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The Influence of Soundscapes and Visual Landscape Evaluation in Taoist Temples on Spatial Worship Experience

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Abstract

This study investigates the soundscape of Taoist temples and its influence on visitors' worship experiences, integrating auditory perception, visual landscape evaluation, and emotional and experiential responses into a comprehensive analytical framework. Based on questionnaire surveys conducted in multiple Taoist temples, the study examines how different sound sources affect soundscape evaluation and how this evaluation shapes perceptual and experiential outcomes. The results indicate that Taoist ritual sounds (e.g., ritual music and chanting) play a significant positive role in shaping visitors' soundscape evaluation, whereas artificial sounds related to general human activities show a negative effect. Soundscape evaluation is found to significantly influence visual landscape evaluation and emotional perception, and further contributes to visitors' overall temple experience. Visual landscape evaluation is found to partially mediate the relationship between soundscape evaluation and emotional perception, while emotional perception further mediates the relationship between soundscape evaluation and temple experience. A comparison across sensory dimensions suggests that soundscape evaluation exerts a relatively stronger influence on temple experience than visual landscape evaluation, highlighting the important role of auditory experience in religious and cultural environments. The study also identifies a synergistic interaction between auditory and visual evaluation, indicating that multisensory integration can enhance the overall experiential quality of Taoist temples. Overall, this research provides empirical insights into the role of soundscapes in religious spaces and offers practical implications for the design, management, and optimization of multisensory environments in Taoist temples.

Keywords: Taoism; soundscapes and visual landscape; spatial worship experience; structural equation modeling

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1. Introduction

Soundscape research originated in the 1970s with the pioneering work of R. Murray Schafer, who defined a soundscape as any acoustic field that can be studied and emphasized that it consists of sound events rather than visual objects, proposing the concept of "tuning the world" through acoustic design [1]. This perspective facilitated a shift in soundscape research from noise control toward ecological and cultural dimensions. The International Organization for Standardization subsequently provided a formal definition, describing soundscape as the acoustic environment as perceived, experienced, and understood by

people in a given context [2]. This standard further introduced a conceptual framework incorporating key elements such as context, sound sources, and auditory perception, thereby laying the foundation for subsequent empirical studies. Soundscape ecology further expanded this perspective by proposing that soundscapes consist of biophony, geophony, and anthropophony, forming distinctive spatiotemporal patterns and establishing a parallel framework with landscape ecology [3]. The distinctions among distant soundscape, proximal soundscape, and perceived soundscape further clarify the boundary between objective acoustic phenomena and subjective cognition [4]. At the perceptual level, soundscape descriptors are commonly organized within a two-dimensional model of pleasantness and eventfulness, supplemented by appropriateness as a third dimension, providing a basis for predictive modeling [5]. Over more than fifty years of development, soundscape research has evolved from foundational definitions to applications in well-being, environmental planning, and cultural heritage conservation [6], with a paradigm shift from noise control to positive soundscape planning, offering new pathways for applications in heritage spaces [7].

The construction of religious rituals and sacred spaces is inherently a multisensory process. By engaging multiple senses simultaneously—or through strategies of sensory deprivation and overload—ritual practices generate a strong sense of liminality, thereby evoking participants' evaluation of the "sacred" [8]. Within ritual performances, sensory experiences are often transformed into symbolic metaphors, guiding participants to shift their attention from physical sensations to ritual actions, and ultimately toward identification with the belief systems and social relations embedded within them [9]. With the evolution of modern urban environments, traditional religious sites located in high-density contexts inevitably develop complex sensory interactions with surrounding communities. Taking Wong Tai Sin Temple as an example, the integration of ritual instrument sounds, chanting, and human voices creates a hybrid soundscape that provides both relaxation and novelty for worshippers and visitors. However, this form of sensory heritage also exists in dynamic interaction—and sometimes tension—with urban comfort conditions. Empirical interviews suggest that, compared with ritual sounds themselves, negative evaluations and potential conflicts are primarily associated with external environmental noise (e.g., traffic and crowd-related sounds) and olfactory factors such as incense burning [10].

In religious worship and spiritual experience, sound and music are not merely auxiliary elements but core media that convey emotion and materialize religious narratives [11]. Empirical studies indicate that music can establish an effective feedback mechanism, using spiritual stimulation to focus believers' attention on objects of faith and thereby induce or reinforce a transcendental sense of "sacred encounter" [12]. Furthermore, the social form of ritual practice significantly influences emotional outcomes. Compared with co-active rituals emphasizing individual introspection (e.g., collective meditation), interactive collective rituals involving higher levels of coordination (e.g., congregational chanting or singing) are more likely to elicit high-arousal positive emotions (such as joy) and flow states, whereas the former tend to foster low-arousal self-transcendent states such as tranquility and inspiration [13]. The depth of such extraordinary sensory experiences is shaped not only by external soundscape conditions but also by individual absorptive capacity and culturally embedded assumptions regarding the "porosity" of mental boundaries [14].

Within Taoist temples, specific soundscape configurations contribute to the construction of a "transcendent boundary" between everyday and sacred space [15]. Whether through chanting or the interweaving of bells and ritual instruments, the acoustic characteristics of Taoist ritual sounds directly reflect their underlying philosophical foundations. For instance, certain forms of ritual music employ stable rhythmic structures and specific modal systems to produce a serene and tranquil auditory quality. Such design not only facilitates

meditative states among practitioners but also serves functional purposes related to spiritual purification and the maintenance of social harmony [16]. In physical space, evaluations of temple soundscapes exhibit significant group differences and audiovisual interaction effects. Empirical research conducted at Laojun Cave indicates that Taoist priests' evaluations of soundscapes are strongly influenced by belief systems, activity types, social context, and spatial positioning. In contrast, ordinary visitors' acoustic comfort and physiological responses are significantly affected by Taoist ritual sounds, demonstrating clear preferences and measurable responses under conditions of high audiovisual congruence [17].

Compared with Western religious architecture, soundscape studies of Taoist temples reveal pronounced cultural differences. In Western churches and monasteries, architectural volume, reverberation time, and sound energy distribution are often deliberately designed to enhance the sacredness of music and chanting [18,19], while the symbolic meaning of sound itself is relatively less emphasized, relying more on physical acoustic conditions to shape spatial experience. In contrast, in Taoist temples, ritual sound sources (such as chanting and ritual instruments) not only perform musical functions but also carry rich religious symbolism and philosophical meaning, with their perceptual effects highly dependent on religious context and spatial order. These sound sources function as cultural symbolic sound sources, whose meanings are culturally encoded and interpreted through shared religious knowledge, ritual conventions, and spatial hierarchies. Unlike the Western paradigm that primarily emphasizes acoustic performance and architectural form, Eastern religious soundscapes rely more on symbolically meaningful sound events to construct sacred spatial experience. This indicates that the mechanism of soundscape formation in Eastern religious spaces is not dominated solely by physical acoustic parameters, but by culturally embedded symbolic sound sources interacting with spatial and ritual contexts. Therefore, investigating Taoist temple soundscapes from the perspective of cultural symbolic sound sources provides a distinctive research positioning and helps bridge the gap between acoustic design approaches and culturally grounded sensory experience. The soundscape within Taoist temples is not merely a physical accompaniment to ritual practice, but also a concrete expression of traditional Taoist natural aesthetics, profoundly influencing spatial evaluation and spiritual experience.

This study takes representative Taoist temples in China as the research context, focusing on the mechanisms linking soundscape evaluation and experiential outcomes in religious spaces. The research objectives are twofold: (1) to examine how different soundscape elements (e.g., ritual sounds, environmental background sounds, and human activity sounds) influence spatial experience and spiritual cognition through perceptual evaluations such as pleasantness, eventfulness, and appropriateness; and (2) to construct causal pathways among soundscape elements, perceptual dimensions, and experiential outcomes using structural equation modeling (SEM), and to quantify both direct and indirect effects among variables. The findings aim to address the lack of mechanistic and quantitative analysis in soundscape studies of religious architecture, and to provide theoretical and methodological support for optimizing acoustic environments and conserving cultural heritage in Taoist temples.

2. Theoretical Framework and Model Building

Soundscape evaluation is not merely a passive response to a single acoustic stimulus, but a complex cognitive-emotional process through which individuals integrate and interpret multiple sound elements within a specific spatial and cultural context. Prior research has shown that both the physical properties and informational characteristics of sound sources serve as critical foundations influencing soundscape evaluation [20,21]. Consequently, categorizing sound sources facilitates a deeper understanding of how different

auditory elements contribute to the formation of the overall soundscape [22]. ISO/TS 12913-2:2018 emphasizes that soundscape research should concurrently consider three core components—"people, acoustic environment, and context"—and that the characterization of the acoustic environment should include distinctions among sound source types [23]. Existing studies commonly classify sound sources into natural sounds, human sounds, and mechanical sounds, with evidence suggesting that these categories exert differentiated effects on soundscape evaluation. For example, in urban recreational spaces, natural sounds and human activity sounds are typically perceived positively, whereas mechanical sounds are more likely to generate negative evaluations [24].

