Article

Investigating the Influence of Introducing Biophilic Elements into the Shopping Mall Environment: Perception of Public Visitors

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ABSTRACT

As a beloved destination place of urban public space, the public attitude towards shopping malls is significant to sustainable development. The aim of this study is to investigate the perception of biophilic design in relation to the landscape preferences of mall visitors and to assess visitor intentions, testing the impact, extent, and role of biophilic design elements. This study was conducted with a quantitative approach using a questionnaire survey method; the data were collected from 427 public visitors at an archetypal shopping mall in Shanghai, China. SmartPLS (version 4.0.9.2) was used to access a second-order measurement and structural model based on path modeling and bootstrapping. The results suggest a number of discoveries. Firstly, biophilic design has positive impacts on visitors' landscape preference, and the approach facilitates revisit intentions and positive referrals within individuals. Secondly, the knowledge has been extended that beyond simply the green dimension (plants), visitors are able to holistically perceive biophilic design elements and subordinate attributes (e.g., curved lines, repeating patterns, spatial focal points). Lastly, biophilic design can create a restorative experience for mall visitors and can be viewed as a complementary service to provide the health benefits of an unstructured stay in a natural setting.

KEYWORDS: landscaping in shopping mall; biophilic design; preference studies; revisit intention; restorative experience; PLS-SEM

Open Access

Received: 06 August 2023
Accepted: 12 October 2023
Published: 19 October 2023

ABBREVIATIONS

BD, biophilic design; BSM, Biophilic shopping mall; LP, landscape preference; RE, restorative experience; BI, behavior intention

INTRODUCTION

In recent years, the application of biophilic design in urban public space has garnered considerable attention, and a number of studies are investigating the opportunities it offers for sustainable built environments to achieve livable cities [1–4]. The concept of biophilic design (BD) refers to the idea of drawing experience from nature and creating an urban artificial environment that satisfies human inherent closeness to nature through the utilization, extraction, reproduction, and simulation of nature [5]. For landscapes of urban public space, BD can be seen as a design strategy and tool that provides visitors with natural contact, enhances environmental interaction experiences, and promotes health and well-being [6,7].

A shopping mall considered among the most well-liked and frequently used urban public spaces among public visitors [8–10]. Driven by digitization, intelligence, and innovative technology, the model of shopping malls is shifting from a traditional commercial to one that emphasizes the environmental interaction experience [11]. This transformation redefines the relationship between space and function of the typology, and its open area gradually changes toward community attributes. The open area of shopping malls emphasizes leisure and social activities, and its performance has become more akin to a park [12,13]. Some practices even present the landscape, cultural, or historical characteristics of different regions [14]. The recent adoption of BD in shopping malls has a definite growing tendency, which encompasses interior landscape, outdoor greening, building and facades, and architecture networking, among others; this approach is considered beneficial for green, comfort, efficiency, and sustainability [15–18]. People now give physical and mental health greater consideration than ever before, especially in the wake of COVID-19 [19]. According to several studies, implementing BD can help public visitors acquire health benefits from the experience of the shopping mall environment which is integrated with nature, and, to a lesser or greater extent, may reduce psychological exhaustion and feelings [16,20].

This study defines a 'biophilic shopping mall' (BSM) as a shopping mall that integrates nature into the public open area on and inside the particular building by using BD elements proposed by Kellert et al. [21]. The BD aspects may including the introduction of natural features, the simulation of shapes and forms of nature, the reproduction of natural processes, the utilization of light and space, the connection of place attachment within users, or the promotion of human-nature interactive experiences to facilitate follow-up research.

As shopping malls attempt to maximize their social value by optimizing artificial environments and bringing nature back to urban public spaces, there are still some unknowns and unanswered debates. On the one hand, researchers have emphasized the significance of gathering public opinions on various aspects of urban public space [22]. However, there is currently less prior literature focusing on BSMs as a well-liked and frequently used category. Hence, it is necessary to investigate public perceptions and responses to BSMs [23–25]. It is also worth noting that although there have been preliminary studies exploring and developing quantitative measurement methods for BD, there has been a lack of extensive validation, and the effective measurement instrument still has a blank [7,26,27]. On the other hand, some researchers have pointed out that the application of BD elements implies higher implementation and maintenance costs [28]. It has been discovered that in medical, office, or other related environments, the integration of BD can indirectly alter economic values [29]. Consequently, some researchers speculate that the benefits of BD may assist in helping visitors bond with shopping malls, increase the mall's attractiveness towards the users, and foster place attachment within the visitors as well. This will directly affect the public's willingness to visit, stay time, and willingness to pay, thereby positively stimulating the economic value of shopping malls [30]. Despite this, some researchers continue to remain concerned about the impact of BSMs towards good cost-effectiveness, that is, whether BD can have the ability to significantly improve future shopping mall visitor behavior intentions [25,31,32].

Based on the above background, research gaps, and controversies, the authors of this study have decided to research the visitors of Shanghai Nanxiang Impression City Mega in China. This study intends to understand the perception that BD creates for public visitors in their shopping mall experiences and to assess the visitors' intentions. The objective is specified in three research questions:

RQ1. Are the effects of BD on shopping mall visitors positive or negative? To what extent can it affect their landscape preferences?

RQ2. Are the visitors to shopping malls acquiring satisfying, healing experiences as a result of BD effects? How does it affect landscape preferences?

RQ3. Although designers have made many efforts to introduce BD into shopping malls, can it actively enhance visitors' future behavior intentions?

THEORETICAL PERSPECTIVE AND HYPOTHESIS DEVELOPMENT

Biophilic Design and Shopping Mall Landscape Preference

Due to the development of intelligence, innovation, and digitization, the functions of shopping malls are changing, with a move towards a public area akin to a park [11]. Shopping malls typically comprise of experiential retail areas that cater to visitor demands by offering them a variety of convenient services and activity venues, including catering, entertainment, leisure, and social activities. These are all situated in a setting with a diverse natural landscape [8]. The "biophilic design store" was the first BD concept to be introduced in a commercial context [33]. This concept embrace the integration of natural elements and the benefits they provide. Although certain components of BD were employed in some practices during the early years, it was not always highlighted. BD has generally been applied to window displays, commercial streets, retail spaces, and shopping malls [20,25,34–37]. Surprisingly, there have been only a few prior empirical studies to evaluate visitors' responses to BD in the commercial environment.

