



UNIVERSITI PUTRA MALAYSIA

***ESTABLISHING SOUNDSCAPE PREFERENCE CRITERIA FOR URBAN
SHOPPING STREET DESIGN IN KUALA LUMPUR, MALAYSIA***

NOR HAMIZAH BINTI ABDUL HAMID

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By

NOR HAMIZAH BINTI ABDUL HAMID

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of
Philosophy**

July 2022

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

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July 2022

Chair : Norsidah binti Ujang, PhD
Faculty : Design and Architecture

Many of the attempts in Malaysia to address environmental noise pollution issues focus on lowering the sound level using the environmental noise management approach and environmental impact assessment. Nevertheless, the country's noise pollution problems persist. The soundscape approach, a more constructive way to deal with the problem of noise pollution, applies in the early stage of the design process. However, in the absence of proper soundscape preference criteria in Malaysia, thus, the main aim of this study is to establish soundscape preference criteria for urban shopping street design in Kuala Lumpur. The methodological design used was quantitative research involving descriptive analysis, most and least preferred soundscape analysis, preference dimension analysis, analysis of differences and analysis of relationships. Based on field survey and observation data, which includes 411 respondents throughout three urban shopping streets in Kuala Lumpur, the statistical analyses suggest that various factors influence the subjective evaluations of soundscape perception, noise sensitivity, sound sources and context. This study is divided into three objectives: to identify the user's preference for soundscape in urban shopping streets, to identify the key factors that influence the user's preference of soundscape in urban shopping streets and to determine the relationships that exist among the soundscape, noise sensitivity, context, and sound source. The first objective highlighted three soundscape preference criteria: eventfulness, appropriateness, and calmness. The most preferred soundscape is varied, changing and lively. The second objective confirms that the subjective evaluations of site environmental patterns are also relevant to the soundscape evaluations with significant results on the day, weather, and sound level. In contrast, background, and behavioural factors, except for the visiting frequency, are insignificant. The third objective has discovered that visual perception and the visual quality of the environment are strong predictors of the user's soundscape perception. The soundscape preference criteria devised at the end of this thesis come with 40 validated factors: the 22 soundscape perceptions, six visual

perceptions, three visual quality, four perceived sound sources, and five urban sound environments. The present study results are essential for urban designers and planners by providing soundscape criteria to improve design solutions for noise pollution in urban shopping streets soundscapes.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**PENUBUHAN KRITERIA KEUTAMAAN SOUNDSCAPE UNTUK REKA
BENTUK JALAN MEMBELI-BELAH BANDAR DI KUALA LUMPUR,
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Oleh

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Banyak percubaan di Malaysia untuk menangani isu pencemaran bunyi alam sekitar tertumpu dengan menurunkan tahap bunyi menggunakan pendekatan pengurusan bunyi alam sekitar dan penilaian kesan alam sekitar. Namun begitu, masalah pencemaran bunyi di negara ini berterusan. Pendekatan soundscape, cara yang lebih membina untuk menangani masalah pencemaran bunyi, terpakai semasa peringkat awal proses reka bentuk. Walau bagaimanapun, dengan ketiadaan kriteria soundscape pilihan yang sesuai di Malaysia, oleh itu, matlamat utama kajian ini adalah untuk mewujudkan kriteria soundscape pilihan bagi reka bentuk jalan beli-belah bandar di Kuala Lumpur. Reka bentuk metodologi yang digunakan ialah kajian kuantitatif yang melibatkan analisis deskriptif, analisis soundscape yang paling disukai dan paling kurang disukai, analisis dimensi keutamaan, analisis perbezaan dan analisis hubungan. Berdasarkan tinjauan lapangan dan data pemerhatian, yang merangkumi 411 responden di seluruh tiga jalan membeli-belah bandar di Kuala Lumpur, analisis statistik menunjukkan bahawa pelbagai faktor mempengaruhi penilaian subjektif persepsi soundscape, sensitiviti bunyi, sumber bunyi dan konteks. Kajian ini dibahagikan kepada tiga objektif: untuk mengenal pasti keutamaan pengguna terhadap soundscape di jalan membeli-belah bandar, untuk mengenal pasti faktor utama yang mempengaruhi keutamaan pengguna terhadap soundscape di jalan membeli-belah bandar dan untuk menentukan hubungan yang wujud antara soundscape, sensitiviti bunyi, ciri jalan dan sumber bunyi. Objektif pertama menyerlahkan tiga kriteria keutamaan soundscape, iaitu eventfulness, appropriateness dan calmness. Soundscape yang paling disukai adalah pelbagai, berubah dan meriah. Objektif kedua mengesahkan bahawa penilaian subjektif corak persekitaran tapak juga relevan dengan penilaian soundscape dengan hasil yang ketara pada hari, cuaca dan tahap bunyi. Sebaliknya, faktor latar belakang dan tingkah laku, kecuali kekerapan melawat, adalah tidak penting. Objektif ketiga telah mendapati bahawa persepsi visual dan kualiti