Within Taoist temples—spaces distinguished by religious functions and cultural contexts—an additional category of Taoist ritual sounds, characterized by explicit cultural symbolism and ritual significance, plays an essential role in shaping spatial evaluation and experiential construction. Based on principal component analysis of sound source perception evaluations, this study categorizes sound elements in Taoist temples into four types: natural sounds, human sounds, mechanical sounds, and Taoist ritual sounds, and further investigates their influence mechanisms on soundscape evaluation. Accordingly, the following hypotheses are proposed:

HA1 (Hypothesis Group A): *Perceived natural sounds in Taoist temples have a direct effect on soundscape evaluation.*

HA2: *Perceived human sounds in Taoist temples have a direct effect on soundscape evaluation.*

HA3: *Perceived mechanical sounds in Taoist temples have a direct effect on soundscape evaluation.*

HA4: *Perceived Taoist ritual sounds in Taoist temples have a direct effect on soundscape evaluation.*

From a multisensory perspective, sound influences not only judgments of the acoustic environment but also visual cognitive processes. Previous research indicates that auditory information can modify or reinforce the interpretation of visual cues, thereby shaping overall environmental evaluation [25]. In natural scenic areas and tourism spaces, soundscapes have been shown to significantly affect evaluations of visual landscapes [26]. As a prototypical audiovisual composite cultural space, Taoist temples may exhibit soundscape characteristics that modulate spatial atmosphere and emotional states, consequently influencing visitors' overall evaluation of the visual environment. Therefore, this study proposes:

HB1 (Hypothesis Group B): *Soundscape evaluation in Taoist temples has a direct effect on visual landscape evaluation.*

From an experiential standpoint, soundscape and visual evaluations influence overall experience quality through emotional responses. Prior studies suggest that acoustic environmental quality is closely linked to individuals' emotional states, relaxation levels, and sense of pleasure [20]. In immersive environment research, emotional responses are considered key psychological mechanisms connecting environmental stimuli to immersive experiences. Accordingly, the following hypotheses are proposed:

HC1 (Hypothesis Group C): *Soundscape evaluation in Taoist temples has a direct effect on visitors' emotional responses.*

HC2: *Soundscape evaluation in Taoist temples has a direct effect on visitors' immersive experience.*

Within a multisensory interaction framework, visual landscapes also play a critical role in shaping emotional responses and immersive experiences. A high-quality visual

environment can enhance positive emotions and strengthen spatial immersion and overall experiential attractiveness [27–29]. Accordingly, the following hypotheses are proposed:

HD1 (Hypothesis Group D): *Visual landscape evaluation in Taoist temples has a direct effect on visitors' emotional responses.*

HD2: *Visual landscape evaluation in Taoist temples has a direct effect on visitors' immersive experience.*

Furthermore, emotional responses may act as key mediators between environmental perception and immersive experience. Positive emotional states can reinforce overall environmental evaluation and amplify the effects of both soundscape and visual stimuli on immersive experience. Therefore, this study proposes:

HE1 (Hypothesis Group E): *Visitors' emotional responses have a direct effect on their immersive experience in Taoist temples.*

Building on these direct effects, potential mediating mechanisms are further examined to explore how soundscape and visual evaluations jointly influence immersive experience through emotional pathways [30,31]. Accordingly, the following mediation hypotheses are proposed:

HF1 (Hypothesis Group F): *Visual landscape evaluation mediates the relationship between soundscape evaluation and visitors' emotional responses.*

HF2: *Visual landscape evaluation mediates the relationship between soundscape evaluation and visitors' immersive experience.*

HF3: *Visitors' emotional responses mediate the relationship between soundscape evaluation and immersive experience.*

HF4: *Visitors' emotional responses mediate the relationship between visual landscape evaluation and immersive experience.*

Based on the above research hypotheses, this study establishes the research proposition of "audiovisual landscape evaluation → worship experience in Taoist temples" and outlines the design of subsequent measurement indicators. The specific conceptual model of the study is shown in Figure 1.

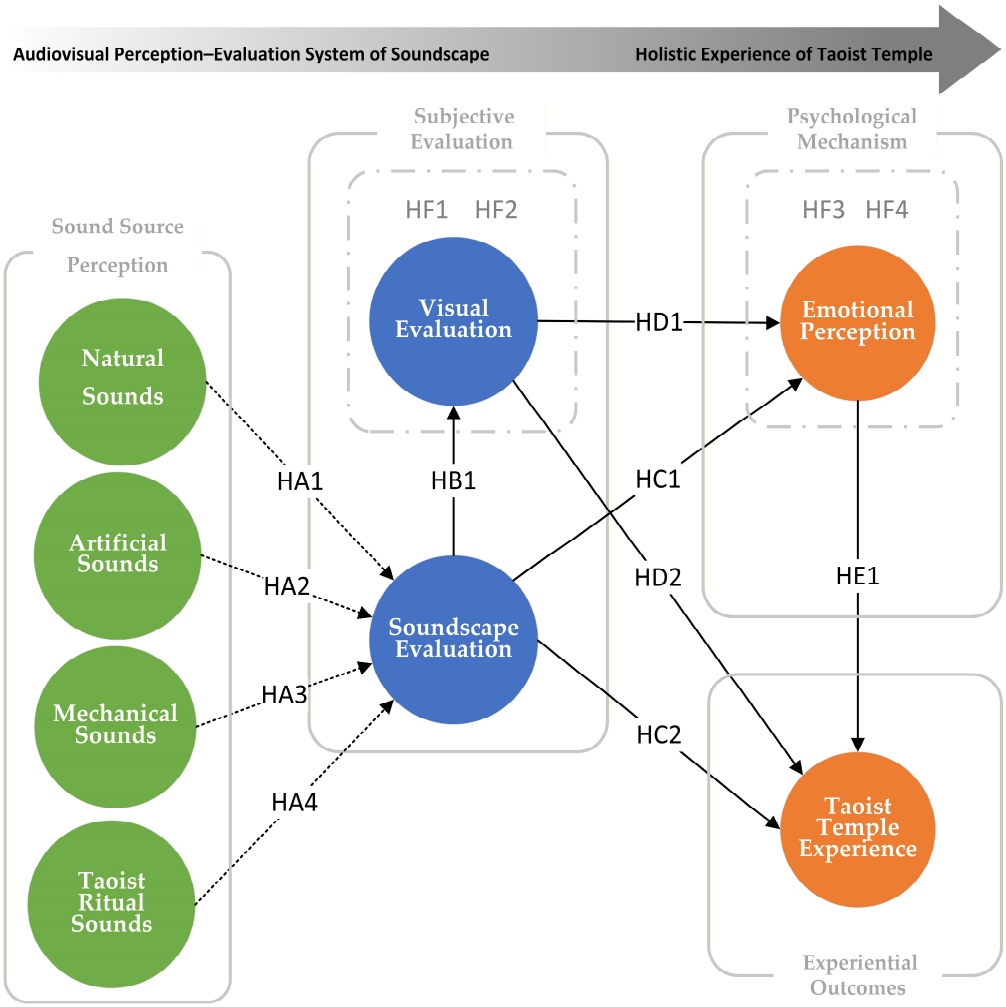


Figure 1. Research conceptual model for "Audiovisual Perception–Evaluation System of Soundscape—Holistic Experience of Taoist Temple" (direct hypotheses are located in the paths, while mediating hypotheses are in the latent observation factor boxes).

3. Methods

3.1. Site Selection

To investigate the perceptual characteristics of Taoist temple soundscapes in different spatial contexts and their influence on experiential mechanisms, this study selected four representative Taoist temples in Guangdong Province, China, as field survey sites: Sanyuan Palace, Chunyang Guan, Wong Tai Sin Temple, and Chongxu Ancient Temple, Luofu Mountain (Figure 2). The selected sites differ significantly in spatial type, environmental context, and functional usage, providing diverse situational support for soundscape research.

In terms of spatial type, Sanyuan Palace, Chunyang Guan, and Wong Tai Sin Temple are located in high-density urban environments, representing typical "urban temples" whose acoustic environments are easily affected by traffic noise, human activities, and urban background sounds. In contrast, Chongxu Ancient Temple is situated in a mountainous natural environment, representing a "mountain-forest temple," where the soundscape is dominated by natural sounds and ritual sounds, with relatively limited external human interference. These differences in sound source composition and environmental context between the two types of sites provide a solid foundation for comparing soundscape evaluation and experience across different settings.

