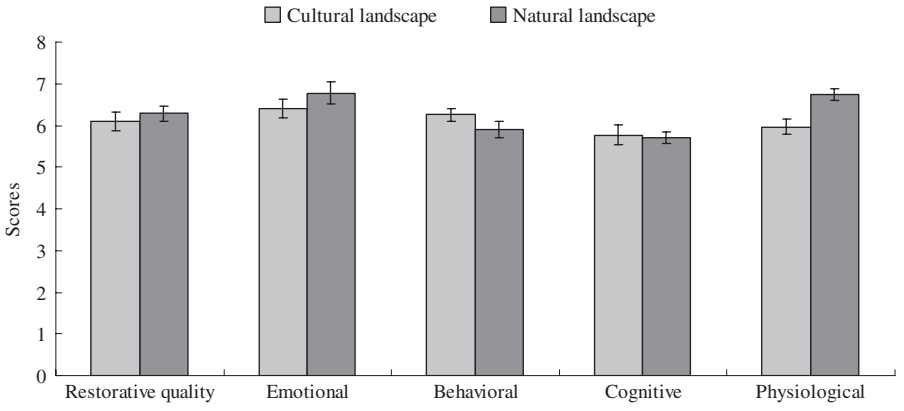

Figure 2. Mean restoration scores and four components scores of restorative quality (± standard error) within respondents for cultural and natural landscape.

natural landscape will make users feel calmer and induce better physiological responses than a cultural landscape. Within a landscape type, there was no significant difference of restorative quality between wilderness and urban green space ($p = 0.562$) nor between traditional and modern cultural landscape ($p = 0.414$). Wilderness possessed lower consensus of restorative potential (SD = 0.578) than urban green space (SD = 0.203), and traditional cultural landscape possessed lower consensus of restorative potential (SD = 0.827) than modern cultural landscape (SD = 0.280).

Relationships between restorative quality and landscape characteristics

The correlation analysis indicated that the restorative quality of cultural landscape increased with the naturalness of land vegetation, percentage of land covered by water, accessibility of water and water quality (see Table 2). The restorative quality of natural landscape increased with the number of landscape elements, visual scale and number of colours (see Table 3).

Although there were complex interactions among the landscape characteristics, the correlation analysis just illustrates the relationship between restorative quality and landscape characteristics individually. Previous study has demonstrated that multivariate regression analysis can solve this problem [33]. By using the values of the 15 landscape characteristics as the independents and mean restorative scores as the dependent, the significant correlations were further described using the stepwise multiple linear regression analysis for both natural and cultural landscape (Table 4).

The normality of the residuals, analysis of variance and multi-collinearity of the models were tested. The Kolmogorov-Smimo test indicated that the residuals of both landscape types followed a normal distribution (Kolmogorov-Smirnov $Z = 0.622$, $p = 0.834$ (cultural landscape); Kolmogorov-Smirnov $Z = 0.419$, $p = 0.995$ (natural landscape)). Variance analysis results revealed a linear correlation between the landscape characteristics and restorative quality ($F = 21.030$, $p = 0.001$ (cultural landscape); $F = 9.016$, $p = 0.017$ (natural landscape)). By referring to values in Menard [34] and Arriaza et al. [30] (value of tolerance < 0.2 or VIF > 10, which indicates a problem), our models had no problem with multicollinearity. Thus, our models were acceptable.

Table 2. Correlations between mean restorative quality of cultural landscape and landscape characteristics (Pearson).

		Restorative quality of the cultural landscape	NLE	VS	NC	PLCV	TLV	NLV	GSP	PLCW	NW	AW	WQ	PWCAP	TB	RNP
Number of landscape element (NLE)	Coefficient	0.582														
	Sig. (2-tailed)	0.078														
Visual scale (VS)	Coefficient	–0.035	0.243													
	Sig. (2-tailed)	0.924	0.498													
Number of colour (NC)	Coefficient	0.335	0.666*	0.031												
	Sig. (2-tailed)	0.343	0.035	0.931												
Percentage of land covered by vegetation (PLCV)	Coefficient	0.204	0.252	0.364	0.395											
	Sig. (2-tailed)	0.573	0.482	0.301	0.259											
Type of land vegetation (TLV)	Coefficient	0.104	0.643*	0.064	0.840**	0.438										
	Sig. (2-tailed)	0.774	0.045	0.860	0.002	0.205										
Naturalness of land vegetation (NLV)	Coefficient	0.683*	0.795**	0.295	0.368	0.533	0.463									
	Sig. (2-tailed)	0.029	0.006	0.408	0.296	0.113	0.177									
Growth status of plant (GSP)	Coefficient	0.343	0.729*	0.326	0.737*	0.701*	0.844**	0.735*								
	Sig. (2-tailed)	0.332	0.017	0.359	0.015	0.024	0.002	0.015								

(*Continued*)

Table 2. (*Continued*).

