FEAR OF COVID-19, LANDSCAPE SPATIAL CONFIGURATION AND ENVIRONMENTAL SATISFACTION IN URBAN PARKS

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Abstract

The COVID-19 pandemic has changed the mobility, accessibility dynamics and user behaviours in urban parks. A prevalent concern among park users is the heightened fear associated with the potential transmission of COVID-19, leading to apprehensions about personal health and perceived infection risks. However, at present, there is limited understanding of how park users perceive this public health crisis, along with the safety and satisfaction in urban parks after the spread of the pandemic. This study investigates the mediating role of fear of COVID-19 on the relationship between landscape spatial configuration and environmental satisfaction in urban parks. The study, which was conducted in Lanzhou, China, involved 450 urban park users (231 females, 219 males) aged between 18 and 75 years. Analytical findings reveal that urban park landscape spatial configuration affects fear of COVID-19 and environmental satisfaction. Furthermore, such fear negatively predicts environmental satisfaction. Importantly, the study establishes the mediating role of fear of COVID-19 in shaping the link between urban park landscape spatial configuration and environmental satisfaction. The implications of the results are discussed in conjunction with the relevant literature, thereby providing valuable insights for urban park planners and policymakers. Based on the study findings, an adaptive design of urban parks in the event of pandemics or health crises can be conceptualised to avoid the loss of users and contribute to resilience planning in urban design and public health.

Keywords: Urban Park, Landscape Spatial Configuration, Fear of COVID-19, Environmental Satisfaction

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INTRODUCTION

With the global outbreak of the COVID-19 pandemic in December 2019, the disease spread out to different countries within a short period. According to relevant data, 219 countries were affected by COVID-19, infecting hundreds of millions and causing millions of lives (Parra & Tan, 2021). In response to the spread of the diseases, the World Health Organization, with the cooperation of various countries, introduced severe restrictions, such as lockdowns, school and business closures, cancellations of public gatherings, travel restrictions and limitations on import and export trade transactions (Huang et al., 2023).

The rapid spread of COVID-19 and the sharp rise in deaths from infections sparked panic and anxiety. Ahorsu et al. (2022) refer to an individual's anxiety and fear of COVID-19 infection as 'fear of COVID-19'. Meanwhile, environmental cognitive theory (ECT) emphasises that positive spatial layout and organisation can positively affect people's satisfaction and comfort with the environment (Yan, 2023). However, most existing studies have focused on the aesthetics and functionality of urban parks while ignoring the impact of landscape spatial configuration, specifically the layout and organisation of spaces in parks, on environmental satisfaction. At present, there remains a lack of specific guidance and case studies on alleviating public fear and anxiety through reasonable landscape spatial configuration in response to public health emergencies. As a result, urban parks have failed to realise their potential mental health benefits during pandemics. In such events, there is an urgent need to utilise parks to reduce the psychological and physical ailments caused by fear or anxiety. This is because certain outdoor activities could be used to enhance individuals' mental well-being and combat loneliness in the COVID-19 era.

This study explores how urban parks' landscape spatial configuration affects users' environmental satisfaction, along with the mediating role of fear of COVID-19 in this relationship. By revealing this mechanism, we aim to provide theoretical and practical guidance for future urban park designs, help urban planners better respond to similar public health challenges and improve the mental health of the public during the pandemic.

LITERATURE REVIEW
Environmental Cognitive Theory (ECT)

ECT is a human behaviour theory that posits the interaction between personal attributes, behaviours and environments in shaping human behaviours. Kurt Lewin (2013) believes that the environment significantly impacts people's psychological activities, which in turn affect people's behaviours. In this theory, behaviour is represented by 'B', personal attributes by 'P' and the environment by 'E'. Hence, environmental stimuli (E) necessitate personal psychological perception (P) to maintain individual behavioural preferences (B). Particularly during the COVID-19 pandemic, when disease-ridden environments impacted

personal perceptions of COVID-19, urban parks provided a place to rest, escape, or relieve anxiety. Thus, research should seek to understand these emotional responses, which can help urban planners design use environments that promote well-being and increase safety in public parks (Swapan et al., 2024).

Urban Park Landscape Spatial Configuration
When designing urban park landscapes, several factors must be considered. First, it is necessary to create an excellent natural environment ('E' in ECT), including planting various trees, shrubs, flowers and other plants. Second, it is necessary to ensure the siting of urban parks, meet the accessibility of urban parks (including buses, trams or subways) and provide convenient services for residents who depend on urban public transportation (Grzyb, 2024). Connectivity within the urban park landscape spatial configuration is another critical aspect to consider. This involves designing the layout to facilitate seamless connections between parks and their surroundings, including adjacent urban areas and infrastructure, thereby enhancing accessibility, usability and overall functionality (Al-Kodmany, 2024).