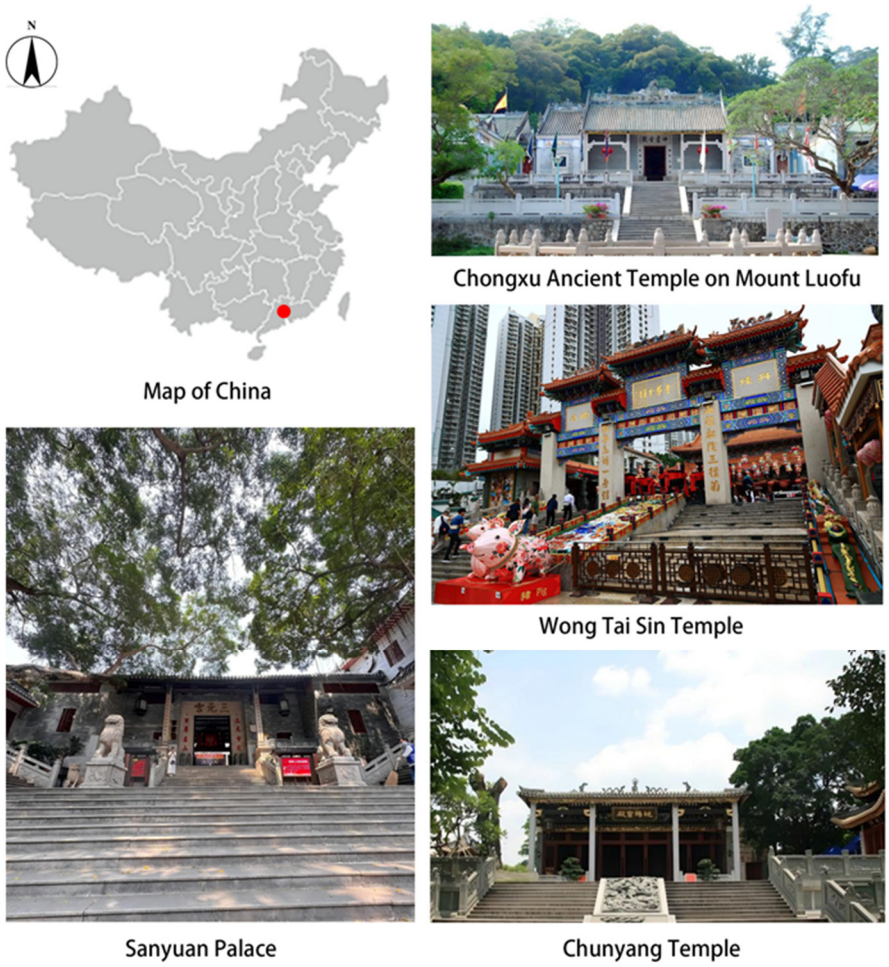


Figure 2. Images of the four Taoist temples (Source: Photographed by the authors).

Regarding functional attributes, all four temples serve both religious and tourism purposes. They are important spaces for local religious practice while also functioning as publicly accessible cultural heritage sites. This "religion–tourism" dual function means that their soundscapes not only support ritual and meditative activities but also influence visitors' spatial experiences and perceptual evaluations, making them particularly valuable for study.

Furthermore, the selected temples have long historical lineages and stable spatial layouts, with regular daily ritual activities. Their acoustic characteristics are therefore relatively consistent and observable, facilitating the collection of stable and reliable survey data. Conducting comparative studies across these different types of temples allows for a more systematic understanding of the relationships among soundscape elements, perceptual evaluation, and spatial experience, thereby enhancing the generalizability and explanatory power of the study's findings.

3.2. Questionnaire Framework

The questionnaire was designed to address the core objectives of this study and was developed based on relevant soundscape research findings and the spatial characteristics of Taoist temples. Prior to the formal survey, a pilot test was conducted in several Taoist temples in Guangdong Province, with approximately 60 questionnaires distributed. During the pilot phase, SPSS statistical analyses were performed to examine the reliability, construct validity, and clarity of each evaluation item. Items that were ambiguous or demonstrated low statistical performance were revised, resulting in the finalized formal questionnaire. To

ensure consistency in environmental conditions, the formal surveys were conducted on weekdays between 10:00 and 14:00, a period characterized by relatively stable activities and moderate visitor presence. Data collection was carried out under favorable weather conditions, avoiding rainfall, strong winds, or other extreme meteorological events that could temporarily alter the acoustic environment. The surveys were administered during periods representing typical weekday visitor flow, thereby reducing the influence of excessive crowd noise commonly observed during weekends or festival periods. Investigators followed standardized procedures and selected comparable survey locations within each temple. On-site observations were conducted to record contextual information such as ongoing activities and instantaneous crowd density, ensuring environmental comparability across survey sites. The formal questionnaire comprises six sections. Section 1 provides an introduction to the study, collects respondents' socio-demographic information, and records objective information about the physical environment of their location. Section 2 evaluates respondents' perception of the overall acoustic environment. Section 3 assesses preferences for different types of sounds within the Taoist temple. Section 4 measures the subjective perceptual characteristics of the temple's soundscape. Section 5 focuses on respondents' evaluation of the temple's visual landscape. To ensure data completeness while minimizing respondent burden, all perception and evaluation items employed single-response Likert-type scales. A 5-point scale was applied, with specific anchors tailored to the content of each question to facilitate subsequent statistical analysis and comparative research. The complete questionnaire is provided in Appendix A and summarized in Table 1.

Table 1. Questionnaire framework.

Latent Variables	Observed Variables	Items	References
Sound Source Evaluation	PLS	Perceived Loudness of Various Sounds	[31]
Soundscape Evaluation of Taoist Temple	1–4	Ratings for the temple soundscape on the attributes: Eventful, Pleasant, Vibrant, Calm.	[23,32]
Visual Evaluation of Taoist Temple	1–4	Ratings for the temple visual landscape using five adjective pairs: Landscape Attractiveness \Landscape Harmony \Landscape Openness\Landscape Interestingness	[33]
Emotional perception	1	I find the environment attractive.	[31]
	2	The environment makes me feel relaxed.	
	3	I like this environment.	
	4	I find the environment pleasant.	
	5	I feel comfortable in this environment.	
Taoist Temple Experience	1	To what extent does the current sound environment inside and outside the Taoist temple influence your overall sense of reverence?	[28]
	2	To what extent does the current sound environment inside and outside the Taoist temple influence your sense of immersion during worship activities?	

The questionnaire survey was conducted at Sanyuan Palace, Chunyang Guan, Wong Tai Sin Temple, and Chongxu Ancient Temple, Luofu Mountain. A total of approximately 380 formal questionnaires were distributed across the four selected Taoist temples, and 326 valid responses were ultimately collected, serving as the total sample for this study. By temple type, 198 valid questionnaires were obtained from urban temples, while 128 valid questionnaires were collected from the mountain-forest temple. Regarding the determination of the total sample size, the research design first referred to commonly used sample

size estimation methods in social surveys and environmental behavior studies, combined with relevant statistical principles for preliminary assessment. Furthermore, based on previous studies on soundscape evaluation in urban public spaces, research has shown that a sample size of approximately 100–150 responses is sufficient to provide an effective and stable assessment of public space soundscape characteristics. In this study, 326 valid questionnaires were collected; detailed information is presented in Table 2. In terms of gender distribution, there were 146 male respondents (44.8%) and 180 female respondents (55.2%), with a slightly higher proportion of females. Regarding age structure, respondents were predominantly 18–29 years old (40.2%) and 30–44 years old (38.0%), indicating that the sample mainly consisted of young and middle-aged adults; those under 17 years old (10.1%), 45–59 years old (6.4%), and 60 years or older (5.2%) accounted for smaller proportions. In terms of educational attainment, the majority held a bachelor's degree or equivalent (63.5%), followed by high school/technical school (16.0%), master's degree or above (9.5%), and junior high school or below (11.0%), indicating a relatively high overall education level. Regarding occupational distribution, management and technical personnel accounted for the largest share (30.1%), followed by students (23.6%) and other occupations (22.7%), while workers (10.7%), service personnel (7.4%), and teachers (5.5%) were comparatively fewer, reflecting a diverse occupational composition. In terms of visitation purpose, tourism and sightseeing (61.0%) were the primary motivations, followed by prayer or offering fulfillment (19.0%) and religious activities (12.0%), with 8.0% reporting other purposes. As for visitation frequency, first-time or occasional visitors—those visiting once or less (40.2%) and 2–3 times (39.6%)—constituted the majority, while those visiting 4–5 times (11.0%) or six times and above (9.2%) were relatively few. In summary, the overall sample structure of this survey is reasonable and representative, reflecting the characteristics and differences across gender, age, occupation, and educational background.

Table 2. Respondent Information.

Demographic Information	Category	Number	Percentage
Gender	Male	146	44.8%
	Female	180	55.2%
Age	Under 17	33	10.1%
	18–29	131	40.2%
	30–44	124	38.0%
	45–59	21	6.4%
	60 and above	17	5.2%
Education Level	Junior high school or below	36	11.0%
	High school/Technical secondary school	52	16.0%
	Bachelor's degree/Associate degree	207	63.5%
	Master's degree or above	31	9.5%
Occupation	Student	77	23.6%
	Worker	35	10.7%
	Teacher	18	5.5%
	Service personnel	24	7.4%
	Management and technical personnel	98	30.1%
	Other	74	22.7%
Purpose of Visit	Tourism and sightseeing	199	61.0%
	Prayer or offering fulfillment	62	19.0%
	Religious activities	39	12.0%
	Other	26	8.0%
Frequency of Visits	Once or less	131	40.2%
	2–3 times	129	39.6%
	4–5 times	36	11.0%
	6 times or more	30	9.2%

3.3. Statistical Analysis

3.3.1. Preliminary Analysis

Preliminary data analysis was conducted using SPSS 26.0, including reliability testing, assessment of data normality, and bivariate correlation analysis [34]. First, Cronbach's alpha was employed to examine the internal consistency of the scales. The overall questionnaire achieved an α value of 0.745, exceeding the 0.7 threshold, indicating good reliability [35], with detailed values shown in Table 3. The α coefficient for the "Acoustic Environment" subscale was 0.608, slightly below the ideal level; however, given that this subscale contains only three items, the limited number of items likely contributed to the lower α value. Overall, all subscales demonstrated satisfactory reliability, meeting the requirements for subsequent analysis. Next, the Shapiro–Wilk test was used to assess normality. The results indicated that the data did not follow a normal distribution; therefore, subsequent correlation analyses used Spearman's rank correlation (rho) [36]. Bivariate correlation analysis confirmed significant positive relationships among key constructs, supporting the suitability of the data for subsequent structural equation modeling. Construct validity was evaluated through the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity to determine the factorability of the data. As shown in Table 4, KMO values for all subscales exceeded 0.6, and Bartlett's test results were all significant ($p < 0.001$), indicating sufficient sampling adequacy and strong correlations among items, confirming suitability for factor analysis. Among the subscales, the "Overall Audiovisual Evaluation" scale had the highest KMO value (0.855), indicating excellent factorability. The KMO values for "Sound Source Evaluation," "Soundscape Evaluation," and "Visual Landscape Evaluation" all exceeded 0.7, demonstrating good construct representativeness. The KMO for "Acoustic Environment" was 0.604, within an acceptable range. Overall, the factorability and construct representativeness of the questionnaire were satisfactory, providing a solid basis for subsequent SEM analysis.

