



Multimodal Hong Kong: Perceiving pedestrian footbridge spaces in a high-density area through sensewalking

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ABSTRACT

In prior research on Hong Kong's acoustic environment, noise has been the primary focus, highlighting its diverse sources and its detrimental impact on physical and mental health. However, there is still limited exploration of multi-sensory perspectives. Mong Kok is one of the world's most densely populated areas, with a density of 130,000 people per square kilometre. Amid the bustling urban life, interactions and activities of residents, tourists, and vendors contribute to the complex soundscape. The area offers a diverse array of markets, street food, and intense traffic, creating a dynamic smellscape. This study focuses on the Mong Kok pedestrian footbridge (approximately 400 metres), selecting six locations on and beneath the footbridge. During the on-site sensory walk experiment (n=20), we conducted measurements of sound pressure levels (SPL), had participants complete online questionnaires, and conducted group interviews during and after the walking process. The sensory walk includes evaluating the soundscape, smellscape, and related preferences, evoking emotions and memories, as well as expectations and ideas for improvement and suggestions. Participant feedback helps highlight what they are most concerned about, and the usage patterns and preferences of the six locations reflect the desired soundscape and smellscape, guiding recommendations for sensory design in high-density spaces.

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1. INTRODUCTION

Currently, local research in Hong Kong predominantly focuses on noise and air pollution and their impacts on health. Scholars have increasingly paid attention to the soundscape of urban public open spaces in Hong Kong, with many studies focusing on the relationship between overall noise levels, soundscapes evaluation, subjective perceptions, and health. Despite the challenges posed by the high-density construction and road network in Hong Kong, the soundscape continues to shape the city and influence people's behaviour [1].

In the study “Are the noise levels acceptable in a built environment like Hong Kong?”, results show that the mean daytime and nighttime hourly L_{eq} values are already at or above the Acceptable Noise Levels (ANLs), 50% or more (3.6 million) inhabitants of Hong Kong are exposed to noise levels that are higher than ANLs at nighttime, having noise impact on residents [2-3]. Visitors in urban open spaces in Hong Kong evaluate traffic noise as the main source of sound, occasionally accompanied by bird songs and water sounds; the correlation between acoustic equality and sound level is weak and subject to subjective contextual influences [4]. In terms of soundscape preference, loudness and pleasantness perceptions are associated with the maximum noise levels, and daily users of the park have a greater overall preference for a good soundscape [5].

Senswalking is an important method for perceiving the city with sensory integration [6-8]. In Hong Kong's research, Biserna narrated his experience of Hong Kong's sound borderscape [9], Gui conducted soundwalks of Hong Kong female immigrants in public spaces [10] and Chan explored the smellscape of Hong Kong in relation to agriculture, politics, and colonialism [11]. However, there is still a notable gap in studies examining individual multisensory perceptions in Hong Kong.

While Mong Kok is the smallest administrative area in Hong Kong by number of residents (~50,000), it boasts one of the highest densities in the world (~130,000 residents per square kilometre), see Figure 1. We selected the Mong Kok pedestrian footbridge as the main route for a sensory walk, assessing auditory and olfactory perceptions at six locations on and beneath the footbridge, encompassing various functional spaces such as subway stations, culinary establishments, scenic spots, and entertainment venues. Studies on Mong Kok's pedestrian footbridges have focussed on different aspects that contribute to Hong Kong's urban complexity, diversity and hybridity as vertical streets [12-14]. In terms of sensory experience, how do people perceive the footbridge as a daily practice place? What is the sensory perception like for those unfamiliar with the site of the footbridge?

