sustainability

MDPI

Article

Soundscape Perception Preference in an Urban Forest Park: Evidence from Moon Island Forest Park in Lu'an City

Yanlong Guo [1,2,*], Ke Wang [1], Han Zhang [3,*] and Zuoqing Jiang [4]

[1] Social Innovation Design Research Center, Department of Design, Anhui University, Hefei 203106, China
[2] Anhui Institute of Contemporary Studies, Anhui Academy of Social Sciences, Hefei 203106, China
[3] College of Environmental Science and Engineering, Ocean University of China, Qingdao 266100, China
[4] Institute of Botany, Chinese Academy of Sciences, Beijing 100049, China
* Correspondence: 20106@ahu.edu.cn (Y.G.); zh7049@stu.ouc.edu.cn (H.Z.); Tel.: +86-152-5655-6306 (Y.G.)

Abstract: Urban forest parks improve the environment by reducing noise, which can promote the development of physical and mental health. This study aimed to investigate the soundscape preferences of visitors in different spaces. It also provides practical suggestions for the study of urban green-space soundscapes. This study took the example of Moon Island Forest Park in Lu'an City, based on the questionnaire field survey that acquired public soundscape perception data. SPSS 26.0 was used to analyze five different spatial soundscape perception preferences in Moon Island Forest Park, starting from the subjective evaluation of users' soundscape perception, based on user preference for different spatial sound source types. A one-way analysis of variance (ANOVA) was used and a separate analysis of soundscape preferences in each space was undertaken; the mean (SD) was also used to reveal the respondents' preference for each sound-source perceptual soundscape. The study found that the five dimensions of different spaces were significantly correlated with sound perception preferences. First, the same sound source had different perceptual characteristics and differences in different functional areas. Second, different spatial features were influenced differently by typical sound sources. Third, in each functional area, water sound was the main sound source of positive impact and mechanical sound was the main source of negative impact. Mechanical sound had the greatest negative impact on the overall area. Overall, natural sound provided the most popular significant contribution to the soundscape preference; second was the human voice, and mechanical sound produced a negative effect. The results of these studies were analyzed from the perspective of soundscape characteristics in different spaces, providing a more quantitative basis for urban forest park soundscape design.

Keywords: urban forest park; sound source environment; sound source perception; spatial variation; one-way ANOVA

Citation: Guo, Y.; Wang, K.; Zhang, H.; Jiang, Z. Soundscape Perception Preference in an Urban Forest Park: Evidence from Moon Island Forest Park in Lu'an City. *Sustainability* **2022**, *14*, 16132. https://doi.org/10.3390/su142316132

Academic Editor: Axel Schwerk

Received: 17 October 2022
Accepted: 30 November 2022
Published: 2 December 2022

1. Introduction

Recurrent outbreaks of COVID-19 have negatively affected public mental health and physical health, increasing demand for parks and outdoor green spaces [1]. Research has shown that urban forest parks are developed on the basis of forest resources, positive ecological value and social benefits [2,3], being effective in protecting biodiversity [4–7], improving urban noise [8,9], providing public stress relief [1,10–13], and enhancing resistance [14–17]. Therefore, urban forest parks are built in large numbers in the context of ecological civilization and sustainable development. However, it is worth noting that the environmental enhancement of parks has been explored from the perspective of the visual landscape to perceptual experience [18–21]. Soundscape becomes an important part of the senses and is an important resource, second only to the visual landscape. It is gradually gaining importance in the sustainable development of urban forest parks [22,23]. Therefore, understanding sound in the park environment is directly related to the quality of life of residents.

In the case of urban forest parks, visitors embrace nature when they have personal knowledge and understanding of the environment. In fact, soundscape perception is influenced by the individual, location, and environmental characteristics [24,25], and there is large variation among individuals [26]. In different landscape environments, soundscape experience is also different. Scholars have conducted various studies on different spatial environments such as urban forests, green spaces and communities. The main concerns are soundscape change [27–31], quality evaluation [32–36], spatial dependence [37], and restoration studies [38]. In terms of soundscape preference, scholars have studied sound source preference [39], sound source type [40], perceptual experience [41], and demographic–sociological [42] differences. In terms of the methodology of soundscape research, researchers use decision support systems, such as studying the effect of bird song on relieving visitors' psychological stress [43]. In order to study more reliable methods for building perceptual birdsong models (PBM) [44] and soundscape recordings [45], researchers have analyzed and explored the influencing factors of soundscape change. Scholars have achieved fruitful results in protecting green-space biodiversity, improving public recreational benefits and reducing noise, which has some reference value. Soundscape research represents a shift in research in the field of sound assessment on the basis of the traditional perception of sound, extending the existing physical measurements [46]. Although several studies have been conducted to assess the soundscape of national parks [47,48], most of the existing literature focuses on soundscape variations in different spaces rather than soundscape preferences. Few studies have compared the soundscape preferences of different spaces in a region, and they are, therefore, less significant in guiding the different spaces of the whole park.

Therefore, this study took the Moon Island Forest Park in Lu'an City as the research object. This study was based on user preferences for different spatial sound source types, subjective evaluation from sound source perception characteristics, and soundscape perception. We explored the differences in soundscape perception preferences in different functional areas of urban forest parks, based on the three typical sound sources: natural sound, human recreational sound, and mechanical sound, and the impact on overall sound source perception preference was used to provide specific methodological guidance for the environmental enhancement of the urban forest park soundscape.

2. Methods

2.1. Overview of the Study Area

The study area was located in Moon Island Forest Park, Lu'an City, Anhui Province. Moon Island is located in the west of Lu'an City and it is moon-shaped due to the natural impact of the river, hence the name "Moon Island". Moon Island covers an area of approximately 150 hm^2, with a water surface area of approximately 215 hm^2. Approximately four-fifths of the island's land is used by Wanxi College. The southern part is the Moon Island resettlement area. The current residential population is approximately 5290 people. The total length of the greenway around the island is approximately 5 km. The green corridor is dominated by large trees with a high shade coverage and combines flowering trees and shrubs. The use of multi-level plants constitutes a characteristic urban greenway in Lu'an. Moon Island Forest Park plays an important role in improving the ecological environment, providing public recreation services and displaying the ecological image of the city, whilst meeting the demand for green space. The park receives a lot of traffic with visitors of all ages, including children, teenagers, the middle-aged, and the elderly. This facilitated the acquisition of large amounts of basic experimental data. In addition, the site is warm in winter and cool in summer, with all four seasons being much like spring. The plant configuration and water features are very rich. Moon Island Forest Park is a comprehensive urban forest park integrating ecological protection, recreational green space, education, and study. The soundscape environment is well suited to the needs of this paper; therefore, Lu'an Moon Island Forest Park was selected as the study area. Research exploration included the geographical location, general layout, composition of the sound environment and its spatial distribution, and other conditions, as shown in Figure 1.