Table 3. CFA results for reliability and measurement construct validity.

Model Constructs	Cronbach's Alpha	CR	AVE	HTMT < 0.95
Soundscape Evaluation of Taoist Temple	0.766	0.796	0.495	yes
Visual Evaluation of Taoist Temple	0.731	0.832	0.561	yes
Emotional perception	0.910	0.933	0.737	
Taoist Temple Experience	0.578	0.808	0.682	yes

Table 4. Predictive accuracy (R^2), predictive relevance (Q^2) and effect sizes (f^2).

Model Constructs	R^2	Q^2	f^2 Soundscape Evaluation	f^2 Visual Evaluation	f^2 Emotional Perception	f^2 Taoist Temple Experience
Natural Sounds			0.051			
Artificial Sounds			0.216			
Mechanical Sounds			0.036			
Taoist Ritual Sounds			0.068			
Soundscape Evaluation of Taoist Temple	0.173			0.194	0.216	0.092
Visual Evaluation of Taoist Temple	0.162				0.350	0.009
Emotional perception	0.485					0.034
Taoist Temple Experience	0.280					

3.3.2. PLS-SEM

Structural equation modeling (SEM) is used to analyze the relationships between observed variables and latent constructs, allowing for the examination of causal relationships among latent variables. In this study, to investigate the complex relationships among soundscape evaluation, visual landscape evaluation, and spatial experience in Taoist temples, and considering the non-normal distribution of the sample, a nonparametric SEM approach—Partial Least Squares SEM (PLS-SEM)—was selected. The analysis was conducted using SmartPLS version 3.3.3 with a two-stage modeling procedure. First, the measurement model was assessed for reliability, convergent validity, and discriminant validity; subsequently, the structural model was evaluated in terms of path coefficients, R^2, and F^2 [37]. To improve result stability, 5000 bootstrap resamples were performed [38]. Compared with covariance-based SEM (CB-SEM), PLS-SEM requires a smaller sample size [39]. Regarding sample size determination, this study referred to the inverse square root method. Based on calculations, the minimum significant path coefficient in the model was 0.254, with a significance level set at 5%, yielding a minimum required sample size of 69 [40]. Additionally, the study considered the "10-times rule," which recommends 10 observations per latent variable [41]. Given that this study includes a total of eight latent variables, the collected sample of 326 respondents is sufficient to meet the requirements for analysis.

4. Results

Based on preliminary research and data analysis, this study established a structural equation model (SEM) of the soundscape elements → perceptual evaluation → experiential outcomes pathway, aiming to examine how different soundscape elements in Taoist temples influence individuals' spatial experiences and spiritual cognition through subjective perceptual dimensions.

4.1. Measurement Model Evaluation

Previous studies have indicated that the quality assessment of a structural equation model (SEM) should include Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), and discriminant validity (HTMT). In the model, Cronbach's alpha values above 0.7, CR > 0.7, AVE $\geq$ 0.50, and HTMT < 0.95 indicate good validity [42,43]. As shown in Table 3, the results generally meet the recommended thresholds, although some indicators fall slightly below conventional criteria for establishing the validity and reliability of the measurement model. To eliminate low standardized factor loadings, several items were removed from the scales. Variance Inflation Factor (VIF) testing showed that the VIF values of all latent variables and observed variables ranged from 1.002 to 4.341, indicating no multicollinearity issues. Regarding internal consistency reliability, the Cronbach's alpha values of the latent variables ranged from 0.578 to 0.910. The alpha value for Emotional perception reached 0.910, indicating high internal consistency. The alpha values for Soundscape Evaluation and Visual Evaluation of Taoist Temple both exceeded 0.65, falling within an acceptable range. The Cronbach's alpha for Taoist Temple Experience (0.578) is below the commonly recommended threshold of 0.70, indicating limited internal consistency. This may be related to the multidimensional and context-dependent nature of experiential constructs in religious environments. Therefore, the reliability of this construct should be interpreted with caution, although its composite reliability (CR = 0.808) remains above the acceptable level. Further assessment using composite reliability (CR) showed that all latent variables had CR values greater than 0.79, significantly exceeding the recommended threshold of 0.70, indicating good overall internal consistency and stability of the scales. Convergent validity was evaluated using average variance extracted (AVE). Results showed that AVE values for Emotional perception, Taoist Temple Experience, and Visual Evaluation

of Taoist Temple all exceeded 0.50, meaning that the latent variables explained more than half of the variance in their observed indicators. The AVE for Soundscape Evaluation was close to 0.50, which is considered acceptable in multidimensional soundscape research, demonstrating a solid basis for convergent validity across constructs. For discriminant validity, the heterotrait–monotrait ratio (HTMT) was used. All HTMT values between latent variables were below 0.85, and none of the confidence intervals included 1, indicating good discriminant validity and effectively distinguishing between constructs such as Soundscape Evaluation, Visual Evaluation of Taoist Temple, Emotional perception, and Taoist Temple Experience. In summary, the measurement model meets the basic requirements for PLS-SEM analysis in terms of internal consistency, convergent validity, and discriminant validity, providing a reliable foundation for subsequent structural model analysis and hypothesis testing.

4.2. Structural Model and Hypothesis Testing

As shown in the figure, this study constructed the final structural equation model (SEM) based on the previously proposed theoretical framework and research hypotheses. In the figure, circles represent latent variables, rectangles represent measurement indicators, and the values on the lines connecting latent variables indicate path coefficients ($p < 0.05$, $p < 0.01$). Lines between indicators and latent variables represent factor loading paths, with the numerical values denoting outer loadings. Arrow directions reflect causal relationships among latent variables. Dashed lines between latent variables indicate paths that did not reach significance at the 95% confidence interval, while solid lines indicate paths that are significant at the 95% confidence interval. Line thickness reflects the significance level of the paths. This study tested 14 research hypotheses concerning the relationships among Sound Source Evaluation → Soundscape Evaluation → Visual Evaluation → Emotional perception → Sense of Immersion, and evaluated the structural model to assess the overall explanatory power.

To evaluate the predictive capability of the structural model, this study examined three aspects: explanatory power (R^2), predictive relevance (Q^2), and effect size (f^2). Results are presented in Table 4. The most commonly used indicator for assessing structural models is the coefficient of determination (R^2). R^2 is the square of the correlation between actual and predicted values, incorporating all data used in model estimation, and measures the model's predictive capability within the sample [44–46]. R^2 values of 0.75, 0.50, and 0.25 are generally interpreted as substantial, moderate, or weak, respectively [47,48]. Specifically, Soundscape Evaluation ($R^2 = 0.173$) and Visual Evaluation ($R^2 = 0.162$) exhibit relatively weak explanatory power, indicating limited explanatory power, which is not uncommon in complex perceptual and behavioral research contexts. Emotional perception ($R^2 = 0.485$) demonstrates moderate explanatory power; and Taoist Temple Experience ($R^2 = 0.280$) indicates that antecedent variables provide a certain level of explanation. Next, the blindfolding procedure was used to assess the model's predictive relevance (Q^2), which reflects the out-of-sample predictive capability of the model [44]. As a relative measure of predictive relevance, Q^2 values of 0.02, 0.15, and 0.35 indicate small, medium, and large predictive relevance of an exogenous construct for an endogenous construct. The results show that Soundscape Evaluation ($Q^2 = 0.040$), Visual Evaluation ($Q^2 = 0.080$), Emotional perception ($Q^2 = 0.350$), and Taoist Temple Experience ($Q^2 = 0.155$) all have $Q^2 > 0$, indicating overall predictive relevance. Notably, Emotional perception exhibits a high Q^2 value, reflecting strong predictive capability, while Taoist Temple Experience shows moderate predictive relevance. Finally, effect sizes (f^2) were examined to assess the impact of exogenous variables on endogenous variables. Guidelines for f^2 suggest that values of 0.02, 0.15, and 0.35 indicate small, medium, and large effects, respectively, while

values below 0.02 indicate no effect [44]. Results indicate that Natural Sounds, Artificial Sounds, Mechanical Sounds, and Taoist Ritual Sounds exert small to moderate effects on Soundscape Evaluation; Soundscape Evaluation and Visual Evaluation show notable effects on Emotional perception, with Visual Evaluation demonstrating a relatively large effect; the effect of Emotional perception on Taoist Temple Experience is small but still statistically and theoretically meaningful. Overall, the distribution of path effects in the model is reasonable, and key influence relationships are clear.