		Restorative quality of the cultural landscape	NLE	VS	NC	PLCV	TLV	NLV	GSP	PLCW	NW	AW	WQ	PWCAP	TB	RNP
Percentage of land covered by water (PLCW)	Coefficient	0.787**	0.742*	0.290	0.234	0.138	0.105	0.695*	0.318							
	Sig. (2-tailed)	0.007	0.014	0.416	0.516	0.704	0.774	0.026	0.371							
Naturalness of water (NW)	Coefficient	0.778**	0.679*	0.397	0.162	0.269	0.014	0.763*	0.314	0.947**						
	Sig. (2-tailed)	0.008	0.031	0.256	0.655	0.452	0.969	0.010	0.377	0.000						
Accessibility of water (AW)	Coefficient	0.639*	0.749*	0.313	0.342	0.098	0.163	0.591	0.360	0.903**	0.853**					
	Sig. (2-tailed)	0.047	0.013	0.378	0.334	0.788	0.654	0.072	0.306	0.000	0.002					
Water quality (WQ)	Coefficient	0.693*	0.795**	0.318	0.364	0.221	0.204	0.700*	0.368	0.948**	0.940**	0.920**				
	Sig. (2-tailed)	0.026	0.006	0.371	0.301	0.540	0.572	0.024	0.296	0.000	0.000	0.000				
Percentage of water covered by aquatic plants (PWCAP)	Coefficient	0.603	0.588	0.577	0.059	0.327	−0.056	0.715*	0.296	0.851**	0.958**	0.816**	0.876**			
	Sig. (2-tailed)	0.065	0.074	0.081	0.872	0.357	0.878	0.020	0.406	0.002	0.000	0.004	0.001			
Type of bank(TB)	Coefficient	0.570	0.677*	0.552	0.172	0.293	0.053	0.692*	0.335	0.887**	0.949**	0.889**	0.938**	0.978**		
	Sig. (2-tailed)	0.085	0.032	0.098	0.634	0.412	0.884	0.027	0.344	0.001	0.000	0.001	0.000	0.000		
Ratio of building in the photo (RNP)	Coefficient	−0.036	−0.060	−0.378	−0.125	−0.857**	−0.291	−0.350	−0.467	−0.159	−0.218	−0.088	−0.188	−0.288	−0.278	
	Sig. (2-tailed)	0.921	0.870	0.282	0.730	0.002	0.414	0.322	0.174	0.660	0.545	0.809	0.604	0.419	0.437	

(*Continued*)

Table 2. (*Continued*).

		Restorative quality of the cultural landscape	NLE	VS	NC	PLCV	TLV	NLV	GSP	PLCW	NW	AW	WQ	PWCAP	TB	RNP
Type of topography (TT)	Coefficient	−0.048	0.547	0.481	0.373	0.409	0.442	0.408	0.448	0.417	0.445	0.578	0.621	0.549	0.665*	−0.474
	Sig. (2-tailed)	0.896	0.101	0.160	0.288	0.240	0.201	0.241	0.194	0.230	0.197	0.080	0.055	0.101	0.036	0.166

*Significance at the 0.05 level; **Significance at the 0.01 level.

Table 3. Correlations between mean restorative quality of natural landscape and landscape characteristics (Pearson).

		Restorative quality of the natural landscape	NLE	VS	NC	PLCV	TLV	NLV	GSP	PLCW	NW	AW	WQ	PWCAP	TB	RNP
Number of landscape element (NLE)	Coefficient	0.690*														
	Sig. (2-tailed)	0.027														
Visual scale (VS)	Coefficient	0.649*	0.701*													
	Sig. (2-tailed)	0.042	0.024													
Number of colour (NC)	Coefficient	0.728*	0.613	0.457												
	Sig. (2-tailed)	0.017	0.059	0.185												
Percentage of land covered by vegetation (PLCV)	Coefficient	0.030	−0.417	−0.441	−0.007											
	Sig. (2-tailed)	0.934	0.231	0.202	0.984											
Type of land vegetation (TLV)	Coefficient	0.116	−0.022	−0.431	0.183	0.695*										
	Sig. (2-tailed)	0.749	0.952	0.213	0.613	0.026										
Naturalness of land vegetation (NLV)	Coefficient	−0.076	0.185	0.441	−0.467	−0.372	−0.458									
	Sig. (2-tailed)	0.836	0.609	0.202	0.173	0.290	0.183									
Growth status of plant (GSP)	Coefficient	0.200	−0.082	−0.320	0.044	0.852**	0.858**	−0.297								
	Sig. (2-tailed)	0.579	0.822	0.368	0.904	0.002	0.001	0.404								

(*Continued*)

Table 3. (*Continued*).

