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**A study to explore smellscape: from understanding and
interpretation to evaluation and design in urban intermodal
transit spaces in UK and China**

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In Memory of Dr. Victoria Henshaw

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Abstract

Smellscape has increasingly come to the attention of planners and architects as important for improving environmental quality and enriching people's experiences of public spaces. Ambient smells have significant influences on people's memories and emotions, which contribute to their perceptions of spaces. Current approaches to exploring smellscape have been to describe and classify smells and to analyse the smell environment, focusing on chemical features of smells and people's smell preferences. However, there is little research that provides a systematic framework for understanding and evaluating smellscape from the standpoint of people's perceptions and few examples of designing smellscape for specified functional spaces. This study aims to generate a systematic approach to exploring smellscape, from understanding and interpretation to evaluation and design in a specific type of public space - urban intermodal transit spaces, that large numbers of people visit every day, and which have intensive traffic flows and various functions. Such spaces are also considered as local landmarks with social and cultural meanings, which can provide a rich context to explore smellscape. There is an increasing demand for improved environmental quality in urban intermodal transit spaces. This study provides a framework of understanding, evaluating and designing smellscape to enhance people's experiences in urban intermodal transit spaces.

It sets out three research questions to explore smellscape in this particular context: How can smellscape best be understood? How can the quality of smellscape be measured? How can a pleasant smellscape be designed?

From a linguistic and environmental psychological perspective, this study takes people's natural spoken language as a source for understanding people's perceptions of the smell environment and for assessing smellscape quality. Grounded Theory was taken as a methodological and analytical approach with a case study method. Two typical urban intermodal transit spaces were selected in a (global) Western and Eastern context to fully explore the complexity of smellscape and compare to generate new insights into this field. Data were collected through small walking with semi-structured interviews and a smellscape pleasantness rating survey, which were

analysed through an iterative comparative analysis process involving coding and memo writing.

The smellscapes in the studied cases are diverse, whilst participants in both cases were found to share similar perceptual processes and evaluation criteria. An analytic procedure has been generated from the studied cases explaining people's perception of smell environments through key elements in the concept, influenced by eleven perceptual patterns. This analysis answers the question of how to understand smellscape. In terms of people's assessment of the pleasantness of smellscape, nine indicators were identified, which have been developed into a framework for measuring smellscape quality and classifying different types of smellscapes. The most dominant type of pleasantness in urban intermodal transit spaces is mainly influenced by cleanness and freshness. The perceptual process and evaluation criteria help with understanding and analysing existing smellscapes, and also inform the design objective for achieving a pleasant smellscape in target spaces. In terms of designing a pleasant smellscape in the target context, a design framework has been constructed at three scales with design methods and examples, responding to identified components from smells and smell sources, individual differences, physical environmental settings and contextual issues. This also gives an example of integrating smellscape design into a traditional design framework for a specified functional public space at the macro, midi and micro levels.

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Chapter 1: Introduction

1.1 Background

Over recent decades, emphasis in architecture and urban design has been placed on visual qualities. However, other sensory perceptions, like olfactory and auditory perceptions, are providing alternative dimensions to gain a full understanding of cities. Sensory experience largely contributes to a sense of “place” in cities that engages people with the built environment. In contemporary times, it is argued that cities should improve environmental qualities and enable more interactions between people and the urban environment. From this starting point, many researchers have suggested a need to explore an alternative approach to designing the urban environment through sensory stimuli, including sound, light, smell, wind and heat. The importance of our sensory perceptions of the ambient environment are increasingly noted and explored through studies of acoustic comfort, lighting comfort and thermal comfort. However, the sense of smell, as a secondary sense, is less immediate in our daily activities (Porteous 1985). As Henshaw (2013) points out, most people never think of or even notice the influences of smells on their behaviours and perceptions of places. However, as Tolaas (2010) has argued, smells are essential and compelling in our daily experience since with each breath we take, we smell the environment and we have to breathe 24 hours a day to keep our physical bodies functioning properly.