According to Kellert et al., BD is a concept and tool based on the theory of the biophilia hypothesis that can support and revitalize human biophilia [21]. Although people live in urban environments and have life experiences that are far from natural processes and elements, they retain an intrinsic impulse to connect with nature [38]. These contacts typically trigger beneficial health responses, such as decreased levels of blood pressure, heart rate, muscle tone, and stress hormones, as well as improved mental focus and creative problem-solving abilities [39,40]. The innate motivation for people to seek and spend time in the natural environment seems intuitive, which is an instinct and quality preserved by human evolution [38].

The aforementioned theory may provide a basis for BD to explain the popularity of shopping malls as urban public spaces. In previous studies, researchers have found that visitors prefer commercial areas with trees, which are rated as attractive, relaxing, and well-maintained environments with high visual quality and additional comfort [35,36]. People respond positively to the presence of internal landscapes or gardens in the open areas of shopping malls and, in turn, prefer this kind of environment [41]. Among the different dimensions of the shopping mall, the green dimension with natural elements is the preferred landscape by the public, with said conjecture supported by an empirical investigation [24]. The green dimension encompasses a number of vital elements, such as plants (trees, lawns, and flowers), waterscapes, seats, sculptures, and other artworks [23,42]. Based on this discovery, this study puts forward the following hypothesis:

H1. The landscape preferences of shopping mall visitors are positively impacted by the integration of BD.

Restorative Experience in A Shopping Mall

Contemporary urban residents' ideological notions have experienced considerable modifications concerning the severity of both individual and public health and well-being after the outbreak [19,43]. The improvement of mental weariness, cognitive function, and mental wellness is the most frequent focus of urban residents [44]. Incorporating natural elements into design techniques has proven to be a successful way of enhancing the manner in which people interact with built environments to attain favorable healthy effects [6,39]. For instance, elderly depressive symptoms are less prevalent in nursing homes when the homes offer greater tree canopy coverage [45].

Restorative experience is referred to as the critical mechanism for enhancing people's health [46]. Environmental psychologists have established through the attention recovery theory (ART) that the feelings of being away, extent, fascination, and compatibility are the four factors that impact the degree of benefits in restorative experiences [47,48]. Restorative research for urban public space is concentrated in green spaces, especially urban parks. Most public visitors feel that simply being in a park environment can significantly boost their mood and relieve weariness in daily life [49–51], even in small parks [52]. Furthermore, different categories of natural scenes are believed to provide varied restorative effects [53].

Although researchers have emphasized the restoration capabilities of urban green spaces [54,55], any built environment can also acquire the ability to facilitate human recovery if it incorporates environmental aspects or scene stimulation that encourages the healing process [25,56,57]. The fundamental goal of BD is to “provide people with opportunities to live and work in healthy places and spaces, reduce stress, and improve overall health and well-being through reconnection with nature” [5]. There is reason to believe that BD can enhance the restorative potentials of many sorts of urban public spaces [48,58]. This sentiment can be supported by Rosenbaum et al., who conducted an experiment with simulated shopping mall videos to test the different perceptions of restorativeness using the attention recovery theory. The result indicated that visitors have more restorative experiences in an environment that incorporate BD elements (e.g., green plants, birds, and fountains) as opposed to one which lacks such features [23]. In another study, they demonstrated the restorative potential provided by the green space that has been installed in the atrium of a shopping mall [30]. Therefore, the researchers of this study have put forward the following hypothesis:

H2. The restorative experiences of shopping mall visitors are positively impacted by the integration of BD.

Relation of Landscape Preference and Restorative Experience

Environmental experiences are closely related to landscape qualities. People are innately drawn to things of beauty as part of the human spirit’s needs [59]. In other words, when individuals perceive unsightly scenery, their spiritual needs are unable to be satisfied, a difference that can be explained by landscape preference. According to Kaplan and Kaplan, landscape preference reveals the outcome of individuals’ interactions with the environment through a process of perception, cognition, and evaluation [60]. Coherence, complexity, legibility, and mystery are the four environmental qualities that have an impact on preference, and the extent of preference within an individual increases when these four qualities are present in a particular environment [61–63].

Van den Berg et al. related, the preferred environment to a restorative environment that provides restorative experiences [64]. The preferred environment offers a safe and comfortable setting in which the individual is free to engage in activities that promote self-regulation, thus allowing the individual to turn attention to self-reflection and thereby improving physical and mental health [65–67]. Some researchers have studied the impact of restorative environments on individual preferences and found that the more intensely people perceived restorativeness, the more prospectively they were to give a higher preference score to that environment [68–70]. However, other studies have also discovered that highly restorative environments do not always produce highly preferred surroundings [71,72]. The relationship between restorative experiences and landscape preferences is yet to be tested; therefore, the following hypothesis is proposed in this study:

H3. The restorative experience of the shopping mall environment positively impacts visitors' landscape preferences.

Biophilic Shopping Mall and Visitor Behavior Intention

Recent research on the commercial milieu suggests that the physical environment has a positive impact on visitors' behavior intentions [73]. Behavior intentions include revisit intentions, the intention to recommend the mall to others, and payment intentions [74,75]. Previous research has shown that visitor attitudes directly influence behavior intentions, with customer attitudes reflected through preferred choices [76]. Rosenbaum et al. explored visitors' behavior intentions by linking restorative experiences and transformative servicescapes in shopping malls [30]. The findings suggest that landscapes, green efforts, and furniture that encourage socialization and relaxation not only contribute to perceptions of the restorative qualities of malls but also have a direct, positive relationship with visitors' revisit intentions and the intention to recommend the mall to others [73].

Based on all the above theoretical perspectives, it is deemed that the four concepts, namely BD, landscape preference, restorative experience, and behavior intentions seem to be working in synergy in the shopping mall environment. However, it is not clear as to how this can be achieved. Therefore, the following hypothesis is further developed in this study:

H4a. Behavior intentions of shopping mall visitors are positively impacted by the integration of BD.

H4. Landscape preferences positively impacted the behavior intentions of BSM visitors.

H4b. The restorative experience positively impacted the behavior intentions of BSM visitors.

Conceptual Model

Based on the above discussion and hypothesis, a conceptual model is proposed in this study, as illustrated in Figure 1.

