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Study on the Relationship between Object Perception of Soundscape and Overall Soundscape Satisfaction

-- A Case Study of Fenghuang Town, Zhaoqing, "the hometown of longevity in the world"

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Abstract: With rising living standards, health and longevity have become widely discussed topics among the public, and forest resources, with their multiple health benefits, have emerged as ideal destinations for longevity and Yangsheng (means "care for life") tourism. Beyond traditional visual aesthetics, tourists increasingly seek multisensory experiences, particularly in smell and hearing when engaging with forest environments. Among these, the "soundscape" has gained significant attention as an important sensory resource. This study explores the object perception of visitors' soundscape experiences to Fenghuang Mountain, known as the "the hometown of longevity in the world," develops a measurement system for object perception, and empirically validates its effectiveness. The study further analyzes the relationship between object perception evaluation and soundscape satisfaction, offering new insights for the planning and management of longevity hometowns. By optimizing soundscape resources, the study aims to enhance visitor experiences and promote the harmonious coexistence of tourism and natural environments.

Keywords: Soundscape; Object Perception; Soundscape Satisfaction.

1. Introduction

As people's living standards continue to improve, the pursuit of a healthy lifestyle has become a widespread social phenomenon. Concepts of longevity and Yangsheng are increasingly taking root in people's minds, encouraging people to explore natural and healthy ways to enhance quality of life. Forest resources, with their multiple benefits such as improving air quality, showcasing natural beauty, and promoting physical and mental well-being, have become essential for improving life quality and pursuing longevity-focused wellness. The fresh air, lush vegetation, and tranquil ambiance of forest environments have shown significant effects in relieving psychological stress, promoting relaxation, and enhancing physical health, making forests a preferred destination for longevity and Yangsheng tourism. On this basis, people's interest is expanding beyond the traditional visual aesthetics of forest resources to encompass a broader range of sensory experiences, including smell, hearing, and even touch. Among these, the auditory experience of the "soundscape" (such as birdsong, flowing water, and wind rustling through leaves) creates a distinctive atmosphere within forest settings. The natural sounds perceived by visitors enrich their landscape perception experience; immersed in a forest environment filled with natural sounds, visitors can relax, reduce anxiety and stress, and gain psychological benefits conducive to health.

In recent years, as the concept of soundscape and tourism demands have evolved and upgraded, soundscape has gradually attracted attention in fields such as landscape architecture, psychology, and tourism studies. Most research has focused on soundscape evaluation, while studies on tourist satisfaction and perception evaluation from a soundscape perspective are gradually emerging. Currently, research on soundscape evaluation of forest resources in China remains in its early stages, and a unified, systematic framework for soundscape theory has yet to be established. This study, using Fenghuang Town in Dinghu District, Zhaoqing City, Guangdong Province— "the hometown of longevity in the world"—as a case study, applies a questionnaire-based approach to assess tourists' object perception of soundscape in forest environments. This includes tourists' evaluations of the likability, comfort, and harmony of different sound sources in the forest. Furthermore, the study explores the relationship between object perception and soundscape satisfaction.

Fenghuang Town is located within the forest ecosystem of the Dinghu Mountains, featuring a typical subtropical monsoon climate. Most of the rainfall occurs in spring and summer, with less precipitation in autumn and winter, and northerly winds prevailing in winter. With abundant water and thermal resources, with favorable climatic conditions supporting the growth of wildlife and vegetation, resulting in a forest coverage rate of 90%. The landscape is characterized by continuous mountain ranges interwoven with numerous streams, with red flowers, green trees, fresh air, and crystal-clear streams visible everywhere. In this paper, the forest resources of Fenghuang Town are collectively referred to as "Fenghuang Mountain." Fenghuang Mountain is part of the same range as Dinghu Mountain and is often called Dinghu Mountain's "backyard garden." The town's forests are home to numerous species, including wild higher plants, birds, reptiles, amphibians, insects, and large fungi, providing a rich array of natural soundscape resources such as birdsong and rustling leaves. The town also features water systems such as Jiulong Lake, Huangjin Gully, and Canglong Gully, where visitors can hear the rippling of lake water, the cascading of waterfalls, and the echoes in the valleys. These sounds, combined with the forest's tranquility, create a unique forest soundscape system.

2. Literature Review

2.1. Review of Soundscape-Related Literature

The concept of "soundscape" began to emerge in the 1920s, when Finnish geographer Granoe, J.G. sought to employ a comprehensive and holistic sensory approach into geographic research. Thus, he attempted to create a new term to express the idea of a "listener-centered acoustic environment," studying sounds that people either want or do not want to hear, with the goal of differentiating between sound studies and noise studies [1]. Soundscape has also been translated as "sound scenery," "acoustic landscape," or "sonic landscape." The term combines "sound" and "landscape," originally understood as "sounds within natural and urban environments that are worthy of appreciation and remembrance from an aesthetic and cultural perspective." This interpretation was introduced by Canadian musicologist and environmentalist R. Murray Schafer in his work *The Tuning of the World* [2].

