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Influence of Perceived Soundscape and Sound Environment on Subjective Well-being of Park Visitors

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ABSTRACT

Urban parks are public leisure areas that stimulate good feelings and alleviate stress. Studies of park soundscapes have shown that natural soundscapes are associated with higher restorations after park visitations. Little is known whether different parks with similar sound sources would result in different perceived subjective well-being and stress reduction of the park visitors. This paper offers deeper insight into the Malaysian parks' perceived soundscapes and highlights the effects after visitations on subjective well-being and stress reduction. On-site surveys were conducted in four selected parks in Kuala Lumpur and Putrajaya, with 428 park visitors as the study's sample. From March to May 2022, respondents were recruited with random sampling method. Acoustic measurements and perceptual responses to the park's soundscape were recorded during the survey sessions. The relationships between objective and subjective measurements of the environment with perceived subjective well-being of the park users were evaluated with Spearman's correlation tests. Findings revealed that sound levels of the parks from objective measurements differ from the perceived loudness of the park. Perceived soundscape is correlated with subjective well-being and sound environment with the satisfaction level of the park users after visitations. The findings also suggest that sounds from activities in parks increase the park users' soundscape experience and well-being. These results implicate Malaysian park planning and management by serving a further understanding of the relationship

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between the soundscape of the parks and how they improve the well-being of park users.

Keywords: Parks, sound environment, soundscape perception, stress, subjective well-being

INTRODUCTION

Rapid population growth in urban centres has increased the pressure on urban infrastructures, resources, services, and natural ecosystems. In Malaysia, urban public parks improve mental health and provide opportunities for physical activities (Adiati et al., 2018; Grilli et al., 2020; Sakip et al., 2018). Urban parks also provide physiological and psychological benefits compared to urban surroundings (Mokhtar et al., 2018). However, some still argue that the parks in Kuala Lumpur do not offer enough relief from the pressures of city life (Alidi & Ismail, 2019). According to Samad et al. (2021), the urban parks in Malaysia have not attained an adequate level to provide residents with a healthy environment. The increase in urbanisation has reduced the quality and quantity of nature experience (Razak et al., 2016).

Public spaces are essential for meetings and social interactions as it improves mental health while contributing to the well-being of the communities. Numerous studies have examined the advantages of green spaces in cities from their social, economic, and environmental values (Jabbar et al., 2021; Sander & Zhao, 2015; Scopelliti et al., 2016). These urban green spaces promote physical exercise, relaxation, socialisation, and stress reduction (Dadvand et al., 2016; Grahn & Stigsdotter, 2010). Recent research has linked various characteristics of urban parks to their advantages and boost the cities' liveliness (Brown et al., 2014; Chiesura, 2004; Dadvand et al., 2016; Scopelliti et al., 2016; Tzoulas et al., 2007). Sakip et al. (2015) and Ngesan et al. (2013) further highlighted that public park offers interrelationship between the community and increases the values of properties.

Physical activities in natural setting have improved well-being (Barton & Perry, 2010; Thompson et al., 2011;). Residents reported frequent use of urban parks to have greater happiness and life satisfaction and lower psychological discomfort and anxiety (Coldwell & Evans, 2018; Konijnendijk et al., 2013). A duration of at least 20 minutes in the park is associated with subjective well-being scores and the improvement of life satisfaction scores (Yuen & Jenkins, 2020). Human reactions to acoustics may reflect motivational and emotional processes, as evidenced by a preference for one setting and the avoidance of another (Van den Bosch et al., 2018). Thus, more recent studies have shifted to identifying the impact of the environment on the well-being of park users to include the comfort of the acoustic environment (Shao et al., 2022).

Acoustic Environment and Effect on Park Visitations

The acoustic environment is important for providing a great visitor experience in recreational spaces as noise control is

recommended for parks with high levels of sound environment (Merchan et al., 2014). Noise levels higher than World Health Organisation's (WHO) recommendation for outdoor spaces (55dB) may cause interference in speech intelligibility and inconvenience in communicating and relaxing in these spaces. However, only lowering noise levels does not always result in a more favourable assessment of the surroundings (Van den Bosch et al., 2018).

Perceived Soundscape and Effect on Park Visitations

Soundscape is the combination of all sounds at a given location, emphasising on the relationship between an individual or the society's sound perception (International Organisation for Standardisation, 2014). The soundscape approach considers the acoustic environment based on the interactions of sound sources, environment, and humans. It is defined as the acoustic equivalent of a landscape and comprises all desired and undesired sound sources (Eleinen et al., 2016). The experience of park users is linked with the landscape and soundscape of the park (Brambilla et al., 2013; Liu et al., 2013; Liu et al., 2014; Tse et al., 2012). Steele et al. (2015) also discovered that the appropriateness and pleasantness of soundscape are influenced by the activities carried out in the areas.

The prevalence and dominance of sound sources mediate the relaxing experience in the park. Urban parks' acoustics mirror their surroundings and enhance the natural experience (Krause et al., 2011). Based on the taxonomy of soundscape data collection in previous studies (Brown et al., 2011; Jo & Jeon, 2021), natural sounds include birds chirping, water flowing and leaves rustling, traffic sounds from vehicles and traffic around the park, human activities like people talking, children shouting, and sounds from other sources such leaves blower, constructions. Natural sounds ease stress, anxiety, and agitation and aid emotional recovery. Physiological signs such as skin conductance level, heart rate and variability support the restorative benefits of the parks (Annerstedt et al., 2013; Jo et al., 2019; Medvedev et al., 2015; Suko et al., 2019). Results of studies by Axelsson et al. (2010) suggest how soundscape may be defined in terms of eventfulness and pleasantness. The significant implication of soundscape in urban planning and design is not only to decrease noise pollution but to use sounds as an environmental resource in creating pleasant spaces for psychological restoration (De Coensel et al., 2010; Rehan, 2016).

Soundscape and Subjective Well-being

Some authors have studied the emotional impacts of soundscape on public parks (Fiebig et al., 2020; Han et al., 2022; Hedblom et al., 2017; Irvine et al., 2009; Jahncke et al., 2015; Masullo et al., 2021; Qiu et al., 2020; Ratcliffe, 2021; Van den Bosch et al., 2018). Ma and Thompson (2015) found that human emotions are dependent on sound acoustics, while Choi (2015) observed that environmental sounds could elicit pleasant emotions. Soundscape and acoustic satisfaction affect overall

physical environmental satisfaction (Gozalo et al., 2019; Jo & Jeon, 2020; Kang & Zhang, 2010).