Additionally, effective connectivity enhances the accessibility, usability and overall functionality of urban parks. The proximity of urban parks encourages their integration with commercial and cultural districts, and the creation of more parks near mixed-use areas surrounded by shops, restaurants and service facilities can lead to highly attractive and useful urban parks (Qin et al., 2024). Finally, the present study points out that the spatial configuration of urban park landscapes can affect the risk of COVID-19 transmission and the well-being of urban residents. Crowded urban parks may exacerbate users' fear of COVID-19. Therefore, well-maintained urban parks with a good-quality landscape spatial configuration can calm users and reduce pandemic-related anxiety (Padeiro et al., 2022).

Fear of COVID-19
Urban parks are one of the essential places for outdoor activities for city dwellers. However, during the COVID-19 pandemic, the public's ('P' in ECT) use of urban parks and their fear of COVID-19 became contradictory, and such contradiction and fear may persist. People were cautious about using public places, such as urban parks, due to the fear of contracting the virus. Fear of COVID-19 has influenced users' behavioural patterns in using urban parks. People avoided crowded parks and rush hour to reduce their risk of infection. While research has shown that urban parks are essential in improving people's mental health, fear of COVID-19 negatively impacted personal mental health during the pandemic (Zull Kepili et al., 2023). This fear exacerbated anxiety, stress and depression, especially among those who felt lonely or were diagnosed with a mental illness (Mayorga et al., 2022). Currently, COVID-19-related lockdowns have been

lifted. As a result, fear of COVID-19 among urban park users may have diminished, but this continued to have lasting effects on people's perceptions of public health, social distancing and physical and mental health. As such, urban park management departments and local authorities should continue to monitor the changing COVID-19 situation, along with shifting public attitudes, as a way to build resilience against future outbreaks and pandemics.

Environmental Satisfaction
Environmental satisfaction refers to the level of satisfaction an individual develops when interacting with and experiencing a particular landscape. This concept refers to users' subjective assessment of a landscape to meet their aesthetic, functional and emotional needs or their behavioural preferences ('B' in ECT) (Song et al., 2023). The spatial configuration of urban park landscapes is widely believed to have a positive impact on environmental satisfaction. However, recent research suggests that individual fear, particularly fear of COVID-19, negatively influences satisfaction levels (Davis et al., 2021). The fear associated with the pandemic has not only altered perceptions of urban park landscape spatial configuration but also significantly impacted environmental satisfaction in various ways.

The Current Study
Recently, people worldwide have experienced various problems caused by COVID-19 and have had to overcome the negative situations arising from the pandemic (Rosni & Zainol, 2022). Indeed, the pandemic has negatively impacted economies, human health and psychology worldwide. Related to this, urban parks have emerged as vital spaces where residents can seek solace and recreation amidst these trying circumstances. However, the pandemic and associated policy responses have led to significant psychological distress among urban dwellers, necessitating a closer examination of factors influencing the public's fear and well-being.

Therefore, this study focuses on urban park users as a sample group, given the increasing research interest in understanding fear of COVID-19 and the factors mitigating this fear since 2020. Zhang & Li (2023) investigated how urban park landscape spatial configuration can alleviate user stress and anxiety during the pandemic, while Xie et al. (2020) investigated the relationship between urban park satisfaction and fear of COVID-19. Despite these valuable contributions, existing research has not comprehensively addressed the relationships between urban park landscape spatial configuration, fear of COVID-19 and environmental satisfaction.

We believe that the results obtained in this study will guide urban planners and urban park managers to design and manage urban parks that can help increase resilience against pandemics. In turn, this can increase the need for

outdoor exercise among dwellers during pandemics, serving as an effective intervention to prevent mental health problems faced by users who cannot go outside to relieve stress and anxiety during such trying times.