visual persekitaran adalah peramal yang kuat bagi persepsi soundscape pengguna. Kriteria keutamaan soundscape yang dirangka pada akhir tesis ini datang dengan 40 faktor yang disahkan, yang terdiri daripada 22 persepsi soundscape, enam persepsi visual, tiga kualiti visual, empat sumber bunyi yang dirasakan, dan lima persekitaran bunyi bandar. Keputusan kajian semasa adalah penting untuk pereka dan perancang bandar dengan menyediakan kriteria soundscape untuk menambah baik penyelesaian reka bentuk untuk pencemaran bunyi di soundscape jalan beli-belah bandar.



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"Indeed, Allah will not change the condition of a people until they first change what is in themselves." (Qur'an,13;11).

*Putrajaya
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LIST OF ABBREVIATIONS

| | |
|------|---|
| EIA | Environmental Impact Assessment |
| ENMA | Environmental Noise Management Approach |
| EV | Expert Validation |
| JBB | Jalan Bukit Bintang |
| JMI | Jalan Masjid India |
| JTAR | Jalan Tuanku Abdul Rahman |
| NUA | New Urban Agenda |
| SDG | Sustainable Development Goal |
| TF | Theory of Familiarity |
| TIC | Theory of Individual Constructivism |
| TIP | Theory of Informational Processing |
| TP | Theory of Perception |
| TSC | Theory of Social Constructionism |

CHAPTER 1

INTRODUCTION

1.1 Background

Urbanisation has been one of the most important factors shaping the built environment in the twentieth and twenty-first centuries. The urbanisation trend is a transformative force that can and should be leveraged to ensure sustainable development. Notably, a sustainable development has been emphasised by professionals, environmental activists, and politicians. Sustainability, as a wide concept, encompasses aspects of social, economic, and environmental concerns (World Commission on Environment and Development, 1987). Meanwhile, the New Urban Agenda (NUA) highlights four primary sustainability dimensions across the sectors and scales that are involved in the urban development- social, economic, environmental, and cultural (UN-Habitat, 2020b). The complexity of urbanisation is entangled in a nexus of considerations of key dimensions and has highlighted the linkages between NUA and the UN Sustainable Development Goal (SDG) 2030. The inclusion of the SDGs 11, which aims to make cities and human settlements more inclusive, safe, resilient, and sustainable, highlights some of the connections between the two global agendas.

According to the UN-Habitat data, there are currently 1,934 metropolitan areas in the world with a population of more than 300,000 people. By 2035, it is estimated that approximately 1 billion people will live in metropolitan areas, with the addition of 429 new metropolises (UN-Habitat, 2020a). One of the most essential tools for guiding the sustainable development agenda is urbanisation, which gives a tremendous opportunity for effective environmental action. However, poorly planned, or uncontrolled urbanisation areas have resulted in economic chaos, civil unrest, congestion (UN-Habitat, 2016) and currently dealing with a lot of environmental concerns that could jeopardise the chances to achieve a sustainable development. Noise pollution is one of the many environmental concerns that has arisen because of urbanisation (Yuan et al., 2019).

Harmful pollutants caused by unwanted or disturbing sounds (noise) are a major environmental problem affecting human health, particularly in urban areas (World Health Organization, 2015). Since 1980, the World Health Organization (WHO) has conducted research on the influence of noise on the community, discovering that around 120 million individuals worldwide suffer from disabling hearing disorders. In terms of the disability-adjusted life-years (DALYs) that are lost due to environmental noise, it is estimated that 61 000 years are for ischaemic heart disease, 45 000 years for children's cognitive impairment, 903 000 years for sleep disturbance, 22 000 years for tinnitus, and 654 000 years for

annoyance, all of which are lost in the European Union Member States and other western European countries (Fritschi et al., 2011).