Since 2010, soundscape and subjective wellbeing have been studied using multiple definitions and metrics (Aletta et al., 2019; Alvarsson et al., 2010; Benfield et al., 2014; Kang et al., 2016; Moscoso et al., 2018). Studies focused on the improvement of moods from natural sounds (Benfield et al., 2014; Hartig et al., 2014) and expanded to include various health benefits such as restoration (van Kamp et al., 2015) recovery from physiological stress and other stress-related mental disorders (Cerwen et al., 2017; Kang et al., 2016). Recent studies include well-being index, and other cultural and social wellness such as positive feelings and health-related well-being (Aletta et al., 2019; Bates et al., 2020; Moscoso et al., 2018). Weijs-Perree et al. (2020) discovered that satisfied public space users were happier through experience sampling method (ESM).

While studies relating to presence of greeneries and wellbeing has been well-documented, little is known about the relationship between soundscapes with subjective well-being. Mavoa, Davern et al. (2019) and Mavoa, Lucassen et al. (2019) investigated the relationship between subjective well-being and the natural environment with spatial analysis. Individuals with positive soundscape experience reported higher levels of well-being compared to those of negative experiences (Aletta et al., 2019). Kim (2020) and Ren et al. (2018) explored the influence of cultural frameworks on auditory environment and found distinct differences in the semantic value of descriptors and relationship between preferred auditory environment and expectations between East-Asian and North-American listeners. This research adapted the focus on parks and subjective well-being but approaches the study with an in-situ method in parks of Malaysia as Asian and Western countries perceived soundscapes differently (Axelsson et al., 2010; Fang et al., 2021; Jeon & Hong, 2015; Kim, 2020; Ren et al. 2018).

In Malaysia, soundscape approach has been introduced in highlands (Din et al., 2017); campus landscape area (Mohd et al., 2017) and urban shopping streets (Abdul Hamid et al., 2023) but not in urban parks. Therefore, this research proposed to apply the soundscape method in urban parks based on measurements of soundscape perception by Axelsson et al. (2010). This study addresses the geographical and socio-cultural gap on the auditory influences of park's environment towards enhancing and improving subjective wellbeing of the park visitors in Malaysia. It investigates how park's soundscape affect subjective well-being of park users based on the objective measurements of sound level, and soundscape descriptors. In-situ assessments were carried out in the selected parks to obtain information on the acoustic readings and subjective responses to the acoustic environment.

Theoretical Underpinnings

This study uses the soundscape ecology model to examine people-place-interaction in the parks from an auditory perspective. It

investigates how space and preference affect sound perception (Aburawis & Dokmeci, 2018; Herranz-Pascual et al., 2010). The conceptual framework (Figure 1) in ISO 12913-1 (International Organisation for Standardisation, 2014) highlights context influences sound sources, perception, and cognitive processes and responses. Environmental ecology theory suggests that people's responses to the environment, experience, mood and preferences relate with how they perceived the environment (Abuwaris & Dokmeci Yorukoglu, 2018; Herranz-Pascual, 2010).

METHODOLOGY

Selection of Urban Parks

This study focused on the soundscape perception of the park respondents in Kuala Lumpur and Putrajaya, the nation's capital and Malaysia's national federal administrative capital, to reflect an urban setting. The effect of the park soundscapes on the subjective well-being of the park visitors was based on the characteristics of the four selected parks: (1) highly accessible and frequently visited by the community, (2) location of parks: suburban/urban, (3) activities in the park and (4) sound sources within the park (Table 1). All four urban parks (40 hec to 100 hec) have a similar hierarchy function in providing leisure and recreational facilities for the demands of a growing urban population (Town and Country Planning Department Peninsular Malaysia, 2021). The three parks in Kuala Lumpur were selected from the smaller urban parks (40 hec), while Putrajaya Botanical Garden was chosen for its large-scaled size, representing big urban parks with comparable qualities.

KLCC Park (50 acres). KLCC Park is located in the central business district of Kuala Lumpur outside Suria and Petronas Twin Towers, features an iconic lake symphony, jogging and walking trails, and wading pool for children with cascading waterfall.

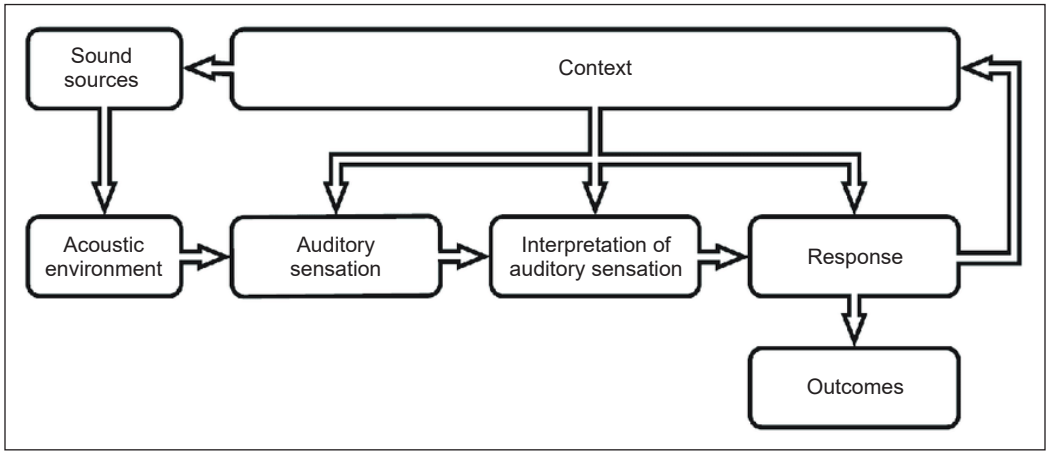

Figure 1. Conceptual framework of soundscapes (source from International Organisation for Standardisation, 2014)

Table 1
Characteristics of the selected parks

No.	Park	Type of park	Description	Size (ac)
1	KLCC Park	City Park (Urban Park)	Smaller hardscape and landscaped spaces for a highly intensified urban environment in the city center, provide breathing spaces for people to gather, socialise, rest and relax	50
2	Taman Tasik Permaisuri	District Park (Suburban Park-7 km from city center)	Densely surrounded by several residential areas and is integrated with other sports and recreational facilities in the neighbourhood	122
3	Bukit Jalil Recreational Park	District Park (Suburban Park-20 km from city center)	Located on hilly terrain and surrounded by ongoing developments in the district, commercial buildings and residential areas and a golf resort. Also integrated with other sports and recreational facilities in the neighbourhood	80
4	Putrajaya Botanical Garden	Metropolitan Park (Urban Park)	Located in the Putrajaya, often referred as "City in the Garden", the park is adjacent to the largest man-made pond and a neighbouring park	230

Bukit Jalil Recreational Park (80 acres). Bukit Jalil Recreational Park is in a developing district in the southern suburbs of Kuala Lumpur, with numerous ongoing developments. The park is situated on gently sloping terrain, neighbouring the Lebuhraya Bukit Jalil and well equipped with children's playground, picnic spots and lake in the park.