‘...smells that are now universal and specific smells, produced by particular activities, sources of energy, aromas and spices, plants, flowers, animals and garbage overlay one another, forming landscapes of smell that are invisible, but nonetheless present and real...’ (Zardini and Schivelbusch 2005: 276)

In recent years, the significant influence of smells on people’s memories and perceptions of places have been noted across disciplines, ranging from neurologists

and psychologists to human geographers and architects. Humans can detect and distinguish a trillion smells at different intensity levels (Bushdid et al. 2014), which suggests that the human body is a naturally sensitive smell detector. One contributing factor in the role of smell in perceptions and memories of place (Henshaw 2013; Porteous 1985) is that part of our olfactory bulbs are directly linked to the limbic system that controls emotional reactions (Herz and Engen 1996). Psychological laboratory experiments have shown that people's memories of smells are found to be more persistent than memories of other sensory experiences (Engen and Ross 1973). Smells are also closely related to air quality and people's health conditions (Schiffman and Williams 2005). In many cases, pollutants produce distinct and unpleasant smells (Henshaw 2013), e.g. traffic fumes. These studies have drawn attention to the role and importance of smells in the built environment. It would seem that smells, as both resources and wastes, need to be planned and designed as well as controlled.

Such exploration of smells focuses on human perceptions of smells and the physical environment, and these constitute the concept of 'smellscape'. Although Porteous (1985) first introduced the concept of smellscape, he did not define it. In her urban smellscape study, Henshaw (2013: 5) defined 'smellscape' as

‘the overall smell environment, but with the acknowledgement that as human beings, we are only capable of detecting this partially at any one point of time, although we may carry a mental image or memory of the smellscape in its totality’.

This concept stresses human perceptions of the smell environment. However, unlike other sensory elements, smells are more difficult to record, describe, measure and design with (Porteous 1985; Tuan 1977), which has caused difficulties in current approaches to understanding, interpreting, evaluating and designing smellscapes.

1.2 Exploring smellscape in urban intermodal transit spaces

As will be discussed in Chapter 2, current smellscape studies are mainly in general public spaces, i.e. urban streets, squares, city centres and open-air markets, but these need to be supplemented with studies of specific functional public spaces in order to produce detailed design guidance. Responding to this gap, this study has a particular interest in exploring smellscape within the specific context of urban intermodal transit spaces. Intermodal transit spaces are places where passengers change between different land-transport means, including bus, heavy rails, light rails, taxis and street cars, which integrate station buildings with urban streets and other open spaces nearby, according to American Planning Association (2006: 284). In most cases, railway stations are centres of the connections with other parts of the public transport system. There are two common types of intermodal transit spaces in cities: integrated transit centres, where most transport modes are accommodated within a complex building; dispersed transit network, each transport mode are built and served independently while connected through pathways or streets in a walking distance. The exploration of smellscape in urban intermodal transit spaces as social, emotional and functional spaces can provide a rich content for this study to analyse.

1.2.1 Urban intermodal transit spaces as places and nodes

Urban intermodal transit spaces provide various functions for everyday activities, such as retail, restaurant, leisure and transport, and temporary accommodation to large population flows from diverse social and cultural backgrounds. Such spaces are important in cities, connecting places and people:

‘The station is, therefore, a form of bridge- a connection between parcels of cityscape.... the station as ‘bridge’ is a common modern interpretation of the type. (Edwards 2013: 175)

Intermodal transit spaces in contemporary cities should be considered as both ‘nodes’ and ‘places’, which provide connections between transport and non-transport spaces as well as inhabited spaces for passengers and local residents (Bertolini 1998). Such spaces can be meaningful for users and visitors, forming place attachments and identities. In this sense, it is important to introduce more interactive and meaningful elements for people in the future development of urban intermodal transit spaces:

‘A transport node or interchange is a place of mixed emotions- excitement tinged with anxiety, happiness at greeting loved ones and sadness when they depart, comings and goings, the beginning and end of a good night out. In urbanized societies, these spaces are often our principal meeting places.’ (Jones 2006: 8)

One typical characteristic of intermodal transit spaces is that they accommodate large passenger flows and act as social-mix agents, where people of different classes, races and ages meet in the same space (Richards 1986). Although in many Western countries, intermodal transit spaces are owned by private companies, they still arguably remain within the public arena (Edwards 2013). For example:

The station is where city dwellers can buy groceries, use a bank, get a haircut or change money. It is a civic gathering space, where music can be heard, where transit information is dispensed, and where the drama of urban life can be witnessed in full flow.(Edwards 2013: 173)

Urban intermodal transit spaces, as public spaces, provide open access for all people to most parts of the station and allow passengers to have freedom to carry out various kinds of activities, such as eating, drinking, singing, smoking and using toilets. Such activities bring sensory elements, such as sounds and smells, into stations, which give distinct features to intermodal transit spaces. People’s sensuous experiences in these spaces can evoke emotional connections between people and stations (van Hagen 2011). Smellscape, as part of sensory-scapes, can contribute to the place making of urban intermodal transit spaces; and the study of smellscapes can provide new insights into urban planning and design processes.

