

Analysis of students' positive emotion in green campus during COVID-19 pandemic in China

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Abstract

Green space in university campus is of paramount importance to students' emotional and psychological restoration. Students' positive emotion can be aroused when immersed in green space and naturalness. However, to what extent can perceived naturalness influence students' positive emotion remains unclear, especially in the context of COVID-19 countermeasures. This study, therefore, attempts to investigate in-depth the nature and strength of the relationships between students' positive emotion and their perceived naturalness, place attachment and landscape preference, which are potentially varying across universities in different social and environmental contexts and different restriction policies regarding the COVID-19 pandemic. A course of questionnaire-based surveys was administered in two university campuses in Heilongjiang and Hunan Provinces, China, resulting in 474 effective samples. Structural equation modeling was used to explore the hypothetical conceptual framework of latent variables and the indicators. The findings indicate that the higher students' perceived naturalness results in the greater positive emotion. Students' perceived naturalness in green spaces of campus has a positive effect on their place attachment and landscape preference. Moreover, the difference of mediate effects of place attachment and landscape preference were addressed which verifies the contextual influences.

1 Introduction

As a public health issue, the global pandemic of COVID-19 poses a serious threat to the built environment and human health ¹. Epidemiological data from the World Health Organization showed that, as of August 31, 2021, the cumulative number of reported cases worldwide was nearly 216 million and the cumulative number of deaths was nearly 4.5 million. Under the influence of COVID-19, many countries have adopted lockdown to impose different levels of restrictions on people's activities ^{2,3}. In China, university students successively returned to school from the fall 2020. Still, the outdoor activities of students were limited in most universities in order to prevent the potential spread of the epidemic ⁴.

Under this circumstance, some university students experience the reduction of social activities and encounter other troubles, such as financial stresses and academic frustrations, which may cause negative outcomes regarding emotional and mental health ⁵. A recent research addressed that approximately 45% of Chinese students had mental health problems during the COVID-19 period ⁶. In fact, even before the COVID-19 period, university students' negative emotion and mental health problems were commonplace due to time pressure, competition, and the pressure to achieve good academic grades ⁷.

According to psychological emotion theory, emotions are caused by appraisals of the characteristics of events ⁸. As one of the most important indicators of mental health, positive emotion is considered to alleviate psychological disorders such as depression and anxiety for university students, which in turn have a positive impact on their academic performance and quality of life ^{9,10}. On the other hand, several studies have shown that individuals who exhibit high level of negative emotion often show more distress,

anxiety, and dissatisfaction^{11,12}. Hence, there is an urgent need to effectively employ preventive measures to help students with emotional regulation^{13,14}.

The campus green spaces (CGSs) include lawns, woods, and other landscaped spaces available to university students, which are the main place of contact with nature for students in Chinese universities¹⁵⁻¹⁷. The CGSs as the primary places provide spaces for students where they could conduct outdoor activities and get rest and recovery to meet the emotional and psychological needs under the mild regulations for controlling the spread of COVID-19¹⁸. The psycho-evolutionary theory suggests that people's emotions can be positively affected by observing the natural environment¹⁹. As proven in previous studies, the exposure to green space is strongly associated with students' emotions^{20,21}. A significant positive correlation between students' perceived naturalness and their restoration and health has been evidenced¹⁷, which indicates the effect of perceived naturalness in regulating emotions. van den Bogerd et al. (2020) has summarized the restorative effects of the CGSs on university students' emotions, including "reducing harm", "restoring capacities" and "building capacities"²². Therefore, the CGSs in university where students can rest, relax, and meet friends can facilitate to evoke their positive emotion.

Although green spaces have similar characteristics to a certain extent, it is not reasonable to regard the perceived naturalness of the CGSs in different areas as the same on students' restorations²³. Conceptually, the perceived naturalness in different regions are localized with cultural, social, and environmental contexts²⁴, involving place attachment and landscape preference^{25,26}.

At present, university students in different regions of China have experienced different periods of lockdown. The perception of naturalness, emotions, and level of stress are affected by the regulations depending on the varying intensity of COVID-19 spreads²⁷. Thus, comparative research in different social and environmental contexts will help broaden our understanding of the relationships between perceived naturalness and emotions and mental health of university students. However, few published studies have compared the different effects of perceived naturalness on emotions across different regions. Studies have not yet explored the potential effects of perceived naturalness of the CGSs on university students' emotions and the related mediate effects of place attachment and landscape preference in the context of the COVID-19 pandemic.