Taman Tasik Permaisuri (122 acres). Taman Tasik Permaisuri is located in the suburban areas of Kuala Lumpur with dense residential areas surroundings. It houses a lake with fountains, shady picnic spots, equipped with a football and futsal court and landscaped on naturally hilly terrain. The jogging trails were left in a raw natural state in the southern section of the park.

Putrajaya Botanical Garden (230 acres). Putrajaya Botanical Garden is located in a relaxed urban setting due to the city's function as an administrative capital. Park visitations during the weekday are relatively low. The park overlooks a man-made lake and offers activities such as explorer trails, canopy bridges, and various collections of botanical plants across the park. Figure 2 shows the location and surroundings of the selected parks.

Data Collection and Sampling of Respondents

The questionnaire survey was conducted for three months, on sunny, breezy days, from March to May 2022. Prior to the survey, a soundscape checklist of the selected study areas was conducted to note the predominant sound sources identified from the study areas as shown in Table 2.

The respondents' perceptions of the park's soundscape were gathered. The sample size was selected based on prior soundscape research, which stipulated that the total valid responses should be

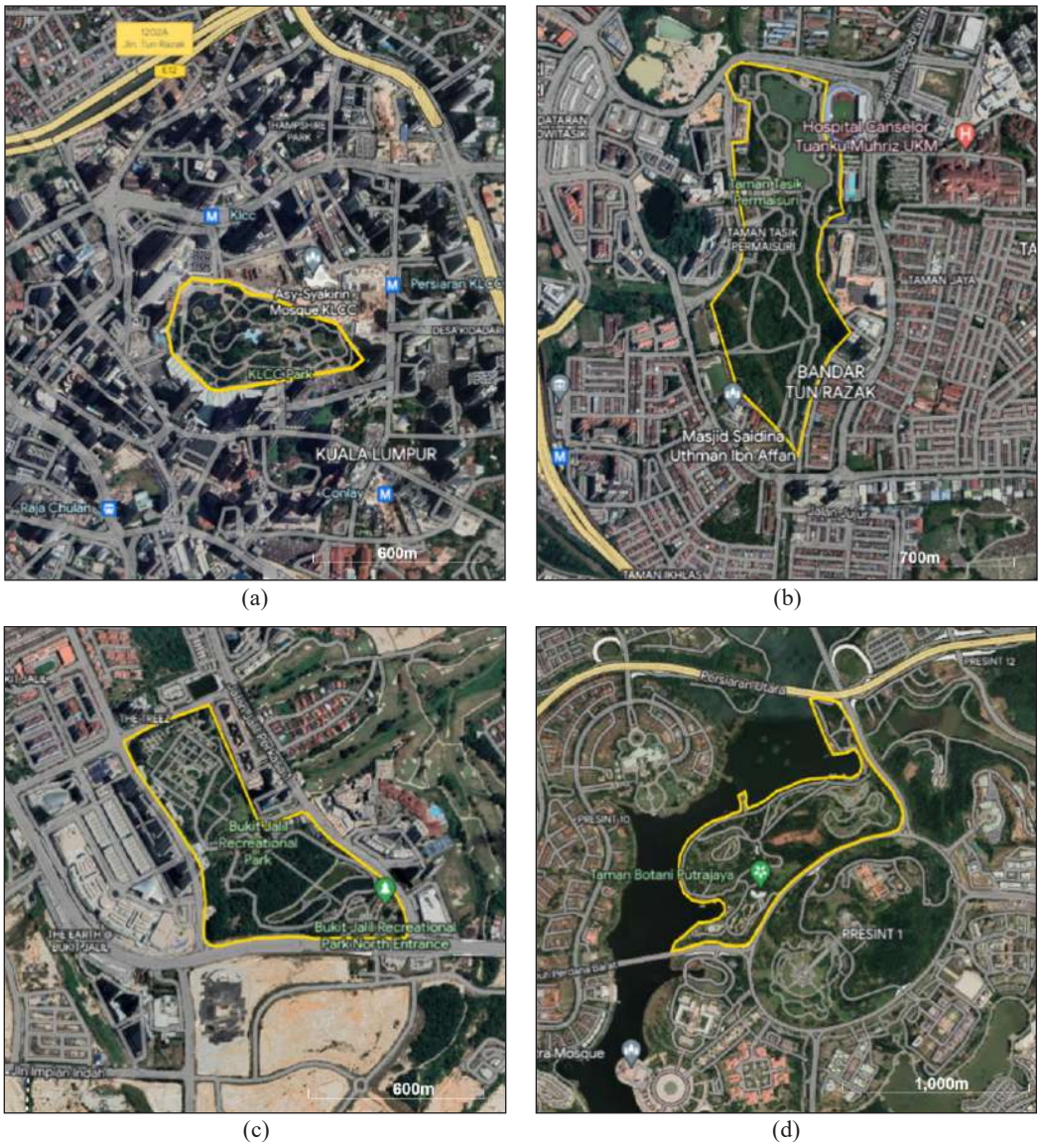

Figure 2. Study location of selected parks in Kuala Lumpur and Putrajaya: (a) KLCC Park; (b) Taman Tasik Permaisuri; (c) Bukit Jalil Recreational Park; and (d) Putrajaya Botanical Garden (source from Google, 2019)