The International Organization for Standardization (ISO) defines soundscape as a "accoustic environment," referring to the auditory setting perceived, experienced, or understood by one or more individuals within an environment [3]. Kull applied the concept of landscape from the European Landscape Convention—which defines a landscape as an area perceived by people, characterized by the interaction of natural and human factors—to the understanding of soundscape. He views a soundscape as an integrated acoustic environment composed of both natural and artificial sound sources [4]. Cheng Zheng and Shi Yunxuan, based on the source of sounds, categorize sounds into natural sounds, artificial sounds, and mechanical sounds [5]. Natural sounds include all sounds related to nature such as sounds of water, wind, plants, and animals; artificial sounds primarily encompass conversation, shouts, children playing, and footsteps, often originating from tourists and nearby residents in forest areas; and mechanical sounds include those from musical instruments in recreational facilities, vehicle traffic, and construction activities [6]. People perceive sounds through their auditory system, which subsequently influences their evaluations.

2.2. Research on Forest Resources Soundscape

Forest resources offer people the opportunities and venues to immerse themselves in nature, breathe fresh air, relax, and relieve stress. With the growth of forest tourism and recreation, tourists have become increasingly discerning. They no longer find satisfaction solely in visual landscape experiences but place greater emphasis on engaging multiple senses in the tourism process. Among these, hearing is one of the key senses through which visitors engage in the travel experience. Soundscape resources are essential for enhancing tourists' sense of place at a destination and help shape a complete and profound travel experience [7].

In recent years, the soundscape resources of forest resources have attracted attention in academia. Research on the soundscape of forest resources has primarily focused on describing, evaluating, and optimizing soundscapes, as well as establishing evaluation criteria and standards for forest soundscapes. Chen Feiping took the forest soundscape within the boundaries of Sanzhualun National Forest resources as research object, conducting both subjective and objective quality assessments of forest soundscapes [8]. Hong Xinchen, Lin Zhouyu, and Zhang Wei used methods such as questionnaire surveys, gray statistical methods, fuzzy comprehensive evaluation, and analytic hierarchy processes to analyze and evaluate the leaf soundscape, rain soundscape, and wind soundscape in Fuzhou National Forest, providing effective methods and theoretical foundations for future studies of various forest soundscapes [9]. Following this, he applied this evaluation index system to assess the overall soundscape of Fuzhou National Forest resources, leading to optimization strategies. This evaluation system and research methods were subsequently applied to the soundscape grading of Harbin National Forest resources, yielding both overall and graded assessments of its soundscape [10]. Zhong Le and Wang Weifeng, adopting a quantitative approach, constructed a comprehensive evaluation system for forest soundscapes. This system provides scientific basis for the planning and development of forest soundscapes in China and offers new directions for the development and application of research in the field of acoustics [11].

The earliest evaluation method for soundscape was proposed by Canadian musicologist and ecologist R. Murray Schafer. He used the terms "keynote sounds," "signals," and "soundmarks" to describe a particular soundscape. This classification method helps express the sound perception of a specific area or environment and aids in distinguishing the soundscape of a particular region [12]. Pninit Cohen and others proposed a comprehensive evaluation method for the soundscape environment of urban parks, based on a series of validated and feasible methods: field measurements, data analysis, standard index indexing, and data scaling, to assess the quality of the soundscape environment [13]. Ge and Hokao adopted subjective image evaluation and spatial analysis methods of soundscape formation to study the overall sound environment of urban street areas in Saga City, Japan, providing a unique direction for urban sound environment research and urban street area planning [14].

In recent years, soundscape evaluation has gradually matured, with assessment methods increasingly diverse and refined. These include subjective qualitative evaluations based on questionnaire surveys (perceptions from soundscape users) and objective physical evaluations grounded in acoustic parameter calculations. Soundscape evaluation primarily focuses on the perception of the soundscape itself [15]. Objective soundscape evaluation methods generally involve physical measurements of sound pressure levels at various locations and times within a specific area. Li Qi and others monitored sound levels at multiple points on a campus in real time, identifying the main sources of noise pollution on weekends and evaluating the sound environment quality at Qilu Institute of Technology, offering suggestions for improvement [16]. Sun Yinyin and others conducted field surveys and analyses of park soundscapes, utilizing GIS to establish databases and soundscapegraphy for East Lake Park and South Lake Park in Tai'an City [17]. Objective evaluation methods typically emphasize noise measurement and analysis, and then then control the noise, with less consideration given to listeners' feelings and experiences. In contrast, soundscape evaluation prioritizes the interactions between people, sound, and the environment, recognizing that listeners are an integral part of the soundscape, and their perceptions cannot be ignored. Subjective soundscape evaluation is based on individuals' conscious responses to various sounds and typically uses questionnaires, ratings, and rating scale methods to assess people's emotional responses and subjective reactions to landscape sounds. These evaluations are then aggregated and analyzed to assess the soundscape