To clearly explain the variables in this study, we provide the operational definitions of all variables: urban park landscape spatial configuration refers to the spatial distribution and layout of the environmental quality of urban parks, the accessibility of roads within parks, the connectivity of roads bordering parks and the proximity to services around parks. Fear of COVID-19 refers to health and safety concerns and anxieties due to the COVID-19 pandemic. Environmental satisfaction refers to an individual's satisfaction with the overall atmosphere of an urban park environment. The relationship between variables can be better understood and studied by clarifying these operational definitions. In this context, the main objective of the current study is to explore the mediating role of fear of COVID-19 in the relationship between landscape spatial configuration and environmental satisfaction in urban parks (**Figure 1**). To achieve this, the following hypotheses are proposed:

H1. Landscape spatial configuration negatively affects fear of COVID-19.
H2. Landscape spatial configuration positively affects environmental satisfaction.
H3. Fear of COVID-19 positively affects environmental satisfaction.
H4. Fear of COVID-19 mediates the relationship between urban park landscape spatial configuration and environmental satisfaction.
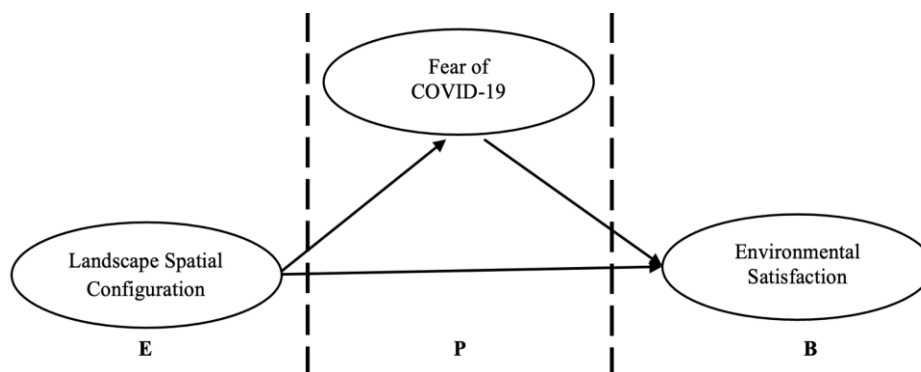

Figure 1: Conceptual model of the study
Source: Authors

RESEARCH METHOD
Study Site and Selection of Sample Park
The study site, Lanzhou City, is the capital of Gansu Province and home to the majority of regional administration headquarters in the province (Xu et al., 2007). Xigu District is an important part of Lanzhou City and has unique socioeconomic

characteristics. We selected Xigu District because it represents the typical characteristics of medium- and large-scale urban areas in Lanzhou, making the research results more universal and applicable. As such, participants from Xigu Park, Lanzhou City, China, were recruited for this study. Xigu Park mainly serves urban residents, has good accessibility and has sound service facilities. Thus, it can provide valuable data on the role and effectiveness of medium- and large-scale urban parks during the pandemic.

Based on the sample size reported by G Power, we chose the F-tests method, selected [ANOVA: Fixed effects, omnibus, one-way] and set the parameter effect size f=0.25, α=0.05, β=0.8. We calculated that the sample size for this study should be at least 128.

In this study, we used a simple random sampling method to conduct a questionnaire survey. Individuals aged 18–75 who actively used Xigu Park were included, while users outside this age group were excluded. Data were collected from July to October 2023 via 500 questionnaires that were distributed on-site. A total of 450 valid questionnaires were collected, with a response rate of 90%.

Questionnaire Design

In this study, data were collected and analysed using questionnaires that were divided into two parts. The first part solicited demographic data, including the respondents' age and gender. The second part comprised the main questionnaire of the study, including three variables (landscape spatial configuration, fear of COVID-19 and environmental satisfaction). The scale used in this study was the same as that used in many studies, although some items were modified to accommodate our study. First, we used the landscape spatial configuration questionnaire, which was developed by Zheng (2021) to create urban parks' landscape spatial configuration scale. To make it suitable for this study, we selected 17 items with four dimensions (environmental quality, accessibility, connectivity and proximity), which were more helpful in refining the landscape spatial configuration dimensions of urban parks and improving the accuracy, depth and representativeness of the data. Second, we used the Fear of COVID-19 Scale developed by Ahorsu et al. (2022). To accommodate the measurements of COVID-19 fear among urban park users in this study, we modified this tool by removing two items and adjusting the remaining items. Finally, environmental satisfaction was measured based on the study of Cheng et al. (2022). In particular, we selected five items applicable to this study. **Table 1** shows all the items used in this study, which we assessed using a 5-point Likert scale.