This study aims to explore the hypothetical effects of place attachment and landscape preference in the relationship between the perceived naturalness of CGSs and university students' positive emotion under the restriction policies and regulations to control the spread of COVID-19 pandemic. We comparatively investigate the hypotheses considering the social and environmental differences between two universities in Hunan and Heilongjiang provinces, China. Due to the different epidemiological conditions during the COVID-19 period in China, these two universities were imposed control regulations with different intensities. The findings are expected to provide up-to-date contextual insights into the relationship between perceived naturalness and positive emotion, and to systematically understand the mechanism

that perceived naturalness in CGSs evokes the student's positive emotion. Furthermore, the implications are expected to help the planning and management of university green spaces for improving the mental health and wellbeing of university students.

2 Conceptual Framework

2.1 The effect of perceived naturalness and emotions

Perceived naturalness refers to the proximity of the landscape to the perceived natural state²⁸, while emotion is defined as a value judgment that relates external events to inner concerns²⁹. A wealth of evidence has been provided for verifying the relationship between the perceived naturalness of the CGSs and university students' emotions^{17,22}. Many natural elements, such as abundant plant species and large areas of vegetation may help students improve their emotional state and mental health in their daily lives³⁰. Malekinezhad et al. (2020) has found that university students' perceptions of the campus with green qualities may enhance positive emotion and contribute to improving mental health³¹. On the other hand, a lack of natural elements in the environment can lead to an increase of negative emotion such as anxiety, impulsiveness, and sadness among university students³².

Regarding to the COVID-19 pandemic, researchers have demonstrated that the lockdown leads to restriction of physical activity and experience of negative emotion such as anxiety and depression among university students^{18,27}. In contrast, exposure to the natural environment during COVID-19 helps reduce negative emotion such as anger, fear, and confusion³³. The enhancement of perceived naturalness may give rise to an increase of positive emotion, which contributes to release stress and alleviate depression³⁴. Despite the rapid control of COVID-19 in China in 2020, sporadic outbreaks and lockdowns are still occurring³⁵. It is needed to explore how perceived naturalness of the CGSs can affect university students' positive emotion during the COVID-19 pandemic. The relationship between the perceived naturalness of the CGSs and university students' positive emotion needs to be understood across social and environmental contexts^{23,36}. Thus, this study proposed that hypothetical regional differences exist in the influences of the university students' perceived naturalness of CGSs on their positive emotion across different universities characterized with social and environmental features.

2.2 The mediate effect of place attachment

Place attachment, as place identification and place dependence, is a positive emotional connection established between people and places through memory and exposure to the environment^{37,38} and associated with perceived naturalness³⁹. Higher perceived naturalness results in stronger attachment, more exposure, and experience with the added benefits from the contact with nature^{16,17}. For university students, natural environments were more popular than urban environments⁴⁰. The students' perceived naturalness of CGSs can lead to the development of place attachment⁴¹. In contrast, lack of natural elements in campus causes the absence of students' perceived naturalness and place attachment⁴².

As an emotional bond between people and important places, students' place attachment is linked to their emotions⁴². The place attachment can enhance self-esteem and sense of belonging, and bring positive emotion such as relaxation and happiness to students⁴³. Furthermore, place attachment is used to connect the perceived naturalness of CGSs and positive emotion⁴⁴. The CGSs are conducive to forming students place attachment and evoking their positive emotion when they feel frustrated, fearful, and stressed due to external events⁴⁵. However, the mediate effect of place attachment is unclear in the relationship between student's perceived naturalness and positive emotion during the COVID-19 pandemic.

2.3 The mediate effect of landscape preference

Compared to unnatural landscapes, university students have more preference for natural landscapes with lots of trees, open areas, and water^{46,47}. Landscape preference is formed through the interaction of people and the natural environment (Zheng et al., 2011). The environmental preference matrix summarized human preferences for landscape as "understanding" (coherence and legibility) and "exploration" (complexity and mystery)⁴⁸. Several evidence has been presented for the relationship between landscape preferences and the perceived naturalness of the CGSs⁴⁹. The well-designed CGSs as high-quality landscapes can provide university students opportunities to reduce stress and increase social interactions⁵⁰.

CGSs provided natural spaces to meet university students' landscape preferences, which contributed to university students' positive emotion^{51,52}. Moreover, university students exposed to a preferred environment tend to have more positive emotion and reduce negative emotion⁴⁶. It is also demonstrated that, as a basis for the restorative effects of the environment, preferences moderate the effect of perceptions of green space on positive emotion⁵³. After experiencing the COVID-19 lockdown, university students were more eager for being outdoor environments^{18,54}. The positive attitude of being outside may have an impact on students' perceived naturalness and landscape preference, which may affect their positive emotion of enjoying the CGSs.