Even though the disruptive effects of environmental noise are well documented, noise pollution complaints have often been ignored in developing countries, particularly in Malaysia; Malaysia's concern is on basic human needs, for instance health, education, sanitation facilities, urban poverty, and housing for the lower-income group (Ministry of Urban Wellbeing Housing and Local Government Malaysia, 2016). Noise pollution, in contrast to many other environmental concerns, continues to rise. Noise pollution has increased in the community because of rapid population growth and social economic developments. An increasing din that is disrupting sleep, interrupting conversation, causing anxiety and hearing damages, have been regarded as a necessary price for individuals to pay in urban areas.

In 2015, the Department of Environment Malaysia received a lot of complaints about the noise. However, transportation noise is not the most common complaint, since noise from the commercial and construction sites accounts for more than half among all complaints (Chin, 2016). New noise sources tend to occur wherever new development is expanding. Large-scale surveys in France, Germany, Netherlands, Slovakia, and United Kingdom, on the other hand, have identified road traffic as the most important source of annoyance (World Health Organization, 2018). Furthermore, in six European countries, traffic noise was evaluated as an environmental stressor in terms of public health impact according to the Environmental Burden of Disease in Europe (Fritschi et al., 2011). In recent years, epidemiological studies have found more evidence of a link between exposure to road traffic and ischemic heart disease. Ischemic heart diseases (15.0%) were also the leading causes of death in Malaysia (Department of Statistic Malaysia, 2020).

1.2 Research problem

The urban sustainability indicators are an important instrument for assessing the performance of cities such as environmental, economic, and social, with a special focus on the measures of environmental health (Science for Environment Policy, 2018). Cities are ranked based on their performance of 16 indicators including nuisance, which measures the percentage of the population who is affected by noise pollution (Mega & Pedersen, 1998). Kuala Lumpur City Hall environmental concerns have been emphasised in the Urban Design Guideline Kuala Lumpur (UDGKL) in ensuring public safety and health through eight strategies (Kuala Lumpur City Hall, 2014). Nevertheless, considerations on environmental sounds that have resulted from noise pollution are currently an issue that needs to be addressed holistically throughout the design and planning perspective.

Noise pollution awareness is not a new scenario as the Malaysian authorities has been alerted as early as 1979 (Abdul Rahim et al., 2011). A greater understanding of environmental sound is required to serve as an indication of urban sustainability. Several scholars and practitioners have commented on this problem over the years, and it has been stated that there has been visual dominance within the built environment field, with other sensory impressions (including sound) not receiving enough attention (Hedfors, 2016; Southworth, 1969). As a result, the acoustic aspect has been overlooked (Aletta et al., 2014; Brambilla et al., 2013). However, the soundscape approach is a rapidly expanding sector, fulfilling the gap (Kang & Schulte-Fortkamp, 2016). The soundscape concept has significant practical implications in terms of policy as well as the design process, as evidenced by the literature review in chapter two. The soundscape concept was largely used in countries such as Greater London, Berlin, Stockholm, and Antwerp, which were actively promoting practical examples of soundscape projects around the world (Kang & Schulte-Fortkamp, 2016), but there were only a few research on soundscape application in Malaysia. Evidently, this gap gives substance and significance to the execution of local soundscape preference criteria research, for the design and planning process.

In Malaysia, the practical implementation for environmental sounds was borrowed from the environmental noise assessment procedure such as the Environmental Impact Assessment (EIA) and Environmental Noise Management Approach (ENMA). The noise assessment procedure focus has been on mechanical methods of noise reduction according to specific decibel levels. As compared to 2018, the highest statistics of environmental protection expenditure in Malaysia for 2019 showed 7.0% annual growth rate with a value of RM2,885.3 million (Department of Statistic Malaysia, 2021). For years, the trends in pollution management expenditure, which includes air, surface water, groundwater, and noise, have remained as the largest contributor. Due to the pollution management expenditure, the Malaysian government has spent RM 2,021.2 million (70.1%) in 2019 and RM 1,835.0 million (68.1%) in 2018 of the overall environmental protection expenditure (Department of Statistic Malaysia, 2020b, 2021).