Table 2
Predominant sound sources identified in the study areas

Type of sounds	Predominant sound sources identified
Natural sounds	Birds chirping, water flowing, leaves rustlings, monkeys, insects
Traffic sounds	Motorised traffic, honking of vehicles
Sounds from other sources	Constructions, ventilations, leaf blower, music, radio
Sounds from human activities	Laughter, children cries, speech, singing

greater than 100 (Kang & Zhang, 2010). A total of 428 responses were gathered throughout the study using random sampling. Approximately 100 participants at each site were asked to complete a questionnaire that comprised the scaling of eight perceptual attributes on a five-point Likert scale: pleasant, unpleasant, calm, uneventful, monotonous, chaotic, eventful, and vibrant, ranging from "strongly disagree (1)" to "strongly agree (5)" which was based on a similar tool to measure soundscape perception used by Axelsson et al. (2010), Fang et al. (2021) and Liu et al. (2013). Five-point Likert scale was also employed to measure the dominance of sound sources, namely "do not hear at all (1) to dominate completely (5)." The questionnaire covers the following aspects:

(a) Sounds heard in the park, including traffic sounds, nature sounds, human sounds, and other noises
(b) Soundscape perception is based on perceptual attributes of pleasant, calm, uneventful, monotonous, chaotic, eventful, and vibrant.
(c) The perceived loudness of the park
(d) Satisfaction with the park's soundscape
(e) Effect of soundscape experience in the parks, such as stress level, subjective well-being: life satisfaction, and happiness level

Variables and Measures

This study employed studies of the park soundscapes based on three aspects: objective acoustic environment by equivalent continuous sound pressure level (Shao et al., 2022), subjective acoustic environment, measured by perceived sound intensity (Engel et al., 2016; Kang & Zhang, 2010; Kuwano et al., 1991) and perceived soundscape by the dominance of sound sources (Jeon & Hong., 2015; Liu et al., 2013), and soundscape perceptual attributes (Axelsson et al., 2010; Hong & Jeon, 2013). The subjective well-being measures are based on a single-item Likert scale to measure happiness and satisfaction after park visitation (Yuen et al., 2020).

Objective Acoustic Environments. The acoustic measurements were measured based on the on-site sound walk method. Different observation sites were sampled due to the different sizes of these urban parks, with 20 points in KLCC Park, 27 points in Bukit Jalil Recreational Park, 24 points in Taman Tasik Permaisuri and 34 points in Putrajaya Botanical Garden, respectively (Figure 2). The SL-5868P sound level meter, held at a height of 1.5 meters above ground and at least 3.5 meters away from any sound-reflecting walls, buildings or other structures, is used to measure the sound pressure level. A-weighted continuous equivalent sound level (LAeq), the standard weighting method for outdoor measurements to represent the loudness of sound perceived by human ears for a real human reaction to the level of intensity and discomfort (Guo, 2019), was measured in dBA values along park routes. Mean values of the sound pressure level were then calculated for each park.

Subjective Acoustic Environment. Subjective measurements of the environment in the selected parks were measured based on a 5-point Likert scale regarding perceived overall sound intensity (Engel et al., 2016; Kang & Zhang, 2010; Kuwano et al., 1991). Mean scores of three and above signify that the selected park is louder than expected, while those below three refer to quieter parks than expected.

Perceived Soundscape. The data collection used in the study adopted the Soundscape Indices (SSID) Protocol, which was based on Method A of the ISO/TS, 2018 (Aletta et al., 2020; International Organisation for Standardisation, 2018; Lionello et al., 2021; Mitchell et al., 2020). The questionnaire focuses on how people perceived the soundscape by identifying sound sources at the park with a 5-point Likert scale: traffic noise, human sounds, natural sounds, and other noises. The perception of the soundscape was also evaluated with adjective attributes taken from prior research (Axelsson et al., 2010; Hong & Jeon, 2013).

Pleasantness and eventfulness to measure soundscape dimension are then calculated using Equations [1] and [2], respectively, based on the affective quality responses (International Organisation for Standardisation, 2019):

$$Pleasantness = \{(p - a) + \cos 45° \, (ca - ch) + \cos 45° (v - m)\} / (4+\sqrt{32}) \quad [1]$$

$$Eventfulness = \{(e - u) + \cos 45° \, (ch - ca) + \cos 45° \, (v - m)\} / (4+\sqrt{32}) \quad [2]$$

where *p* is pleasant, *a* is annoying, *ca* is calm, *ch* is chaotic, *e* is eventful, *u* is uneventful, *v* is vibrant, and *m* is monotonous.

Subjective Well-being. The subjective well-being of the soundscape experience in the parks is examined in the third section of the questionnaire using single-item satisfaction and happiness questions (Cheung et al., 2014; Guo et al., 2019; Lukoševičiūtė et al., 2022), as well as perceived reduction in stress level. According to Cheung et al. (2014) and Lukoševičiūtė et al. (2022), when compared to multiple items' subjective well-being scales, single-item satisfaction and happiness level performed similarly. The reliability coefficient of the indicators for subjective well-being indicator was estimated at 0.80 (Cronbach's alpha), considered a good consistent variable to the scale.

Data Analysis

Statistical parameters were calculated using IBM SPSS Statistics 27.0 based on data from questionnaire surveys and sound pressure level measurements. The background of the respondents is as shown in Table 3. Park respondents consisted of both foreigners and locals who are visiting the park as Kuala Lumpur is home to diverse expatriates residing in the city. ANOVA test was carried out to identify the effect of soundscape experience on stress, happiness, and satisfaction level after park visitation. Spearman's rho correlation analysis was carried out to identify the relationship between perceived soundscape and sound

Table 3
Background of respondents

Variables	KLCC Park	Bukit Jalil Recreational Park	Taman Tasik Permaisuri	Putrajaya Botanical Garden
Gender, N (%)				
Male	49.2	53.5	62.9	66.7
Female	50.8	46.5	37.1	33.3
Ethnicity, N (%)				
Malay	35.6	32.0	20.0	32.0
Chinese	31.4	49.5	51.4	49.5
Indian	18.6	16.5	25.7	16.5
Others	14.4	1.9	2.9	1.9
Age, N (%) (years)				
18 - 25	22.9	15.8	16.2	18.6
26 - 35	28.8	34.7	27.6	20.6
36 - 45	28.0	30.7	21.9	31.4
46 - 55	12.7	5.0	13.3	15.7
56 and above	7.6	13.9	21.0	13.7
Noise Sensitivity, N (%)				
Sensitive	42.4	19.0	28.4	31.1
Not Sensitive	57.6	81.0	71.6	68.9

sources from the parks and the correlation between eventfulness and pleasantness with the sound levels of the park. PCA analysis was also carried out on the soundscape perceptions of the park visitors.