During the last two decades, public transport systems have been developed across countries, which have changed urban fabrics and landscapes in many cities (Trip 2007). Public transport systems, particularly railways, are proved to have significant impacts on reducing carbon emissions (Edwards 2013: 18). The rapid development of public transport systems has resulted in a large number of intermodal transit spaces in central locations, surrounded by communities, offices, commercial districts and open

spaces (Bertolini 1998; Edwards 2013). The design of urban intermodal transit facilities and planning of the surrounding area are given particular social meanings to the city and its visitors. New designs of many intermodal transit spaces have made them landmarks, such as Kings Cross Station and Birmingham New Street Station in the UK, providing various functions, such as retail, restaurant, leisure and transport. Such spaces bring economic benefits to the city by creating job opportunities in the relevant construction, service and retail industries as well as improving quality of urban life (Edward 2013: 3-5). However, this in return requires a sustainable and pleasant environment in urban intermodal transit spaces for a large number of people to visit and have a short stay on a daily basis.

1.2.2 Smellscape in urban intermodal transit spaces

There is an increasing awareness that improving the design and environmental quality of urban intermodal transit spaces may influence people's overall satisfaction with transport services more generally (Trip 2007). There are useful measures for assessing the effects of large infrastructure projects on several aspects of environmental quality (Edward 2013: 85-87): noise, vibration, pollution, journey disruption, impact upon land-use. Most of them are closely related to people's sensory experience, such as noise, pollution and vibration, and this is suggested as a significant factor affecting people's experience of, and emotional responses to, transit spaces, like railway stations, as well as their evaluation of qualities of the surrounding environment (van Hagen 2011). This indicates that the biggest challenge for future urban intermodal transit space design will be the human sensory pleasantness and environmental quality of both indoor and outdoor spaces. Meanwhile, the various functions and activities in urban intermodal transit spaces may produce a diversity of smellscape. They thus provide excellent opportunities for studying and understanding the complexity of space-smell-human inter-relationships. By exploring smellscape planning and design, this thesis hopes can also provide an alternative approach of improving the environmental quality in urban intermodal transit spaces.

However, as will be discussed in Chapter 7, one conflict in achieving smellscape pleasantness in urban intermodal transit spaces is that traffic fumes are inevitable in

such spaces, and need to be controlled and considered in planning and design process to create a healthy environment for users. Traffic-related air pollution can cause many health problems (Finkelstein 2004), such as asthma and other breathing difficulties (KuÈnzli et al. 2000). The level of particles in the air around intermodal transit spaces in metropolitan cities can be over ten times higher than rural areas (Want et al. 2009), which requires an efficient and better planning strategy to reduce the intensity of pollution around such spaces. Traffic related air pollution has negative impacts on our olfactory experiences, given that traffic fumes are widely found to be one of the most disliked smells (Henshaw 2013: 68). Designing a pleasant smell environment would contribute to the environmental sustainability in urban intermodal transit spaces (Taylor 2003). The quality of smellscape in such spaces may also influence people's travel experiences and willingness of using public transport.

However, in current design frameworks and practices, there are no examples or guidance for designing and managing smells in urban intermodal transit spaces. Existing planning and design are aware of other sensory aspects, such as lighting systems designed to enhance security at night and auditory designs to reduce ambient background noise levels. One good example of dealing with traffic noise is shown in Figure 1.1, the Hessing Cockpit and Acoustic Barrier in Rotterdam designed by ONL practice. This acoustic barrier along the high-speed road aims to prevent traffic noise traveling to residential area in a distance, blocking the traffic noise from visitors and residents (Jones 2006). Such design practice inspires planners and designers to think of ways of dealing with negative sensory environmental elements in future projects. Research into the smellscape of urban intermodal transit spaces can provide an understanding of the existing smell environment and its influence on people's perceptions and waiting behaviours. The results can contribute to future design frameworks for transit spaces and provide an example to guide exploring and designing smellscape in other types of specified functional spaces.