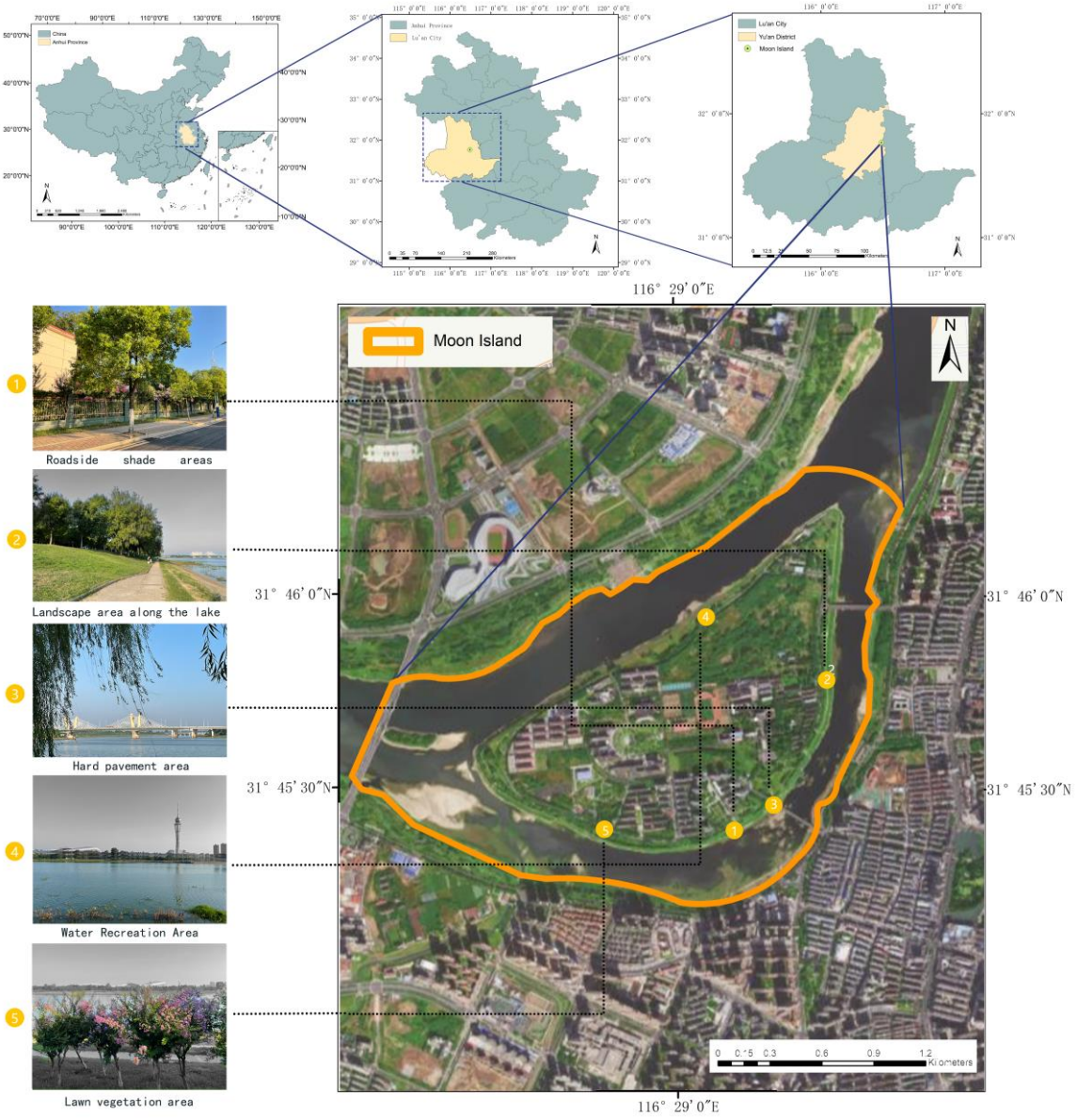

Figure 1. Functional zoning and sampling point distribution of the study area site.

To improve the relevance of the study results and take into account the heterogeneity of the park's internal environment, we selected specific sample sites rather than the entire park for landscape evaluation. Reasonable sample sites with a rich variety of sound elements and visual landscape types were included, thus, achieving the best results. Through field surveys, 20 urban park environments were selected. When setting sample points, we considered the functional division of the park and the distribution of the main attractions. The main tour route of Moon Island Forest Park was selected as the main route. This study invited two experts in landscape design research to rate videos of 15 urban park environments. The top 5 were selected as the study sample, covering the main specialty parks and major attractions within the park, which are highly representative of the urban park environment features, as shown in Table 1.

Table 1. Moon Island Forest Park sound source environment.

	Digital Coding	Sampling Points	Environmental Characteristics
(E) Moon Island Forest Park sound source environment	E1	Roadside shade area	Close to the roadside, rich vegetation and shade
	E2	Lawn vegetation area	Dense woods, high and low level of plant landscape
	E3	Hard pavement area	Hard pavement, road intersection
	E4	Water recreation area	Rich water source, near water table
	E5	Landscaped area along the lake	Walkway along the lake, waterfront recreation

2.2. Questionnaire

Before the questionnaire was implemented, the landscape type of Moon Island Forest Park was evaluated through field surveys. The park includes natural landscape elements (creeks, lakes, lawns, boulevards, bushes) and artificial landscape elements (sculptures, bridges, children's play facilities, adult fitness facilities, and trash drop-off points). It can be inferred that the park contains a rich soundscape [49–51]. Referring to previous studies by scholars, it was found that the sound type is a determining factor in the sustainability of urban forest parks [52]. The definition of sound sources by Kraus [53,54] was used as the basis for the classification of soundscape types in this study's questionnaire. In addition, combined with the ISO [55] definition of a soundscape and the actual situation of the Moon Island Forest Park in Lu'an, a total of 8 secondary indicators were selected to measure the type of sound source people perceive. The sound source categories were based on the results of the pilot study, and natural sound, anthropogenic sound, mechanical sound, and traffic sound were selected as the primary indicators to investigate soundscape preferences in different regions [49], as shown in Table 2.

Table 2. Elements of soundscape composition in Moon Island Forest Park.

	Digital Coding	Sound Source Type	Name of Sound Source	Indicator Reference
(Q) Moon Island Park sound source	Qa	Natural sound	Qa1 Bird song	Buxton et al. [50]
			Qa2 Insect sound	Ma et al. [51]
			Qa3 Wind sound	Hong et al. [52]
			Q4 Water sound	Jeon et al. [53]
	Qb	Human recreational sound	Qb1 Children's entertainment sound	Ma et al. [51]
			Qb2 Leisurely conversation sounds	Jeon et al. [53]
	Qc	Mechanical sound	Qc1 Traffic sounds	Ma et al. [51]
			Qc2 Mechanical sound	Shao et al. [54]

The questionnaire consisted of two parts: collecting background information from visitors and assessing the perception of the park landscape (the main part of the questionnaire). The objective of the first part of the questionnaire was to obtain data on simple demographic characteristics of the respondents, such as gender; age (under 18, 19–30, 31–40, 41–50 and 51+); education (junior high school and below, high school, specialist, undergraduate and postgraduate); monthly income status (under 2000, 2001–4000, 4001–8000, 8001–12,000, more than 1200); and the distance between the respondents residence and the park (inner ring, inner ring–middle ring, outer ring–bypass highway, bypass highway–edge of the city, outside of the city). As shown in Table 3, the second part of the questionnaire was an assessment of visitors' preference for different spatial landscapes.