Table 1: Study variables with their respective indicators

Construct	Item	Description
Landscape Spatial Configuration (1=strongly disagree, 5=strongly agree)		
Environment Quality	EQ1	This park has a good-quality activity space.
	EQ2	This park is built in a good location.
	EQ3	This park has good activity facilities.
	EQ4	This park has good landscape design.
	EQ5	There is a wide variety of plants in this park.
	EQ6	This park has an excellent physical environment (e.g. air, trees and natural vegetation).
Accessibility	AC1	There are many ways to get to this park (e.g. walking, driving and taking the bus).
	AC2	This park is close to where I live.
	AC3	The cost of transportation to reach this park is cheap.
	AC4	I spent less time on the way to this park.
	AC5	Traffic is smooth ton the way to this park.
Connectivity	CN1	There are many crossroads on the way to this park.
	CN2	An excellent road system connects this park.
	CN3	There are many road types to reach this park (e.g. walking trails, cycle lanes and driving roads).
Proximity	PX1	There are service sectors surrounding this park (e.g. restaurants).
	PX2	There are many types of service sectors surrounding this park (e.g. restaurants, cafes, supermarkets and malls).
	PX3	I can easily access the service sectors surrounding this park.
Fear of COVID-19 (1=strongly disagree, 5=strongly agree)		
	FC1	I am most afraid of getting COVID-19 in the park.
	FC2	It makes me uncomfortable to think about possibly getting COVID-19 in the park.
	FC3	My hands become clammy when I think about possibly getting COVID-19 in the park.
	FC4	I am afraid of losing my life because of COVID-19 while playing in the park.
	FC5	When watching news and stories about COVID-19 on social media I become nervous or anxious.
Environmental Satisfaction (1=strongly disagree, 5=strongly agree)		
	ES1	Satisfaction with park greenery.
	ES2	Satisfaction with road paving design.
	ES3	Satisfaction with environmental visual aesthetics.
	ES4	Satisfaction with the water environment comfort.
	ES5	Satisfaction with air quality.

Source: (Zheng, 2021; Ahorsu et al., 2022; Cheng et al., 2022)

RESULTS
Descriptive Statistics
Out of the 450 valid questionnaires obtained, 48.67% (n=219) were completed by males, while 51.33% (n=231) were completed by females. The respondents' ages ranged from 19 and 71 years old. The primary types of users surveyed included residents and individuals who were working, studying and living in Lanzhou City, Xigu district. When the absolute value of data skewness is less than 3, and the absolute value of kurtosis is less than 7, the sample data generally conform to the normal distribution (Blanca et al., 2013). The sample data in this study meet the requirements of normal distribution and are thus suitable for further analysis.

Reliability and Validity Analysis
In this study, PLS-SEM was employed to test the research hypotheses. Various criteria were considered to assess the validity and reliability of the measurement. The evaluation of the measurement model involved examining the outer loadings, convergent validity, composite reliability and discriminant validity. Outer loadings exceeding 0.6 indicate satisfactory validity. Reliability assessment included the consideration of Cronbach's alphas and composite reliability, with a threshold of 0.7 indicating acceptable reliability. **Table 2** indicates that all constructs surpass this threshold, demonstrating strong reliability. Convergent validity was evaluated using average variance extraction (AVE), in which a threshold exceeding 0.5 indicates satisfactory convergent validity (J. F. Hair et al., 2013).

In addition, the results of the Fornell-Larcker reveal that all square roots of AVE exceed the off-diagonal elements in the corresponding rows and columns. The cross-load method is performed by checking the cross loadings of the indicator. The difference between the outer loadings of the indicator within the related construct and all its loadings should at least be 0.1. The Heterotrait–Monotrait (HTMT) ratio should be less than 0.85 (J. F. Hair et al., 2013). The results indicate that the model has both convergence and discriminant validity.

Table 2: Measurement model results for the latent constructs

Construct	Items	Loadings	Cronbach's Alpha	CR	AVE
Landscape Spatial Configuration			0.946	0.952	0.543
Environment Quality	LSC_EQ1	0.855	0.928	0.943	0.734
	LSC_EQ2	0.851			
	LSC_EQ3	0.863			
	LSC_EQ4	0.860			
	LSC_EQ5	0.865			
	LSC_EQ6	0.848			
Accessibility	LSC_AC1	0.846	0.920	0.940	0.757
	LSC_AC2	0.869			
	LSC_AC3	0.889			
	LSC_AC4	0.887			
	LSC_AC5	0.857			
Connectivity	LSC_CN1	0.898	0.877	0.924	0.803
	LSC_CN2	0.892			
	LSC_CN3	0.898			
Proximity	LSC_PX1	0.876	0.869	0.920	0.793
	LSC_PX2	0.894			
	LSC_PX3	0.900			
Fear of COVID-19	FC1	0.815	0.898	0.925	0.710
	FC2	0.856			
	FC3	0.851			
	FC4	0.861			
	FC5	0.829			
Environmental Satisfaction	ES1	0.851	0.903	0.928	0.721
	ES2	0.840			
	ES3	0.851			
	ES4	0.852			
	ES5	0.850			