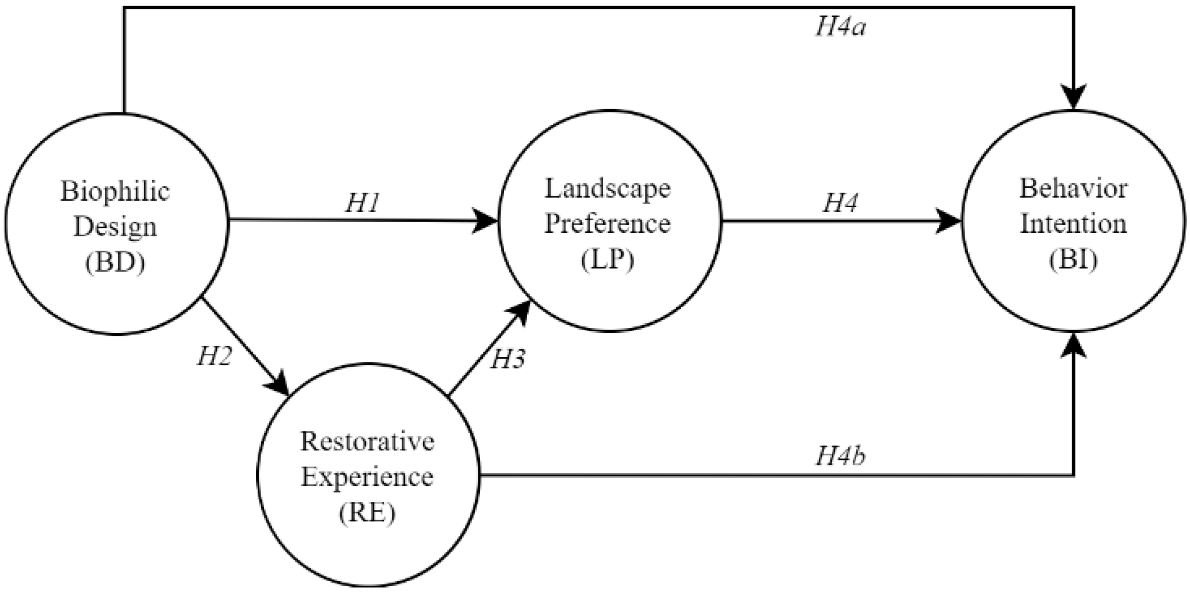

Figure 1. Conceptual model.

METHODOLOGY

Measurement Scale and Questionnaire Design

This study employed a questionnaire survey of quantitative design to lead the research procedure. The measurement scales from previous studies were used, and a self-administered BSM questionnaire was developed. It consists of five parts, namely the four components in descending order being the biophilic design (BD), landscape preference (LP), restorative experiences (RE), and behavior intentions (BI), as well as the sociodemographic section. The question design was adapted from the biophilic design perception [21,26], landscape preference matrix [60,77], short version of the perceived restorative scale [47,78], and behavior intentions [79,80] for structural and question sources (Table 1). The Chinese version of the questionnaire was used in this study, and responses collected on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Photographs were utilized as part of the questionnaire to aid the general comprehension of the participants; they were considered appropriate for preference studies due to their excellent performance in capturing information through images, which can ensure that each respondent has the same consistent environmental stimuli [60]. Each respondent is asked to look at a photo stimulus around which to rate the score, and each response will be used to obtain the quantitative results of environmental perception qualities and behavior related to the introduction of BD. A pilot test was then conducted to verify the clarity of the content as well as the reliability and validity of the measure.

Table 1. Results of the measurement model (n = 427).

Construct/Measures		Mean (SD)	Outer-loadings	*P*-value	Cronbach's α	CR	AVE
Biophilic Design (Cronbach's α = 0.939; CR = 0.94; AVE = 0.796)							
Environmental Interaction & Place Connection	The environment makes me feel in awe. (EIPC1)	3.021 (1.322)	0.782	< 0.001	0.863	0.897	0.593
	There are indigenous materials to increase a sense of connection with the place. (EIPC2)	3.054 (1.287)	0.758	< 0.001			
	The landscape here allows me to have a sense of historical connection and triggers the feeling of personal experience. (EIPC3)	2.956 (1.304)	0.76	< 0.001			
	The landscape here allows me to have a sense of connection with culture and generate identity. (EIPC4)	2.892 (1.363)	0.768	< 0.001			
	The environment is worth exploring and discovering here. (EIPC5)	3.052 (1.279)	0.773	< 0.001			
	The environment triggers a strong sense of attachment to nature. (EIPC6)	3.03 (1.277)	0.778	< 0.001			
Environmental Stimuli & Visual Attraction	There are attractive designs of fractal structures here. (ESVA1)	3.026 (1.223)	0.706	< 0.001	0.806	0.866	0.564
	There are pools of connected light attraction here. (ESVA2)	3.091 (1.237)	0.761	< 0.001			
	There is a central focal point here. (ESVA3)	3.098 (1.304)	0.759	< 0.001			
	The richness in environmental information stimulates imagination here. (ESVA4)	3.061 (1.292)	0.773	< 0.001			
	There are complementary contrasts here. (ESVA5)	3.068 (1.31)	0.754	< 0.001			
Natural Feature Design	There are designs that simulate the shape of plants here. (NFD1)	2.981 (1.293)	0.729	< 0.001	0.822	0.875	0.584
	There are designs that simulate the appearance of trees here. (NFD2)	3.084 (1.312)	0.743	< 0.001			
	There are actual plants here. (NFD3)	3.119 (1.354)	0.729	< 0.001			
	There are designs that imitate the biological forms in general here. (NFD4)	3.075 (1.284)	0.8	< 0.001			
	There are shapes designed to evoke associations of natural features here. (NFD5)	3.15 (1.246)	0.816	< 0.001			
Aesthetic Quality	There are natural lines here. (AQ1)	3.194 (1.292)	0.712	< 0.001	0.747	0.841	0.569
	There are senses of hierarchy and appropriate size ratios here. (AQ2)	3.098 (1.267)	0.793	< 0.001			
	There are senses of openness and visual extension here. (AQ3)	3.112 (1.303)	0.741	< 0.001			
	The structures and facilities (inorganic) and nature (organic) match well here. (AQ4)	3.11 (1.243)	0.77	< 0.001			