Notably, the influence of mechanical sounds on soundscape evaluation was found to be statistically insignificant. This result may be explained by the environmental characteristics of Taoist temples. These spaces are typically dominated by natural sounds (e.g., wind, birds, and water) and ritual sounds (e.g., chanting and ritual instruments), which form the primary auditory background for visitors. Acoustic masking refers to the psychoacoustic phenomenon in which the perceptual prominence of one sound is reduced by the presence of another sound [49]. In Taoist temples, ritual sounds often possess structured rhythmic patterns and cultural symbolic meanings, while natural sounds provide continuous ambient auditory textures. These sound sources may effectively mask low-level mechanical noises, such as distant traffic or equipment sounds, thereby reducing their perceptual impact. Furthermore, the spatial configuration of Taoist temples—characterized by courtyards, vegetation, and layered architectural layouts—can physically attenuate mechanical noise while enhancing localized ritual and natural sounds. As a result, visitors' soundscape evaluations are more strongly influenced by culturally meaningful and contextually integrated sound sources than by incidental mechanical noise. This finding suggests that, in religious environments with dominant symbolic and natural auditory elements, mechanical sounds may play a secondary role due to both perceptual masking and spatial buffering effects.

As shown in Table 5 and Figure 3, Emotional perception exhibits strong explanatory power within the structural model, whereas Soundscape Evaluation, Visual Evaluation, and Taoist Temple Experience show relatively weaker explanatory power, though still within an acceptable range for social science research. Regarding the paths from Sound Source Evaluation to Soundscape Evaluation, Natural Sounds, Artificial Sounds, and Taoist Ritual Sounds have significant effects on the evaluation of the temple's soundscape, whereas Mechanical Sounds do not, indicating that in the specific cultural and spatial context of a Taoist temple, not all types of sound sources effectively translate into positive soundscape evaluations. In addition to potential individual differences in evaluation, this result may also be due to the long-term superposition and interweaving of multiple sound sources in temple environments, which can make it difficult for respondents to clearly distinguish mechanical sounds, as their evaluation is more easily masked by natural or ritual sounds. Further, both Soundscape Evaluation and Visual Evaluation have significant positive effects on Emotional perception, with Visual Evaluation exerting a more pronounced influence. This indicates that in the overall perceptual process of the temple, visual cues play a more direct and strong role in emotional arousal and psychological experience. Meanwhile, Emotional perception significantly affects Taoist Temple Experience, and Soundscape Evaluation and Visual Evaluation also exert indirect effects on the final temple experience through emotional perception. Overall, although some constructs exhibit weaker explanatory power than Emotional Perception, all major hypothesized paths are statistically significant ($p < 0.05$ or $p < 0.01$), indicating that the model retains a reasonable degree of explanatory value and practical relevance in the multifactorial real-world context of Taoist temples, while its explanatory strength remains limited for certain constructs.

Table 5. Hypothesis assessment.

Hypothesis	Path	β-Value	STDEV	t Value	*p* Value	BC95%CI	Support
HA1	Natural Sounds → Soundscape Evaluation	0.206	0.096	2.154	0.031	[0.052, 0.274]	Yes
HA2	Artificial Sounds → Soundscape Evaluation	−0.233	0.117	1.999	0.046	[−0.373, −0.032]	Yes
HA3	Mechanical Sounds → Soundscape Evaluation	−0.177	0.197	0.896	0.370	[−0.301, 0.274]	
HA4	Taoist Ritual Sounds → Soundscape Evaluation	0.241	0.082	2.939	0.003	[0.113, 0.368]	Yes
HB1	Soundscape Evaluation → Visual Evaluation of Taoist Temple	0.403	0.081	4.993	0.000	[0.279, 0.543]	Yes
HC1	Soundscape Evaluation → Emotional perception	0.364	0.070	5.181	0.000	[0.251, 0.481]	Yes
HC2	Soundscape Evaluation → Taoist Temple Experience	0.310	0.081	3.817	0.000	[0.183, 0.449]	Yes
HD1	Visual Evaluation of Taoist Temple → Emotional perception	0.464	0.070	6.635	0.000	[0.345, 0.575]	Yes
HD2	Visual Evaluation of Taoist Temple → Taoist Temple Experience	0.101	0.108	0.941	0.347	[−0.079, 0.278]	
HE1	Emotional perception → Taoist Temple Experience	0.217	0.103	2.111	0.035	[0.039, 0.382]	Yes

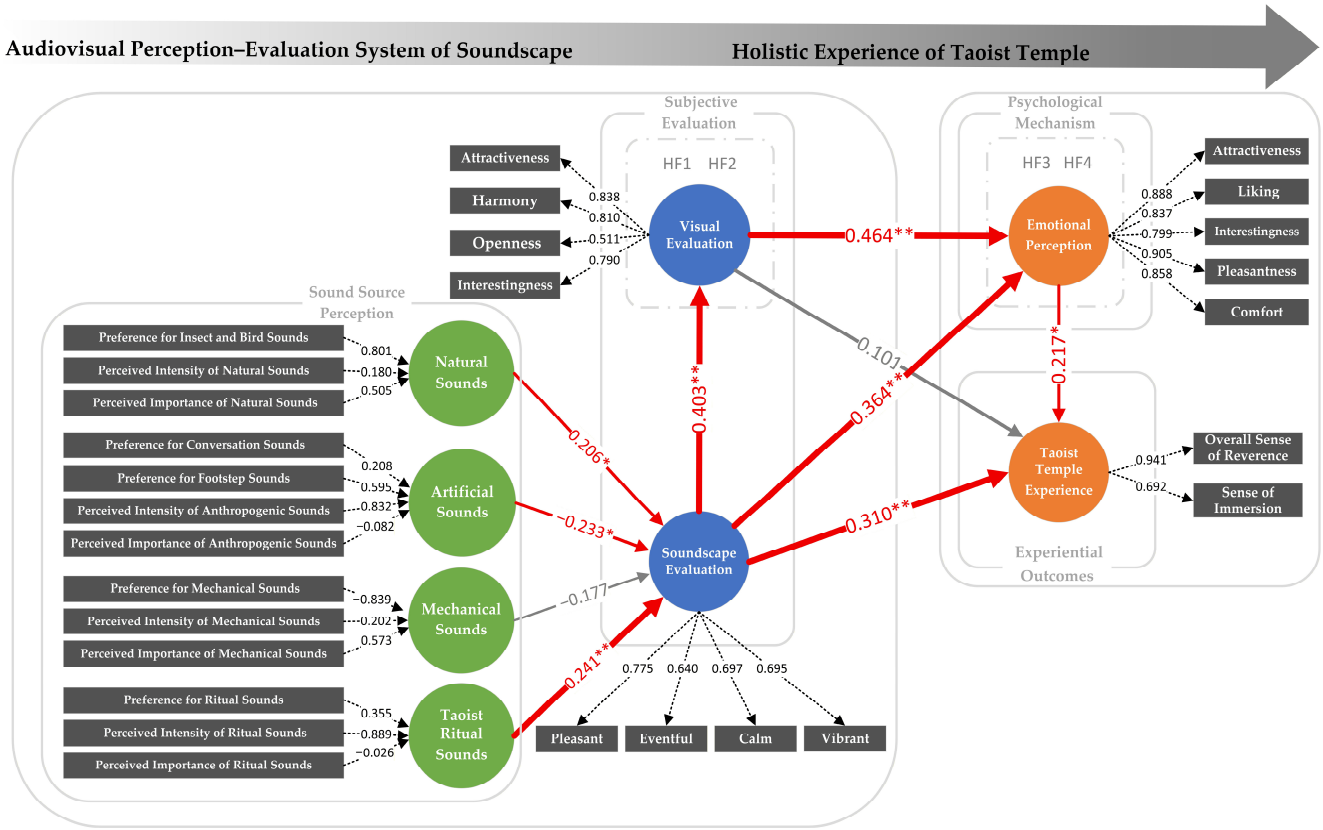


Figure 3. Structural Equation Analysis Results. (Red paths indicate statistically significant relationships, whereas black paths indicate non-significant relationships. Solid arrows represent hypothesized structural paths, and dashed arrows represent factor loadings of observed variables on their corresponding latent constructs. Asterisks denote the level of statistical significance, where * indicates significance at the 0.05 level and ** indicates significance at the 0.01 level).

(1) Effects of Sound Source Evaluation on Soundscape Evaluation

The path analysis from Sound Source Evaluation to Soundscape Evaluation shows significant differences in how different types of sound sources affect soundscape evaluation. Artificial Sounds have a significant negative effect on Soundscape Evaluation ($\beta = -0.233$, $p = 0.046$), indicating that human activity-related sounds partially reduce the overall quality of soundscape evaluation in temple spaces, supporting hypothesis HA2. Natural Sounds have a significant positive effect ($\beta = 0.206$, $p = 0.031$), suggesting that sounds from the natural environment enhance the soundscape experience in Taoist temples, supporting hypothesis HA1. In contrast, Mechanical Sounds do not show a significant effect ($\beta = -0.177$, $p = 0.370$), so hypothesis HA3 is not supported; this may be related to the relatively low frequency and controllable intensity of mechanical sounds in the temple environment, which prevents them from becoming dominant factors in soundscape evaluation. Taoist Ritual Sounds have a significant positive effect on soundscape evaluation ($\beta = 0.241$, $p = 0.003$), highlighting the important role of culturally and religiously symbolic sounds in constructing the temple's soundscape, supporting hypothesis HA4. This further confirms the core position of ritual sounds in religious spatial soundscape experiences.