[18]. Subjective evaluation methods reflect respondents' judgments, which are then summarized and analyzed to inform soundscape assessment [18]. Subjective evaluation methods, centered on the listeners' perspectives, gauge public perception of the soundscape, emphasizing participants' experiences. They not only address the limitations of objective evaluations but also align better with social functionality and value requirements. Therefore, this study adopts a purely visitor-based subjective perception approach for soundscape evaluation surveys.

2.3. Recent Measurement Studies on Object Perception of Soundscape

Hearing is one of the human senses and a means of conveying information. Unlike vision, which provides an immediate and intense impact, sound can evoke memories and associations, thereby shaping auditory perception. Auditory perception is the conscious process by which individuals use their ears to attend to, sense, and interpret internal and external information [19]. Chen Pingping suggests that tourists' experiential needs for sound can be summarized into three levels: object experience, situation experience, and experience of artistic conception. Scenic area developers should strive for harmony and alignment between these experiential needs and the design of soundscapes in their sites [20]. "First is the realm of object, second is the realm of situation, and third is the realm of artistic conception. The realm of object: when creating landscape poetry, it's essential to depict beautiful scenes, such as springs, rocks, clouds, and peaks. Poets should keep vivid images of these landscapes in their minds, as clear as if held in the palm of their hand. In the process of writing, they should carefully consider and grasp these images to achieve an effect of visual likeness. The realm of situation: the poet's emotions—joy, pleasure, sorrow, and lament—should be fully expressed in the mind, as if personally experiencing these feelings. By immersing themselves in these emotions and reflecting on them, poets can deeply grasp the emotional essence. The realm of artistic conception: it also involves unfolding emotions in the mind and contemplating them, thus capturing the true essence of poetry [21]. The terms "the realm of object" and "the realm of situation" first appeared in the work *Poem Format and Style* by poet Wang Changling living the in Tang Dynasty, in which he describes the realms of poem writing using the terms "the realm of object," "the realm of situation," and "the realm of artistic conception." Here, the realm of object is concrete, representing objective material that can be universally experienced and perceived. The realms of situation and artistic conception are intangible, relying on individual experience and feelings, and thus vary from person to person. "The realm of artistic conception" is used in art and architecture, emphasizing the "spirit" of the work and the "imagery" of space. Describing tourists' soundscape perception through object and situation perception builds on subjective evaluation methods, integrating social psychology characteristics and literary concepts. Dividing soundscape perception into a three-dimensional object and situation perception systems at two different levels aligns more closely with the scientific connotation of soundscapes, making it both practical and meaningful. Additionally, alongside object and situation perception evaluations, overall soundscape satisfaction serves as the focal point and outcome of this perception evaluation method, and it is also one of the indicators this study will investigate among tourists.

The realm of object is universally experienced and perceived, serving as the starting point and foundation for people's perception of a landscape. It represents the most direct sensory experience in the cognitive process. When exposed to different types of sound elements, people develop various psychological responses. Object perception refers to people's subjective evaluation of soundscapes based on different sound sources. In existing research, typical dimensions for evaluating a single sound source include loudness, likability, comfort, harmony, impression, rhythm, satisfaction, sociocultural sense, and historical cultural sense, among others [22]. Through an in-depth review of relevant literature and selecting indicators by their frequency of occurrence, and considering the actual conditions of Fenghuang Mountain's forest resources, this paper chooses three dimensions—likability, comfort, and harmony—to build the indicator layer of object perception. Likability refers to the degree to which tourists favor a particular sound. Based on tourists' preferences for various sound elements, appropriate techniques can be applied to enhance preferred positive sounds while reducing disliked negative soundscapes, helping create better soundscape environment for forest resources [23]. Comfort represents the degree of auditory pleasure and enjoyment that people derive from a sound source [24]. Harmony refers to the degree of alignment and integration between the soundscape perceived by visitors and the surrounding environment [11]. During activities in forest resources, people can hear a variety of sounds, which can generally be categorized by source into natural sounds, artificial sounds, mechanical sounds, and historical and cultural sounds. After conducting multiple field surveys at Fenghuang Mountain forest resources, it was found that there were no historical and cultural sounds in the area. Excluding this category, and using soundwalking methods to identify sounds, the sound elements in Fenghuang Mountain's forest resources were broadly divided into three main categories and eleven subcategories (Table 1) [25].