FINDINGS AND RESULTS

Characterisation of the Park: Sound Environment and Soundscape

Characterisation by the Sound Environment. The public park with the highest acoustic levels was KLCC Park and Bukit Jalil Recreational Park, at a mean of 63.18 and 60.4 dBA LAeq, respectively (Table 4). All four parks exceeded the recommended decibel of 55dB of LAeq for outdoor playgrounds. Sound levels in parks could vary considerably between the different park types and locations. According to an ANOVA test, the sound levels were significantly different among the locations (F value = 38.328, p <.001). Noise levels were higher in KLCC Park and Bukit Jalil Recreational Park, surrounded by developments and heavy traffic.

These differences in the perceived sound level were statistically significant (X^2= 69.653; df = 3; p < 0.001). The perceived sound level at Putrajaya Botanical Garden was considered the lowest (mean = 1.90, std dev = 1.09), similar to the objective sound level measurement among the four study areas, while Bukit Jalil Recreational Park, the second noisiest park by objective measurement, is considered louder than expected (mean = 3.92, std dev = 1.15).

Table 4
Characterisation of the selected parks by sound environment and perceived soundscape

		KLCC Park	Taman Tasik Permaisuri	Bukit Jalil Recreational Park	Putrajaya Botanical Garden
Objective	dB $L_{Aeq, mean}$	63.18 (±2.90)	58.06(±3.35)	60.4 (±3.30)	55.57 (±4.44)
Subjective	Perceived loudness	2.75 (±1.27)	3.75 (±1.05)	3.92 (±1.15)	1.90 (±1.09)

Note. Subjective measurements measured by a 5-point likert scale

KLCC Park, with the highest sound pressure level of 63.18 dBA, scored a mean score of 2.75, indicating that the perceived loudness of the soundscape is within the park visitors' expectations due to its location in the central business district of Kuala Lumpur. In relation to the above, the perceived loudness in the parks may differ from the results of objective sound level measurements in accordance with the expectations of the park users regarding the space. It is because the individual's subjective perception and preference, as well as other social and cultural factors, strongly influence the objective and subjective evaluations of sounds (Hall et al., 2013).

Characterisation by the Perceived Affective Quality of the Soundscape. Though simple sound level measurements are the most often used techniques to evaluate sound quality (Hall et al., 2013), lowering the sound level of an area does not always improve acoustic comfort (Kang & Yang, 2002). All four parks were examined for sound dominance as shown in Figure 3. Traffic noises can be heard in all four parks, regardless of location or size, but they do not dominate the soundscape as they do in most urban environments because respondents recalled other categories of sounds more prominently. This reveals that Malaysian parks have similar soundscapes, dominated by natural noises like birds, insects, and leaves rustling. Whether the parks are situated along a major highway like Bukit Jalil Recreational Park or in a bustling urban centre like KLCC Park, traffic noise does not drown out other sound sources.

The park environment is also characterised by its perceived affective quality. It can be summarised from the results that 'eventfulness' and 'vibrancy' were considered significant characteristics of the park soundscapes in Putrajaya Botanical Garden, while the other three parks reflect 'calmness' and 'pleasantness' as the significant characteristic of the park soundscapes. It reflects the functions of the park, where many team-building and family day events are held in Putrajaya Botanical Garden over the weekends, contributing to the eventfulness and vibrancy of the soundscapes in the park, whereas the other three parks reflect recreational and leisure purposes. Overall, the park users' attitudes towards all four park soundscapes were positive. The eight perceptual attribute dimensions (Figure 4) were then projected onto the orthogonal model of soundscape (Figure 5). The orthonormal projection is based on the assumption that the participants

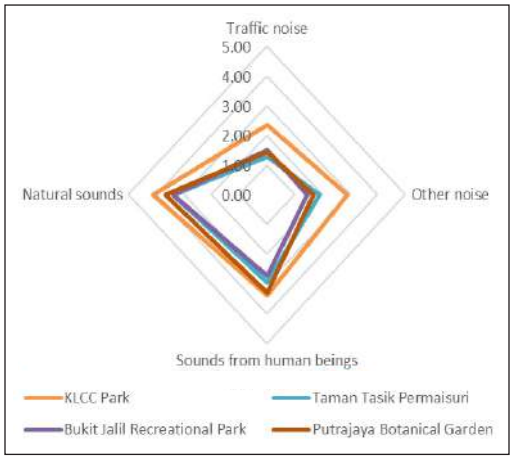

Figure 3. Comparison of the sound profile in the parks

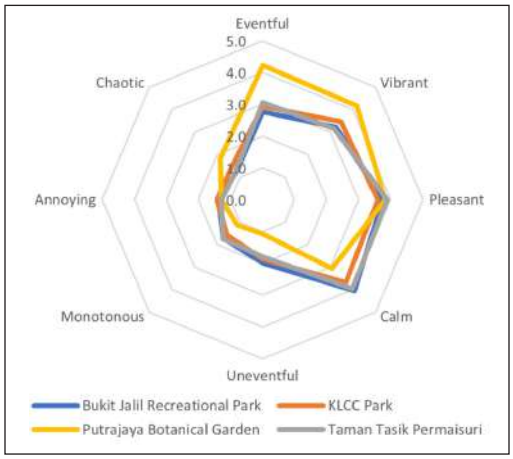

Figure 4. Perceived soundscape of the parks

interpret single Likert scale categories as equidistant and the eight perceptual attributes as connected according to the circumplex model.

Each symbol in Figure 5 corresponds to one of the study areas described in the legend. It can be noted from Figure 5 that all the parks were classified as 'Exciting' (second quadrant). Interestingly, not a single park in the selected sites was assessed as calm, as most of the research on soundscapes

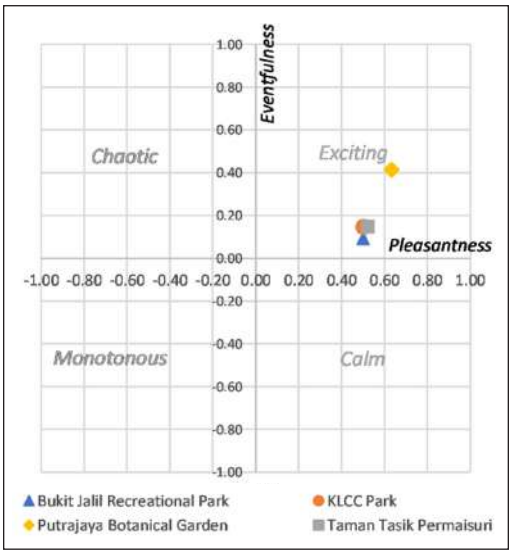

Figure 5. Pleasantness and eventfulness of the soundscapes on ISO complex

in public spaces would suggest so to reflect a tranquil area for relaxation (Axelsson et al., 2010; Guo, 2019). The most pleasant environment corresponded to Putrajaya Botanical Garden due to its dominance of natural sound sources in the botanical park and the lowest sound level reported among all four parks.