		Restorative quality of the natural landscape	NLE	VS	NC	PLCV	TLV	NLV	GSP	PLCW	NW	AW	WQ	PWCAP	TB	RNP
Percentage of land covered by water (PLCW)	Coefficient	0.508	0.863**	0.503	0.482	−0.270	0.123	0.165	0.146							
	Sig. (2-tailed)	0.134	0.001	0.138	0.158	0.451	0.735	0.649	0.688							
Naturalness of water (NW)	Coefficient	0.602	0.870**	0.528	0.499	−0.340	0.019	0.286	0.009	0.916**						
	Sig. (2-tailed)	0.065	0.001	0.116	0.142	0.336	0.958	0.422	0.981	0.000						
Accessibility of water (AW)	Coefficient	0.573	0.813**	0.465	0.424	−0.380	0.049	0.328	−0.025	0.830**	0.972**					
	Sig. (2-tailed)	0.083	0.004	0.176	0.222	0.279	0.892	0.355	0.946	0.003	0.000					
Water quality (WQ)	Coefficient	0.577	0.868**	0.519	0.477	−0.316	0.083	0.255	0.085	0.965**	0.985**	0.944**				
	Sig. (2-tailed)	0.081	0.001	0.124	0.163	0.374	0.820	0.477	0.815	0.000	0.000	0.000				
Percentage of water covered by aquatic plants (PWCAP)	Coefficient	0.544	0.904**	0.508	0.528	−0.290	0.000	0.146	0.043	0.940**	0.912**	0.806**	0.920**			
	Sig. (2-tailed)	0.104	0.000	0.134	0.117	0.417	10.000	0.687	0.906	0.000	0.000	0.005	0.000			
Type of bank(TB)	Coefficient	0.606	0.861**	0.515	0.476	−0.344	0.029	0.295	0.017	0.905**	0.998**	0.981**	0.983**	0.898**		
	Sig. (2-tailed)	0.063	0.001	0.128	0.165	0.331	0.937	0.408	0.962	0.000	0.000	0.000	0.000	0.000		
Ratio of building in the photo (RNP)	Coefficient	0.312	0.431	−0.053	0.466	0.096	0.517	−0.591	0.348	0.333	0.170	0.123	0.227	0.381	0.174	
	Sig. (2-tailed)	0.379	0.213	0.885	0.175	0.792	0.126	0.072	0.324	0.347	0.638	0.735	0.528	0.277	0.630	

(*Continued*)

Table 3. (*Continued*).

		Restorative quality of the natural landscape	NLE	VS	NC	PLCV	TLV	NLV	GSP	PLCW	NW	AW	WQ	PWCAP	TB	RNP
Type of topography (TT)	Coefficient	−0.567	−0.167	0.149	−0.555	−0.338	−0.369	0.651*	−0.420	−0.202	−0.260	−0.234	−0.243	−0.279	−0.272	−0.489
	Sig. (2-tailed)	0.087	0.646	0.681	0.096	0.339	0.295	0.042	0.227	0.577	0.467	0.516	0.499	0.435	0.446	0.152

*Significance at the 0.05 level; **Significance at the 0.01 level.

Table 4. Significant predictors for restorative quality of cultural and natural landscape emerging from the stepwise multiple linear regression analysis, respectively.

Dependent	Independent	Unstandardized Beta	Standardized Beta	*t*	Significance	Collinearity statistics	
						Tolerance	VIF
Restorative quality of cultural landscape ($R^2 = 0.798$; *adjusted* $R^2 = 0.730$)	(constant)	7.442		8.078	0.000		
	Percentage of land covered by water	0.560	0.976	5.119	0.001	0.826	1.211
	Type of topography	−1.053	−0.455	−2.385	0.049	0.826	1.211
Restorative quality of natural landscape ($R^2 = 0.530$; *adjusted* $R^2 = 0.471$)	(constant)	4.863		10.071	0.000		
	Number of colour	0.563	0.728	3.003	0.017	1.000	1.000

Table 4 shows that a cultural landscape containing more water features and a flat terrain was much better to promote the mental restoration of users; and keeping the richness of colour in the natural landscape is vital to improve the performance of mental fatigue relief.