(2) Relationships among Soundscape Evaluation, Visual Evaluation, and Emotional–Immersion Experience

At the perceptual level, Soundscape Evaluation positively and significantly affects Visual Evaluation ($\beta = 0.403$, $p < 0.001$), indicating that a favorable soundscape can enhance visitors' overall evaluation of the temple's visual environment, supporting hypothesis HB1. This validates the facilitative role of sound in visual evaluation from an audiovisual interaction perspective. Further analysis of the effects of soundscape and visual evaluation on psychological experience variables shows that Soundscape Evaluation has a significant positive effect on Emotional perception ($\beta = 0.364$, $p < 0.001$) and also significantly enhances Sense of Immersion ($\beta = 0.310$, $p < 0.001$), supporting hypotheses HC1 and HC2. This suggests that in Taoist temple contexts, soundscapes not only directly influence emotional states but also enhance overall immersion experience. For the visual paths, Visual Evaluation has a significant positive effect on Emotional perception ($\beta = 0.464$, $p < 0.001$), supporting hypothesis HD1; however, its direct effect on Sense of Immersion is not significant ($\beta = 0.101$, $p = 0.347$), so hypothesis HD2 is not supported. This implies that visual environment influences on immersion are more likely realized indirectly through emotional mechanisms. Finally, Emotional perception has a significant positive effect on Sense of Immersion ($\beta = 0.217$, $p = 0.035$), supporting hypothesis HE1, further confirming the key mediating role of emotional mechanisms between environmental evaluation and immersive experience.

In the temple context, Soundscape Evaluation and Visual Evaluation both significantly affect emotional perception, with the contribution ratio of visual evaluation to soundscape evaluation approximately 1:0.78, indicating that visual information has a more dominant role in emotional arousal. However, regarding the formation of reverence experience, the overall effect of Soundscape Evaluation is substantially stronger than Visual Evaluation, with its total effect approximately 2.3 times that of visual evaluation. Further analysis shows that the direct effect of visual evaluation on reverence experience is not significant, with its influence primarily realized indirectly through emotional perception. In contrast, soundscape evaluation exerts both a significant direct effect and cumulative effects through multiple pathways such as "Visual $\rightarrow$ Emotional." Therefore, soundscapes in religious contexts are more likely to evoke deep emotional resonance and play a dominant role in constructing the sense of reverence. These results indicate that while the proposed model

captures statistically significant relationships, additional variables or contextual factors may be needed to improve its explanatory power in future research.

4.3. Mediation Analysis

To further reveal the underlying mechanism through which soundscape evaluation influences the holistic experience of a Taoist temple, the Bootstrap method was employed to test the mediating effects within the model. By calculating the indirect effects, z-values, and variance accounted for (VAF) of each mediating path, the role of mediators in different pathways was analyzed, with detailed values presented in Table 6. The results indicate that in the "Soundscape Evaluation → Visual Evaluation →Emotional perception" pathway, the indirect effect was 0.187, with a z-value of 3.90, reaching significance ($p < 0.001$). This suggests that soundscape evaluation can not only directly influence emotional perception but also enhance emotional experience by improving individuals' evaluation of the temple's visual environment. In terms of variance explained, the VAF of this path was 25.3%, indicating that visual evaluation partially mediates the effect of soundscape evaluation on emotional perception—approximately one-quarter of the influence is realized indirectly through visual evaluation. In the "Soundscape Evaluation → Visual Evaluation → Taoist Temple Experience" pathway, the indirect effect was 0.081, with a corresponding z-value of 1.69, which was not significant ($p > 0.05$). This shows that although soundscape evaluation significantly affects individuals' evaluation of the temple's visual environment, its indirect impact on the overall temple experience through visual evaluation alone is unstable. The VAF of this path was 14.7%, further indicating that visual evaluation plays a weak mediating role in the influence of soundscape evaluation on temple experience. By contrast, in the "Soundscape Evaluation → Emotional perception → Taoist Temple Experience" pathway, the indirect effect was 0.120, with a z-value of 2.86, reaching significance ($p < 0.01$). This indicates that emotional perception serves as a significant mediator between soundscape evaluation and temple experience. A favorable soundscape can meaningfully enhance individuals' emotional experiences, which in turn strengthens their evaluation of the overall temple experience. The VAF of this path was 22.3%, showing that over one-fifth of the effect of soundscape evaluation on temple experience is mediated through emotional perception, representing a partial mediating effect. Additionally, in the "Visual Evaluation → Emotional perception → Taoist Temple Experience" pathway, the indirect effect was 0.101, with a z-value of 1.98, indicating marginal significance at the 0.05 level. This result suggests that the impact of the temple's visual environment on overall experience is not entirely direct but is partially realized through the elicitation of individuals' emotional responses. The VAF of this path was 33.3%, demonstrating that emotional perception plays a relatively important mediating role in the influence of visual evaluation on temple experience, with the highest explanatory proportion among all mediating paths, also reflecting a partial mediating effect.

Table 6. Mediation hypothesis testing.

Hypothesis	Path	β-Value	STDEV	t Value	*p* Value
HA1	Natural Sounds → Soundscape Evaluation	0.206	0.096	2.154	0.031
HA2	Artificial Sounds → Soundscape Evaluation	−0.233	0.117	1.999	0.046
HA3	Mechanical Sounds → Soundscape Evaluation	−0.177	0.197	0.896	0.370
HA4	Taoist Ritual Sounds → Soundscape Evaluation	0.241	0.082	2.939	0.003

Based on the results of the path analysis, to assess the overall goodness-of-fit of the model, this study employed the GoF (Goodness-of-Fit) index in PLS-SEM [38]. According to commonly used benchmarks in previous research, GoF values of approximately 0.10, 0.25, and 0.36 correspond to small, medium, and large levels, respectively [50]. A GoF ≈ 0.10 indicates a small level, suggesting that the model demonstrates only weak overall explanatory power; it may be suitable for exploratory analysis, but there is considerable room for improvement in overall explanatory ability. A GoF ≈ 0.25 represents a medium level, indicating a balanced performance between measurement quality and structural explanatory power, with the structural model providing reasonable explanation for the endogenous variables, thus showing good practical research value. A GoF ≈ 0.36 indicates a large level, where both the quality of the measurement scales and the explanatory power of the paths are high, representing a structurally strong model. In this study, the model achieved a GoF = 0.413, which is substantially higher than the large-level reference threshold (0.36). Both the measurement model and the structural model reached a desirable level of adequacy.

5. Discussion

As cultural spaces that combine religious rituals with public accessibility, Taoist temples' soundscapes are not only generated by the superposition of multiple types of sound sources but are also deeply embedded within specific religious contexts and spatial orders, forming a unique perceptual system distinct from typical urban or natural environments.

Before discussing the theoretical implications, several limitations of this study should be explicitly acknowledged. First, the investigation was conducted at a limited number of Taoist temple sites, which may restrict the generalizability of the findings across different regional or architectural contexts. Second, the analysis relied primarily on subjective questionnaire data, which reflect perceived experience but may be influenced by individual differences and situational factors. Third, the study focused mainly on auditory and visual evaluations, while physiological indicators (e.g., heart rate variability or skin conductance) and other sensory modalities were not incorporated. These limitations should be considered when interpreting the results and point to directions for future research integrating objective measurements and multisensory data.

This study identified the pathway through which visitors perceive Taoist temple spaces via "Sound Source Evaluation → Soundscape Evaluation → Emotional perception → Sense of Immersion" and analyzed the formation mechanism of spatial experience from a multisensory interaction perspective, enriching our understanding of individual evaluation and experiential processes in religious spaces. It should also be noted that this study prioritizes ecological validity over strict experimental control. Rather than isolating a single variable under fully standardized conditions, the research aims to examine how soundscape and visual evaluation jointly shape experience in real Taoist temple environments, where contextual complexity is an inherent part of religious spatial evaluation. Unlike previous studies that primarily focused on descriptive accounts of soundscape evaluation or single-sensory analysis [7], this research emphasizes the mediating role of soundscape within a multi-level perceptual structure and validates the scientific basis of an emotion-centered pathway for experience generation.

5.1. Influence of Soundscape Elements in Taoist Temples on Perceptual Evaluation

The informational attributes of a soundscape greatly influence individuals' overall evaluation of the acoustic environment [20], and different types of sound sources exhibit differentiated perceptual effects in specific contexts. Unlike previous studies that focused on urban or natural spaces [22], this research further emphasizes the role of culturally symbolic Taoist ritual sounds in the construction of the soundscape within religious con-

texts. Previous studies have indicated that music and sounds used in religious rituals can significantly shape spatial atmosphere and individual evaluation [11,51]. Consistently, this study finds that Taoist ritual sounds have a significant positive effect on soundscape evaluation (supporting Hypothesis HA4), highlighting their central role in the soundscape construction of religious spaces.

At the same time, natural sounds also show a significant positive effect on soundscape evaluation (supporting Hypothesis HA1), indicating that in Taoist temples—spaces emphasizing the relationship between humans and nature—natural sounds remain an important source of positive perceptual experience. This finding aligns with conclusions from existing soundscape ecology research [3]. In contrast, Artificial sounds exert a significant negative effect on soundscape evaluation (supporting Hypothesis HA2), suggesting that non-ritual human activity sounds in religious spaces may disrupt the existing spatial order and atmosphere, thereby weakening the overall soundscape experience.