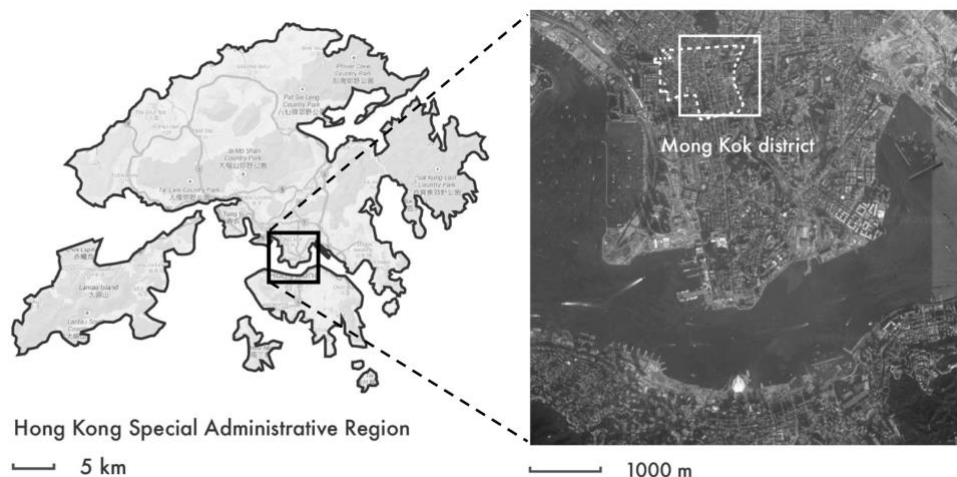


Figure 1: Left: Hong Kong Special Administrative Region (SAR) with Kowloon in the middle (inside the rectangle). Right: The location of Mong Kok District at the heart of Kowloon.

In high-density urban areas, footbridges connect intersecting streets, serving as spaces for daily activities. We aim to understand the immediate and authentic perceptions of individuals as they walk through a series of locations. This includes evaluating preferences, emotional memories, overall expectations, and how these perceptions occur, are evoked, and change over time. The significance of this study lies in its exploration of participant feedback to elucidate their primary concerns and expectations. Ultimately, these findings can inform guiding recommendations for sensory design in high-density spaces, facilitating the creation of more conducive and enriching urban environments.

2. METHODOLOGY: SENSEWALKING

In academic research, the term "sensewalk" or "sensewalking" typically refers to a method of walking that involves attending to two or more senses. Some anthropologists have defined "sensobiographic" walking [15], which describes the urban sensory ambiance and place experiences [16]. "Sensory walk" is used interchangeably with "sensewalk." In addition to vision, methods of sensory walking that focus on auditory perception are generally referred to as "soundwalk" or "soundwalking." Similarly, those that focus on olfactory perception are referred to as "smellwalk" or "smellwalking," or sometimes "scentwalk" or "scentwalking" [17]. When describing individual odors, terms such as "odor" or "sense of smell" are commonly used, following conventions from the medical and interactive design fields [18]. Sensewalking has emerged as a qualitative method for exploring aspects of the physical and cognitive experience of being in a specific environment, often an urban one [7].

Currently, some studies of sensewalks combine sound and smell, focusing on two senses simultaneously (olfaction and audition) when exploring a sensescape [17]. Bruce et al. compared the findings of a soundwalk and a smellwalk in a British town, arguing that sensory expectations are highly influential in urban place experience and perception, providing different layers of meaning and understanding of place [19]. Bass applied his observations of incense in four Buddhist temples in Shanghai gathered while conducting sound and smellwalks to explore the relationship between religious studies and new materialism [20]. Kartal used the research method of sensewalking to analyse socio-spatial rather than physical changes in Istanbul, providing recommendations for urban planning [21]. Ba et al.'s study of urban public spaces demonstrated the effects of odour on sound source and sound environment evaluations, as well as the effects of sound on odour source and odour environment evaluations [22]. Based on the timeline, the scale of participants in sensory walks, duration, data collection methods, etc., are shown in the table below.

Table 1: Summary of current methods in sensewalking research that focus on sounds and smells.

Research	Participants	Site	Duration	Data collection
Bruce et al., 2015	Study 1: 52, stakeholders; Study 2: 82, residents	English towns and cities	45-90 mins	Questionnaire
Bass, 2019	The author	Temples in Shanghai, China	45-60 mins	Photography
Kartal, 2021	50, public	Historic street in Istanbul, Turkey	60 mins	Photography and questionnaire
Ba et al., 2022	37, student	Pedestrian street, street and park in Harbin, China	60 mins	Photography and questionnaire

3. CASE STUDY

Based on the above, this study selected six stopping points (areas) on and beneath the Mong Kok pedestrian footbridge. See Figure 2: The 6 stopping points are as follows: A: located at one exit of Mong Kok East Station to the footbridge, B: the corresponding location beneath the bridge of point A, C: on the corner of the footbridge, D: middle section of the footbridge, E: the corresponding location beneath the bridge of point D, F: on the footbridge, spanning the section along Nathan Road.