Table 1. *Cont.*

Construct/Measures		Mean (SD)	Outer-loadings	*P*-value	Cronbach's α	CR	AVE
Landscape Preference (Cronbach's α = 0.914; CR = 0.921; AVE = 0.745)							
Coherence	The landscape is continuous here. (Ch1)	3.082 (1.29)	0.821	< 0.001	0.678	0.823	0.608
	The landscape is repeated here. (Ch2)	3.19 (1.256)	0.709	< 0.001			
	The landscape is hierarchical here. (Ch3)	3.105 (1.256)	0.805	< 0.001			
Legibility	The landscape elements can be easily distinguished here. (L1)	3.131 (1.261)	0.806	< 0.001	0.715	0.84	0.637
	The landscape is not easily disoriented here. (L2)	3.129 (1.264)	0.802	< 0.001			
	There are prominent or conspicuous landmarks here. (L3)	3.119 (1.268)	0.787	< 0.001			
Complexity	The landscape is intricate here. (Cp1)	3.059 (1.294)	0.764	< 0.001	0.771	0.853	0.593
	The landscape is rich here. (Cp2)	3.119 (1.242)	0.79	< 0.001			
	The landscape is irregular here. (Cp3)	3.141 (1.258)	0.739	< 0.001			
	The landscape is varied here. (Cp4)	3.002 (1.298)	0.786	< 0.001			
Mystery	The landscape encourages people to venture forth here. (M1)	3.044 (1.29)	0.754	< 0.001	0.754	0.844	0.575
	The landscape is meandering here. (M2)	3.061 (1.238)	0.756	< 0.001			
	The landscape is deep and mysterious here. (M3)	3.04 (1.302)	0.768	< 0.001			
	The landscape is novelty here. (M4)	3.052 (1.279)	0.755	< 0.001			
Restoration Experience (Cronbach's α = 0.942; CR = 0.953; AVE = 0.835)							
Being away	Being here is an escape experience. (BA1)	3.023 (1.343)	0.77	< 0.001	0.841	0.887	0.611
	Spending time here gives me a break from my day-to-day routine. (BA2)	3.059 (1.289)	0.793	< 0.001			
	It is a place to get away from it all. (BA3)	3.042 (1.332)	0.799	< 0.001			
	Being here helps me to relax my focus on getting things done. (BA4)	3.11 (1.293)	0.803	< 0.001			
	Coming here helps me to get relief from unwanted demands on my attention. (BA5)	3.035 (1.292)	0.743	< 0.001			
Extent	The surrounding is consistent and harmonious here. (E1)	3.016 (1.246)	0.796	< 0.001	0.754	0.844	0.576
	I am quite curious about the unseen parts here. (E2)	3.077 (1.275)	0.728	< 0.001			
	Being here extends good associations here. (E3)	3.082 (1.325)	0.74	< 0.001			
	Things and activities are orderly here. (E4)	3.023 (1.289)	0.769	< 0.001			

Table 1. *Cont.*

Construct/Measures		Mean (SD)	Outer-loadings	*P*-value	Cronbach's α	CR	AVE
Fascination	The setting has fascinating qualities. (F1)	3.145 (1.296)	0.78	< 0.001	0.795	0.867	0.619
	There is much to explore and discover here. (F2)	3.103 (1.285)	0.775	< 0.001			
	The setting is fascinating. (F3)	3.091 (1.267)	0.777	< 0.001			
	I want to spend more time looking at the surroundings. (F4)	3.059 (1.289)	0.816	< 0.001			
Compatibility	I can do things I like here. (C1)	3.066 (1.245)	0.755	< 0.001	0.831	0.881	0.596
	Being here suits my personality. (C2)	3.007 (1.267)	0.762	< 0.001			
	I have a sense that I belong here. (C3)	2.995 (1.271)	0.798	< 0.001			
	I can find ways to enjoy myself here. (C4)	3.07 (1.239)	0.763	< 0.001			
	I have a sense of oneness with this setting. (C5)	3.094 (1.31)	0.781	< 0.001			
Behavior Intention (Cronbach's α = 0.836; CR = 0.929; AVE = 0.868)							
Revisit Intention	I will plan to come back to this shopping mall in the future. (RvI1)	3.136 (1.245)	0.833	< 0.001	0.742	0.853	0.66
	I will consider this place as my first choice when I select shopping mall next time. (RvI2)	3.026 (1.29)	0.76	< 0.001			
	I will come back to this shopping mall in the next few years more than I do right now. (RvI3)	3.033 (1.276)	0.843	< 0.001			
Recommend Intention	I will say positive things about this shopping mall to other people. (RmI1)	3.03 (1.295)	0.763	< 0.001	0.719	0.843	0.641
	I will recommend this shopping mall to those who seek my advice. (RmI2)	3.044 (1.268)	0.809	< 0.001			
	I will encourage my relatives and friends to visit this mall. (RmI3)	3.061 (1.262)	0.828	< 0.001			

Notes: CR = composite reliability, AVE = average variance extracted. Five-point Likert-type scale from 1 being strongly disagree to 5 being strongly agree.

Research Site and Data Collection

This study selected Shanghai Nanxiang Impression City Mega in China as the research site. The purposeful use of BD elements in this mall, which revolves around designing its open area as a “third place” away from home or work, provides visitors with landscapes and facilities that introduce natural features, simulate natural shapes or forms, and allow for a natural contact experience while engaging in public activities and socializing. According to the definition of BSMs, which was established in this study, this mall satisfies the requirements and thus has been chosen as the research site.

This study utilized a cross-sectional method during the data collection phase by distributing the photo questionnaire to mall visitors at the selected research site. An onsite data collection process was conducted for this study during weekdays and weekends from April 14th to May 29th. Two trained interviewers waited in two specific areas around the main entrances beside the central atrium. A systematic random sampling technique without formulating any specific procedures in terms of sample allocation was implemented to approach a visitor over the age of 18 walking through these particular areas every ten minutes. If anyone declined to participate, the next individual passing through the area would be selected. The questionnaire was distributed on a digital platform, namely Wenjuanxing, and was set up in a manner that a single respondent (device) could only answer once and that all questions were compulsory. Within the aforementioned time horizon, a total of 523 questionnaires were collected. Once the initial data collection had been completed, a screening of invalid questionnaires was then conducted with the following criteria: The answers are all consistent; the answer has obvious rules; the answer time is too short or too long, or; the data is deemed as a multivariate outlier. Through the screening, a total of 96 questionnaires were detected to be invalid.

Ultimately, 427 valid questionnaires were determined. In other words, the validity rate of the questionnaire was 81.64%. The descriptive statistics for respondents are shown in Table 2.

RESULTS

This study used the partial least squares-structural equation modeling (PLS-SEM) method to estimate the hypothesis model and selected Smart PLS 4.0.9.2 as the chosen software to analyze the data. Currently, PLS-SEM is gaining popularity in landscape research because of its ability to handle non-normal data and test the predictive and explanatory power of complex models [81,82], particularly when developing results that have managerial implements and impact commercial practices [83]. PLS-SEM was chosen for this study for four reasons: The model is exploratory in nature and is not a validation of an existing model; PLS-SEM predicts key target structures; PLS-SEM is able to estimate complex models with relatively small sample sizes better than traditional research methods; PLS-SEM is able to have good predictive and explanatory power and draw reliable conclusions [81].