The soundscape perception in the other three parks was rated similarly in terms of 'pleasantness' and 'eventfulness', but Putrajaya Botanical Garden scored higher on 'pleasantness' due to the park's location in an area with only traffic during peak hours. The other three parks are surrounded by developments and neighbouring busy traffic. It is consistent with the results that mentioned that environments with the predominant presence of traffic were classified as chaotic and annoying (Kogan et al., 2016; Van den Bosch et al., 2014; Yang et al., 2019). Uebel et al. (2022)

also concluded that anthropogenic noise is connected with unpleasant experiences within parks, similar to the three selected study areas. The dominance of traffic noise from outside the park's boundary during the may influence the result in low 'pleasantness' scores despite the high 'eventfulness' score in the parks. The 'eventfulness' of the park's soundscape may be attributed to the sections of the park where human sounds and various bird sounds were dominantly heard in these parks. Putrajaya Botanical Garden scored higher on 'eventfulness' scores due to the activities and events occurring in the park, especially during the evenings and weekends.

Perceived Soundscape Experience on Subjective Well-being and Stress Reduction

Figure 6 depicts the mean scores of the total number of observations for each reported subjective well-being in terms of happiness and satisfaction level and reduction of stress level from the park soundscapes at the end of the park visits.

The high perceived subjective well-being of the respondents reflects those who are in the parks for at least 16–60 minutes, where positive emotions such as happiness and satisfaction increased while stress levels were reduced. It is in line with numerous studies that agree that being in a park for 15–50 minutes improves the psychological quality of life and increases restoration (Bratman et al., 2015; Tyrväinen et al., 2014). It is clear from the figure above that the soundscape in Putrajaya Botanical Garden has resulted in the highest increase in subjective well-being, with mean scores of over 4.0 for all three aspects, while Taman Tasik Permaisuri scored the least for stress reduction and satisfaction level among the four parks with mean scores of 3.86 and 3.69, respectively. This can be explained by the expectations of having access to urban parks, which is in line with findings from Cheng et al. (2021) that access to urban parks increases the residents' expressed happiness and that happiness benefit is highest in parks larger than 100 acres (Schwartz et al., 2022).

Figure 6. Subjective well-being of the respondents after park visitation

KLCC Park showed a significant decrease in stress level with a mean score of 4.19, and an increase in happiness level with a mean score of 4.05. Bukit Jalil Recreational Park, on the other hand, scored moderately among the four parks in all aspects of the perceived emotional effects after the park visitation.

ANOVA test was carried out to identify if the mean scores of the emotional effects of park visitation differ from the selected parks. Even though apparent differences emerge between the selected parks for the decrease in stress levels, they do not reach statistical significance (Figure 6). The subjective well-being of the park users, measured by the sum of happiness level and satisfaction level, is statistically significant, indicating a difference between the mean scores of the subjective well-being after park visitation ($F_{3, 427} = 4.309$, $p = 0.05$). It reflects that the perceived soundscape of the parks has significant differences among the four selected parks in terms of improving the subjective well-being for happiness and life satisfaction levels after park visitations.

Relationship Between Perceived Soundscape, Sound Environment and Subjective Well-being. Further analysis was carried out to determine the relationship between perceived soundscape and sound environment with the impacts after park visitations. When the pleasantness of the soundscape increases in KLCC Park and Taman Tasik Permaisuri, the satisfaction level of the respondents also increases. The pleasantness of the soundscape also significantly influences the decrease in the stress level of the respondents and the increase in happiness level (r_s = .260, $p < 0.01$; r_s = .290, $p < 0.05$) after visitation in KLCC Park. The eventfulness of the soundscape showed no statistical significance in influencing the well-being of the park respondents. The findings are partially in agreement with Yang (2022), who discovered that pleasantness is positively correlated with greenspace; but differs where eventfulness is negatively correlated with green spaces. Therefore, it is suggested that the effect of eventfulness may differ according to the context of the study.

When correlated with the sound pressure level in the parks (LAeq) and perceived loudness of the sound levels in the park, there are some significant correlations between the variables with the satisfaction level of the park users. The sound pressure level of the KLCC park (LAeq) and the perceived loudness are both significant negative correlated with the satisfaction level of the park users (r_s = -.194, $p < 0.05$; r_s = .214, $p < 0.05$). The higher correlation coefficient (r_s =0.214 vs r_s = 0.194) demonstrates the relationship between the expectation of loudness in the park soundscape and the objective sound pressure level measurement, where the perceived loudness impacts the subjective well-being the park users more. It is similar to Putrajaya Botanical Garden, located in a quiet urban area by a large lake and major roads into the city. Therefore, the perceived loudness of the parks is within the expectations of the park users and correlates significantly with the satisfaction level of

the park respondents (r_s = -.218, $p < 0.05$). The other two parks' perceived loudness and sound level showed no significant correlation with subjective well-being and stress reduction. The findings suggest that the perceived loudness and sound level of the park influence the park users' subjective well-being, especially towards the satisfaction level after visitations. It is also related to how these two parks were categorised as exciting compared to the usual calm environment. The results also demonstrated different soundscape preferences from the four parks, with the sound pressure level of the soundscapes in Putrajaya Botanical Garden and KLCC Park influencing the subjective well-being of the park users and pleasantness of soundscape reflective in the four parks of the study area. The relationship between perceived soundscape and the perceived subjective well-being at each park is as shown in Table 5.