Table 1. Fenghuang Mountain Forest Soundscape Resource Composition Table

Types of Sounds	Sound Sources
Natural Sounds	Wind
	Rustling Leaf
	Flowing Streams
	Bird Songs
	Buzzing of Insects
Artificial Sounds	Talking
	Singing
	Footsteps
Mechanical Sounds	Airplane Roar
	Traffic Noise
	Construction

Note: compiled based on relevant literature

Therefore, the evaluation of object perception combines the above-mentioned three dimensions (likability, comfort, harmony) with the following eleven sound elements. This study employs a combination of the semantic differential method and the five-point Likert scales to design the survey questionnaire. The semantic differential scale, proposed by C.E. Osgood, is a psychometric method that measures psychological feelings using verbal characteristic scales, capturing respondents' perceptions and thus generating quantifiable data [50].

2.4. Overall Soundscape Satisfaction

Soundscape perception emphasizes not only physical attributes but also the perceptual content of the soundscape. This perception of soundscape attributes forms the basis for evaluating tourists' satisfaction from a soundscape perception perspective. Tourist satisfaction is a state of pleasure or disappointment formed by comparing a destination's expectations with the actual experience upon arrival. The higher the tourists' overall satisfaction with the soundscape, the more positive their evaluation [26]. Miller conducted research on the soundscape of urban parks in the United States by combining established subjective soundscape evaluation standards and quantitative data from quantifying sound elements, obtaining the overall soundscape satisfaction of visitors and residents toward parks [27]. Liao Weiming and Chen Feiping used a questionnaire survey method to study the soundscape satisfaction of Jiangxi's SanZhualun forest resources based on tourists' perceptual experiences [28]. Drawing on these scholars' findings, this study considers overall soundscape satisfaction as the focal point and outcome variable for soundscape measurement.

2.5. Research Hypotheses

This study has two main objectives: first, to construct and validate a measurement system for object perception in the soundscape experience of tourists in the hometown of longevity in the world; second, to further analyze the relationship between the dimensions of object perception and overall soundscape satisfaction. The hypotheses are therefore established as follows:

1. Construction of the Object Perception Measurement System

As mentioned earlier, object perception is the starting point and foundation of tourists' sensory experience and represents the most direct sensory experience. Only when tourists are physiologically satisfied with their perception can they appreciate deeper levels of perception conveyed by the sounds they hear, such as perceptions of likability, comfort, and harmony. This leads to a positive psychological experience of the tourism soundscape [29]. Tourists' physiological perception of the tourism soundscape forms the foundation of their satisfaction. When the direct sensory attributes of the soundscape (i.e., physical attributes) fall within a certain threshold, the psychological experience of the soundscape will directly influence tourists' satisfaction with the tourism soundscape. In this regard, object perception, as the foundation and starting point, will positively influence tourists' overall soundscape satisfaction. Based on the above reasoning, this study hypothesizes:

H1: Object perception consists of three dimensions: likability, comfort, and harmony.

H2: The likability of object perception positively influences overall soundscape satisfaction.

H3: The comfort of object perception positively influences overall soundscape satisfaction.

H4: The harmony of object perception positively influences overall soundscape satisfaction.

Based on theoretical derivations and hypotheses, the research framework is illustrated in Figure 1.

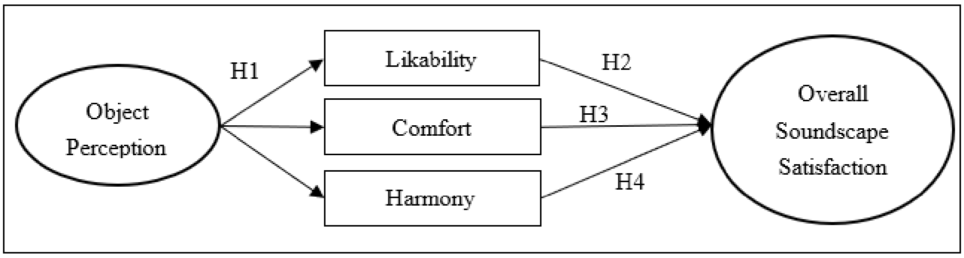

Figure 1. Research Framework Diagram

3. Research Methods

3.1. Data Collection Method

Soundscape is an important component of tourists' sensory experiences, and using questionnaires to collect research data can effectively gather respondents' psychological feelings and intrinsic perceptions. This paper obtained tourists' perceptions and evaluations of the forest resource soundscapes, followed by quantitative analysis to achieve scientifically sound soundscape evaluation results.