This study used PLS-SEM for a two-step analysis method, followed by Bollen–Stine-type bootstrapping and 5000 resamples were adopted for the goodness of model fit measure.

Table 2. Sample characteristics (n = 427).

Items	Frequency	(%)
Gender		
Males	202	47.2
Females	225	52.7
Age		
18–20	22	5.2
21–30	146	34.2
31–40	165	38.6
41–50	63	14.8
Over 50	31	7.3
Education		
High school and below	97	22.7
College or university	250	58.5
Postgraduate and above	80	18.7
Monthly income (¥)		
Under 3000	58	13.6
3000–6000	113	26.5
6000–10000	156	36.5
Over 10000	100	23.4
Average length of stay in public areas		
Within 10 min	86	20.1
10–30 min	155	36.3
30–60 min	165	38.6
More than 60 min	21	4.9

Measurement Model Assessment

Firstly, a confirmatory factor analysis (CFA) was conducted to test the measurement model. The results are shown in Table 1.

- The factor outer loadings (λ-values) for each variable ranged from 0.706–0.843, each variable had values above 0.70 (p-value < 0.001), which is in line with the requirements of the study;
- The composite reliabilities (CR) values for each construct ranged from 0.823–0.897 and the average variance extracted (AVE) for each construct ranged from 0.564 to 0.66, meeting the criterion of greater than 0.7 and 0.5;

- All Cronbach's α value was above 0.7 in the range of 0.715 to 0.863, except for coherence (Ch = 0.678) which was nearly 0.7. For the explorative model, a value greater than 0.6 is considered acceptable [84].

The reliability and convergent validity were more satisfactory according to Fornell and Larcker criteria [84]. The discriminant validity tests (see Table 3) were higher for each indicator and its associated latent constructs than its loadings on all remaining latent variables. Based on the assessment study for cross-loadings, the differential validity of this study for SEM analysis was acceptable [85].

In the endogenous latent variable test (Table 4), the coefficient of determination (R^2) was 0.866 for LP, 0.842 for RE, and 0.816 for BI, with all R^2 figures well above the values proposed by Cohen, indicating that more than 40% of the structure could be explained [86]. Furthermore, in the model fit analysis, the normed fit index (NFI) was 0.911 with a value greater than 0.9, and the standardized root mean square residual (SRMR) of the measurement model was 0.061, with values less than 0.10 or 0.08 considered a good fit and suitable for avoiding model misspecification [84,87].

Structural Model Assessment

Figure 2 and Table 4 depict the assessment results of the structural model. The statistical findings suggest that the six proposed and evaluated hypotheses were supported.

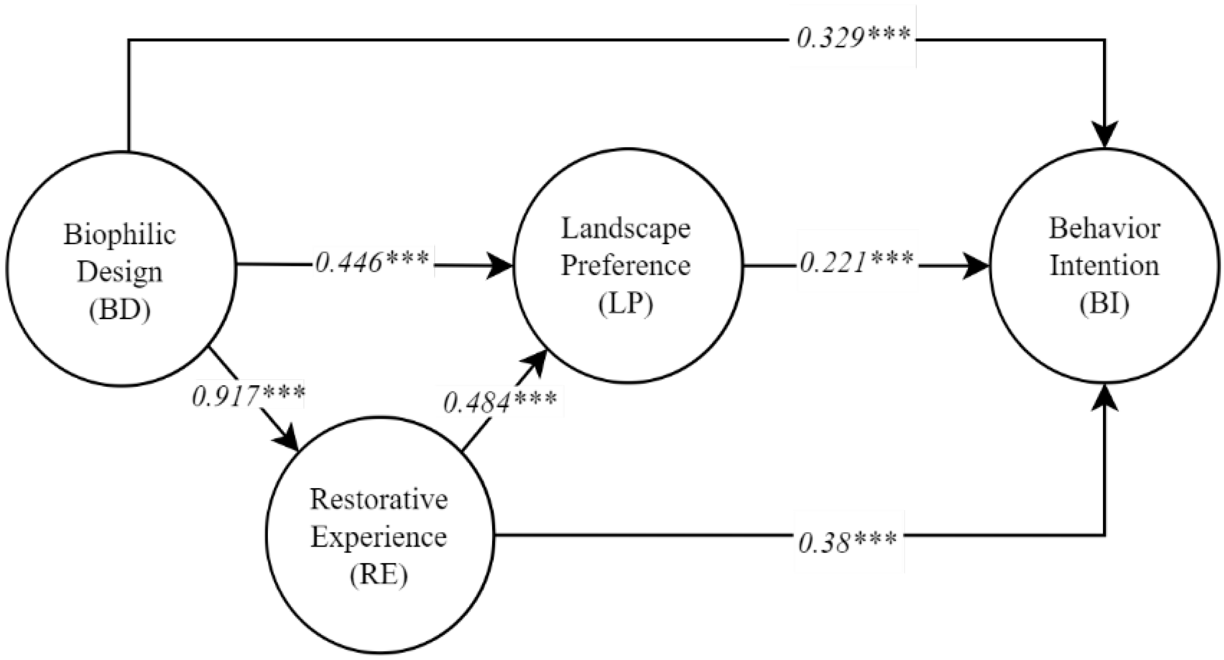

Figure 2. Structural model.

Table 3. Cross-loading and discriminant assessment.