According to data, decreasing the sound level is not always practical or cost-effective, despite spending billions of Ringgit Malaysia. Furthermore, the acoustic comfort is a more complex phenomenon that has little to do with the sound level, which inevitably will not improve the people's quality of life (Yang & Kang, 2005b). Another criticism is that it is somewhat one-sided when it comes to sound, with an overabundance of attention on negative aspects such as protection from noise (Hellström, 2004), rather than on holistic experience qualities. Although eliminating noise pollution is unfeasible, it can be managed and planned with the correct tools, methods, and strategies to reduce the project's negative influence on its final evaluation (Kang & Zhang, 2010; Zhang & Kang, 2007). Therefore, proposing a soundscape preference criterion is the necessary step forward, as it may result in unnecessary changes to design proposals that are not appropriate for the acoustic environment. Many of the

previous tools concentrated on conceptualisations, prescriptions, and comprehension of auditory experience. However, few have focused on the types of changes that can be made in the acoustic environments (Brown & Muhar, 2004; de Coensel et al., 2010; Fowler, 2013; Hellström, 2004).

Correspondingly, there are two unanswered questions: “What are the most significant soundscape preference criteria?”, and “How the soundscape preference criteria should be integrated into real practice in Malaysia?” The answers to this question will play a key role in bridging the gap between the ideal soundscape projects to be implemented in Malaysia, where the soundscape preference criteria should be applied early in the design and planning process. There is no evidence that a soundscape preference criterion has been established for the design and planning process in Malaysia.

1.3 Problem statement

Therefore, the study's problem statement is as follows:

The urbanisation rate in Malaysia increased to 75.1% (24.3 million people) in 2020 and is expected to increase to 88.0% in 2050 (Department of Statistics Malaysia, 2022). Kuala Lumpur has exceeded the national urban rate, with 100% of the population living in an urban area. In Malaysia, an urban shopping street implies an important economic and employment impact on the cities and countries where it occurs, making it a key strategic industry. It accounts for multiple functions, including tourism, relaxation, shopping, and others. Besides the positive impact, the presence of multiple functions causes high sound levels and complex sound sources. These features result in a very different soundscape from other spaces, such as an urban park.

However, very few studies have focused on soundscape in urban shopping streets (Meng et al., 2013; Yu et al., 2016). Results from the previous studies have positioned the noise pollution scenario in Malaysia at a critical level (Ismail et al., 2015). Furthermore, despite research showing that soundscapes play an important role in the architectural atmospheres of public spaces and may influence people's choices in using urban squares, architects do not usually account for acoustics during the conceptual phase of design (Kamenicky, 2014). A better understanding is gained of the relationships between soundscapes and urban space design, increased use, and making spaces more successful. The soundscapes study has implications for environmental noise management and sound quality and non-acoustic fields like urban design and planning by providing a different perspective on how people perceive their environments (Brown et al., 2011). Even when the acoustic environment is acknowledged, studies commonly focus on noise reduction.

Therefore, despite much knowledge in noise control, less is known about which soundscape perception criteria might contribute positively to an ideal urban acoustical environment. Thus, there is a need to develop a soundscape preference criterion that contributes to urban sustainability, given that more than half of the world's population is now living in cities.

1.4 Aim

The aim of this study is to develop soundscape preference criteria to enhance the urban soundscape quality of urban shopping streets. This aim will be achieved by answering the questions and objectives that are listed below.

1.5 Research questions

- i. What is the user's preference of soundscape in urban shopping streets?
- ii. What are the key factors that influence the user's preference of soundscape in urban shopping streets?
- iii. What are the relationships that exist among the soundscape, noise sensitivity, context, and sound source?

1.6 Research objectives

- i. To identify the user's preference of soundscape in urban shopping streets
- ii. To identify the key factors that influences the user's preference of soundscape in urban shopping streets.
- iii. To determine the relationships that exists among the soundscape, noise sensitivity, context, and sound source.

1.7 Scope of research

In general, the research scope encompasses three areas. First, the context that is discussed in this research is limited to the urban shopping streets of Kuala Lumpur's city centre. Streets with similar typologies that are located within the diverse economic activities, with high concentration of pedestrian users, and a diversity of sound source categories- including human, traffic, mechanical and natural sounds, have been chosen as sample sites. To this extent, this research has acknowledged that soundscape research is the study of the people's reactions to sounds in specific contexts, either by place or activity (Bild et al., 2018). A specific urban context, such as a street, could be a criterion for determining the quality of life (Çubukçu & Erin, 2016). As mentioned earlier, the urban shopping streets was chosen because a street is one of the most

significant elements in an urban environment since it provides accessibility, interconnectivity between the physical and social aspects, aesthetics, public facilities and much more (Ab Rahman et al., 2019). Accordingly, subchapter 3.4.5 (refer The Sample Sites Selection) has elaborated on the detail selection.