Due to the different processes of sound propagation and odor diffusion, people perceive them differently: participants can hear surrounding sounds while stationary at the stopping points, but need to extend to a certain range to smell surrounding odors. At each point, we designated a small area (white dotted line) for participants to roam freely, listen and smell.



Figure 2: The site: Mong Kok footbridge; The sensory walk route: purple dotted line from Point A to Point F, 6 stopping points in total with description; Strolling area at each point: white dotted line

3.1. Participants

Participants were recruited in groups, including students majoring in architecture and other fields and researchers related to soundscapes, totaling 20 individuals aged between 18 and 30, 7 males and 13 females. In previous studies on Mong Kok footbridge, according to the authors' observations of individuals' lived practices, most people's activities are commuting [13]. For local Hong Kong people, especially those living in the Mong Kok area, flyovers may be a part of daily life [23]. Therefore, when selecting sensewalking participants for this study, we considered people who rarely use or even never cross the overpass to explore how they feel and how they feel different from locals. Of the 20 people who eventually participated, 5 were local residents of Hong Kong, while the others were from mainland China or other countries.

3.2. Procedure

Six sensory walks were conducted in March 2024 on different days over the course of two weeks, some at noon (1–2 pm) and others in the evening (7–8 pm) each lasting 45–60 minutes. Before the experiment, participants were asked about their use of the footbridge, previous sensory walk experiences, and any auditory or olfactory impairments. The process includes an online questionnaire at each stopping point and interviews during and after the walk, with specific question details in Section 3.3.

3.3. Methods

During the sensory walks different kinds of information was gathered, such as sound pressure level (SPL) and ratings of environmental quality. In the present paper, we report analysis and results from focus group discussion and interviews conducted immediately after each sensory walk.

At each stopping point, participants first engage in smelling and listening within the area, then fill out an online questionnaire, and finally answer two or three brief questions. Based on different emotional and attitudinal responses, such as expressing positivity and interest, we may ask appropriate follow-up questions. Throughout the process, we randomly ask questions such as "How do you feel right now?" "What are your feelings about this location?" "Have your emotions changed significantly?" to record the current transient situation.

After the sensory walk concludes, we ask participants five overall evaluation questions: "What is your overall evaluation of the soundscape and smellscape along the entire route? Which location left the deepest impression, liked the most, or disliked the most?" "Did any sounds or smells at any location evoke emotions or memories for you?" and "What are your expectations for sound and smell? Do you have any other opinions or suggestions for improvement?" Table 2 shows the focus group script. Based on this, we stimulate discussions within the walking group to supplement and enrich viewpoints.

Table 2. Focus group script: interview themes and examples of questions

Broad themes	Example questions
Evaluation	(1) What is your overall evaluation of the soundscape and smellscape along the entire route? (2) Which location left the deepest impression, liked the most, or disliked the most? (3) What factors affect your evaluation?
Feelings	(1) How do you feel right now? (2) What are your feelings about this location? (3) Have your emotions changed significantly? (4) Did any sounds or smells at any location evoke emotions or memories for you?
Expectations	(1) What are your expectations for sound and smell? (2) How do you hope this place will change in the future? (3) Will you come here more often? (4) Do you have any other opinions or suggestions for improvement?

4. RESULTS

4.1. Evaluation

For the overall evaluation of the entire sensory walk, 16 participants described the soundscape as "very noisy and chaotic, not very enjoyable", with about half of the participants expressing

"some irritation", primarily due to negative emotions induced by the sound environment. At Point C (see map in Figure 2), near the corner, the construction site of the old Food and Environmental Hygiene Department building (expected to be connected to the existing footbridge from the corner position) had a sound pressure level of 81.7dbA, even higher than the traffic noise.