Variable	EIPC	ESVA	NFD	AQ	Ch	L	Cp	M	BA	E	F	C	RvI	RmI
EIPC1	**0.782**	0.522	0.534	0.521	0.541	0.481	0.581	0.624	0.623	0.530	0.566	0.585	0.613	0.565
EIPC2	**0.758**	0.493	0.568	0.509	0.562	0.506	0.595	0.603	0.584	0.554	0.607	0.581	0.572	0.523
EIPC3	**0.760**	0.539	0.589	0.521	0.564	0.482	0.550	0.583	0.582	0.580	0.592	0.624	0.581	0.567
EIPC4	**0.768**	0.581	0.570	0.549	0.527	0.514	0.581	0.572	0.596	0.574	0.577	0.611	0.582	0.550
EIPC5	**0.773**	0.616	0.599	0.559	0.613	0.577	0.646	0.598	0.634	0.658	0.618	0.639	0.645	0.616
EIPC6	**0.778**	0.615	0.636	0.580	0.595	0.540	0.651	0.643	0.642	0.612	0.634	0.651	0.591	0.601
ESVA1	0.519	**0.706**	0.515	0.491	0.534	0.491	0.524	0.496	0.523	0.497	0.488	0.524	0.478	0.486
ESVA2	0.554	**0.761**	0.587	0.527	0.544	0.571	0.570	0.522	0.577	0.542	0.550	0.558	0.552	0.509
ESVA3	0.535	**0.759**	0.596	0.495	0.529	0.552	0.528	0.505	0.591	0.539	0.537	0.564	0.545	0.514
ESVA4	0.580	**0.773**	0.580	0.539	0.543	0.518	0.557	0.536	0.592	0.557	0.575	0.591	0.549	0.528
ESVA5	0.553	**0.754**	0.616	0.520	0.557	0.570	0.582	0.546	0.543	0.532	0.536	0.577	0.607	0.541
NFD1	0.496	0.524	**0.729**	0.483	0.470	0.481	0.463	0.475	0.487	0.480	0.503	0.527	0.517	0.449
NFD2	0.518	0.556	**0.743**	0.501	0.506	0.511	0.551	0.506	0.542	0.512	0.550	0.538	0.532	0.492
NFD3	0.566	0.550	**0.729**	0.535	0.554	0.523	0.552	0.564	0.590	0.550	0.556	0.596	0.556	0.514
NFD4	0.656	0.630	**0.799**	0.615	0.597	0.572	0.621	0.625	0.637	0.592	0.615	0.616	0.609	0.609
NFD5	0.641	0.674	**0.816**	0.668	0.673	0.619	0.653	0.623	0.627	0.620	0.691	0.652	0.621	0.621
AQ1	0.475	0.496	0.503	**0.712**	0.494	0.489	0.473	0.441	0.494	0.489	0.494	0.534	0.482	0.476
AQ2	0.555	0.522	0.585	**0.794**	0.581	0.489	0.550	0.502	0.572	0.542	0.560	0.579	0.530	0.525
AQ3	0.530	0.520	0.538	**0.741**	0.527	0.504	0.526	0.479	0.516	0.528	0.506	0.543	0.533	0.538
AQ4	0.554	0.531	0.600	**0.770**	0.521	0.530	0.550	0.527	0.534	0.579	0.560	0.619	0.502	0.539
Ch1	0.601	0.602	0.614	0.584	**0.821**	0.574	0.586	0.578	0.583	0.581	0.594	0.596	0.587	0.573
Ch2	0.517	0.486	0.501	0.467	**0.709**	0.452	0.469	0.448	0.485	0.480	0.481	0.484	0.472	0.400
Ch3	0.602	0.590	0.604	0.587	**0.805**	0.563	0.614	0.618	0.633	0.626	0.631	0.595	0.597	0.586
L1	0.558	0.586	0.605	0.543	0.588	**0.806**	0.611	0.564	0.642	0.594	0.658	0.640	0.595	0.575
L2	0.521	0.579	0.547	0.550	0.528	**0.802**	0.557	0.534	0.574	0.561	0.580	0.590	0.529	0.518
L3	0.529	0.559	0.549	0.502	0.518	**0.787**	0.546	0.542	0.562	0.547	0.546	0.550	0.512	0.551
Cp1	0.596	0.564	0.563	0.536	0.586	0.529	**0.764**	0.595	0.578	0.553	0.574	0.577	0.580	0.520
Cp2	0.584	0.581	0.603	0.532	0.574	0.617	**0.790**	0.595	0.593	0.619	0.624	0.600	0.622	0.582
Cp3	0.575	0.536	0.533	0.496	0.522	0.533	**0.739**	0.540	0.544	0.513	0.524	0.530	0.509	0.519
Cp4	0.652	0.586	0.602	0.581	0.529	0.526	**0.786**	0.622	0.609	0.587	0.604	0.631	0.602	0.568

Table 3. *Cont.*

Variable	EIPC	ESVA	NFD	AQ	Ch	L	Cp	M	BA	E	F	C	RvI	RmI
M1	0.571	0.503	0.524	0.432	0.526	0.524	0.565	**0.754**	0.569	0.585	0.565	0.540	0.538	0.519
M2	0.597	0.499	0.587	0.532	0.518	0.488	0.608	**0.756**	0.552	0.502	0.556	0.563	0.567	0.498
M3	0.614	0.559	0.567	0.492	0.567	0.525	0.607	**0.768**	0.600	0.536	0.546	0.580	0.582	0.523
M4	0.595	0.544	0.552	0.506	0.539	0.543	0.537	**0.755**	0.595	0.542	0.570	0.596	0.547	0.545
BA1	0.643	0.588	0.589	0.557	0.560	0.557	0.581	0.600	**0.770**	0.630	0.571	0.614	0.629	0.584
BA2	0.634	0.588	0.586	0.559	0.542	0.560	0.578	0.596	**0.793**	0.573	0.585	0.635	0.597	0.546
BA3	0.597	0.593	0.611	0.536	0.566	0.610	0.609	0.598	**0.799**	0.604	0.609	0.669	0.627	0.573
BA4	0.644	0.617	0.622	0.561	0.633	0.624	0.621	0.629	**0.803**	0.645	0.640	0.668	0.635	0.632
BA5	0.582	0.556	0.553	0.529	0.555	0.553	0.561	0.561	**0.743**	0.622	0.577	0.622	0.566	0.562
E1	0.602	0.584	0.609	0.586	0.601	0.598	0.602	0.537	0.643	**0.796**	0.601	0.657	0.578	0.603
E2	0.573	0.549	0.514	0.492	0.558	0.526	0.567	0.545	0.588	**0.728**	0.578	0.598	0.557	0.529
E3	0.560	0.488	0.518	0.488	0.512	0.488	0.512	0.530	0.562	**0.740**	0.519	0.531	0.525	0.533
E4	0.572	0.533	0.551	0.581	0.527	0.540	0.556	0.554	0.589	**0.769**	0.557	0.593	0.563	0.529
F1	0.584	0.539	0.603	0.573	0.576	0.568	0.565	0.581	0.600	0.577	**0.780**	0.636	0.565	0.543
F2	0.579	0.550	0.593	0.516	0.566	0.551	0.601	0.562	0.551	0.567	**0.775**	0.603	0.566	0.505
F3	0.639	0.571	0.589	0.539	0.572	0.599	0.592	0.573	0.611	0.586	**0.777**	0.598	0.610	0.571
F4	0.647	0.594	0.631	0.583	0.596	0.629	0.622	0.603	0.637	0.611	**0.816**	0.639	0.587	0.570
C1	0.558	0.533	0.557	0.553	0.519	0.550	0.537	0.545	0.577	0.566	0.559	**0.755**	0.585	0.548
C2	0.580	0.600	0.604	0.632	0.539	0.619	0.606	0.575	0.626	0.622	0.623	**0.762**	0.623	0.564
C3	0.701	0.619	0.634	0.618	0.603	0.577	0.638	0.633	0.711	0.623	0.658	**0.798**	0.640	0.602
C4	0.626	0.577	0.578	0.536	0.527	0.536	0.548	0.532	0.619	0.624	0.576	**0.763**	0.582	0.571
C5	0.615	0.564	0.593	0.570	0.585	0.590	0.597	0.611	0.628	0.598	0.618	**0.781**	0.594	0.553
RvI1	0.653	0.618	0.629	0.580	0.604	0.593	0.640	0.629	0.661	0.596	0.623	0.655	**0.833**	0.594
RvI2	0.574	0.538	0.548	0.500	0.520	0.482	0.541	0.541	0.596	0.529	0.558	0.565	**0.759**	0.490
RvI3	0.660	0.617	0.633	0.570	0.608	0.586	0.647	0.622	0.646	0.655	0.620	0.685	**0.843**	0.602
RmI1	0.560	0.527	0.521	0.534	0.507	0.561	0.509	0.499	0.570	0.536	0.519	0.565	0.535	**0.763**
RmI2	0.595	0.519	0.580	0.521	0.527	0.547	0.577	0.541	0.580	0.563	0.575	0.562	0.541	**0.809**
RmI3	0.627	0.601	0.598	0.598	0.584	0.543	0.619	0.607	0.630	0.636	0.575	0.636	0.590	**0.828**