2.4 Hypothetical structure

Several studies have shown that social and cultural contexts influence the form and function of green spaces, which affects individuals' perceptions of the environment^{36,55}. In this study, the mechanism of students' positive emotion influenced by perceived naturalness of CGSs is assumed to vary depending on regional contexts. Moreover, this study aims to examine the role of place attachment and landscape preference in the relationship between students' perceived naturalness of the CGSs and their positive emotion. It is assumed that the university students' positive emotion in the CGSs is proportional to their place attachment and landscape preference. In addition, the mediate effects of students' place attachment and landscape preference are hypothesized to link the perceived naturalness and positive emotion.

Figure 1 depicts the hypothetical relationships between the latent variables in conceptual framework. We assumed that the students' perceived naturalness directly affects their positive emotion (H1), place attachment (H2), and landscape preference (H3). Place attachment and landscape preference play the mediating roles to link perceived naturalness and positive emotion, respectively (H4 and H5). In addition, place attachment influences on landscape preference (H6).

Table 1
Latent variables and the corresponding exogenous variables.

Construct	Code	Measuring questions (Indicators)
Perceived naturalness (PN)	PN01	I think the campus green spaces have many wild plants and animals.
	PN02	I can feel the strong natural voice in the campus green spaces.
	PN03	The campus green spaces make me feel friendly.
	PN04	I feel safe and calm in the campus green spaces.
	PN05	I feel the campus green spaces are wild.
Positive emotion (PE)	PE01	I feel active.
	PE02	I feel enthusiastic.
	PE03	I feel cheerful.
	PE04	I feel joyful.
	PE05	I feel excited.
	PE06	I feel proud.
	PE07	I feel inspired.
	PE08	I feel strong.
	PE09	I feel grateful.
Place attachment (PA)	PA01	The campus green spaces are comfortable and allow me to do the things I want.
	PA02	There is no other place like the campus green spaces.
	PA03	I can get more satisfaction in the campus green spaces than in other places.
	PA04	What I do on the campus green spaces is more important than what I do elsewhere.
	PA05	The campus green spaces allow me to see what I am interested in.
	PA06	I feel that the campus green spaces are part of my life.
	PA07	I have a strong identification with the campus green spaces.
	PA08	The campus green spaces are special, and I have good feelings about them.
Landscape preference (LP)	LP01	I think the various parts of the campus green spaces form a whole.
	LP02	The various parts of the campus green spaces form a beautiful landscape.

Construct	Code	Measuring questions (Indictors)
	LP03	I think the campus green spaces contain a multitude of elements and features.
	LP04	I think there are many intricate elements in the campus green spaces.
	LP05	I think the campus green spaces contain many functions.
	LP06	I can clearly understand the campus green spaces.
	LP07	I think the campus green spaces have clear markers.
	LP08	The campus green spaces make me want to investigate more.
	LP09	The campus green spaces are circuitous and intrigue me.
	LP10	The campus green spaces are far-reaching and mysterious.

The exogenous variables used for constructing latent variables are listed in Table 1. The perceived naturalness were evaluated by the perception of natural attributes and natural feeling¹⁷. Natural attributes refer to the flora, fauna, and sounds in the environment and are measured by PN01 and PN02. Natural feeling refers to the feeling brought by the natural environment and is measured through PN03 to PN05. Students' positive emotion were measured by the Positive Affect Scale, which constitutes the emotional component of subjective well-being⁵⁶. In the Chinese cultural context, positive emotion could be assessed through nine different emotions⁵⁷ which were presented as PE01 to PE09. Place dependence and place identity are the two main dimensions of place attachment⁴³. In this study, place dependence referring to the value of the place largely above other places was measured by PA01 to PA04, and place identity referring to the place as a part of oneself is measured by PA05 to PA08. According to the environmental preference matrix⁴⁸, landscape preference was evaluated by four dimensions, including (1) coherence measured by LP01 and LP02, (2) legibility measured by LP03 to LP05, (3) complexity measured by LP06 and LP07, and (4) mystery measured by LP08 to LP10.

3 Methodology

3.1 Study locations

The field surveys were conducted in two campuses, namely campus of university A (UA) in Changsha of Hunan Province and campus of university B (UB) in Harbin of Heilongjiang Province, in China. According to the Köppen climate classification, Changsha is classified as Cfa and characterized with mild temperate, fully humid with hot summers, while Harbin is classified as Dwa and characterized with snow, dry winters and hot summers⁵⁸. The locations of studied universities are shown in Fig. 2. UA started to reopen in September 2020 when the outdoor activity limits for COVID-19 pandemic control was phased out. Due to sporadic outbreaks in Heilongjiang Province at that time, UB implemented a stricter lockdown

after students returned for the fall semester compared to UA. The characteristics of two universities are listed in Table 2.