The second scope of research is on the evaluation methods, objective or subjective evaluations can be used to measure the acoustic environment. In an objective evaluation, the A-weighted sound pressure level and equivalent level, as well as Loudness, Roughness, Sharpness, and related percentiles are often employed (Axelsson et al., 2010; Brambilla et al., 2013; Rychtáriková & Vermeir, 2013). However, an objective assessment alone is insufficient to explain and quantify the people's perceptions of soundscape (Genuit & Fiebig, 2016; Waye & Öhrström, 2002) when the data is collected from on-site surveys and observations. This study focuses on psychological attributes, which will be analysed using the subjective evaluation and semantic analysis method to better understand how users perceive soundscape.

The third scope is on obtaining data on the most significant soundscape perceptions of the urban shopping streets, as well as the criteria for incorporating soundscape perception into the urban design process. The findings were analysed to determine which factors should be considered in the formulation of the soundscape preference criteria.

1.8 Significance of the study

This study is driven back by the lack of research on this topic, whereby despite the abundance of literature on soundscape, there is still little discussion on soundscape criteria and the action that is needed based on the user's perception in urban shopping streets, which could be integrated into the design process. Several researchers in Malaysia have discussed their work on soundscape studies (Anuar et al., 2017; Din et al., 2015, 2017; Mastura et al., 2014). Most of them have employed a series of field measurement and audio-visual experiments to investigate the acoustic environment in the highlands and on campus. However, none of them has specifically addressed the soundscape criteria in urban shopping streets. Therefore, it is significant to conduct research on this topic to ensure that the soundscape criteria can be implemented and integrated properly into the design process. Consequently, this study contributes to the body of knowledge, particularly in terms of incorporating soundscape criteria into the design process towards delivering an acoustic comfort environment.

The focus of this study is potentially significant in terms of increasing and improving the knowledge of auditory aspects in the urban shopping streets. It will raise the industry players' awareness and comprehension of the importance of implementing soundscape approach during the design process. This study

could be used by the government as a reference in future sustainable development programmes, particularly in an acoustic environment. Moreover, this study contributes to the body of knowledge by examining the most recent key dimension of soundscape, thus, paving the way for the development of a practical soundscape approach in the design process.

Correspondingly, most designers are visual-dominant, hence are prone to overlook this environmental concern. Therefore, the soundscape preference criteria at the end of the study are very important to assist and expose urban designers to incorporate soundscape into the urban design process from the early stages. As a result, unsustainable practices such as high levels of anthropogenic sounds or chronic noise exposure, as well as a project's negative impact on its final evaluation, money that are spent on noise pollution management expenditures, and so on, are avoided.

1.9 Structure of the research

Chapter 1, the 'Introduction', the thesis begins with a research background before moving on to the problem statement, research aim, research questions, research objectives, research scope and research significance.

Chapter 2 is the 'Literature Review', which is organised into three primary sections, provides an overview of the previous research. The first section provides the distinction between the Noise Management Environmental Approach and the Soundscape Approach. The next section is an explanation of the research construct, namely, soundscape perception, sound source, noise annoyance and context. In the final section, the theoretical framework is summarised, and the conceptual framework is set out.

Chapter 3, the 'Methodology' describes the development of the research strategy and the procedure of conducting the research. It also explains how the data collection methods and procedures for research are chosen. The flow of the data collection procedure is described in depth in the following sections. It also covers the piloting stage, sample size, sample sites selection, sampling procedure and the instrument process.

Chapter 4, the 'Results and Discussions' are subdivided into four sections. The first section summarises the research findings on the user's soundscape preferences using the descriptive analysis of the most and least preferred mean. The Principal Component Analysis is presented in the second section to get the key components of Soundscape Perception. The results of MANOVA, ANOVA, T-TEST, and Multiple Comparison Analyses on 'Factor Affecting Soundscape Perception' are shown in the third section.

Finally, in Chapter 5, the 'Conclusion and Recommendation' summarises the research findings, highlights the major findings, revisits the research's aim and questions, outlines recommendations, states the limitations and provides suggestions for future research areas.



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