Note: Bold front—each indicator's load.

Table 4. Results of PLS-SEM analysis.

Hypotheses	Path	β-values	Result	R^2	f^2	95% CI	Model fit
H1	BD → LP	0.466***	Supported	0.866	0.256	0.374, 0.556	SRMR = 0.061
H3	RE → LP	0.484***	Supported	0.866	0.277	0.395, 0.574	NFI = 0.911
H2	BD → RE	0.917***	Supported	0.842	5.313	0.903, 0.932	
H4	LP → BI	0.221***	Supported	0.816	0.036	0.099, 0.339	
H4a	BD → BI	0.329***	Supported	0.816	0.074	0.207, 0.455	
H4b	RE → BI	0.38***	Supported	0.816	0.097	0.248, 0.511	

Notes: SRMR—standardized root mean square residual, NFI—normed fit index. *p < 0.1, **p < 0.05, ***p < 0.001.

The standardized path coefficient values between BD and LP and between BD and RE were 0.466 (p = 0.000) and 0.917 (p = 0.000) respectively, indicating that BD in the mall had a direct and significant effect on the visitors' perception of landscape preference as well as restorative experience at a confidence level of 0.05. Therefore, H1 and H2 are supported. The standardized path coefficient value between RE and LP was 0.484 (p = 0.000), indicating that restorative experience had a significant direct effect on the landscape preference of mall visitors at the 0.05 confidence level. Therefore, H3 was supported.

Similarly, the path coefficient values between LP, BD, RE, and BI were 0.221, 0.329, and 0.38 respectively, indicating that all three concepts have a significant and direct effect on the behavior intention of mall visitors. Therefore H4, H4a, and H4b are also supported at the 0.05 confidence level.

In the mediating relationship tests, as shown in Table 5, both direct and indirect effects hold simultaneously for all structures and in the same direction, i.e., simultaneously positive. Of these, the Variance Accounted For (VAF) value of RE in BD and LP was 48.79% (t = 10.492); The VAF value of RE in BD and BI was 50.8% (t = 10.492); The VAF values for LP in BD and BI, and VAF values for LP in RE and BI were 23.84% (t = 3.339) and 21.83% (t = 3.444) respectively. All VAF values were between 20% and 80% indicating complementary partial mediation [88].

Table 5. Mediation effect test result.

IV	Me	DV	Direct effect	Indirect effect	Total effect	VAF	Result	Mediation
BD	RE	LP	0.466*** (10.171)	0.444*** (10.492)	0.91	48.79%	Supported	Partial
BD	LP	BI	0.329*** (5.176)	0.103** (3.339)	0.432	23.84%	Supported	Partial
BD	RE	BI	0.329*** (5.176)	0.349*** (5.679)	0.687	50.8%	Supported	Partial
RE	LP	BI	0.383* (5.75)	0.107** (3.444)	0.49	21.83%	Supported	Partial

Notes: IV—Independent variable, DV—Dependent variable, Me—Mediator variable. In parentheses are t-values. *p < 0.1, **p < 0.05, ***p < 0.001.

DISCUSSION

Prior research has noticed an increasing emphasis on interactive experiences with nature in commercial environments, but the impact of BD as a considerable method to bring nature back remains an unexplored area of study [27]. This study fills the research gap through empirical investigation by proposing a conceptual framework for testing public acceptance and adaptability to the landscape provided by BD, giving experience to quantified measurement development. Based on the objectives and research questions, this study draws the following findings from the path analysis.

The results indicated that shopping mall visitors' landscape preferences are positively and significantly impacted by the introduction of BD elements (supported by H1), which indeed provides evidence for a more popular shopping mall environment. This study provides justifying support for the positive views of BD [20,24]. In addition, this study comprehensively explores the impact of BD elements rather than just the "green dimension" (e.g., as plants), as other elements of BD and subordinate attributes (e.g., local materials, repetitive patterns, natural lines, spatial focus) also play a curial role in the visitors' perception of landscape preferences, extending the views of previous studies [24]. Simultaneously, the result shows that introducing BD elements has positively impacted the shopping mall visitors' restorativeness perception (supported by H2), which is consistent with the research results of Rosenbaum et al. [23] and Nalbantlar et al. [16]. This implies that BD can provide a restorative experience in a shopping mall environment. The healing effect brought by this restorative experience can further stimulate the landscape preferences and future behavioral intentions of BSMs, additionally enhancing the attractiveness of the venue (RE has a partial mediating effect on 48.79% BD for LP and 50.8% BD for BI).