Figure 1.1 View of the Hessing Cockpit and Acoustic Barrier in Rotterdam is designed by ONL Architects (Source: <http://vaa.onl/projects/soundbarrier>)

1.3 Research aim and questions

Existing studies of smellscape are from various disciplines and covering different aspects but few have established a systematic approach with which to explore and design smellscape (also see Chapter 2). Three gaps have been identified as fundamental to constructing a systematic approach to exploring smellscape, from interpretation to evaluation and design:

- 1) the demand for a framework of describing and understanding smellscapes;
- 2) the need for defining indicators of smellscape quality and criteria for assessment;
- 3) the demand for exploring smellscape within a specified functional space to provide examples and guidance for practice.

As discussed in Section 1.2, a study of smellscape in the particular context of urban intermodal transit spaces can provide rich content to explore the complexity of smellscape, and as well, provide an example to explore and design smellscape in specific functional public spaces. This thesis, therefore, aims to explore and

understand smellscape through interpreting people's perceptions of it, and to provide planning and design guidance to improve smellscape quality, taking urban intermodal transit spaces as examples.

More specifically, the objectives of the study are to:

- develop a framework with key elements influencing people's perceptions which can be used to describe smellscape from the studied cases;
- identify key indicators influencing people's evaluations of smellscapes, taking urban intermodal transit spaces as examples;
- generate a framework for design of a pleasant smellscape, particularly for urban intermodal transit spaces.

In order to achieve the objectives and explore the gaps, this study sets out three general research questions within the context of urban intermodal transit spaces:

1) How can smellscape best be understood?

This question necessitates using a framework to help understand the smellscape concept, in order to map out the interrelationships between essential elements in the concept: human perceptions, place, and smell environment, particularly in the researched context. This inquiry also sets out two sub-questions to better understand and interpret smellscape: What components influence people's perceptions of smellscape? How do people perceive these components?

2) How can the quality of smellscape be measured?

Following the last question, this question aims to identify a set of smellscape indicators derived from people's evaluations of their olfactory environment. This involves sub-questions identifying people's evaluation criteria for qualities of smellscapes. It also asks which are the most important elements of aspects of human perception, place and smell environment influencing smellscape qualities and their

interrelationships.. This question links the first and third questions, and uses these understandings as the basis of an analytical process for designing smellscape.

3) How can a pleasant smellscape be designed?

After answering the first two questions, this study will be able to structure the components and characteristics of smellscape in urban intermodal transit spaces according to criteria of smellscape pleasantness. The last question, which translates theoretical work to practical guidance, explores the construction of a framework for designing smellscape to a satisfying quality that meets the criteria through systematically planning and designing around the key elements identified.

1.4 Structure of the thesis

The thesis is structured as a narrative that explains the background to the study as the context for the description of the research, the analysis and findings. It starts with an introduction to and justification of the study through reviewing existing studies in Chapter 1 and 2, which help set out the research framework and methodology discussed in Chapter 3. The collected data are described in Chapter 4 and analysed in Chapters 5, 6 and 7, answering each of the research questions. It then draws to the conclusion in Chapter 8, summarising findings of this study and presenting suggestions for applying and developing these findings in practice and future work.

The existing literature reviewed in Chapter 2 explains the sociological, scientific background of studying smells, people and places. The concept of smellscape is explained and discussed and the current approaches to exploring smellscape are reviewed from three main aspects: detection, description and categorisation of smells; analysis of smellscape; design and management of the smell environment. Limitations of current approaches are discussed and four gaps are identified in the existing literature to construct a systematic approach to explore smellscape: these limitations initiate the research questions of this study. In Chapter 3, a theoretical framework is constructed by using people's natural language as a source to understand, evaluate and inform design strategies, from a linguistic and environmental psychology perspective. Based on this theoretical framework and the nature of smellscape as the

human perceived smell environment, it explains how and why Grounded Theory is taken as a methodological and analytical approach in a case study method. The fieldwork was carried out through a smell walking method with observations, interviews and a scale-rating survey of smellscape pleasantness along a designed route. The collected data from smell walking in selected cases are presented in Chapter 4 in three parts: description of the physical environment observed along the smell walking route; participants' descriptions of the perceived smell environment at each stop; people's ratings and descriptions for evaluating the pleasantness of smellscape at each stop along the route.