Table 2
Characteristics of the universities in this study.

	UA	UB
Location	Changsha, Hunan Province	Harbin, Heilongjiang Province
Number of students	Approx. 59000	Approx. 26000
The overall area	317 ha	136 ha

In the campus of UA, the green space is scattered and includes lawns, trees, and a river. There are many geese in the river. Crowded outdoor activity area. Minor noise caused by the green space under construction. Each green space has a unique character. The green areas in UB consisting of large lawns, distinct flora, and fauna. Rich variety of plants. The river flows through the campus. Good opportunities for outdoor activities. Good natural quality and strong attraction. The scenes of two campuses are shown in Fig. 3.

3.2 Measures and survey

A questionnaire was developed for survey with five parts. The first part is regard to collecting the information on students' socio-demographic characteristics, including gender, age, education level, and monthly living expense. The second part is used to acquire students' perceived naturalness in the form of self-rated naturalness scale (SRNS) ¹⁷. The third part applies the Positive Affect Scale from the Positive and Negative Affect Scale (PANAS) (in Chinese), as a snippet of full scale, for obtaining students' positive emotion when exposed to the CGSs ⁵⁷. The fourth part directs at evaluating students' place attachment in their university based on the Place Attachment Scale (PAS) ⁴³. The final section measures students' landscape preference based on the environmental preference matrix ⁴⁸. Except the first part, all questions are answered by respondents using a Likert-type scale from 1 to 5 (1-strongly disagree, 2-somewhat disagree, 3-neither disagree nor agree, 4-somewhat agree, 5-strongly agree). The screenshots of questionnaire forms are shown in Fig. 4.

From February to April 2021, students were randomly invited to join the surveys in the two selected universities. All participants voluntarily took part in our surveys, and the collected questionnaire forms are anonymous for the privacy issues. Before answering the questionnaire, respondents were informed of the purpose of the questionnaire and asked to recall their emotional states during their routine activities in the CGSs over the past two weeks. Finally, Of the 539 possible eligible questionnaires, 474 completed questionnaires passed the validity check (UA: 253, UB: 221; effective response rate: 87.94%).

3.3 Structural Equation Modeling

Structural equation modeling (SEM) is a popular method for data analysis that has been widely used in many fields, such as psychology, sociology, and education. Unlike other modeling approaches, structural equation modeling integrates a measurement model and structural model, which can directly respond to the relationship between latent and observed variables, as well as the relationship between latent variables ⁵⁹.

The equation of the measured model is as follows:

$$X = \Lambda_x \xi + \delta(1)$$

$$Y = \Lambda_y \eta + \epsilon(2)$$

where X denotes the vector consisting of measured variables of the i th independent latent variables, Y denotes the vector of measured variables of dependent latent variable; Λ_{xi} and Λ_y are matrices of factor loadings for X and Y , respectively; δ and ϵ are measurement errors of independent and dependent latent variables, respectively; and ξ is a vector of latent independent variables and η is a vector of latent dependent variables. The variances and covariances among the measurement errors of measured independent variables in X are contained in Ω_δ and the variances and covariances among the measurement errors for the measured dependent variables is included in Ω_ϵ .

The regression equation of the structural model is as follows:

$$\eta = B\eta + \Gamma\xi + \zeta(3)$$

where B is the regression coefficient matrix regarding the latent dependent variables; Γ is the regression coefficient matrix relating latent independent variables; and ζ is the vector of error term in the structural model equation that contains the equation prediction errors. The variances and covariances among the latent independent variables are included in a matrix Φ , and the variances and covariances among latent dependent prediction errors are contained in a matrix Ψ .

To estimate the SEM model, it is generally assumed in this study that the outcomes were continuous, when the random variables follow a normal distribution. Maximum likelihood (ML) was used to figure out the estimation of model regarding all parameters simultaneously. ML yields estimates that seek to maximize the likelihood that the measured data consistent with the implied model, which is given as ⁶⁰:

$$F_{ML} = \log|\Sigma(\hat{\Theta})| + tr(S\Sigma^{-1}(\hat{\Theta})) - \log|S| - (p + q)(4)$$

where $\Sigma(\hat{\Theta})$ is the matrix that the theoretical model implies composing of abovementioned matrices of estimated parameters (denoted by $\hat{\Theta}$), including Λ_{xi} , Λ_y , Ω_δ , Ω_ϵ , B , Γ , Φ and Ψ ; tr is the trace of matrix; S is the covariance matrix observed in the data; p is the number of indicators for exogenous latent variables in the model and q is the number of indicators for the endogenous latent variables in the model.