Among each point, 14 participants considered the experience at point F to be the best. Completed in 2021, the section of the Mong Kok Footbridge spanning Nathan Road, a six-lane road in both directions, is another popular tourist spot outside the Garden Street Market that can be seen from point D on the footbridge. The ground of this section is paved with grey-black bricks, with cubic flower beds arranged at one-metre intervals on both sides (although not yet planted due to management reasons), also in grey-black. The railings are decorated with glass, giving a very clean and airy appearance, maintaining a unified design language with a modern style. The visual and design updates have an impact on the perception of sound and odor:

"Although it's still a bit noisy, it feels much wider, and the noise is relatively less noticeable." [Participant 2]

"It does look somewhat renovated, and there's no feeling of dirtiness in the smell either." [Participant 3]

In addition, microclimates also affect the dispersion of odors and human thermal comfort. Previous studies have pointed out the impact of environmental factors such as climate and sunlight on the level of air pollution, which is even more severe in high-density areas [24]. A study on high-density housing in Hong Kong mentioned sensorial urbanism, where in poorly ventilated conditions, "the air is often musty, with smells of food and bodies and little or no natural light" [25]. During the two weeks, the average temperature in the evening is slightly lower than at noon, sometimes windy. In the evening experiment on April 9th, due to rain in the afternoon, participants reported feeling more comfortable and cooler, with the perception that the wind carried away more odors. However, the overall evaluation of the sound environment remained "very annoying".

In hot and humid weather, point A and F, where wind can be felt, tend to receive better evaluations. The section of the footbridge spanning Nathan Road at point F is wider, allowing for north-south airflow. Point C is at the corner of the footbridge, facing relatively open spaces on both sides, with higher wind speeds. Point A connecting to Mong Kok East Station, occasionally receives air conditioning breeze. However, air conditioning does not necessarily improve odor:

"When the wind blows, it doesn't feel as hot, and it also takes away some unpleasant smells." [Participant 13]

"It's more comfortable near the air conditioning, but when you walk to a spot without air conditioning, there's a worse contrast. The air conditioning brings a bit of a musty smell, while the areas without air conditioning smell of sweaty people." [Participant 6]

4.2. Feelings

The interactive effects between smells and sounds. After measuring with a sound level metre, the sound pressure level beneath the bridge was higher than the average on the bridge, but participants did not perceive a significant difference, which may be related to the masking effect of smells and sounds [26], especially food odors, which directly stimulate the brain-gut axis physiologically.

"When there are snack shops around, the aroma of food distracts my attention from the noise." [Participant 15]

"As I walk and smell the aroma, I feel hungry, and then my mind is filled with various kinds of food, so my perception of the sound is not as strong." [Participant 16]

However, when asked whether the aroma of food from snack shops was pleasurable or made traffic noise less annoying, participants stated, "It just temporarily distracts attention, but the noise is still equally annoying."

Gender differences, and identity variances. In odor hedonic judgement, it tends to prove that no so clear differences occur between men and women [27]. The results of one meta-analysis indicate that women generally outperform men in olfactory abilities, and the effect sizes we observed were notably small [28]. In our study, when asked about their preference for odors, there were noticeable gender differences in responses.

"The smell of snacks is greasy. If talking about pleasure, I prefer the camphor scent at the pharmacy entrance at Point B." [Participant 10, female]

"I prefer simpler sounds and scents. The smell of food is a mixture of cooking oil, patrons' e-cigarettes, and some decay and garbage odors, very complex. It's not as straightforward as the camphor and disinfectant scent at Point B." [Participant 6, female]

"I don't really notice much when I'm not hungry, but when I am, I do enjoy the smell of something fragrant." [Participant 12, male]

"Compared to other smells, the smell of food is acceptable and has uniqueness. Even with eyes closed, you can tell it's Hong Kong." [Participant 7, male, Hong Kong local]

Local participants from Hong Kong did not express strong annoyance or preference for the overall sounds and smells of the footbridge. "It's indeed very noisy, but I'm used to it. These foods are very common, from snacks to staples, nothing special." When asked about triggering memories and familiarity, local participants and those from mainland China provided different perspectives.

"I'm familiar with the snack shop at this corner. I used to come here often to the McDonald's next to it when I was a kid." [Participant 7, Hong Kong local]

"I used to attend tutoring classes in front of the footbridge (north side of Point B) during junior high school. It's very familiar." [Participant 10, Hong Kong local]

"I'm not very familiar. It's completely different from the environment I grew up in, with different climates and foods." [Participant 4, China mainland]

"The only familiar thing might be the construction noise from this construction site. It's as noisy as the construction site next to my old home, but construction noise probably sounds similar anywhere." [Participant 3, China mainland]

4.3. Expectations

Despite participants' strong dissatisfaction with the overall traffic noise on the footbridge, they expressed a sense of helplessness regarding methods for noise improvement. Some even mentioned that commuting on the footbridge (for transportation purposes) was acceptable.