Discussion

Health effects of cultural landscape

Previous researchers have concluded that the natural or green environment has better restorative effects than the built environment such as the urban landscape [4,8,35]. The present study shows that the cultural landscape has an effect on mental restoration similar to that from the natural landscape. Nowadays, in spite of the efforts to conserve natural resources, with urbanization and population growth all around the world, it is likely that the natural environment will be shrinking year by year, and that the built environment (cultural landscapes) will increase. Cities are 'the natural preserve' of a cultural landscape. The natural landscape in cities is in such features as a landscaped river bank, or areas of a zoo, or a botanical garden. Even these are 'cultural' – because they are an artificial natural landscape.

It is important to develop the restorative potential of cultural landscape. Since the restorative capacity of cultural landscape is more dependent on its quality than the restorative capacity of natural landscape, it is necessary to introduce good design and maintenance to the cultural landscape. This point was well understood by previous generations. For example, the use of gardens in the Forbidden City in Beijing is like the 'naturalness' of landscaping in 18th C England fabricated by 'Capability' Brown. It is a cultural device making full use of natural elements but combining those with the built environment. Of course, the protection of traditional culture is equally important to provide the restorative sites for the public in China. With a history of 5,000 years of civilization, the traditional Chinese culture has made great impacts on Chinese people psychologically. In this cultural atmosphere, a sense of belonging arises spontaneously, which makes people feel easy and calm. During the 'Cultural Revolution' (1966–1976), the cultural environment was certainly not reassuring, and so many traditional cultural features were destroyed, which led to a huge loss of restorative environments.

Health effects of natural landscape

The public green space is an important component of urban infrastructure. Previous researches have demonstrated the social role of green space for residents' mental stress relief [36]; restorative and preventive health benefits [37–39]; decreasing health inequality [40], and enhancing social contact and sense of community [41,42]. The urban green space provides a relatively low-cost contribution to improving and maintaining people's physical and psychological health. For most urban residents, the urban green space is the most convenient and frequent visiting place where they can make contact with nature. For example, in the central and eastern China, because of the long history of civilization and huge population, the natural environment has been almost completely destroyed. There are fewer opportunities to access the real nature for urban residents. Fortunately, the present study suggests that the urban green space can substitute the real nature to release people's mental stress. Similar result has also been demonstrated by the work of Tian and Li [43] who indicate that a well-designed urban green space can relieve mental stress with equal effect to, or even better than, that of the natural environment. Most green spaces in the urban area are 'artificial' or 'cultural' – built and maintained by human choice, not natural processes. This provides an opportunity for landscape architects to increase health effects of urban green spaces. Of course, it still needs a better understanding of the green space features which improve the restorative potential.

Compared to urban green space, wilderness has an ambiguous restorative capacity. This can be explained by the fact that some kinds of nature would make people feel fear, for instance, the dense dark forest may appear to be a hiding place for potential attackers [44]. This shows that natural landscape also needs management and maintenance to improve its capacity for mental stress relief.

Landscape characteristics for promoting the restorative capacity of cultural and natural landscape

This study indicates that although there is no significant difference in the restorative potential between the cultural and natural landscape, they have different predictors (Table 4). For the natural landscape, rich colours are the key to promoting its restorative potential. In the natural landscape, vegetation is the major component. Thus the rich colours are mainly reflected by the plants. Rich colours imply the diversity of plant species and different growth steps of one species, which are more likely to provide a variety of food sustainably both within a year and for a long time than the simple plant species does. Living in an environment possessing rich colours, people will feel relaxed and calm, because, though unconsciously, it reduces our fear of deficiency of food. Although there appears to be no research published on the effect of biodiversity on mental restoration, previous literature has demonstrated that biodiversity would have a positive effect on landscape preference [45], yet, landscape preference and restorative quality have a very close relationship [5,46–48].

In regard to the cultural landscape, the presence of water is the first important factor to promote mental stress relief. This result parallels the findings of previous works [15,49]. Based on a review, Völker and Kistemann [19] suggest that urban environments with water augment interest, attentiveness and the restorative effect. According to the habitat theory developed by Appleton [50], water is a vital factor to support human survival. In the cultural

landscape, there are more man-made elements such as buildings and pavement, which do not imply the presence of water, so the direct appearance of water is necessary to guarantee the water supply and make people feel easy. Similarly, the ancient Chinese philosophers think highly of water [51]. They regard water as the gentleman who possesses a noble quality. When they stand in front of the river or sea, they feel calm and tolerant and distracting thoughts are removed. The flat terrain in the cultural landscape is another positive predictor of its restorative capacity. In the ingrained idea, we consider the cultural landscape as a safe environment, and so we need not seek complex terrain to cover ourselves from dangers. Furthermore, it is much easier for us to choose a flatter terrain to build this landscape with cultural features, and the flat terrain is beneficial to organize many people for some activities such as a meeting, which will help us to increase unity and fighting power, and to gain more resources to guarantee our survival and development.