The questionnaires were distributed on-site at Fenghuang Mountain forest resources in Dinghu District, Zhaoqing City, Guangdong Province, targeting tourists visiting the forest tourism area. A total of 400 questionnaires were distributed, 381 were returned, and 360 were valid, resulting in an effective response rate of 90%.

3.2. Statistical Analysis Method

This paper used SPSS 21.0 software to analyze the collected survey questionnaire data and employed AMOS 21.0 software for structural equation modeling validation analysis.

4. Data Analysis

4.1. Frequency Analysis

Firstly, the sample attributes were analyzed, including gender, age, education background, occupation, marital status, and place of residence. Among the tourists, 179 were female, accounting for 49.7%, and 181 were male, accounting for 50.3%. There were 109 tourists aged 18-30, accounting for 30.3%; 147 tourists aged 31-45, making up 40%; 87 tourists aged 46-59, constituting 24.2%; and 17 tourists aged 60 and above, accounting for 4.7%. Regarding education background, 146 tourists had a high school education or below, accounting for 40.6%; 106 had a college education, accounting for 29.4%; 90 had a bachelor's degree, accounting for 25%; and 18 had a master degree or higher, accounting for 5%. As for occupation, 13 tourists were government or public institution staffs, accounting for 3.6%; 72 were professional technical personnel (including teachers, doctors, engineers, writers, lawyers, etc.), making up 20%; 37 were corporate employees, constituting 10.3%; 31 were business personnel, accounting for 8.6%; 51 were service industry workers, accounting for 14.2%; 25 were industrial workers, representing 25%; 8 were farmers, accounting for 2.2%; 9 were housewives, accounting for 9%; 40 were students, making up 11.1%; 20 were self-employed, representing 5.6%; 12 were unemployed, accounting for 3.3%; 21 were freelancers, constituting 5.8%; and 20 were retired, accounting for 5.6%. In terms of marital status, 249 tourists were married, accounting for 69.2%; 99 were unmarried, making up 27.5%; and 12 had other marital statuses (including widowed, divorced), accounting for 3.3%. Regarding place of residence, 199 tourists were from Zhaoqing, accounting for 55.3%; 70 were from the Pearl River Delta region of Guangdong, making up 19.4%; 24 were from the western Guangdong region, representing 6.7%; 34 were from the northern Guangdong region, constituting 9.4%; and 22 were from outside Guangdong Province, accounting for 6.1%.

4.2. Mean Analysis

A mean analysis was conducted on the data related to object perception, and the results are shown in Table 2.

Table 2. Visitor Soundscape Evaluation-Object Perception Mean Table

Question Item	Likability Mean	Comfort Mean	Harmony Mean
Likability of Wind Sounds	3.79	3.93	3.83
Likability of Rustling Leaves	3.96	4.03	3.97
Likability of Flowing Stream Sounds	4.09	4.14	4.03
Likability of Bird Songs	3.90	3.94	3.91
Likability of Insect Buzzing	3.68	3.72	3.76
Likability of Talking Sounds	3.28	3.36	3.33
Likability of Singing Sounds	3.49	3.49	3.43
Likability of Footstep Sounds	3.39	3.37	3.35
Likability of Airplane Roar	2.39	2.46	2.52
Likability of Traffic Noise	2.27	2.38	2.36
Likability of Construction Noise	2.16	2.23	2.33

Data Source: compiled from the analysis of SPSS 21.0 software in this study.

From Table 2, it can be observed that visitors rated the likability, comfort, and harmony of natural sounds in the Fenghuang Mountain forest highly, especially for sounds of the flowing streams and rustling leaves. One reason for this preference is that the stream sounds not only enhance the forest atmosphere but also reflect the serene ambiance within it. The rustling of leaves, produced by the wind passing through them, creates cheerful sounds that uplift people's spirits. Additionally, Fenghuang Mountain forest features four meandering streams, multiple ponds, and rich vegetation. In contrast, scores for artificial and mechanical sounds were relatively low, likely due to the proximity of the forest to the Guang-Fo-Zhao Highway, Zhaoqing Avenue, Fenghuang Mountain Tunnel, and Fenghuang Mountain Second Road, where visitors are frequently disturbed by the honking and noise of passing vehicles.

3. Overall Soundscape Satisfaction

The data on overall soundscape satisfaction shows that visitors give an average rating of 4.09 for the overall soundscape satisfaction of Fenghuang Mountain forest, which falls under the "satisfied" category. This indicates that visitors have a high subjective evaluation of the forest's overall soundscape environment.