"Installing soundproof panels might be feasible, but if they extend beyond the railing to a height similar to human height, it would obstruct the view from the footbridge." [Participant 15]

"The flower beds at Point F could be made more attractive, and some tourist-friendly backgrounds or frames could be set up nearby to distract attention from the noise." [Participant 1]

"In terms of sound, if the commute is around ten minutes, some noise is acceptable, considering that Hong Kong is generally noisy. It seems unnecessary to implement soundproofing specifically for that construction site." [Participant 5]

Many participants noted that noise, within acceptable and non-health-threatening levels, has become a part of daily life in Hong Kong. "Most of the time, it's like a permanent background sound. It's only when you stop to listen, like during the sensory walk, that you feel it's noisy and irritating." More than half of the participants did not support additional interventions for soundscapes on footbridge.

In terms of improving smells, participants expressed that adding pleasant odors is more challenging compared to adding pleasant sounds. Firstly, defining what constitutes a "good" odor is difficult, as previous discussions on food odors have shown various opinions. Additionally, at Point C, different participants had contrasting opinions on the scent of "night breeze bringing the fragrance of lilacs" versus "the mix of natural floral scents with some cheap perfume." Therefore, selecting odors is challenging. Secondly, in high-density areas, the odor environment is already complex and mixed, so even adding good odors may not significantly improve overall perception. Finally, dispersing odors is more challenging compared to sound speakers or sound devices. Participants provided some suggestions:

"I think the priority is to handle waste and garbage promptly. Although it may not appear messy, it's unclear where all the garbage is piled up, perhaps in some alleyway or in the back kitchens of restaurants." [Participant 8, Student]

"Compared to the additive potential of soundscape, it's better to take a subtractive approach in smellscape design." [Participant 17, Researcher]

5. DISCUSSION

In conclusion, from the focus group interviews conducted during and after the sensory walk, we were able to gain insights into both participants' consensus views and individualised perceptions. People perceive the city through sound and smell, and sensory perception is a crucial component influencing their experiences. Differences in perception between the physical and sensory environments, including variations in visual, auditory, and olfactory perceptions, exist independently and also interact with each other. Furthermore, for specific situations, such as the uncontrollable factors present in urban public spaces, quantitative analysis is needed to understand the interaction effects, duration, and magnitude of impacts on soundscape and smellscape. It can be affirmed that in highly noisy environments, the positive influence of pleasant food odors is relatively limited.

5.1. Limitations

The strong traffic function of the footbridge "masks everything with noise." During the sensory walk, it's challenging to determine whether we first hear or first smell, and the duration of sound and odor occurrences is not fixed. Additionally, online questionnaires are constrained by space limitations. During the pre-experiment, some participants mentioned the importance of the order of perceptual evaluation, "If sound perception and evaluation come first, it greatly affects my perception and evaluation of smells, making me gradually lose patience." Of course,

if one chooses relatively quiet spaces like urban green spaces or parks, this issue may not be as prominent. However, the varying degrees of influence brought by the order of sound and odor evaluations should still be considered, as well as the order of stop points in the sensewalk routine [29]. In a multi-sensory perception experiment conducted in the laboratory, participants could be asked, "Which sensory perception is most prominent? How do they affect your pleasure and annoyance?" Subsequent evaluations could then be conducted based on their responses.

5.2. Future work

Current methods of soundscape intervention range from traditional noise reduction techniques combined with innovative approaches, such as installing loudspeakers or introducing natural sound elements for additional masking, to sound installations and artistic interventions [30]. However, can methods for improving smellscape involve retaining some unpleasant odors while introducing new, pleasant ones? Even if people can tolerate some degree of noise from traffic and construction sites, noxious odors have the potential to "infiltrate" into every aspect of daily life in high-density spaces [25].

In future research, incorporating evaluations of sounds and smells from a wider range of urban spaces, such as markets, street food stalls, temples, street-side parks, and green spaces, requires the comprehensive participation of various users and stakeholders. This includes vendors, sanitation workers, domestic helpers, and others representing different social strata, to discuss the equality of soundscape and smellscape experiences [31]. For designers and researchers, engaging in localised, community-based, and inclusive approaches facilitates the application of soundscape standards and even the establishment of smellscape standards, thereby promoting improvements in soundscape and smellscape [32].

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