The length of stay in the park correlates negatively to pleasantness of the park in both KLCC Park and Putrajaya Botanical Garden (Table 6). This suggests that as park visitors become more aware of their surroundings, the perceived pleasantness decreases. The positive significant correlation in KLCC Park and Putrajaya Botanical Garden can be attributed to the characteristics of the parks. KLCC Park is in a busy urban setting, where being in the park for a longer period of time

Table 5
Correlation between soundscape and perceived subjective wellbeing after park visitation

		Perceived affective quality		Sound environment	
		Pleasantness *(rs value)*	Eventfulness *(rs value)*	LAeq, mean *(rs value)*	Perceived loudness *(rs value)*
Stress level	KLCC Park	.260**	-.142	-.102	-.178
	Taman Tasik Permaisuri	.014	-.008	.027	.000
	Bukit Jalil Recreational Park	.184	-.071	.039	.110
	Putrajaya Botanical Garden	.034	.072	-.032	-.132
Happiness level	KLCC Park	.209*	.024	.044	-.074
	Taman Tasik Permaisuri	.191	.115	.040	.085
	Bukit Jalil Recreational Park	.089	-.080	.059	.021
	Putrajaya Botanical Garden	.167	-.049	-.090	-.106
Satisfaction level	KLCC Park	.296**	-.067	-.194*	-.214*
	Taman Tasik Permaisuri	.206*	.050	.052	.030
	Bukit Jalil Recreational Park	.166	.047	.036	.138
	Putrajaya Botanical Garden	.020	-.009	-.098	-.218*
Subjective wellbeing	KLCC Park	.281**	-.025	-.093	-.168
	Taman Tasik Permaisuri	.211*	.084	.046	.063
	Bukit Jalil Recreational Park	.149	-.036	.004	.064
	Putrajaya Botanical Garden	.110	-.041	-.123	-.157

Note. *p<.05; **p<.01

Table 6
Relationship between soundscape perception, perceived emotional effect and length of time spent in the parks

		Time spent in the park
Pleasantness	KLCC Park	-.261**
	Taman Tasik Permaisuri	.020
	Bukit Jalil Recreational Park	-.053
	Putrajaya Botanical Garden	-.203*
Eventfulness	KLCC Park	.072
	Taman Tasik Permaisuri	-.033
	Bukit Jalil Recreational Park	.168
	Putrajaya Botanical Garden	.281**

Note. *p<.05; **p<.01

allows people to take notice of the park's surrounding. In Putrajaya Botanical Garden, which is rich in park events and gatherings, spending more time in the park makes it less enjoyable. Eventfulness also increases with time spent in Putrajaya Botanical Garden as individuals hear nearby activities and events in the park.

Perceived Sound Sources and Subjective Well-being. Spearman's rho correlation was carried out to investigate the relationship between the perceived dominance of sound sources with the effects of the subjective well-being of the park users after park visitation (Table 7). When correlated with the perceived dominance of sound sources in the parks, the increase in satisfaction level of the park respondents after park visitations showed a difference in the categories of the sound source.

Traffic noises negatively correlate with satisfaction levels across all four parks, where three selected parks showed a significant correlation. Natural sound is only positively correlated with satisfaction level in KLCC Park with $r_s = .184$, $p < 0.05$, indicating that more natural sounds can lead to higher satisfaction levels after park visitation, especially in a park with busy urban settings. It agrees with Moscoso et al. (2018) and Buxton et al. (2021), who believe natural sounds enhance well-being, improve health, increase the positive effect, and lower stress and annoyance. While sounds from human activities are negatively correlated in Taman Tasik Permaisuri and Putrajaya Botanical Garden ($r_s = -.248$, $p < 0.01$; $r_s = -.252$, $p < 0.05$), it is positively correlated with Bukit Jalil Recreational Park ($r_s = .267$, $p < 0.01$). It indicates that the park respondents prefer the quiet environment in these two parks, as opposed to Bukit Jalil Recreational Park, where the respondents feel more satisfied with the variety of activities in the park. However, the sounds from human activities demonstrated a significant negative correlation with happiness levels in Bukit Jalil Recreational Park ($r_s = -.210$, $p < 0.05$), suggesting that although they are satisfied with the options of activities in the park, the happiness level of the park respondents

Table 7
Relationship between perceived emotional effects and sound sources

	Sound Source	Traffic Noise *(rs value)*	Other Noise *(rs value)*	Sounds from Human activities *(rs value)*	Natural Sounds *(rs value)*
Stress Level	KLCC Park	-.312**	-.170	-.227*	.164
	Taman Tasik Permaisuri	-.053	.020	-.147	.00
	Bukit Jalil Recreational Park	-.172	-.142	-.194	.780
	Putrajaya Botanical Garden	-.126	-.116	-.084	.026
Happiness Level	KLCC Park	-.063	.024	-.156	.032
	Taman Tasik Permaisuri	-.124	.052	-.063	.065
	Bukit Jalil Recreational Park	-.187	-.064	-.210*	-.075
	Putrajaya Botanical Garden	-.164	-.029	-.119	.024
Satisfaction Level	KLCC Park	-.295**	-.125	-.172	.184*
	Taman Tasik Permaisuri	-.182	.159	-.248*	.116
	Bukit Jalil Recreational Park	-.221*	.006	0.267**	-.038
	Putrajaya Botanical Garden	-.306**	.085	-.252*	.013
Subjective Wellbeing	KLCC Park	-.226*	-.072	-.198*	.123
	Taman Tasik Permaisuri	-.179	.106	-.166	.103
	Bukit Jalil Recreational Park	-.225*	-.053	-.276**	-.074
	Putrajaya Botanical Garden	-.237*	-.003	-.198*	-.026

Note. *p<.05; **p<.01

decrease when the sounds from the human activities become too loud.

DISCUSSION

The study's results revealed that the park's soundscape and environment affect the subjective well-being of the park users. It is significant for urban planners and landscape architects who want to create better spaces for restoration and leisure.

Soundscape Perception in Malaysia

Based on the questionnaire survey and statistical analysis of the four parks in Malaysia, the perceived soundscape and sound sources were shown. The soundscape perception in Malaysia is explained by Eventfulness (Factor 1) 40.1% and Pleasantness (Factor 2) 33.4%, which is similar to the results of soundscape perception in Eastern countries like China and Korea (Deng et al., 2020; Joen et al., 2015). It shows that the perception of soundscape differs according to the cultural differences between the different countries; soundscapes in western countries are dominated by Eventfulness (Factor 2) (Axelsson et al., 2010; Deng et al., 2020). It also signifies that communities in Malaysia value the eventfulness of a park above its pleasantness, with people more eager to visit the park for sports or leisure activities compared to Western recreational cultures of being in the park for picnics and relaxation purposes.