Combination of natural and cultural landscape

This paper divided the landscape into two types: the cultural and natural. Yet both are intertwined: the cultural landscape contains some natural elements, and some cultural factors are often found in the natural landscape. The traditional Chinese philosophies such as Confucius' *Analects* and *Tao te Ching* advocate the idea of 'integrating man and nature' [51,52]. This paper's results seem to reflect this idea: keeping more water features in cultural landscape and introducing moderate interference to increase the biodiversity in natural landscape will benefit mental relief. It is notable that all respondents in the survey are Chinese, whose thoughts and values are heavily influenced by the traditional philosophies. Therefore, the combination of natural and cultural landscapes in construction or modification of an environment in China is desirable to increase the restorative capacity of that environment. We suggest that equipping the cultural landscape with a natural surrounding and introducing some cultural elements such as paths, seats, sculptures, cabins to the natural landscape, will enhance the restorative potential of an environment.

Application for landscape design

As the cultural landscape shows a big variation in restorative potential, we will get more reinforcement of well-being if we pay more attention to cultural landscape design and management. At first, a water feature should be created and preserved in the cultural landscape. We should choose appropriate water forms (lake, pond, creek, fountain, waterfall, etc.) for a site. The existing water features in the cultural landscape should be strictly protected and well maintained. Secondly, in China, we should avoid building the cultural features on sites of large undulating terrain, and a careful attempt to make terrain flat will enhance the restorative potential of cultural landscape. In a natural landscape, design should aim for an abundance of colours. It is probable that emphasizing diversity in plants and displaying native plants especially will enhance the restorative value of sites. Species diversity also generates ecological stability [53,54], which will provide increased well-being for human visitors. In wilderness areas, conservation can include some natural or artificial interference – management – introduced moderately. This can enhance the diversity of plant species according to the Intermediate Disturbance Hypothesis which asserts that biodiversity is maximised at moderate levels of disturbance [55]. For the urban green space, native vegetation should

be introduced, combined with adapted exotic plants, to increase the biodiversity. The urban green space should also be considered to create a significant seasonal change to increase seasonal diversity [56]. This is generally ignored by researchers [57,58].

Limitations and future study

The demographic variables of respondents are considered to be important elements in landscape preference evaluation [59], but the present study does not take them into account. Nevertheless, although the effects of demographic variables have not been tested for mental restoration, we can postulate that the effect should not be ignored because there is a close relationship between mental restoration and landscape preference [5,48]. Besides, all respondents in the present study are Chinese and the cultural landscape used in this study mainly reflects the Chinese culture. To overcome this limitation, the principles should be tested in other cultural contexts; e.g. The Netherlands (abundant water, high density of population), New Zealand (urban, but also dispersed rural population and many mountains), Singapore (multi-ethnic, high density of population, limited land area). In general, respondents in a future study should represent diverse cultural groups and diverse cultural landscapes should be the focus.

Secondly, the present study used only 20 photographs, 10 photographs for each landscape type and 5 photographs for each subtype. The small sample may produce bias which might be reduced by a big sample. Thirdly, the stimuli of photographs are incomplete. When we enter the real environment, we may hear, smell, or even touch something which will affect our emotions [60], and so sampling the real environment with use of the senses is more likely to test our hypothesis reliably and thus to determine whether it is a restorative situation. Fourthly, based on the finding of a recent study [61], sculpture has been found to improve the restorativeness of plazas, as a seat did. Thus, to understand the restorativeness of cultural landscape, we need to study the cultural components of a landscape, such as the Kröller-Müller Museum and open air sculpture garden in the Hoge Veluwe National Park, in the Netherlands. Finally, as mentioned above, the literature on the restorative capacity of cultural landscape is too small, and this paper is just a case study which provides limited evidence. Thus, more researches related to this topic are needed in the future.

Conclusions

The findings of the present study are believed to be the first to demonstrate that the cultural landscape has a restorative capacity which is similar to that of the natural landscape. Furthermore, this study explores the driving force of 15 landscape characteristics on the restorative capacity of the two landscape types. The results indicate that more water features and flat terrain are important to promote the mental restoration of cultural landscape, and that in the natural landscape, abundant colours are the most significant promoter of restorative potential. These results provide some guidelines for landscape design and management.

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