The questions in the questionnaire included "In the current environment, how loud is the sound that you hear" on a scale of 1–9 (1 = not at all, 9 = extremely loud). It is important to note that the respondents answered the questions after hearing and seeing cues; they could see the scene and hear the sound in question, evaluating the sound source preferences in each region in a 3D space. The study was conducted through a field study, using the soundscape perception assessment questionnaire, as shown in Table 4.

Table 3. Demographics of the interviewees.

Attribute	Classification
Gender	Men: 46%; women: 54%
Age	Under 18 years old: 15%; 19–30 years old: 40%; 31–40 years old: 22%; 41–50 years old: 10%; 51 years old and above: 13%
Educational background	Junior high school and below: 21%; high school: 15%; specialist: 10%; undergraduate: 31%; postgraduate: 23%
Monthly income status	2000 or less: 15%; 2001–4000: 26%; 4001–8000: 38%; 8001–12,000: 13%; more than 12,000: 8%
Distance between residence and the park	Inner ring: 46%; inner ring–middle ring: 25%; outer ring–bypass highway: 8%; bypass highway–edge of the city: 14%; outside of the city: 7%

Table 4. Questionnaire setting for the degree of preference in terms of the soundscape in Moon Island Forest Park.

Problem	Sound Source	Subfactor	Indicator Description
Q1: What is your preference for hearing the following sounds from the shaded area on the side of the road?	Natural sounds	Bird sounds	The roadside shade areas have relatively dense and coherent vegetation, and visitors choose this area, to some extent, during their walks, and these activities influence the extent to which visitors prefer the landscape and soundscape.
		Insect sounds	
		Wind	
	Human recreational sounds	Children playing	
		Recreational sounds	
	Mechanical sounds	Traffic sounds	
		Construction sounds	
Q2: What is your preference for hearing the following sounds from the lawn vegetation area?	Natural sounds	Bird sounds	The lawn vegetation area lists the common types of plants found in the park and explores visitors' preference for soundscapes in terms of visual landscape stimulation.
		Insect sounds	
		Water sounds	
		Wind	
	Human recreational sounds	Recreational sounds	
Q3: What is your preference for hearing the following sounds from the landscaped area along the lake?	Natural sounds	Bird sounds	Studies have proven that water sound can be used in city open areas to mask street noise, and that the degree of natural and mechanical sound can be attenuated in this area.
		Insect sounds	
		Water sounds	
		Wind	
	Human recreational sounds	Recreational sounds	
	Mechanical sounds	Construction sounds	
Q4: What is your preference for hearing the following sounds from the water recreation area?	Natural sounds	Bird sounds	The water recreation area lists the common nature sounds of the park, and by looking at thecharacteristics of the water recreation area one can understand the level of preference of children and elderly people for this area.
		Insect sounds	
		Water sounds	
		Wind	
	Human recreational sounds	Children playing	
		Recreational sounds	
Q5: What is your preference for hearing the following sounds from the hard-surfaced areas?	Natural sounds	Bird sounds	Focusing on the most dominant traffic roads present in urban parks we can use the soundscape preferences at road junctions to study the extent to which visitors prefer the main landscape and soundscape types.
		Insect sounds	
		Water sounds	
		Wind	
	Human recreational sounds	Children playing	
		Recreational sounds	
	Mechanical sounds	Traffic sounds	
		Construction sounds	

2.3. Survey Location

In this study, we used a questionnaire survey combined with interviews. Previously, based on the relevant literature and interviews with landscape experts, preliminary questionnaires were developed, and these unified the research program. As respondents' memories of urban forest parks differed, we used a combination of site pictures and sound sources to assist the respondents in completing the questionnaire, in order to better obtain information regarding their soundscape preferences. As mentioned before, through an evaluation survey of urban forest park users, we gained an understanding of the methods for evaluating and capturing people's perceived preferences for park acoustic landscapes.

In the pre-interview at Moon Island Forest Park, we learned that the park is open all day. The research was conducted during the summer vacation. During this time, the peak periods occur in the early morning at 5:00–8:00 and in the evening at 18:00–21:00. Therefore, the survey started at 5:00 a.m. every day, and the afternoon survey started at 18:00. In order to obtain a more comprehensive grasp of the changing patterns of the soundscape of Moon Island Forest Park, panelists conducted on-site user evaluation studies. The investigators were all graduate students with research experience. Based on the principle of efficiency and comprehensiveness, the questionnaire was as simple and clear as possible, improving the utility and accuracy of questionnaire data.

Online questionnaire distribution was via the "Questionnaire.com" platform. The questionnaires were issued on 1 August 2022 and collected on 15 August, with 15 days between issue and recovery. A total of 300 questionnaires were distributed in this survey, and 291 questionnaires were returned, with a questionnaire recall rate of 97%. After eliminating questionnaires with incomplete and apparently random responses (e.g., missing responses representing more than 30% of the answers, or contradicting each other, etc.), 287 valid questionnaires were collected in total. The effective response rate of the questionnaire was approximately 95.66%. It is important to note that many interviewees were reluctant to be interviewed for personal reasons. However, most park users agreed to the use of online questionnaires, including recording the basic demographic information of the interviewees.

2.4. Reliability and Validity

Reliability refers to the consistency and steadiness of the results. Cronbach's alpha is a reliability measure performed in SPSS to measure the internal consistency or reliability of an instrument or questionnaire. It is most commonly used for questionnaires developed using multiple Likert scales to determine whether the scale is reliable. Cronbach's alpha reliability coefficients are calculated because the results of more accurately reflect the actual reliability. In order to be certain of the reliability of the questionnaire, this paper made use of SPSS 25.0 for the Cronbach's alpha reliability analysis. Cronbach's alpha coefficient was 0.975, and the reliability coefficient was tiered from 0 to 1; the nearer to 1, the greater the reliability. This suggests that the reliability of the questionnaire was very good, and as a consequence, it can also be concluded that the reliability of the questionnaire meets the requirements of the survey; therefore, the results can be analyzed.

Prior to conducting the exploratory analysis, the validity of the information was analyzed. The validity evaluation of this questionnaire was carried out using the SPSS 26.0, an exploratory component evaluation for structural validity. Based on the following effects of the exploratory analysis, the validity evaluation was executed with the aid of Bartlett's test of sphericity and the KMO analysis. The results show that the KMO was 0.946, which means that the amassed statistics can be analyzed by way of an aspect analysis, and the coefficient of KMO was between zero and 1. The nearer the coefficient is to 1, the higher the validity of the questionnaire. Furthermore, Bartlett's test of sphericity confirmed that the p-value was 0.000***, which confirmed significance, rejecting speculation that there was correlation between the variables. Consequently, the evaluation was legitimate to the extent that it was considered suitable.