Soundscape, Sound Environment and Perceived Emotional Effects

Similar findings were observed in other research (Ojala et al., 2019; Wang et al., 2020; Zhang et al., 2017), where urban parks positively impact people's well-being and quality of life. This study has demonstrated the park's soundscape's positive effects in decreasing stress and increasing happiness and satisfaction after park visitations. Although in this study, only the increase in satisfaction level after park visitation resulted in statistical significance, it is clear that the pleasantness of the park's soundscape is positively correlated with the increase in subjective well-being from the park visitation. The findings of research from Herranz-Pascual et al. (2019) highlighted that pleasantness, calm, fun, and naturalness are soundscape characteristics which lead to emotional restoration and a reduction in perceived stress.

The research findings also suggested that objective measurements may not significantly predict subjective well-being effects from park visitations. Only KLCC Park showed a significant negative correlation with the park users' satisfaction, indicating that lower sound levels in an urban park may result in higher subjective well-being. It agrees with findings suggesting that urban noise levels exceeding 55dB can result in negative public health outcomes (Counts & Newman, 2019). Results of the research also demonstrate that expectation of the sound levels of parks may influence the satisfaction level of the park users after park visitation. Perceived loudness also correlates negatively with subjective well-being, indicating that the increase in loudness which exceeds the expectations of the park users, influences the purpose and outcome of the visit. The dominance of sounds in the park has also proved to complement the users' purpose of visiting.

The dominance of sound sources is also said to influence the perceived effects on subjective well-being and the reduction of stress of park visitors. In this research, natural sounds positively correlate with the satisfaction level of park visitors in KLCC Park, indicating that more natural sounds in urban parks can increase well-being after visitations. It agrees with previous studies that natural sounds promote health, boost positive affect, and reduce stress and annoyance (Buxton et al., 2021). According to the theories Attention Restoration Theory and Stress Recovery Theory, there is a clear relationship between the park's naturalness and restorative capabilities. On the other hand, for quieter parks, sounds from human activities correlate negatively with satisfaction levels as they disrupt the calmness and tranquillity of the park experience. Previous research on the soundscape quality in urban parks revealed that the sound environment could enhance human-environment interactions and the users' experience in the park (Guo, 2019).

CONCLUSION

The interrelationship between sound sources, acoustic environment, soundscapes, and perceived emotional effects were investigated in this study. The findings

of this research add to the theoretical implications on the context of study for the socio-cultural context and demography of Malaysia. Agreeing to Aburawis and Dokmeci Yorukonglu (2018), soundscape perception is dependent on the experience and context of the space, through the characterisation by sound environment and by perceived affective quality of the soundscape. This study demonstrated that although the parks in Malaysia are composed of similar sound types where natural sounds dominate the soundscape, followed by sounds from human activities, the perceived soundscape of the parks varies. The soundscape perception of Malaysia also reflects how other Asian countries perceive soundscape, along with similar purposes of visits to parks. A quieter environment has higher values of pleasantness, highlighting the importance of tranquillity in such parks. All selected parks reflected an exciting soundscape with high levels of pleasantness and eventfulness. As Malaysia is in the tropical region, findings of this study demonstrated the perception of the park users relating to the auditory environment with similar sound source dominance throughout the year. It provides an understanding on how people perceived the sounds in the parks and the implications of the soundscape on people's subjective well-being when the soundscape does not change drastically over the four-seasons as present in temperate regions.

Regarding the effects of subjective well-being and stress reduction from the perceived soundscapes, the study identified that the soundscape of a park contributes to positive effects such as decreased stress, increased happiness, and satisfaction. Sound levels and perceived loudness also correlates with the increase in subjective well-being from park visits. These findings support the previously established advantages of improving natural components in urban areas and boosting the variety of birds and water sounds (Herranz-Pascual et al., 2019). It is also clear that traffic noises significantly affect the emotional effects of the park visitors. Findings revealed that sounds from human activities contribute to the eventfulness of the parks, making the parks exciting and improving the well-being of park users in Malaysia. However, these results differ to the study by Guo et al. (2023) on soundscape perception and park restorative benefits. The relationship between soundscape perception and subjective well-being in the selected study area suggested a weaker relationship between people-place interaction for the auditory experience. This may be due to the lack of awareness of the sound environment and eventful activities in the parks. Therefore, further emphasis should be undertaken on the concept of soundscape in parks to enhance the park environment in Malaysia. This leads to the implications for planning and designing of a park environment based on the findings of the study. This research strengthens the need for consideration of the preferences of sounds people hear in the park and strongly justifies the need in creating parks of supportive soundscapes to promote the subjective

well-being of the park users. Further studies could focus on exploring the visual effects of park landscapes together with soundscapes, as well as concentrating on the effects of soundscapes on communities sensitive to noises.

Limitation and Scope for Future Studies

One of the limitations of the study is related to the participants' behaviour during the interview. One constraint both interview and semantic scaling have is that they require the participant's awareness and attention to the acoustic environment (Aletta et al., 2016). Requesting the participant's attention to the acoustic environment during the interview may not reflect the result of a subconscious hearing in the park. It may influence how they perceive the sound environment as it is somewhat atypical compared to everyday life. Therefore, the researcher may consider using behavioural observation to deal with this limitation so that the participants are oblivious to the study and do not affect the results.

Another limitation of the study is related to the noise sensitivity of park users. Other than in KLCC Park, most of the park users were not sensitive to noise, which may restrict the generalizability of the results to park users who are sensitive to noises since various researchers have demonstrated that subjective responses to soundscape may differ among individuals (Aletta et al., 2018). Therefore, further studies should be conducted to focus on the effect of soundscape on individuals who are sensitive to noises in parks.

Furthermore, several studies have suggested that visuals (Echevarria Sanchez et al., 2017; Hong & Jeon, 2013; Maffei et al., 2016) may be an important indicator in describing park soundscapes. As a result, future studies could further investigate the relationships between soundscape and visual indicators in urban parks to demonstrate a better relationship between the park environment and the emotional effects of the visitation. Smaller parks in high density cities can have distinctive soundscapes due to their dense population (Zhang et al., 2019). Neighbourhood parks' soundscape can vary based on natural and anthropogenic sounds, and the location of the park. As this research focuses on the urban parks, further studies can analyse the soundscape of parks with different hierarchies such as neighbourhood parks and regional parks to improve the park environment for the benefit of the communities.

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