It is noteworthy that mechanical sounds do not have a significant effect on soundscape evaluation (Hypothesis HA3 was not supported), which differs from some urban studies where mechanical sounds exhibit a significant negative impact [23]. This inconsistency may relate to the spatial characteristics of Taoist temples: on one hand, mechanical sounds occur relatively infrequently in temple environments; on the other hand, the superposition of multiple sound sources may mask their evaluation, reducing their impact on overall soundscape evaluation. By contrast, Taoist ritual sounds have a clear positive effect on soundscape evaluation (supporting Hypothesis HA4), indicating that sounds with religious symbolic meaning and situational relevance are more readily interpreted positively by individuals, thus enhancing the soundscape experience. This further demonstrates the perceptual advantage of "meaningful sounds" over ordinary environmental sounds in religious spaces. In addition, this study finds that soundscape evaluation significantly positively influences visual evaluation (supporting Hypothesis HB1), supporting the cross-modal interaction theory of "audition influencing vision" [24,25]. This further illustrates that in religious spaces, sound is not only perceived independently but also plays a key modulatory role in overall environmental cognition.

Compared to Western religious architecture, the soundscapes of Taoist temples place greater emphasis on the cultural significance of specific human-generated sound sources rather than relying solely on architectural reverberation characteristics. In Western religious spaces such as Catholic or Orthodox churches, building volume, reverberation time, and acoustic energy balance are often employed to amplify the sacredness of music and chanting [18,19,52,53]. In these contexts, soundscapes rely more on physical acoustic conditions to evoke immersion. In contrast, Taoist temples generate soundscape experiences through ritualized sound sources and spatial layout, using cultural symbols and religious context to shape the perceptual experience [17].

5.2. Mechanisms of Soundscape and Visual Evaluation on Taoist Temple Experience

This study demonstrates that soundscape evaluation and visual landscape evaluation in Taoist temples play crucial roles in shaping visitors' experiences, particularly exhibiting significant effects on emotional responses and immersion. Regarding emotional perception, both soundscape evaluation and visual evaluation have significant positive effects on emotional responses (supporting Hypotheses HC1 and HD1). This finding aligns with prior research indicating that the quality of environmental evaluation can significantly influence individuals' emotional states and psychological experiences [21,23].

Regarding sense of immersion, soundscape evaluation exerts a significant positive effect on Taoist temple experience (supporting Hypothesis HC2), indicating that the acoustic environment in religious spaces not only affects perceptual layers but also directly

contributes to the construction of immersive experiences. This finding is consistent with studies on religious experiences showing that sound promotes "sacred experiences" and immersion [12,14]. However, the direct effect of visual landscape on immersive experience is not significant (Hypothesis HD2 was not supported), suggesting that the influence of visual factors on immersion is more likely realized through indirect pathways.

Further mediation analysis indicates that emotional perception plays a significant mediating role between soundscape evaluation and Taoist temple experience (supporting Hypothesis HF3), meaning that soundscape enhances overall experience quality by eliciting positive emotions. This finding supports the theoretical perspective that emotion acts as a key psychological mechanism between environmental stimuli and experiential outcomes [13]. Additionally, visual evaluation serves as a partial mediator in the "soundscape—emotion" path (supporting Hypothesis HF1), suggesting that soundscape and vision are not entirely independent but jointly influence individuals' emotional responses through hierarchical transmission. Moreover, the indirect effect of visual evaluation on temple experience (via emotion) is marginally significant (supporting Hypothesis HF4), indicating that the impact of visual environment on experience depends to some extent on emotional arousal rather than exerting a direct effect. These results refine the hierarchical relationship of "evaluation— emotion—experience" in multisensory environments and extend previous single-modality, vision-dominant cognitive models of environmental experience [25].

Compared to Western religious architecture, where visual elements (e.g., stained glass, altar decorations) often combine with architectural acoustics to construct an overall sacred atmosphere, Taoist temples rely more on soundscapes to guide visitors' attention and emotion [54,55]. Through multisensory interaction, sound plays a dominant role in generating immersive experiences in Eastern religious spaces.

Overall, the results of this study highlight that in the specific cultural context of Taoist temples, soundscape contributes to experience construction not only through direct effects but also indirectly via emotion and visual pathways, revealing the complex mechanisms of multisensory synergy in religious spaces.

5.3. Context-Dependence of Soundscape Evaluation Mechanisms in Religious Settings

Unlike previous studies that often treat the effects of soundscape as relatively stable perceptual mechanisms [5], this study further reveals that in the context of Taoist temples, the influence of soundscape on spatial experience exhibits significant context-dependence.

Specifically, the study found that compared to natural sounds and environmental background sounds, ritual and religiously meaningful Taoist ritual sounds (e.g., chanting, ritual instrument sounds) play a more critical role in soundscape evaluation. This indicates that in religious spaces, the perceptual significance of sound does not solely depend on its acoustic properties but is largely determined by the cultural symbolism and ritual function it carries [53,56]. In other words, soundscape is not only a component of the physical environment but also serves as an important medium for meaning-making within religious experiences.

This finding aligns with the ongoing shift in soundscape research from an "acoustic-parameter-oriented" perspective to a "evaluation- and context-oriented" approach [6], and further demonstrates that the ritual dimension of sound in religious architecture can significantly enhance individuals' immersion and spatial cognition. Related studies have also pointed out that religious soundscapes, through repetitive rhythms, spatial reverberation, and symbolic meaning, can strengthen individuals' spiritual focus and emotional resonance, thereby constructing a unique perceptual experience [12,14,57].

From the perspective of emerging Soundscape Indices frameworks, soundscape evaluation is increasingly quantified through composite indicators integrating acoustic, perceptual, and contextual variables. The present findings suggest that such indices should

incorporate culturally meaningful sound sources as independent dimensions rather than relying solely on acoustic intensity or spectral characteristics. In Taoist temple environments, culturally symbolic ritual sounds exhibit stronger perceptual influence than physically dominant background sounds, indicating that traditional soundscape indices may underestimate context-dependent cultural factors.

Moreover, the study observed that the overlap of different sound sources in Taoist temple environments (e.g., visitor activity sounds combined with ritual sounds) may weaken the perceptual clarity of religious soundscapes, indicating that soundscape experience is also moderated by spatial usage patterns and social behaviors. This result further supports the view of soundscape as an "environment–behavior–culture" interactive product [3,22].

This context-dependent mechanism can also be interpreted through the lens of the cultural acoustic ecosystem, which conceptualizes soundscapes as dynamic systems shaped by interactions among environmental sounds, human activities, and cultural meanings. Within Taoist temples, ritual sounds function as key ecological nodes that structure auditory attention and influence the perceptual hierarchy of other sound sources. Such culturally embedded acoustic ecosystems differ from urban or natural soundscapes, where physical acoustic parameters often dominate perceptual outcomes. These findings imply that predictive soundscape models should move beyond purely acoustic input variables and integrate context-sensitive cultural indicators. Incorporating symbolic sound sources and behavioral context into soundscape indices may improve the explanatory power of prediction models, particularly in heritage and religious environments.

In sum, this study empirically demonstrates that the evaluation mechanisms of Taoist temple soundscapes are highly context-sensitive, with their core not determined by sound type per se, but by the religious context and embedded meaning structures. This finding not only provides a new theoretical perspective for understanding soundscape experiences in Eastern religious architecture, but also contributes to refining context-aware soundscape prediction models and culturally adaptive evaluation frameworks.

6. Conclusions

6.1. Research Findings

This study employed a Structural Equation Modeling (SEM) approach to systematically investigate the influence of soundscape evaluation in Taoist temples on visitors' emotional perception, visual evaluation, and overall temple experience, and further constructed an integrated model linking soundscape evaluation with experiential outcomes.

1. Soundscape evaluation and its influence on spatial experience

Regarding sound source effects, natural sounds ($\beta = 0.206$, $p = 0.031$) and Taoist ritual sounds ($\beta = 0.241$, $p = 0.003$) both significantly enhance soundscape evaluation, while artificial sounds related to general human activities ($\beta = -0.233$, $p = 0.046$) have a negative effect. Soundscape evaluation significantly influences visual evaluation ($\beta = 0.403$, $p < 0.001$) and emotional perception ($\beta = 0.364$, $p < 0.001$), indicating its central role in shaping multisensory environmental experience. In contrast, visual evaluation primarily affects emotional perception ($\beta = 0.464$, $p < 0.001$), while its direct effect on temple experience is not significant. Emotional perception serves as a key mediating variable linking environmental evaluation and overall temple experience. Mediation analysis further shows that emotional perception plays a significant partial mediating role in the relationship between soundscape evaluation and temple experience, while visual evaluation contributes to experience formation mainly through indirect pathways. Overall, soundscape and visual evaluation operate in an interconnected system, with emotional perception functioning as the primary transmission mechanism in experience construction.

2. Comparison of contributions of soundscape and visual evaluation to spatial experience

Within the Taoist temple context, both soundscape and visual evaluation significantly influence emotional perception, with visual evaluation slightly more dominant (approximately 1:0.78). However, in shaping the sense of reverence, the overall effect of soundscape is more pronounced, with a total effect roughly 2.3 times that of visual evaluation. Visual effects mainly operate indirectly through emotional pathways, whereas soundscape exerts both direct and multi-path cumulative effects, highlighting its dominant role in religious contexts.