2.5. Statistics

In this study, a total of 291 questionnaires were used for data analysis. This was performed using SPSS v26.0 software. Based on the results of the questionnaire, the potential relationship between eight indicators of urban forest park soundscape and the respondents' degree of soundscape preference was explored. The analysis of variance (ANOVA) method was used at the inference level to provide an effective analysis of different spatial soundscape preferences, using the mean value analysis, to identify the influence of key sound source perception factors on perceived preferences in urban forest parks.

3. Results

3.1. Soundscape Preference Characteristics of Different Forest Spaces

(1) Degree of soundscape preference in hard paved areas

From the one-way ANOVA, visitors to the hard paved area rated the soundscape higher at the 95% confidence interval, with a mean preference score of 5.95 (Table 5). Among the three different sound sources, natural sound had the highest mean score of 7.08, followed by human recreational sound and mechanical sound at 6.04 and 5.18, respectively, with visitors preferring natural sound, and mechanical sound being the least popular among the public. In terms of the standard deviation, natural sound (1.85) < human recreational sound (2.35) < mechanical sound (2.85); the smaller the value, the more stable the score. A one-way ANOVA on the soundscape information regarding traffic to the challenging paved location yielded a statistical cost of F of 26.006, and there were extensive variations in vacationer preferences for the three sound sources ($p < 0.000$). Multiple contrast assessments via the use of Tamhenian T2 confirmed that, overall, there was a substantial distinction between natural, human recreational, and mechanical sounds ($p = 0.000$). There was a significant difference between natural sound and human recreational sound, and natural sound was considered to be significantly better than human recreational sound, with a mean difference of 0.50; there was a significant difference between natural sound and mechanical sound, and natural sound was considered to be significantly better than mechanical sound, with a mean difference of 1.41. Furthermore, there was a significant difference between recreational sound and mechanical sound, and recreational sound was considered to be significantly better than mechanical sound, with a mean difference of 0.91. There were significant differences between the three sound types, with natural sound > human recreational sound > mechanical sound.

Table 5. One-way ANOVA for hard paved areas.

	N	Mean ± SD	*p*
Natural sound	287	7.08 ± 1.69	<0.001
Human recreational sound	287	6.04 ± 2.32	
Mechanical sound	287	5.18 ± 2.79	
Natural sound vs. human recreational sound			<0.001
Natural sound vs. mechanical sound			<0.001
Human recreational sound vs. mechanical sound			<0.1

(2) Soundscape preference characteristics in shaded roadside areas

From the one-way ANOVA, the mean preference score for the shaded area at the roadside (Table 6) was 5.90. The highest mean score of 6.80 was obtained for natural sound, followed by 5.94 and 4.98 for recreational sound and mechanical sound, respectively, which showed that tourists preferred natural sound, and mechanical sound was the least popular among the public. In terms of the standard deviation, natural sounds (1.80) < recreational sounds (2.29) < mechanical sounds (2.62); the smaller the value, the more stable the score. A one-way ANOVA yielded an F value of 46.346, and there were significant differences in visitors' preferences for the three different sound sources ($p < 0.000$). Tamhenian T2 validated that, overall, there was a widespread difference between natural, recreational

and mechanical sounds (p = 0.000). There was a full-size distinction between natural sound and recreational sound, and natural sound was considerably higher than recreational sound, with a difference of 0.86. There was a large distinction between natural sound and mechanical sound, and natural sound was drastically higher than mechanical sound, with a difference of 1.82. Furthermore, there was a sizable distinction between recreational sound and mechanical sound, and recreational sound was appreciably higher than mechanical sound, with a difference of 0.96.

Table 6. One-way ANOVA for roadside shaded areas.

	N	Mean ± SD	*p*
Natural sound	287	6.80 ± 1.80	<0.001
Human recreational sound	287	5.94 ± 2.28	
Mechanical sound	287	4.98 ± 2.61	
Natural sound vs. human recreational sound			<0.001
Natural sound vs. mechanical sound			<0.001
Human recreational sound vs. mechanical sound			<0.001

(3) Soundscape preference characteristics of the turf vegetation zone

The lawn vegetation zone was different from the other three zones in that no mechanical sounds were present during the research (Table 7), so only natural sounds and human recreational sounds were compared. From the one-way ANOVA, the hard paved area had a higher perception of the soundscape of the lawn vegetation area with a 95% confidence interval, and there was a significantly large difference in the soundscape between the two types of sound, p = 0.000, <0.05. Further results of the multiple comparisons showed that the mean preference score was 6.47, and among the two different sound sources, natural sound had the highest mean score of 6.90, which was significantly more popular than human recreational sound at 6.04.

Table 7. One-way ANOVA for the turf vegetation zone.

	N	Mean ± SD	*p*
Natural sound	287	6.90 ± 1.74	<0.001
Human recreational sound	287	6.04 ± 2.38	
Natural sound vs. human recreational sound			<0.001

In terms of the size of the standard deviation, natural sounds were more popular with the public. In terms of standard deviation, natural sound (1.74) was smaller than human recreational sound (2.38); the smaller the value, the more stable the score. The distinction between the ratings of natural sounds (6.90) and human recreational sounds (6.04) reached the level of significance, p = 0.000, <0.05, and overall, there was a tremendous distinction between natural sound and human recreational sound; natural sound was appreciably higher than human recreational sound, with a distinction of 0.86.

(4) Soundscape preference characteristics of the water recreation area

The water recreation area was different from the other three zones in that no mechanical sounds were present during the research (Table 8), so only natural sounds and human recreational sounds were compared. From the one-way ANOVA, the hard paved area had a higher perception of the soundscape of the water recreation area with a 95% confidence interval, and there was a significant difference in soundscape preference between the two types of sound, p = 0.000, <0.05. Further results from the multiple comparisons showed that the mean preference score was 6.60, and among the two different sound sources, natural sound had the highest mean score of 7.13. Compared to human recreational sound (6.00), the visitors preferred the natural sound, which was obviously more popular among the public. In terms of standard deviation, that of natural sound (1.65) was smaller than

that of human recreational sound (2.35), and the smaller the value, the more stable the score. The distinction between the ratings of natural sounds (7.13) and human recreational sounds (6.00) reached the level of significance, $p = 0.000$, <0.05, and overall, there was a significant difference between natural sound and human recreational sound; natural sound was notably greater than human recreational sound, with a proposed difference of 1.13.

Table 8. One-way ANOVA for the water recreation area.

	N	Mean ± SD	*p*
Natural sound	287	7.13 ± 1.65	<0.001
Human recreational sound	287	6.00 ± 2.35	
Natural sound vs. human recreational sound			<0.001

(5) Soundscape preference characteristics along the lake landscaped area

In general, tourists gave a higher rating to the soundscape perception of the landscaped area along the lake, with a mean preference score of 6.04 at the 95% confidence interval (Table 9). Among the three different sound sources, natural sound had the highest mean score of 7.08, followed by recreational and mechanical sound at 6.04 and 5.18, respectively, which showed that tourists preferred natural sound, and mechanical sound was the least popular among the public. In terms of the size of the standard deviation, natural (1.69) < human recreational (2.32) < mechanical (2.79) sound; the smaller the value, the more stable the score. A one-way ANOVA on the data of visitors' soundscape preferences along the lake landscaped area yielded an F value of 53.277, with significant differences in visitors' preferences for the three different sound sources ($p < 0.000$). Tamhenian T2 confirmed that, overall, there were significant variations between natural, recreational and mechanical sounds ($p = 0.000$). There was a significant distinction between natural and recreational sounds, and natural sound was extensively higher than recreational sound, with a difference of 1.04; there was a significant difference between natural and mechanical sounds, and natural sound was considered significantly better than mechanical sound, with a mean difference of 1.99. There was a significant difference between recreational and mechanical sounds, and recreational sound was significantly better than mechanical sound, with a mean difference of 0.94.