4.3. Reliability and Validity Analysis

This study uses Cronbach's α reliability coefficient to measure the reliability of the questionnaire, while confirmatory factor analysis is employed to assess its validity. The analysis shows that Cronbach's α coefficient for each dimension of the variables exceeds 0.8, as detailed in Table 3, indicating that the scale has good reliability.

Table 3. Cronbach's α reliability coefficient

Dimension	Cronbach's Alpha
Likability	0.844
Comfort	0.847
Harmony	0.861

Data resource: compiled from the analysis of SPSS 21.0 software in this study.

Discriminant validity mainly examines the differences between different constructs. In research, the KMO (Kaiser-Meyer-Olkin) test and Bartlett's test are commonly used to measure a questionnaire's discriminant validity. The KMO and Bartlett's test check for correlations among variables to determine if common factors can be extracted. The higher the KMO value, the more common factors there are among the variables, indicating that factor analysis is more suitable. A KMO value above 0.9 indicates very suitable; 0.8 indicates suitable; 0.7 indicates moderate; 0.6 indicates not very suitable; and below 0.5 indicates extremely unsuitable. For Bartlett's test, a significance level of 0.01 or less implies that the set of questions shares common factor and is suitable for factor analysis. As shown in Table 4, the overall KMO value for the scale is 0.846, falling between 0.8 and 0.9, and Bartlett's test of sphericity result is significant at 0.000 ($P < 0.001$). With all P-values below 0.05, the results meet the significance level, indicating that each question item has good discriminant validity.

Table 4. KMO and Bartlett's test

Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy		.846
Bartlett's test of Sphericity	Approximate Chi-square	8683.014
	df	528
	Sig.	.000

Data resource: compiled from the analysis of SPSS 21.0 software in this study

Construct validity primarily examines the contribution of each question item to its construct. Using the principal component method with maximum orthogonal rotation, common factors with eigenvalues greater than 1 are extracted, resulting in a total of 33 factors. As shown in Table 5, the cumulative contribution rate of the first eight factors is 74.054%, exceeding 60%, while the contribution rate of the first factor is 14.741%, which is below 50%. This indicates that the scale's structural validity is good and basically matches the latent variables set in the theoretical model.

Table 5. Total Explained Variance

Component	Initial Eigenvalues			Extraction Sum of Squared Loadings			Rotation Sum of Squares Loadings		
	Total	Variance %	Cumulative %	Total	Variance %	Cumulative %	Total	Variance %	Cumulative %
1	9.575	29.014	29.014	9.575	29.014	29.014	4.864	14.741	14.741
2	5.119	15.513	44.527	5.119	15.513	44.527	4.338	13.145	27.886
3	2.549	7.725	52.251	2.549	7.725	52.251	3.733	11.311	39.197
4	2.003	6.069	58.320	2.003	6.069	58.320	3.415	10.348	49.544
5	1.852	5.611	63.931	1.852	5.611	63.931	2.375	7.196	56.740
6	1.248	3.782	67.713	1.248	3.782	67.713	2.014	6.104	62.844
7	1.069	3.238	70.952	1.069	3.238	70.952	1.936	5.866	68.710
8	1.024	3.102	74.054	1.024	3.102	74.054	1.763	5.344	74.054
9	.903	2.736	76.790						
…	…	…	…						
33	.089	.270	100.000						

Extraction method: Principal Component Analysis.