The loadings and coefficients are obtained when the difference between the covariance matrix elements of measured data and the covariance matrix elements implied by model are minimized.

4 Results And Discussion

4.1 Descriptive statistics

As the results, the socio-demographic characteristics of respondents are shown in Table 3. The male students joined in survey at UA are little more than the females, while the opposite occurs in UB. The students of 22-year-old and below made up the majority of respondents, followed by those aged 23–26 years old. In terms of educational attainment, the largest proportions of respondents are undergraduates, which are 69.17% in UA and 81.00% in UB. Regarding monthly expenditure, students surveyed at both universities mainly spend 1000–2000 CNY per month, which is account for 65.22% of respondents at UA and 72.40% respondents at UB. According to the statistical yearbook 2019, the per capita disposable income of urban residents in Changsha is 55,211 CNY ⁶¹, while Harbin is 40,007 CNY ⁶².

Table 3
Descriptive statistics on demographic characteristics of the participants.

Factor	Category	UA	UB
Sex	Male	136 (53.75%)	99 (44.80%)
	Female	117 (46.25%)	122 (55.20%)
Age (years)	≤ 22	176 (69.57%)	137 (61.99%)
	23–26	63 (24.90%)	82 (37.10%)
	≥ 26	14 (5.53%)	2 (0.91%)
Education	Undergraduate	175 (69.17%)	179 (81.00%)
	Master	73 (28.85%)	41 (18.55%)
	Doctor	5 (1.98%)	1 (0.45%)
Monthly expense (CNY)	≤ 1000	26 (10.28%)	13 (5.88%)
	1000–2000	165 (65.22%)	160 (72.40%)
	≥ 2000	62 (24.50%)	48 (21.72%)

4.2 SEM estimation results

The Tucker-Lewis index (TLI) is widely used to model linear mean and covariance structures. The value of TLI also ranges between 0 and 1, with results greater than or equal to 0.9 indicating an acceptable fit of

the model (Henseler et al., 2015). The comparative fit index (CFI) reflects the difference between the hypothetical model and the independent model. The value of CFI lies between 0 and 1, with a value greater than or equal to 0.9 indicating that the model is acceptable (Gustafsson and Martenson, 2002). Root Mean Square Error of Approximation (RMSEA) refers to the square root of the asymptotic residual sum of squares. Previous studies have shown that an RMSEA of less than 0.05 indicates a satisfactory model fit and less than 0.08 indicates an acceptable model fit (Xia and Yang, 2019). As shown in Table 4, the model fit indices for both universities meet the desired criteria. The values of TLI and CFI in estimations of models for the two universities are greater than 0.9, and the values of RMSEA for models of both universities are less than the acceptable value of 0.08. These indicate both models have good fits.

Table 4
Model fit indexes.

	TLI	CFI	RMSEA
UA	0.911	0.918	0.072
UB	0.900	0.910	0.075

As shown in Table 5, the standardized factor loadings between latent variables and all corresponding observed variables are greater than 0.6. Regarding the structural models, Table 6 shows the estimate results that differ across two universities. The positive effect of students' perceived naturalness on their positive emotion is significant in two universities. The higher the perceived naturalness that students may have, the more positive emotional states they will reach. Besides the direct influences on positive emotion, in the model of UB, the indirect effect through landscape preference and the joint indirect effect through place attachment and landscape preference are both significant in a positive way. However, the indirect effects are not significant when it comes to the model in UA.

Table 5
Results of the measurement model.

Latent variable	Indicator	UA		UB	
		Estimate	p-value	Estimate	p-Value
Perceived naturalness	PN01	0.616	0.000	0.661	0.000
	PN02	0.627	0.000	0.707	0.000
	PN03	0.817	0.000	0.896	0.000
	PN04	0.795	0.000	0.904	0.000
	PN05	0.832	0.000	0.861	0.000
Positive emotion	PE01	0.836	0.000	0.816	0.000
	PE02	0.845	0.000	0.795	0.000
	PE03	0.883	0.000	0.838	0.000
	PE04	0.898	0.000	0.872	0.000
	PE05	0.874	0.000	0.858	0.000
	PE06	0.830	0.000	0.908	0.000
	PE07	0.805	0.000	0.795	0.000
	PE08	0.752	0.000	0.753	0.000
	PE09	0.826	0.000	0.772	0.000
Place attachment	PA01	0.802	0.000	0.720	0.000
	PA02	0.718	0.000	0.658	0.000
	PA03	0.771	0.000	0.731	0.000
	PA04	0.634	0.000	0.653	0.000
	PA05	0.830	0.000	0.834	0.000
	PA06	0.807	0.000	0.817	0.000
	PA07	0.878	0.000	0.906	0.000
	PA08	0.806	0.000	0.774	0.000
Landscape preference	LP01	0.843	0.000	0.804	0.000
	LP02	0.845	0.000	0.812	0.000
	LP03	0.844	0.000	0.791	0.000
	LP04	0.789	0.000	0.706	0.000