Table 9. One-way ANOVA of landscaped areas along the lake.

	N	Mean ± SD	*p*
Natural sounds	287	7.08 ± 1.69	<0.001
Human recreational sound	287	6.04 ± 2.32	
Mechanical sound	287	5.18 ± 2.79	
Natural sound vs. human recreational sound			<0.001
Natural sound vs. mechanical sound			<0.001
Human recreational sound vs. mechanical sound			<0.1

3.2. Differences in Soundscape Preferences in Different Forest Spaces

Lu'an Moon Island Forest Park, which is a part of the Luxuriant River, has unique environmental advantages. Therefore, starting from the five areas closest to the water source, we analyzed whether the degree of users' preference for different spaces was related to the environment. Taking eight typical sound sources in the area of Lu'an Moon Island Forest Park as an example, five different functional areas (hard paved area, roadside shaded area, lawn vegetation area, water surface recreation area and landscaped area) along the lake from far to near were classified, and the mean value (SD) is shown in Table 10.

Table 10. Mean and standard deviation of respondents' perceived soundscape preference for each sound source.

	Natural Sounds				Human Recreational Sounds		Mechanical Sounds	
	Bird Sounds	**Insect Sounds**	**Wind**	**Water Sounds**	**Children's Entertainment**	**Recreational Sounds**	**Traffic Sounds**	**Construction Sounds**
Hard paved areas	7.25 ± 1.91	6.65 ± 1.34	7.10 ± 1.89	7.35 ± 1.78	6.02 ± 2.41	6.08 ± 2.42	5.23 ± 2.78	4.97 ± 2.91
Curb shaded area	7.24 ± 1.89	6.21 ± 2.38	6.95 ± 1.88		5.88 ± 2.45	6.00 ± 2.34	5.29 ± 2.58	4.68 ± 2.89
Lawn vegetation area	7.09 ± 1.88	6.34 ± 2.17	6.86 ± 1.99	7.22 ± 1.89		6.05 ± 2.39		
Water recreation area	7.34 ± 1.81	6.82 ± 2.05	7.06 ± 1.88	7.33 ± 1.76	6.05 ± 2.44	5.95 ± 2.51		
Landscaped area along the lake	6.55 ± 2.09	6.22 ± 2.30	6.89 ± 1.89	6.72 ± 2.12		6.09 ± 2.35		5.18 ± 2.85

The hard paved area is mainly located where the bridge of Moon Island joins the park entrance, and it includes a more comprehensive range of sounds. In this area, the preference for natural sounds specifically showed the highest preference for water sounds (7.35), followed by bird song (7.25), wind sounds (7.10), and insect sounds (6.65), while the preference for traffic sounds (5.23) and construction sounds (4.97) were both lower, indicating that people still had a low preference for mechanical sounds in areas where these were present. The preference for natural sound meant that the roadside shaded area scored highest for bird song (7.24), followed by wind sounds (6.95) and insect sounds (6.21); water sound was not considered because the roadside shaded area is not near the water, which shows that the roadside shaded area has more trees and a better environment, and bird song had a positive effect on users. In contrast, the preference for the mechanical traffic sounds (5.29) and construction sounds (4.68) was lower. In the lawn vegetation area and the water recreation area, where there was no mechanical sound, the difference between the two areas was that the natural sounds in the water recreation area ((7.34), (6.82), (6.86), and (7.22)) were all higher than the natural sounds in the lawn vegetation area ((7.09), (6.34), (6.86), and (7.22)), where the preference for water sound was higher than for the other natural sounds. This was additionally associated with the special surroundings of Moon Island, being a city park with wooded-areas and a greater array of natural sounds in areas where water sources were not present. However, the natural sounds observed in the viewing area alongside the lake were wind sound (6.89), water sound (6.72), bird song (6.55), and insect sound (6.22).

4. Discussion

4.1. Perceptual Preference for the Same Sound Source in Different Spaces

The spatial variability of the sounds was analyzed. The results of the one-way ANOVA show that the sound sources had different perceptual characteristics and variability. The preference for natural sound was higher among the three typical sound sources, and natural sound was also the most frequent to appear in each area. It is noteworthy that water sound, especially in the lawn vegetation area, exhibited a more obvious preference. The results of the variability analysis of sound source perception in each functional area showed that the variability of water sound was most significant in different areas, except for the "shaded roadside area" where no water sound was detected (Table 8), indicating that the greater choice of water sound in Moon Island Forest Park was associated with the environmental traits of the park. In a previous study, the public expectation of water sound [49] scored the highest; this was presumably due to the water features not producing a pleasing soundscape, such as the sound of water flowing and water dripping [33]. However, in this study, public preference for water sounds was high in different spaces.

4.2. The Influence of Different Spatial Features on Typical Sound Sources

The effect of traditional sound sources can vary, and an identical sound may have specific effects on the average appreciation of the soundscape in different areas as a result of the spatial surroundings and useful characteristics. Apart from the absence of mechanical sound detection in the lawn vegetation area and the water recreation area, mechanical sound

produced negative effects in the areas in which it was present (e.g., Tables 8–10). This is consistent with the results of a previous study demonstrating that there is an interconnection between vision and sound [38]; dissatisfaction with visual features (e.g., cars) can negatively affect soundscape perception [56,57]. The results obtained by measuring the distance of the five areas from the water found that the closer the area to the water, the lower the degree of perceived preference for water sound. In the case of the Moon Island Forest Park, this was found to occur in the landscaped area along the lake, compared with other areas, with the highest preference for soundscape perception occurring in other areas. In addition, the gap of preference compared with other natural sounds was smaller, indicating that the closer the location to the water, the smaller the gap of perceived preference for a soundscape with natural sounds and the better the soundscape It has been modified. environment.

4.3. Influence of Typical Sound Sources on Different Spaces

Among all functional areas, water sound was the main source with a positive impact, and traffic sound was the main source with a negative impact. Traffic sound had the greatest negative impact on the landscaped area along the lake, while it had the lowest frequency during the study period. This is likely due to rapid urbanization accelerating the development of industry, and the large amount of urban construction in the city, which led to the greatest negative impact of mechanical sound. With the exception of the "lawn vegetation area" and the "landscaped area along the lake" where no sound of children was detected (Tables 4 and 5), the sound of children's entertainment and recreational conversation also had a negative impact on the area (Tables 7, 8 and 10). In a previous study, it was concluded that natural sounds and children's sounds were considered to be positive. However, this is different from the results of other studies [58]. This is likely due to liberalization of the one-child policy, allowing second and third children; therefore, children appear more and more frequently in the park.