Chapter 5 discusses the components that emerged through the studied cases of people's perceptions of the smell environment in four categories: perceivers, smells and smell sources, the physical environment, and context. People's process of perceiving components of the four categories is mapped with perceptual patterns, responses and sequences emerged from analysing the data. This component and perceptual model helps a better understanding of the smellscape concept, focusing on human perceptions.

In Chapter 6, a number of indicators are derived from people's descriptions and evaluations of smellscape pleasantness along the routes in the studied cases. These indicators are translated into a seven-point scale rating evaluation system with responding bipolar descriptors summarised from people's own descriptions. This system is built on the theoretical basis of the taken environmental psychological perspective. People's perception of smellscape pleasantness were found to vary, emphasising different indicators, which are mainly from four types: healthiness, preference, life experience and context-led. Identifying types of pleasantness can inform the design objectives to achieve a pleasant smell environment in target spaces.

Following the framework of understanding and evaluation, Chapter 7 reviews current design frameworks of urban intermodal transit spaces and identifies barriers to achieve a pleasant smell environment within the existing frameworks. Based on the specific conditions and findings from the studied cases, a design framework for smellscape in urban intermodal transit spaces is generated, which takes into

consideration design objectives, stakeholders, design strategies and key elements at three scale levels, responding to pleasantness types.

The final Chapter summarises models and frameworks generated by this study to interpret and understand, evaluate and design smellscape, forming a systematic approach and answering the research questions. The theoretical framework of this study, using people's natural language to describe the perceived smell environment, contributes to the theoretical basis of current smellscape studies. A smellscape protocol is included to guide onsite investigations of smellscape. The design framework provides guidance for practitioners to design a pleasant smell environment in urban intermodal transit spaces. Taking into consideration the constraints of the methodology and case selections, future work can be developed to study more types of intermodal transit spaces as well as other types of public spaces. The findings of this study also suggest an investigation into design method of using plants and water features to achieve pleasant smellscape in public spaces.

Chapter 2: Smell, smellscape and place-making: a literature review

2.1 Introduction

This chapter reviews existing literature on smell perceptions and place making, exploring the interrelationship between smell, people and the physical environment that make up the concept of smellscape. Section 2.2 explains the human olfactory system as well as the neurological and psychological background of perceptions of smells. It then reviews the role of smell in forming a sense of place and place attachment as elements of place-making. Section 2.3 reviews current approaches to smellscape: detection, description and categorisation, analysis, management and design. The last section identifies the limitations of and gaps in current approaches to establishing a systematic approach of exploring smellscape which will be investigated in this study. Literature review in this chapter forms the basis of the three research questions.

2.2 Smell perceptions and smellscape

Smell, in this research, refers to emotional and physical sensory stimuli produced by the smell resources in the physical environment. Gibson (1966) described smells from a scientific viewpoint as ‘foreign’ components in the air that stimulate the olfactory receptors to perceive a volatile substance. This explanation emphasizes the physical modality of smells. However, from the perspective of social science, the concept of smells in this research emphasises the psychological impacts created by smells and their surrounding environment.

The concept of perception in this research draws on the work of Rodaway (2002) and Henshaw (2013), and shares a similar meaning to the word ‘experience’, emphasising the process of learning through thinking and feeling (Tuan 1977). It involves two

dimensions: 1) as sensation - the sensory mediated detection and recognition of environmental stimuli; 2) as cognition - the culturally mediated mental process of emotions, memory recollection and other thinking. The understanding of both dimensions is built on scientific explanations of the human olfactory system.

2.2.1 Human olfactory perception system

Preliminary understanding of how the sense of smell works can be gained through the neurological explanation of the human olfactory perception system. People perceive smells through a set of olfactory receptor cells located in the mucous membrane on both sides of the nasal cavity (Schiffman 1990). The olfactory receptors are connected to olfactory bulbs by olfactory nerve fibres, and within the olfactory bulbs, there is a synaptic region called glomerulus, which transmits the stimuli of smells into neural impulses to the brain through olfactory tracts (ibid). Some of the olfactory tracts are directly connected to the limbic system, which is the main part in the brain processing emotions and memories (Engen 1991). The olfactory perception system transmits the information from the olfactory bulb to the cortical regions without a thalamic delay¹, which for other sensory systems requires a series of processes in the thalamus (Farbman 1992). In addition, the olfactory receptors are the only CNS² neurons directly exposed to the environment and have a replacement cycle about every twenty-eight days (Herz and Engen 1996), which ensures the sensitivity of human olfactory perceptions.