LP05	0.791	0.000	0.685	0.000
LP06	0.708	0.000	0.735	0.000
LP07	0.645	0.000	0.692	0.000
LP08	0.843	0.000	0.763	0.000
LP09	0.780	0.000	0.735	0.000
LP10	0.689	0.000	0.611	0.000

Table 6
Results of the structural model.

Hypothesis	UA		UB	
	Coefficient	p-Value	Coefficient	p-Value
H1	0.215	0.047	0.247	0.011
H2	0.827	0.000	0.703	0.000
H3	0.166	0.022	0.295	0.000
H4	0.317	0.080	0.151	0.251
H5	0.791	0.000	0.648	0.000
H6	0.235	0.180	0.294	0.045

The direct mediate effect of place attachment is not verified in the models of both universities. This result is inconsistent with recent research which concluded place attachment was beneficial to students' positive emotion and mental health⁶³. One of the possible explanations for this inconformity is that university students' place attachment is likely to link with their past experiences⁶⁴. Place attachment is dynamic based on personal experience⁶⁵. When people visit an environment, the past experiences and memories may be evoked regarding the local landscape elements in their hometowns which is not aligned with the current environment^{66,67}. The irrelevance of the environment to past experiences can decrease people's place attachment⁶⁸. Due to the influence of the social context and cultural circumstances on the landscape character of the campus, the CGSs may not meet the environmental needs of students from other regions, which may affect their place attachment to the campus. Another possible explanation is the restriction of the freedom to enjoy the CGSs as a result of the closure of public spaces and the restriction of the distance during the COVID-19 pandemic⁶⁹. When students return to the CGSs, their emotional states are getting more positive soon, however, their place attachment are not established immediately. The mediate effects of landscape preference and place attachment have been verified in UB, which indicates that the relationship between students' perceived naturalness of the CGSs and their positive emotion can be sequentially mediated by place attachment and landscape preference.

A campus which is well-designed and meets students' needs for outdoor activities and landscape preference will have a positive effect on their emotional and psychological recovery ^{42,47,70}.

Compared to UB, the joint mediating role of place attachment and landscape preference was not validated at UA. This is mainly due to the absence of a link between students' landscape preferences and positive emotion. People's landscape preferences are heterogeneous and dynamic, and can be influenced by temporal, spatial, and personal factors ⁷¹. As for UA, the disorder and confusion of the green spaces were caused by the construction in the campus. The campus under construction will generate noise, dust, and visual experiences unrelated to the natural environment ⁷². Mounting evidence has shown that disorder and confusion are determined by the artificial structures in the environment which can affect students' landscape preferences and positive emotion ^{4,47}. In addition, the lockdown of universities during COVID-19 epidemic can also affect students' landscape preferences ⁷³. UA has now gradually reopened with the effective control of the epidemic, but strict social distancing measures are still in place for students ⁴. Our survey was conducted approximately five months after the reopening of UA. This allowed students to spend more time in the campuses and led to increasing familiarity with the CGSs. This familiarity can hinder students' perception of the mystery of the CGSs ⁴. As a part of students' landscape preference, mystery promises to provide interesting new information through the environment ⁷⁴. This also implies that the absence of the sense of mystery in the CGSs may have a negative impact on students' landscape preferences, however, it doesn't influence their positive emotion.

5 Conclusion

This study aims at understanding the importance of perceived naturalness in university campus greenspaces for improving students' positive emotion, especially after the controlling regulations of COVID-19 pandemic. The questionnaire-based surveys have been undertaken in two universities in Heilongjiang and Hunan Provinces to collect the data of students' positive emotion, perceived naturalness, place attachment and landscape preference regarding CGSs in different social and environmental contexts.

Comparison of SEM results of the sample groups from the two different universities indicates that perceived naturalness, place attachment and landscape preference influence positive emotion in different manners. The findings suggest that students' perceived naturalness of the CGSs can directly influence their positive emotion. Meanwhile, students' place attachment and landscape preference can be facilitated by perceived naturalness of the CGSs, and ultimately leading to more positive emotion.