4.4. Overall Perceptual Preferences of Different Spatial Soundscapes

In general, the respondents had a greater desire for natural sound in special areas. The comparison of the overall subjective evaluation of natural, human recreational, and mechanical sounds shows that the preference in terms of the soundscape in all five areas was natural sound > human recreational sound > mechanical sound. From the results of this study, we can see that the main sound sources in Moon Island Forest Park are birdsong, cicadas, water, wind, and other sound types with a higher preference, with human recreational sounds and mechanical sounds representing negative sounds. This is consistent with the findings of previous research [59]; loud mechanical sounds were perceived negatively, human recreational sound preference was also low, and natural sound showed a higher preference.

4.5. Limitations and Future Work

This paper studied five sample sites in an urban forest park, The characteristics of the public's perceptual preferences for different spaces were analyzed, revealing the relationship pattern between sound source, soundscape perception, and space. This study only included a single park and a limited number of sample sites. Therefore, the follow-up study included different types of urban parks and more sample sites, in order to study in depth the soundscape preferences in different environments and scenarios. Subsequent studies may choose to combine acoustic landscape perception with forest environments in urban areas without natural water.

5. Conclusions

The soundscape traits of city wooded area parks are essentially constant with the outcomes of previous studies. In this study, a soundscape assessment questionnaire was used, taking Moon Island Forest Park in Lu'an City as an example. With the aim of exploring the degree of users' preference for the perception of typical sound sources in

different functional areas of forest parks, five dimensions of different spaces were found to be associated with sound perception preferences:

(1) Soundscape perception preferences in urban forest parks vary through spatial features. In this study of soundscape perception preferences, in terms of space type, the same sound source had different perceptual characteristics and variability in different functional areas. Soundscape perception preference varies through water sound in different spaces. It is worth noting that water sound is closely related to the environment. The preference for water sounds in the lawn vegetation zone was more obvious. Except for the "roadside shade area" where no water sound was detected, the variability of hydroacoustics is most pronounced in different regions. This shows that the greater desire for water sounds in Moon Island Forest Park was closely associated with the environmental traits of the park.

(2) The study takes into account the public's preference for the soundscape perception of different types of spaces in urban parks. This will allow for more refined study results. In the results of the one-way analysis, in terms of the type of sound source, relative to artificial and mechanical sound, The respondents were more receptive to natural sounds. Specifically, in five different functional areas (hard paved area, roadside shade area, lawn vegetation area, water recreation area, and landscape area along the lake), the natural sounds of birds and water sounds were most popular; in the space where the mechanical sound appears, neither was popular. Therefore, the research and design of soundscape preference should focus on the enhancement of natural sound, and the reduction and control of mechanical sound.

(3) The positive influence of Moon Island Park in Lu'an on the preference of soundscape in different spaces is mainly reflected in the natural sound. The negative impact is mainly reflected in the mechanical sound. Among all functional areas, water sounds were the main source with a positive influence; mechanical sounds were the main source with a negative influence, and mechanical sounds had the greatest negative influence on the overall area. The frequency of mechanical sounds was low, but the negative impact was the greatest; this is likely due to the accelerated urbanization and the greater negative impact caused by the large amount of construction in the city. This was followed by human recreational sound, probably due to the liberalization of the one-child policy, and the increasing frequency of children, middle-aged, and elderly people appearing in the park.

(4) Overall, the respondents had the highest preference for nature sounds in different regions. The comparison of the overall subjective evaluation of natural, human recreational, and mechanical sounds shows that the preference in terms of the soundscape in all five areas was natural sound > human recreational sound > mechanical sound. From this, we can see that the main sound sources in Lu'an Moon Island Forest Park were birdsong, cicadas, water, wind, and other sound types with a higher preference, and human recreational sounds and mechanical sounds were considered to be negative sounds. Compared with previous studies, we set up five representative spaces and used a factor analysis to conduct a soundscape study that refines the spatial characteristics of urban park soundscapes. The results of the study provide valid data to support the improvement of the urban forest soundscape.

Author Contributions: Conceptualization, Y.G. and K.W.; methodology, Y.G. and H.Z.; software, K.W.; validation, Y.G. and Z.J.; formal analysis, Y.G.; investigation, Y.G. and H.Z.; resources, Y.G.; information curation, K.W.; writing—original draft preparation, Y.G. and Z.J.; writing—review and editing, Y.G.; visualization, Z.J.; supervision, Y.G. and H.Z.; task administration, Y.G. All authors have read and agreed to the published version of the manuscript.

Funding: This study was funded by the Anhui University 2020 Talent Introduction Scientific Research Start-up Fund Project (Project No. S020318019/001).

Institutional Review Board Statement: Not applicable.

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

Data Availability Statement: The raw data are available on request from the authors.