4.4. Structural Equation Modeling Analysis

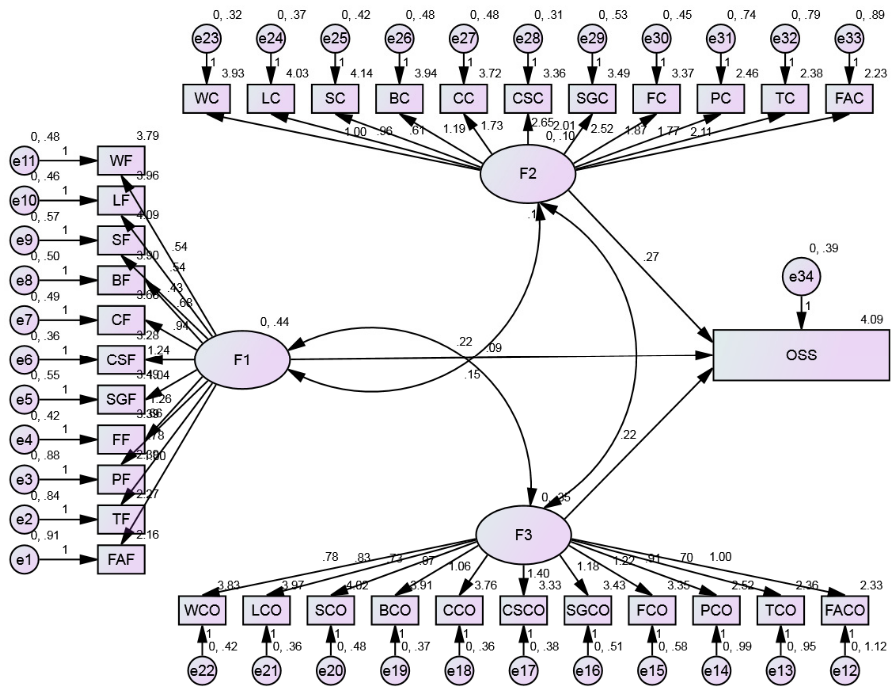

Figure 2. Unstandardized Estimation Model Diagram

Data resource: compiled from the analysis of AMOS21.0 software in this study.

Table 6. Model Regression Coefficients Table

Path Relationship			Estimate	S.E.	C.R.	P
FAF	<---	F1	1			
TF	<---	F1	0.776	0.1	7.762	***
PF	<---	F1	0.664	0.096	6.935	***
FF	<---	F1	1.263	0.117	10.801	***
SGF	<---	F1	1.037	0.105	9.858	***
CSF	<---	F1	1.238	0.113	10.919	***
CF	<---	F1	0.939	0.097	9.71	***
BF	<---	F1	0.675	0.081	8.296	***
SF	<---	F1	0.431	0.073	5.932	***
LF	<---	F1	0.538	0.072	7.468	***
WF	<---	F1	0.536	0.073	7.372	***
FACO	<---	F3	1			
TCO	<---	F3	0.696	0.115	6.035	***
PCO	<---	F3	0.914	0.131	6.961	***
FCO	<---	F3	1.215	0.142	8.569	***
SGCO	<---	F3	1.179	0.136	8.64	***
CSCO	<---	F3	1.399	0.152	9.183	***
CCO	<---	F3	1.065	0.121	8.797	***
BCO	<---	F3	0.966	0.113	8.565	***
SCO	<---	F3	0.732	0.099	7.42	***
LCO	<---	F3	0.828	0.101	8.222	***
WCO	<---	F3	0.779	0.1	7.825	***
WC	<---	F2	1			
LC	<---	F2	0.964	0.145	6.638	***
SC	<---	F2	0.614	0.13	4.707	***
BC	<---	F2	1.19	0.171	6.943	***
CC	<---	F2	1.732	0.214	8.101	***
CSC	<---	F2	2.648	0.286	9.262	***
SGC	<---	F2	2.009	0.24	8.363	***
FC	<---	F2	2.518	0.281	8.967	***
PC	<---	F2	1.871	0.242	7.726	***
TC	<---	F2	1.773	0.238	7.457	***
FAC	<---	F2	2.106	0.27	7.788	***
Overall Soundscape Satisfaction	<---	F2	0.269	0.184	1.46	0.144
Overall Soundscape Satisfaction	<---	F1	0.094	0.085	1.1	0.272
Overall Soundscape Satisfaction	<---	F3	0.22	0.084	2.601	0.009

Data resource: compiled from the analysis of AMOS21.0 software in this study.

This study focuses on Fenghuang Mountain forest in Zhaoqing, examining the measurement of visitors' object perception of the forest soundscape and the path relationships between these perceptions and overall soundscape satisfaction. The model construction and analysis results are shown in Figure 2 (where F1 represents likability, F2 represents comfort, and F3 represents harmony). Through the estimation of unstandardized regression coefficients and significance testing, the model successfully converges and identifies, yielding the results shown in Table 6. The data in the table indicate that the path relationships between observed variables and latent variables are all significant, supporting the hypothesis that object perception is composed of three dimensions, confirming hypothesis H1. Additionally, the data reveal that among the three dimensions of object perception, only the path relationship between harmony and overall soundscape satisfaction is significant. In contrast, the regression relationships between likability and comfort on overall soundscape satisfaction are not significant. This confirms that hypotheses H2 and H3 are not supported, while hypothesis H4 is supported.

Hypotheses H2 and H3 are found to be unsupported, indicating that "likability" and "comfort" do not have direct significant regression relationships with "overall soundscape satisfaction." It is possible that their influence occurs through the mediating effect of higher-level soundscape perceptions. Therefore, visitors' object perceptual evaluations of each sound source may not necessarily have a direct impact on their evaluations of overall soundscape satisfaction. The reason for this is that in their object evaluations of sound source include not only positive and neutral soundscapes but also negative ones. Visitors' lower evaluations of negative soundscapes affect the overall evaluation of object perception, which disrupts the influence of the two dimensions of object perception on overall soundscape satisfaction.