With the improvement of campus environments of Chinese universities in the last two decades, students can experience a more natural and better-designed environment in campus than in other urban spaces (Kim and Cocks, 2021; Mok and Marginson, 2021). Nevertheless, more attention is needed to the emotional and psychological well-being of students, especially under the situation of COVID-19 pandemic. As for the practical implications, this study provides psychological insights into the administration and planning of university campus. Natural elements, such as plants, lawns, and water

body, which are expected to make the CGSs more responsive to the needs of students in various social and environmental contexts, are essential to emotional recovery of students during the COVID-19 pandemic.

Technically, the results emerging from field surveys and simultaneous measurements could provide more useful information on how people perceive the naturalness and what environmental variables affect place attachments, as well as the direct effects of environmental variables on students' emotion. In this study, data were collected in two universities because of the limitation of human resource and budget. Future studies could extend the number of study locations.

Declarations

Author Contributions

S. L., Y. J., J. L., and Z. L. carried out investigation, S. L., Y. J., J. L., and Z. L. made data curation, S. L., Y. J., J. L., and Y. P. made formal analysis, S. L., and Y. J. wrote the original draft preparation, Y. P., W. L., and T. F. reviewed, revised, and edited the manuscript.

Competing interests

The authors declare no competing interests.

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author, upon reasonable request. The data are not publicly available due to privacy reasons.

Ethical Review Statement

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by Academic Ethics Committee of School of Architecture and Art at Central South University, China (Ref. No. SAA202202191501).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