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

References

1. Geng, D.C.; Innes, J.; Wu, W.; Wang, G. Impacts of COVID-19 Pandemic on Urban Park Visitation: A Global Analysis. *J. For. Res.* **2021**, *32*, 553–567. [CrossRef] [PubMed]
2. Kuehler, E.; Hathaway, J.; Tirpak, A. Quantifying the Benefits of Urban Forest Systems as a Component of the Green Infrastructure Stormwater Treatment Network: Quantifying the Benefits of Urban Forest Systems as Green Infrastructure. *Ecohydrology* **2017**, *10*, e1813. [CrossRef]
3. Oldfield, E.E.; Felson, A.J.; Auyeung, D.S.N.; Crowther, T.W.; Sonti, N.F.; Harada, Y.; Maynard, D.S.; Sokol, N.W.; Ashton, M.S.; Warren, R.J., II; et al. Growing the Urban Forest: Tree Performance in Response to Biotic and Abiotic Land Management: Urban Afforestation and Land Management. *Restor. Ecol.* **2015**, *23*, 707–718. [CrossRef]
4. Luitel, B.; Murthy, Y.V.S.; Koolagudi, S.G. Sound Event Detection in Urban Soundscape Using Two-Level Classification. In Proceedings of the 2016 IEEE Distributed Computing, VLSI, Electrical Circuits and Robotics (DISCOVER), Mangalore, India, 13–14 August 2016.
5. Yamada, Y. Soundscape-Based Forest Planning for Recreational and Therapeutic Activities. *Urban For. Urban Green.* **2006**, *5*, 131–139. [CrossRef]
6. Richards, D.G.; Wiley, R.H. Reverberations and Amplitude Fluctuations in the Propagation of Sound in a Forest: Implications for Animal Communication. *Am. Nat.* **1980**, *115*, 381–399. [CrossRef]
7. Aylor, D. Sound Transmission through Vegetation in Relation to Leaf Area Density, Leaf Width, and Breadth of Canopy. *J. Acoust. Soc. Am.* **1972**, *51*, 411–414. [CrossRef]
8. Jeon, J.Y.; Lee, P.J.; You, J.; Kang, J. Perceptual Assessment of Quality of Urban Soundscapes with Combined Noise Sources and Water Sounds. *J. Acoust. Soc. Am.* **2010**, *127*, 1357–1366. [CrossRef]
9. Ware, H.E.; McClure, C.J.W.; Carlisle, J.D.; Barber, J.R. A Phantom Road Experiment Reveals Traffic Noise Is an Invisible Source of Habitat Degradation. *Proc. Natl. Acad. Sci. USA* **2015**, *112*, 12105–12109. [CrossRef]
10. Aktay, A.; Bavadekar, S.; Cossoul, G.; Davis, J.; Desfontaines, D.; Fabrikant, A.; Gabrilovich, E.; Gadepalli, K.; Gipson, B.; Guevara, M.; et al. Google COVID-19 Community Mobility Reports: Anonymization Process Description (Version 1.1). *arXiv* **2020**, arXiv:2004.04145.
11. Strohmeier, M.; Olive, X.; Lübbe, J.; Schäfer, M.; Lenders, V. Crowdsourced Air Traffic Data from the OpenSky Network 2019–2020. *Earth Syst. Sci. Data* **2021**, *13*, 357–366. [CrossRef]
12. Tardivo, A.; Carrillo Zanuy, A.; Sánchez Martín, C. COVID-19 Impact on Transport: A Paper from the Railways' Systems Research Perspective. *Transp. Res. Rec.* **2021**, *2675*, 367–378. [CrossRef]
13. Bamwesigye, D.; Fialová, J.; Kupec, P.; Łukaszkiewicz, J.; Fortuna-Antoszkiewicz, B. Forest Recreational Services in the Face of COVID-19 Pandemic Stress. *Land* **2021**, *10*, 1347. [CrossRef]
14. Hong, X.; Zhang, W.; Chu, Y.; Zhu, W. Study on Subjective Evaluation of Acoustic Environment in Urban Open Space Based on "Effective Characteristics. " *Int. J. Environ. Res. Public Health* **2022**, *19*, 9231. [CrossRef] [PubMed]
15. Asensio, C.; Aumond, P.; Can, A.; Gascó, L.; Lercher, P.; Wunderli, J.-M.; Lavandier, C.; de Arcas, G.; Ribeiro, C.; Muñoz, P.; et al. A Taxonomy Proposal for the Assessment of the Changes in Soundscape Resulting from the COVID-19 Lockdown. *Int. J. Environ. Res. Public Health* **2020**, *17*, 4205. [CrossRef] [PubMed]
16. Rankin, L.; Axel, A.C. Biodiversity Assessment in Tropical Biomes Using Ecoacoustics: Linking Soundscape to Forest Structure in a Human-Dominated Tropical Dry Forest in Southern Madagascar. In *Ecoacoustics*; John Wiley & Sons, Ltd.: Chichester, UK, 2017; pp. 129–145.
17. Payne, S.R. The Production of a Perceived Restorativeness Soundscape Scale. *Appl. Acoust.* **2013**, *74*, 255–263. [CrossRef]
18. Cui, P.; Li, T.; Xia, Z.; Dai, C. Research on the Effects of Soundscapes on Human Psychological Health in an Old Community of a Cold Region. *Int. J. Environ. Res. Public Health* **2022**, *19*, 7212. [CrossRef] [PubMed]
19. Adams, M.; Cox, T.; Moore, G.; Croxford, B.; Refaee, M.; Sharples, S. Sustainable Soundscapes: Noise Policy and the Urban Experience. *Urban Stud.* **2006**, *43*, 2385–2398. [CrossRef]
20. Kang, J.; Zhang, M. Semantic Differential Analysis of the Soundscape in Urban Open Public Spaces. *Build. Environ.* **2010**, *45*, 150–157. [CrossRef]
21. Pijanowski, B.C.; Farina, A.; Gage, S.H.; Dumyahn, S.L.; Krause, B.L. What Is Soundscape Ecology? An Introduction and Overview of an Emerging New Science. *Landsc. Ecol.* **2011**, *26*, 1213–1232. [CrossRef]
22. Zhu, X.; Gao, M.; Zhao, W.; Ge, T. Does the Presence of Birdsongs Improve Perceived Levels of Mental Restoration from Park Use? Experiments on Parkways of Harbin Sun Island in China. *Int. J. Environ. Res. Public Health* **2020**, *17*, 2271. [CrossRef]
23. Ratcliffe, E.; Gatersleben, B.; Sowden, P.T. Associations with Bird Sounds: How Do They Relate to Perceived Restorative Potential? *J. Environ. Psychol.* **2016**, *47*, 136–144. [CrossRef]
24. Zhao, X.; Zhang, S.; Meng, Q.; Kang, J. Influence of Contextual Factors on Soundscape in Urban Open Spaces. *Appl. Sci.* **2018**, *8*, 2524. [CrossRef]