The human olfactory system enables people to detect and distinguish different smells through the olfactory patterns of responding olfactory receptors (Cunningham et al. 1999). Over forty million olfactory receptors have been identified (ibid), which indicates that the human body is a powerful sensor of smells in the environment. There are two types of responses that an olfactory receptor can give: identification and intensity. Each olfactory receptor can be involved in different combinations with other receptors to respond to different smells. Even a single odourant in the air can

¹The Thalamus is a midline symmetrical structure in the brain which delivers sensory and motor signals and is associated with consciousness, sleep and alertness.

² The CNS (central nervous system) is part of the nervous system in the brain that integrates information it receives from, and coordinates and influences the activity of, all parts of the bodies, including retina, optical nerves and olfactory nerves, etc.

result in activating a group of olfactory receptors (Kauer 1987). Accordingly, the number of smells a person can perceive is enormous. The intensity of smells can also cause different degrees of neurological impulse through olfactory cells, and hence, we are able to know how weak or strong the smell is, namely the smell intensity.

Apart from the olfactory receptors, there are trigeminal nerves in the human body that can provide additional information about smell intensity, temperature and even pleasantness (Henshaw 2013: 25). The trigeminal nerves are located on olfactory nerves and are responsible for sensation in the face. In particular, some air pollutants without smells can only be detected through trigeminal nerves (ibid). Such studies indicate that the human body has a strong sensitivity to smells in the surrounding environment. The scientific explanation of the human olfactory system helps better understand smell perceptions, physiologically and neurologically.

2.2.2 Smell perception as sensation

The sense of smell is an arousal sense that influences people's emotions and evokes memories of past experience (Porteous 1985). As explained earlier in this chapter, some of the olfactory tracts are linked directly into the limbic system that controls human emotional experience (Schiffman 1990), illustrating a direct relationship between smell perception and emotional reactions. Engen and Rose (1973) show that the experience of smells has longer memory associations than visual memories. Their study compared the decline of memory accuracy between visual and olfactory senses with a group of students in a laboratory experiment. The results showed that the degree of visual memory accuracy faded to zero after a few weeks. However, the degree of olfactory memory accuracy stayed the same - at twenty percent of the first day - even one year later. This distinguishes the olfactory experience from other sensory stimuli, as Pallasmaa (2013: 54) said:

‘The most persistent memory of any space is often its smell...a particular smell makes us unknowingly re-enter a space completely forgotten by the retinal memory; the nostrils awaken a forgotten image... The nose makes the eye

remember...the scent sphere of a candy store makes one think of the innocence and curiosity of childhood...every city has its spectrum of tastes and odours...'

Smell preference is studied as a most distinctive feature of smell perceptions (Moncrieff). People know immediately whether they like a smell or not according to individual smell preferences. Our knowledge of smells is gained through the later learning process and past experience, influenced living environment, cultural and social context (Classen et al. 2002). Psychological research indicates that the like-dislike (preference) of a place can cause people's emotional changes and influence their evaluations of the overall environmental quality (Mehrabian and Russell, 1974). People's preferences in the perception of smells and the environment form the main factor in olfactory psychological impacts.

'Smell adaptation' refers to the experience when after exposure to a certain smell for a period of time, the initial experience of the smell disappears (Schiffman 1990). For example, people can hardly notice food smells when they stay in the kitchen for some time. However, when they walk out of the kitchen into the garden and then go back to the kitchen, they can perceive the food smells immediately. Smell adaptation is a common experience in smell perception that potentially explains Moncrieff's (1966) findings that people tend to be less intolerant and less sensitive to indoor olfactory environments: that is, the adaptation experience may reduce the sensitivity of smell perception. There is an inter-relationship among smell preferences, evoked memories and emotional reactions. It is argued that odour-evoked memories have four features (Herz and Engen 1996): they are more emotionally potent; they are affected by hedonic properties (term used in psychology and neurology to describe feelings of pleasantness); they are contextually affected; and salient emotion (emotions that associates with sensory stimuli) enhances memory effectiveness. Such studies indicate that smells as environmental stimuli can greatly influence our psychological experience of the environment.