5. Conclusion and Implications

5.1. Main Research Conclusion

In the academic field, soundscape evaluation is generally divided into objective and subjective soundscape evaluations. Objective soundscape evaluation is typically used as the main basis for noise management in the environment, while in tourist experience, subjective perception is often the primary measure. This study argues that in forest environments, humans, as the experiencers of soundscapes, should place importance on subjective experience perception and use it as the primary basis for improving the soundscape environment. Based on a review of relevant literature and a comprehensive analysis of the soundscape conditions of Fenghuang Mountain forest, this study developed an evaluation scale for object perception of soundscapes in forest visitors. Field investigations revealed that the sounds in Fenghuang Mountain forest can be roughly categorized into three types: natural sounds, artificial sounds, and mechanical sounds. These three categories of soundscapes include approximately 11 elements: sounds of wind, bird songs, insects, flowing stream, rustling leaves, footsteps, singing, talking, airplane roar, traffic, and construction noise. To assess these soundscape elements, the term "object perception" is used to describe people's initial perception evaluation of various sounds in the forest. This led to an evaluation system based on three dimensions of object perception: likability, comfort, and harmony. The system has been confirmed through data analysis of structural equation modeling, and this approach—classifying the three types of soundscapes into 11 elements, and measuring perceptions through three dimensions—provides a valuable reference for the measurement of soundscape research.

This study constructed a hypothetical relationship model between the three dimensions of object perception in soundscapes and overall soundscape satisfaction. Through unstandardized validation of the model data using structural equation modeling, it was found that there is a significant regression relationship between harmony in object perception and overall soundscape satisfaction, while there is no significant regression relationship between likability and comfort with overall soundscape satisfaction. This suggests that while people appreciate likability and comfort in forest soundscapes, these factors alone do not directly lead to satisfaction. In other words, people are not necessarily intolerant of human activity sounds in the forest, but as long as these human activity sounds are harmonized with the natural sounds of the forest, people will be satisfied with the soundscape in the forest.

5.2. Implications and Outlook on Future Research

In the questionnaire survey on object perception, statistics reveal that people rate natural soundscapes positively. This suggests the importance of optimizing plant configurations to increase the proportion of natural sounds, as the natural sounds in the forest can create pleasant and appealing auditory perceptions. These sounds not only make people feel comfortable but also harmonize well with the visual environment of the forest, thus enhancing visitors' perceptual value. When planting vegetation in the forest, consideration could be given to introducing plants with dense foliage and large leaf areas, such as camphor trees, cockspur coral trees, Bauhinia, and tree species like bamboo, which are widely used in forests and urban parks. These plants, when affected by the wind, can produce beautiful natural sounds. Additionally, plants like starfruit and silk cotton trees, which are favored by birds, can be planted to help create a distinctive soundscape for the forest.

The survey revealed that mechanical sounds are the least favored by visitors, including traffic noise, airplane roar, and construction sounds (both from nearby construction sites and within the forest). Regarding these sounds, efforts should be made to minimize artificial and mechanical sounds in the forest resources as much as possible. However, it is impossible to completely eliminate the noise from production and human activities around the forest, the only feasible approach is to reduce the noise by influencing the sound propagation process. Studies have shown that bamboo forests are highly effective in noise reduction. Increasing the presence of bamboo and densely foliaged trees like Ligustrum lucidum and Illicium verum near roads can help strengthen the soundproofing effect. For construction sounds within the forest, the park should arrange work schedules reasonably to avoid peak visitor times.

The forest soundscape has significant therapeutic and restorative effects. Scenic area management can create auditory healing zones by effectively utilizing the natural sounds of flowing streams, rhythmical leaf rustling, and bird songs and buzzing of insects, allowing visitors to experience pleasant, joyful, and melodious soundscapes, offering their ears a break from the noise of work and the city. The Fenghuang Mountain forest has a superior soundscape environment is inherently superior, which inherently possesses special rehabilitative functions. Through feasible noise reduction measures, promoting bird breeding, and strengthening the promotion and education of soundscape, a more favorable soundscape environment can be created. This would allow visitors to listen to the sounds of water, wind in the trees, and birds and insects, which can help in the recovery of visitors from sub-health conditions.

This study confirmed that two of the four hypotheses are supported, while the other two are not. Although this result may not fully satisfy the researchers, it opens another window of opportunity. Specifically, in the two unsupported relationships, there may be mediating variables and this hypothesis provides researchers with a clear direction for future research.

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