3. Multisensory interaction

Soundscape evaluation significantly enhances visual evaluation, indicating a positive cross-modal interaction between auditory and visual evaluation. Visual evaluation partially mediates the relationship between soundscape evaluation and temple experience, suggesting that multisensory integration plays an important role in shaping overall experiential quality in Taoist temples.

6.2. Practical Implications

The results of this study indicate that soundscape evaluation in Taoist temples significantly influences visitors' spatial experience, providing multiple practical implications for the management and design of religious architecture:

1. Optimizing soundscape management to enhance spatial experience

The study shows that culturally meaningful Taoist ritual sounds (e.g., ritual instrument sounds, chanting) significantly impact soundscape evaluation, whereas human activity-related sounds and mixed environmental noise may reduce the overall quality of soundscape evaluation. Therefore, it is important to protect culturally significant human-generated sounds and create a sound environment with a clear religious atmosphere, while appropriately increasing the proportion of natural sounds, such as wind and water, to achieve a combination of natural immersion and cultural ambiance. Temple managers and volunteers should be encouraged to participate in soundscape creation and interpretation, so that culturally meaningful sounds not only enrich visitors' sensory experience but also serve as carriers for the transmission of religious culture.

2. Visual landscape design should emphasize cultural interest and aesthetics

The study found that visitors' positive evaluations of the visual environment are mainly reflected in interestingness and attractiveness, and that visual evaluation has a significant positive effect on emotional perception, but does not exert a significant direct effect on temple experience. Therefore, visual landscape design should incorporate elements with religious and cultural characteristics, such as architectural decorations, murals, and signage systems, while avoiding over-commercialization. This preserves the cultural value and aesthetic function of the visual environment, enhancing visitors' overall spatial experience and psychological well-being.

3. Integrating soundscape and visual landscape to enhance spatial immersion

The study also shows that soundscape directly influences visual evaluation, which in turn plays an important mediating role in the pathway from soundscape to spatial experience. Therefore, temple management and design should consider soundscape and visual landscape as an integrated system. For example, scenic areas can combine characteristic ritual sounds with architectural visual elements to jointly design visitor routes, enhancing sensory immersion and cultural resonance. Additionally, the proportion of soundscape and visual elements should be strategically allocated based on visitors' psychological needs and behavioral patterns in different areas, optimizing evaluation pathways and experiential logic, and continuously improving the overall quality of spatial experience.

6.3. Limitations and Future Research

Although this study provides systematic theoretical and empirical support for soundscape evaluation and spatial experience in Taoist temples, several limitations remain. First, the sample and survey sites were limited. The study involved a relatively small sample and conducted questionnaires only in a few temples. Future research could expand the sample size and cover a wider variety and scale of religious buildings to explore both commonalities and specificities of soundscape evaluation and spatial experience across different cultural and architectural contexts. Second, the research methodology has limitations. This study primarily relied on subjective questionnaire evaluations and lacked physiological measurements. Future studies could incorporate laboratory experiments and physiological indicators, such as heart rate or electroencephalography (EEG), to further investigate the specific psychological and physiological effects of soundscape on visitors, and to validate the multisensory mechanism linking soundscape, visual evaluation, and emotional perception. In addition, although the GoF value indicates an acceptable overall model fit, the relatively low R^2 values for several endogenous constructs suggest that the explanatory power of the model remains uneven across variables and should therefore be interpreted with caution. Third, this study mainly focused on the effects of soundscape and visual evaluation on spatial experience and did not examine the synergistic influence of other sensory modalities, such as olfaction and touch. This may limit the comprehensive understanding of multisensory integration mechanisms. Future research could expand the range of sensory modalities to explore how multisensory interactions contribute to overall religious space experience. Another limitation lies in the range of contextual and site-specific variables considered in the present study. Although efforts were made to standardize the survey period and environmental conditions, several factors that may influence sensory experience were not systematically incorporated into the analytical model. These include temple-related attributes (e.g., historical significance, relative religious importance, accessibility, and proximity to urban areas), visitor-related factors (e.g., familiarity with the temple, frequency of visitation, and place attachment), and situational variables during data collection (e.g., visitor flow, weather conditions, weekday versus holiday differences, sound level variation, and the specific form and repetition of ritual performances). Future research should integrate these variables through more fine-grained comparative designs, such as repeated measurements within the same temple across different seasons or weather conditions, or more controlled quasi-experimental studies combining perceptual surveys with objective environmental monitoring. We acknowledge that a single-temple design conducted across different seasons or weather conditions could provide a more fine-grained understanding of perceptual variation. Nevertheless, the present study was intended as a field-based cross-site investigation of general relationships among soundscape evaluation, visual evaluation, and Taoist Temple Experience, rather than a highly controlled within-site comparative experiment. Finally, this study did not systematically analyze differences in soundscape evaluation and spatial experience among visitors with different cultural backgrounds, ages, or religious beliefs. Future research could conduct comparative studies across groups to examine variations in multisensory experience pathways, providing guidance for refined management and personalized design of religious spaces. In summary, the soundscape evaluation–visual evaluation–spatial experience model constructed in this study provides both theoretical and empirical foundations for research on spatial experience in Taoist temples. It also offers concrete references for soundscape planning, visual design, and multisensory integration management in religious architecture, while opening new directions for future research on multisensory experiences in religious spaces.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Special Committee on Scientific Ethics of Guangzhou University (protocol code [2026]098 and date of approval [April 2026]).

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

Data Availability Statement: The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A. The Questionnaire

Construct	Content
Personal information	
Gender	☐Male, ☐Female.
Age	Under 17
	18–29
	30–44
	45–59
	60 and above
Education	Junior high school or below
	High school/Technical secondary school
	Bachelor's degree/Associate degree
	Master's degree or above
Occupation	Student
	Worker
	Teacher
	Service personnel
	Management and technical personnel
	Other
Purpose of Visit	Tourism and sightseeing
	Prayer or offering fulfillment
	Religious activities
	Other
Frequency of Visits	Once or less
	2–3 times
	4–5 times
	6 times or more

Construct	Content	
Sound Sources		1 = too weak, 5 = too strong.
Natural Sounds	Preference for Insect and Bird Sounds	☐1 ☐2 ☐3 ☐4 ☐5
	Perceived Intensity of Natural Sounds	☐1 ☐2 ☐3 ☐4 ☐5
	Perceived Importance of Natural Sounds	☐1 ☐2 ☐3 ☐4 ☐5
Artificial Sounds	Preference for Conversation Sounds	☐1 ☐2 ☐3 ☐4 ☐5
	Preference for Footstep Sounds	☐1 ☐2 ☐3 ☐4 ☐5
	Perceived Intensity of Artificial Sounds	☐1 ☐2 ☐3 ☐4 ☐5
	Perceived Importance of Artificial Sounds	☐1 ☐2 ☐3 ☐4 ☐5
Mechanical Sounds	Preference for Mechanical Sounds	☐1 ☐2 ☐3 ☐4 ☐5
	Perceived Intensity of Mechanical Sounds	☐1 ☐2 ☐3 ☐4 ☐5
	Perceived Importance of Mechanical Sounds	☐1 ☐2 ☐3 ☐4 ☐5
Taoist Ritual Sounds	Preference for Ritual Sounds	☐1 ☐2 ☐3 ☐4 ☐5
	Perceived Intensity of Ritual Sounds	☐1 ☐2 ☐3 ☐4 ☐5
	Perceived Importance of Ritual Sounds	☐1 ☐2 ☐3 ☐4 ☐5
Soundscape Evaluation of Taoist Temple		1 = Strongly disagree, 5 = Strongly agree.
1	Pleasant	☐1 ☐2 ☐3 ☐4 ☐5
2	Eventful	☐1 ☐2 ☐3 ☐4 ☐5
3	Calm	☐1 ☐2 ☐3 ☐4 ☐5
4	Vibrant	☐1 ☐2 ☐3 ☐4 ☐5
Visual Evaluation of Taoist Temple		1 = Strongly disagree, 5 = Strongly agree.
1	Attractiveness	☐1 ☐2 ☐3 ☐4 ☐5
2	Harmony	☐1 ☐2 ☐3 ☐4 ☐5
3	Openness	☐1 ☐2 ☐3 ☐4 ☐5
4	Interestingness	☐1 ☐2 ☐3 ☐4 ☐5
Emotional perception		1 = Very Dissatisfied, 5 = Very Satisfied.
1	I find the environment attractive.	☐1 ☐2 ☐3 ☐4 ☐5
2	The environment makes me feel relaxed.	☐1 ☐2 ☐3 ☐4 ☐5
3	I like this environment.	☐1 ☐2 ☐3 ☐4 ☐5
4	I find the environment pleasant.	☐1 ☐2 ☐3 ☐4 ☐5
5	I feel comfortable in this environment.	☐1 ☐2 ☐3 ☐4 ☐5
Taoist Temple Experience		1 = Strongly disagree, 5 = Strongly agree.
1	To what extent does the current sound environment inside and outside the Taoist temple influence your overall sense of reverence?	☐1 ☐2 ☐3 ☐4 ☐5
2	To what extent does the current sound environment inside and outside the Taoist temple influence your sense of immersion during worship activities?	☐1 ☐2 ☐3 ☐4 ☐5

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