Source: Author's Calculation

Structural Model Analysis

Table 3 and **Figure 2** show the pathway analysis results from testing the hypothesised direct effects among the main variables. As can be seen, the landscape spatial configuration is a negative and significant predictor of fear of COVID-19 ($\beta=-.427$; $p <.001$), thus supporting H1. The study also found that landscape spatial configuration positively and significantly predicts environmental satisfaction ($\beta=.33$; $p <.001$), thus supporting H2. We also found that fear of COVID-19 is a negative and significant predictor of environmental satisfaction ($\beta=-.252$; $p <.001$), thus lending support to H3. The R^2 value for satisfaction is 24.3%.

Table 3: Path coefficient and hypothesis testing (direct effects)

Hs	Relationship	β	t value	Decision	f^2	VIF
H1	LSC →FC	-0.427	10.992	Supported	0.223 (Medium)	1.000
H2	LSC →ES	0.330	7.448	Supported	0.118 (Small)	1.223
H3	FC →ES	-0.252	5.555	Supported	0.069 (Small)	1.223

Notes: LSC=Landscape Spatial Configuration; FC= Fear of COVID-19; ES=Environmental Satisfaction. β=regression weight. The t values are computed through bootstrapping with 450 cases and 5,000 samples. *** $p < 0.01$. VIF: variance inflation factor.

Source: Author's Calculation

Table 4 shows the mediating relationship within the study model. Initially, we estimated the direct effect between the independent and dependent variables without a mediator. The path coefficient between landscape spatial configuration and environmental satisfaction was β=0.330, indicating a significant relationship. This was confirmed by bootstrapping with 5000 resamples (t value=5.029), thus supporting H4. Mediation strength, assessed through variance accounted for (VAF), quantifies the indirect effect's size relative to the total effect. VAF values under 20% indicate no mediation, values of 20%–80% suggest partial mediation and values over 80% signify complete mediation (J. Hair et al., 2017). In this study, we calculated VAF by dividing the indirect effect by the total effect. The VAF values showed that about 24.7% of the indirect impact of landscape spatial configuration on environmental satisfaction can be explained by the partial mediating effect of fear of COVID-19.

Table 4: Strength of mediation effect

Hs	Relationship	Indirect effect	Direct effect	Total effect	t value	p	VAF
H4	LSC→FC→ES	0.108	0.330	0.438	5.029	0.000	24.7%

Notes: LSC=Landscape Spatial Configuration; FC= Fear of COVID-19; ES=Environmental Satisfaction

Source: Author's Calculation

Effect size (f^2) indicates the strength of a phenomenon, estimating the relationship between each endogenous variable in the statistical total (Anderson et al., 2017). Values of 0.02, 0.15 and 0.35 indicate small, medium and large effects. In the current study, landscape spatial configuration (f^2=0.118) and fear of COVID-19 (f^2=0.069) had little effect on environmental satisfaction. However, the results revealed that landscape spatial configuration had a medium effect on fear of COVID-19 (f^2=0.223).
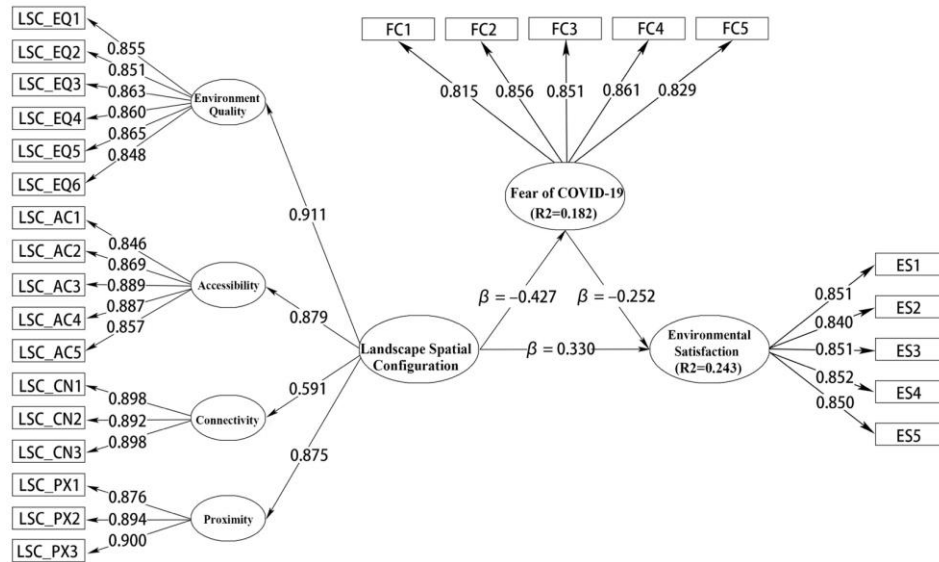
Figure 2: Conceptual model of the study
Source: Authors