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Figures

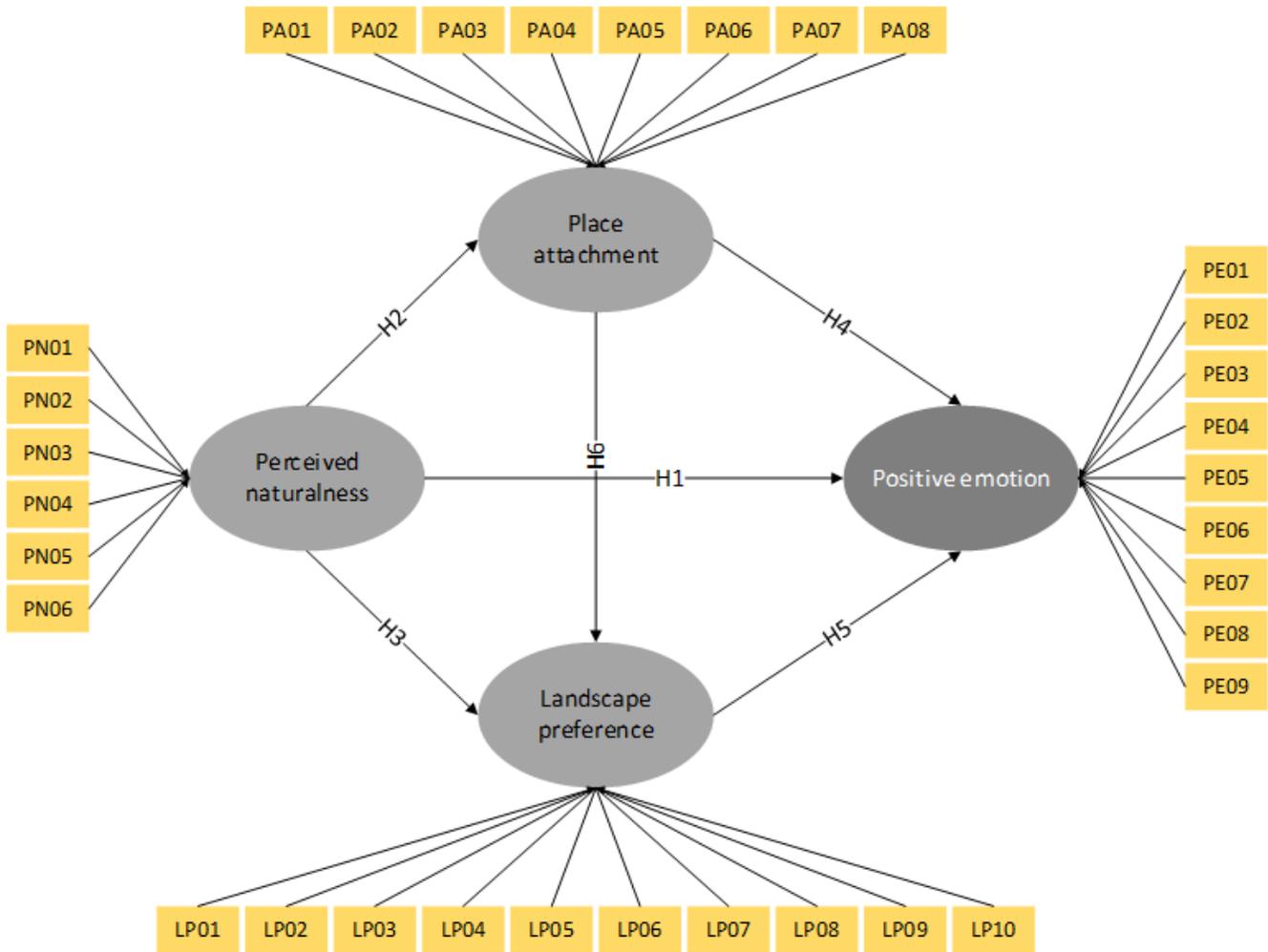


Figure 1

The diagram of conceptual framework

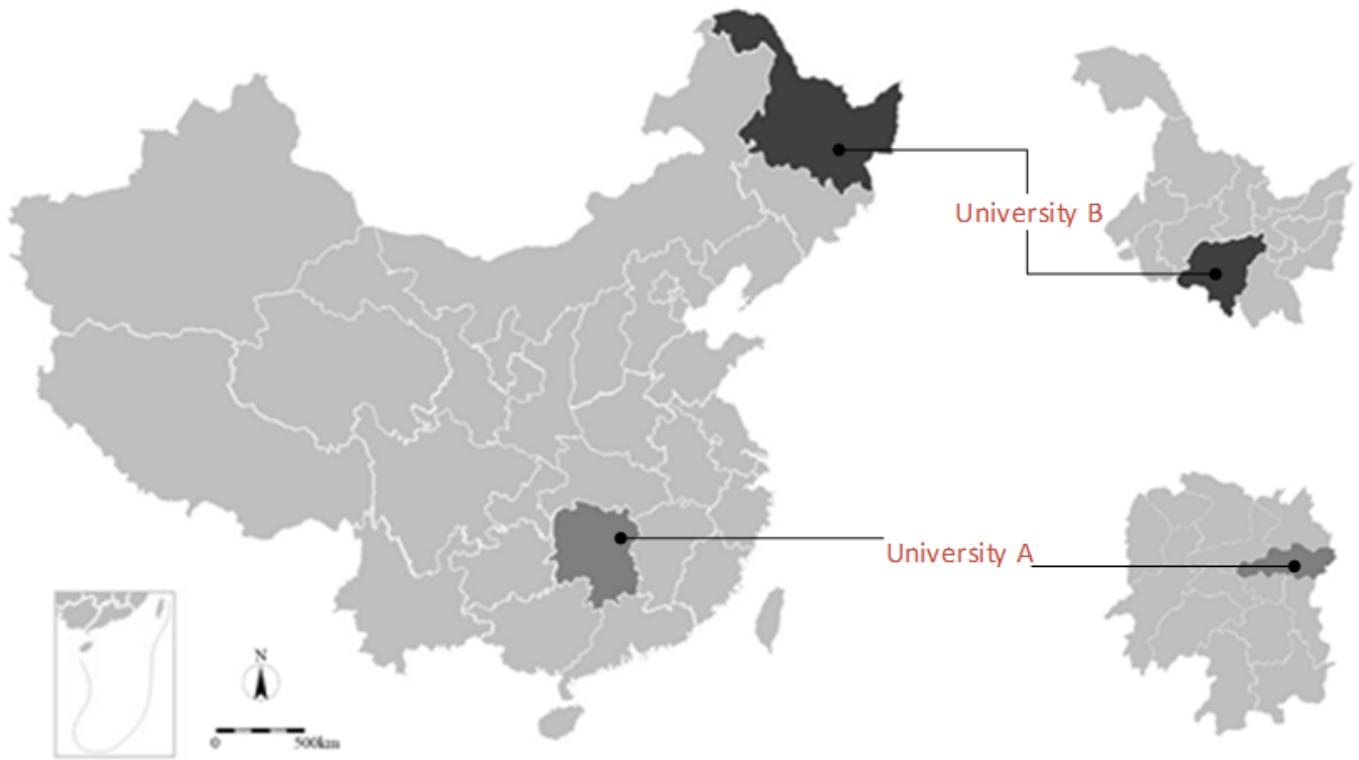


Figure 2

Locations of university campuses in different provinces in China

UA



UB



Figure 3

Scenes of the studied university campuses



Figure 4

Questionnaire form sample in Chinese and English