The researchers of this study have found that landscape preferences are positively influenced by restorativeness perception (supported by H3), i.e., the higher the level of restorativeness perception, the stronger the landscape preference. The result supports the view of Van den Berg et al. [64] and refutes Gao et al. [69], providing evidence of statistical conclusions in urban commercial environments [68,69]. It is worth noting that the impact of BD on RE is greater than that of LP (supported by the fact that H2 has a larger path coefficient = 0.917 than H1 and H3; H1 has an approximate path coefficients = 0.446 to 0.484 of H3), implying that BD is relatively of greater significance for restorativeness than visual aesthetic perception in the environmental perception of shopping mall visitors. Moreover, the findings of this study expand the breadth of shopping mall preference results of Hami [24]; that is, if the environment is able to stimulate visitors' restorative experience by implementing other attributes from BD elements regardless of using green plants, it can gain preference as well.

In addition, although there are many reasons that affect mall behavior intention, this study demonstrates that the various efforts undertaken by designers to introduce nature into mall landscape design can actively improve visitors' behavior intention (supported by H4, H4a, and H4b). Hence, this study provides justifying support for the positive impact of BD [30,31]. The integration of BD can directly and indirectly significantly affect the intention of mall visitors to revisit and recommend the mall to others.

The results indicate that four concepts of this framework, namely BD, LP, RE, and BI, are working together. In this regard, the authors believe that the results of this study can be extended to other public amenities, such as museums, libraries, recreational centers, or gymnasiums, to provide visitors with unique experiences, gain attraction among the general public, and enhance competitiveness between public urban spaces.

Practical Implications

The study presents new perspectives for transforming shopping malls into urban public places that emphasize experiential and social features, with the goal of improving the sustainability of malls while enhancing public health and well-being. Compared to traditional shopping mall landscapes, BD provides a restorative experience, which signifies that BD is able to stimulate the restorative potential of shopping malls. This is not an independent service. Visitors who come to the mall without specific health benefits can also experience staying away from life and work, in places such as urban parks or green spaces, to alleviate mental fatigue and tension.

Although not all public visitors are familiar with the concept of BD, a number of researchers are concerned that the integration of BD may even trigger a sense of dread in certain people [27]. Nevertheless, the integration of BD into the landscaping of shopping malls and its associated beneficial experience will have a significant positive impact on the visual aesthetic perception and behavior intentions of mall visitors. Therefore, the authors encourage the development of more approaches and methods to apply different attributes of BD elements and attributes combinations, rather than merely green plants, to create varying landscapes and further enrich the shopping malls experience.

With regards to shopping mall marketing, given the positive effects of BD, RE, and LP on behavior intention, there is reason to believe that researchers and managers will continue to maintain confidence in the frequency of future visitor visits, staying period in shopping malls, and associated economic impacts, even at increased economic costs. This also provides a good opportunity for marketing. As much, the implementation of BD is highly encouraged not only in newly built shopping malls but also in present shopping malls or other types of commercial spaces that need to be revitalized in order to win the favor of the public, regardless of whether these spaces target high-end or mid- to low-end visitors [25,30].

The rejuvenation of existing space through the application of BD would also strengthen the degree of the placemaking in current public realms. This is due to the fact that placemaking relies on the public space's potential to create an environment that optimizes people's satisfaction, quality of life, and well-being. Taking into consideration the aforementioned implications, incorporating BD into shopping malls would substantially increase their sustainability with respect to environmental safeguarding and monetary resilience.

Furthermore, the continuous use of BD not only promotes further integration and innovation of BSMs but also strengthens people's awareness and understanding of BD, which will play a social education role in the public's knowledge of public urban areas. This is also another significant practical implication that many researchers have expressed concern with [16], and the continual application of BD will help people better understand the relationship between BD, the shopping mall environment, and their own health.

Limitation and Future Research

There are several limitations to this study. Research on the BD commercial environment and landscape preferences of shopping malls is still in its early stages. Existing research is still focused on the general impact of BD or lack thereof, and comprehensive measurement methodologies are still in their exploratory phase. Furthermore, since BD is currently implemented differently in each shopping mall, no specific BD configuration is continuously used; in other words, a standardized BD typology has not yet to exist. Therefore, the authors chose not to analyze specific elements or attributes but opted instead to measure the impact of BD as a whole. Future research could employ surveys to determine the differential influence of integrating specific elements or attributes.

Additionally, BSM practices are widespread in different regions. This study has only chosen a single archetypal application in Shanghai, China, as the study site and thus cannot evaluate whether the influence of BD differs across regions and cultures. Future research should broaden the scope of the study to compare the effects of regional and cultural factors on preferences and behavior intentions.

CONCLUSION

As the emphasis on environmental interactive experience in commercial space intensify and individuals become ever more conscious of and realize the importance of public health and well-being, designers and stakeholders have advocated the application and development of biophilic design in commercial environments. The recent adoption of BD in retail space has a definite upward trajectory. This study examined the influence of introducing biophilic design elements into the shopping mall environment from the user's perspective. Specifically, this study analyzed the perception of biophilic design in relation to the landscape preferences of mall visitors and assessed visitor intention, examining the impact, extent, and role of the biophilic design elements towards said aspect.

The results indicate that the biophilic design has a significant positive impact on visitors' landscape preference and future behavior, which encompasses revisiting and recommending. Essentially, the design response of BD is informed by the human need for proximity to nature and responds to the inherent paucity of green space in today's existing shopping malls. The biophilic design approach supports the feasibility of creating 'healthy places' with restorative experiences in public spaces within the shopping mall environment. The study of BD would not only benefit the design morphology of new shopping malls, but it can also be implemented for the rehabilitation of diminishing existing malls and other commercial spaces, leading to stronger placemaking in a particular urban area. Hance, the introduction of biophilic design would vastly improve the sustainability of shopping malls in terms of environmental protection and economic viability. In summary, this study has provided evidence with regards to the popularity of biophilic shopping malls, contributed knowledge of public response towards biophilic design, provided experience for the development of measurement tools, and helped the research on restorative servicescapes through the restoration potential of biophilic shopping malls.

DATA AVAILABILITY

The dataset of the study is available from the authors upon reasonable request.

AUTHOR CONTRIBUTIONS

This paper was written by Ting Cheng with input and supervision from Prof. Dr. Azizan Marzuki.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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How to cite this article:
Cheng T, Marzuki A. Investigating the Influence of Introducing Biophilic Elements into the Shopping Mall Environment: Perception of Public Visitors. J Sustain Res. 2023;5(3):e230011. https://doi.org/10.20900/jsr20230011