25. Zhang, M.; Kang, J. Towards the Evaluation, Description, and Creation of Soundscapes in Urban Open Spaces. *Environ. Plann. B Plann. Des.* **2007**, *34*, 68–86. [CrossRef]
26. Schneider, P.; Wengenroth, M. The Neural Basis of Individual Holistic and Spectral Sound Perception. *Contemp. Music Rev.* **2009**, *28*, 315–328. [CrossRef]
27. Joo, W.; Gage, S.H.; Kasten, E.P. Analysis and Interpretation of Variability in Soundscapes along an Urban–Rural Gradient. *Landsc. Urban Plan.* **2011**, *103*, 259–276. [CrossRef]
28. Rodriguez, A.; Gasc, A.; Pavoine, S.; Grandcolas, P.; Gaucher, P.; Sueur, J. Temporal and Spatial Variability of Animal Sound within a Neotropical Forest. *Ecol. Inform.* **2014**, *21*, 133–143. [CrossRef]
29. Gage, S.H.; Axel, A.C. Visualization of Temporal Change in Soundscape Power of a Michigan Lake Habitat over a 4-Year Period. *Ecol. Inform.* **2014**, *21*, 100–109. [CrossRef]
30. de Camargo, U.; Roslin, T.; Ovaskainen, O. Spatio-temporal Scaling of Biodiversity in Acoustic Tropical Bird Communities. *Ecography* **2019**, *42*, 1936–1947. [CrossRef]
31. Zhao, Y. Urban Parks Soundscape and Its Relationship with Vegetation Structure: A Pilot Study. *Sheng Tai Xue Bao* **2021**, *41*, 8040–8051. [CrossRef]
32. Dzyuba, N.; Kaverzneva, T.; Leonova, N.; Skripnik, I. Protection against Traffic Noise Acoustic Screens with Solar Cells. *IOP Conf. Ser. Earth Environ. Sci.* **2022**, *988*, 032003. [CrossRef]
33. Johnsen, S.Å.K.; Brown, M.K.; Rydstedt, L.W. Restorative Experiences across Seasons? Effects of Outdoor Walking and Relaxation Exercise during Lunch Breaks in Summer and Winter. *Landsc. Res.* **2022**, *47*, 664–678. [CrossRef]
34. Hong, X.-C.; Wang, G.-Y.; Liu, J.; Dang, E. Perceived Loudness Sensitivity Influenced by Brightness in Urban Forests: A Comparison When Eyes Were Opened and Closed. *Forests* **2020**, *11*, 1242. [CrossRef]
35. Hong, X.-C.; Zhu, Z.-P.; Liu, J.; Geng, D.-H.; Wang, G.-Y.; Lan, S.-R. Perceived Occurrences of Soundscape Influencing Pleasantness in Urban Forests: A Comparison of Broad-Leaved and Coniferous Forests. *Sustainability* **2019**, *11*, 4789. [CrossRef]
36. Xu, X.; Wu, H. Audio-Visual Interactions Enhance Soundscape Perception in China's Protected Areas. *Urban For. Urban Green.* **2021**, *61*, 127090. [CrossRef]
37. Chen, Z.; Zhu, T.-Y.; Liu, J.; Hong, X.-C. Before Becoming a World Heritage: Spatiotemporal Dynamics and Spatial Dependency of the Soundscapes in Kulangsu Scenic Area, China. *Forests* **2022**, *13*, 1526. [CrossRef]
38. Guo, X.; Liu, J.; Albert, C.; Hong, X.-C. Audio-Visual Interaction and Visitor Characteristics Affect Perceived Soundscape Restorativeness: Case Study in Five Parks in China. *Urban For. Urban Green.* **2022**, *77*, 127738. [CrossRef]
39. Zhao, Z.; Wang, Y.; Hou, Y. Residents' Spatial Perceptions of Urban Gardens Based on Soundscape and Landscape Differences. *Sustainability* **2020**, *12*, 6809. [CrossRef]
40. Jeon, J.Y.; Hong, J.Y.; Lee, P.J. Soundwalk Approach to Identify Urban Soundscapes Individually. *J. Acoust. Soc. Am.* **2013**, *134*, 803–812. [CrossRef]
41. Hong, J.Y.; Jeon, J.Y. Exploring Spatial Relationships among Soundscape Variables in Urban Areas: A Spatial Statistical Modelling Approach. *Landsc. Urban Plan.* **2017**, *157*, 352–364. [CrossRef]
42. Liu, J.; Kang, J.; Luo, T.; Behm, H. Landscape Effects on Soundscape Experience in City Parks. *Sci. Total Environ.* **2013**, *454–455*, 474–481. [CrossRef]
43. Jahani, A.; Kalantary, S.; Alitavoli, A. An Application of Artificial Intelligence Techniques in Prediction of Birds Soundscape Impact on Tourists' Mental Restoration in Natural Urban Areas. *Urban For. Urban Green.* **2021**, *6*, 127088. [CrossRef]
44. Hong, X.-C.; Wang, G.-Y.; Liu, J.; Song, L.; Wu, E.T.Y. Modeling the Impact of Soundscape Drivers on Perceived Birdsongs in Urban Forests. *J. Clean. Prod.* **2021**, *29*, 125315. [CrossRef]
45. Ross, I.; Greco, G.; Opondo, C.; Adriano, Z.; Nala, R.; Brown, J.; Dreibelbis, R.; Cumming, O. Measuring and Valuing Broader Impacts in Public Health: Development of a Sanitation-Related Quality of Life Instrument in Maputo, Mozambique. *Health Econ.* **2022**, *31*, 466–480. [CrossRef] [PubMed]
46. Kang, J.; Aletta, F.; Gjestland, T.T.; Brown, L.A.; Botteldooren, D.; Schulte-Fortkamp, B.; Lercher, P.; van Kamp, I.; Genuit, K.; Fiebig, A.; et al. Ten Questions on the Soundscapes of the Built Environment. *Build. Environ.* **2016**, *108*, 284–294. [CrossRef]
47. Puyana-Romero, V.; Ciaburro, G.; Brambilla, G.; Garzón, C.; Maffei, L. Representation of the Soundscape Quality in Urban Areas through Colours. *Noise Mapp.* **2019**, *6*, 8–21. [CrossRef]
48. Taff, D.; Newman, P.; Lawson, S.R.; Bright, A.; Marin, L.; Gibson, A.; Archie, T. The Role of Messaging on Acceptability of Military Aircraft Sounds in Sequoia National Park. *Appl. Acoust.* **2014**, *84*, 122–128. [CrossRef]
49. Murchy, K.A.; Vagle, S.; Juanes, F. Anchored Bulk Carriers Have Substantial Impacts on the Underwater Soundscape in Cowichan Bay, British Columbia. *Mar. Pollut. Bull.* **2022**, *182*, 113921. [CrossRef]
50. Buxton, R.T.; Pearson, A.L.; Allou, C.; Fristrup, K.; Wittemyer, G. A Synthesis of Health Benefits of Natural Sounds and Their Distribution in National Parks. *Proc. Natl. Acad. Sci. USA* **2021**, *118*, e2013097118. [CrossRef]
51. Ma, K.W.; Mak, C.M.; Wong, H.M. Effects of Environmental Sound Quality on Soundscape Preference in a Public Urban Space. *Appl. Acoust.* **2021**, *171*, 107570. [CrossRef]
52. Hong, J.Y.; Lam, B.; Ong, Z.-T.; Ooi, K.; Gan, W.-S.; Kang, J.; Yeong, S.; Lee, I.; Tan, S.-T. A Mixed-Reality Approach to Soundscape Assessment of Outdoor Urban Environments Augmented with Natural Sounds. *Build. Environ.* **2021**, *194*, 107688. [CrossRef]
53. Jeon, J.Y.; Hong, J.Y. Classification of Urban Park Soundscapes through Perceptions of the Acoustical Environments. *Landsc. Urban Plan.* **2015**, *141*, 100–111. [CrossRef]

54. Shao, Y.; Hao, Y.; Yin, Y.; Meng, Y.; Xue, Z. Improving Soundscape Comfort in Urban Green Spaces Based on Aural-Visual Interaction Attributes of Landscape Experience. *Forests* **2022**, *13*, 1262. [CrossRef]
55. Brown, A.L.; Kang, J.; Gjestland, T. Towards Standardization in Soundscape Preference Assessment. *Appl. Acoust.* **2011**, *72*, 387–392. [CrossRef]
56. Preis, A.; Kociński, J.; Hafke-Dys, H.; Wrzosek, M. Audio-Visual Interactions in Environment Assessment. *Sci. Total Environ.* **2015**, *523*, 191–200. [CrossRef]
57. Viollon, S.; Lavandier, C.; Drake, C. Influence of Visual Setting on Sound Ratings in an Urban Environment. *Appl. Acoust.* **2002**, *63*, 493–511. [CrossRef]
58. Zhao, Y.; Sheppard, S.; Sun, Z.; Hao, Z.; Jin, J.; Bai, Z.; Bian, Q.; Wang, C. Soundscapes of Urban Parks: An Innovative Approach for Ecosystem Monitoring and Adaptive Management. *Urban For. Urban Green.* **2022**, *71*, 127555. [CrossRef]
59. Fang, X.; Gao, T.; Hedblom, M.; Xu, N.; Xiang, Y.; Hu, M.; Chen, Y.; Qiu, L. Soundscape Perceptions and Preferences for Different Groups of Users in Urban Recreational Forest Parks. *Forests* **2021**, *12*, 468. [CrossRef]