DISCUSSION

The global outbreak of COVID-19 led to significant socioeconomic and health challenges, along with severe psychological impacts on individuals. As a result, the concept of 'fear of COVID-19' has garnered considerable attention among researchers. Drawing from ECT, this study investigates the mediating role of fear of COVID-19 in the relationship between landscape spatial configuration and environmental satisfaction in urban parks.

H1 explores the predictive power of landscape spatial configuration on fear of COVID-19 in urban parks. Our results indicate a negative correlation between urban park landscape spatial configuration and fear of COVID-19, suggesting that a more rational spatial configuration of urban parks is associated with lower levels of fear among users. Interestingly, this finding contrasts with a study by Pan et al. (2021), which demonstrated that higher accessibility and connectivity of spatial configurations in public green spaces in London were linked to increased risk of COVID-19 transmission and greater user fear. In comparison, the results of our study offer a different perspective.

H2 examines whether the spatial configuration of urban park landscapes predicts environmental satisfaction. Our results support this hypothesis, indicating a positive relationship between spatial configuration and environmental satisfaction. Thus, higher satisfaction levels are associated with a more favourable landscape spatial configuration in urban parks. These findings are consistent with the literature (Mohammadzadeh et al., 2023).

H3 investigates whether fear of COVID-19 significantly predicts environmental satisfaction, and our results indicate a negative impact of fear of COVID-19 on environmental satisfaction, thus supporting this hypothesis. This finding is also consistent with previous studies in the literature (Maury-Mora et al., 2022).

H4 explores whether fear of COVID-19 mediates the relationship between urban park landscape spatial configuration and environmental satisfaction. After confirming the first three hypotheses, the fourth hypothesis was tested, and the analysis revealed that fear of COVID-19 partially mediated the relationship between urban park landscape spatial configuration and environmental satisfaction, with a VAF of 24.7%. Hence, H4 is supported, suggesting that urban park landscape spatial configuration influences fear of COVID-19, subsequently affecting environmental satisfaction. While direct studies corroborating this specific result are limited, existing research provides related insights. For instance, Reid et al. (2022) reported that the abundance and quality of green spaces during the COVID-19 pandemic can enhance residents' mental health. Furthermore, Mayen Huerta & Cafagna (2021) found that users' perceptions of safety in green spaces during the pandemic can impact their subjective well-being, with some users opting to avoid green spaces due to safety concerns.

Implications of the Study
The findings of this study have significant implications for theory, practice, management and policy. They offer theoretical insights from ECT on how landscape spatial configuration affects users' personal experiences, such as satisfaction. The results suggest that optimising landscape configuration can reduce fear of COVID-19 among urban park users, thus supporting this theory empirically. Applying ECT is crucial for identifying environmental characteristics that influence fear and satisfaction. These insights can inform urban planning and policy decisions, which in turn can help optimise park design, management and funding to enhance visitor satisfaction and promote public health benefits, thus contributing to long-term environmental sustainability goals (González et al., 2023).

CONCLUSION
This exploratory study examines how landscape spatial configuration in urban parks can enhance users' environmental satisfaction and mitigate COVID-19 fears. In a novel approach that uses PLS-SEM, we link landscape configuration, COVID-19 fear and environmental satisfaction. Our findings show that while landscape configuration boosts satisfaction, COVID-19 fear reduces its perceived effectiveness, thus lowering satisfaction. Optimising urban park design is crucial

in counteracting COVID-19-induced psychological effects, thus highlighting its role in future health event prevention.

Limitations and Future Avenues for Research
This study has its limitations. In particular, it did not consider the impact of socioeconomic status on park use and satisfaction and relied solely on questionnaires. Thus, future research should include socioeconomic status and use mixed methods to better understand urban park users' perceptions as well as enhance design and management strategies.

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