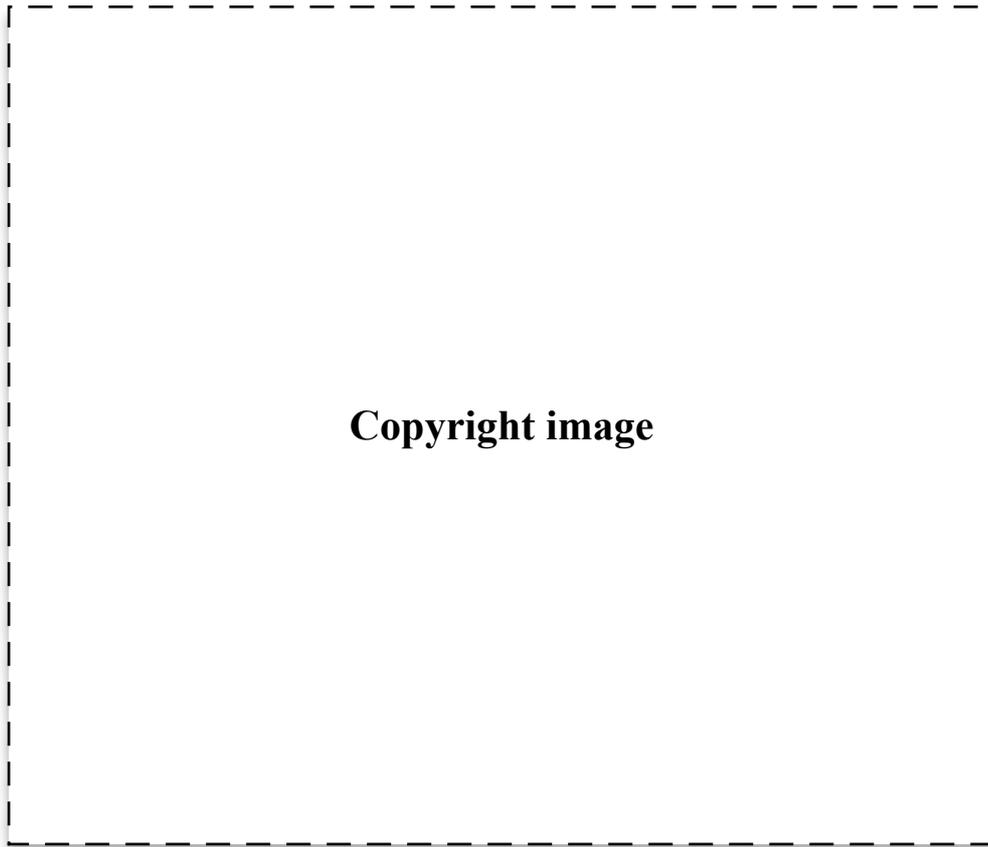
Porteous (1985) emphasises that smellscape cannot be discussed independently of other senses, especially vision and taste. A scientific study found a widespread nerve system in the human body that transmits certain effects of stimulation from one organ to another (Allen and Schwartz 1940). It indicates that all sense organs are

interrelated, so that no one sense modality can be wholly independent from the other (ibid). Psychological research has also indicated an interrelationship between smell perceptions and other senses through memory cues. For example, it is found that there is an overlap between odour memory and visual memory, which indicates that ‘odour-evoked memories’ may stimulate ‘odour imagery’ (Herz and Engen 1996). Other sensory stimuli, i.e. vision, tactile and sound, are found influencing perceptions of smells, particularly enriching the information of surrounding smell environment (Henshaw 2013; Porteous 1985). This means that when discussing smell perception, it is necessary to consider influences of other sensory stimuli on the sense of smell. With the combination of other sensory cues, the perception of smells can enhance cognitions of the physical environment.

2.2.3 Smell perception as cognition

The general physical environment setting affects smell perception from many aspects, such as smell sources, the weather, airflow, temperature, time and so on. Henshaw’s work (2013), indicates that the perception of smells is influenced by a set of odour, individual and environmental characteristics (see Figure 2.1). Such environmental factors cause physiological impacts that influence smell perceptions, while in return, the perceptions of smells can enrich the interpretation of the physical settings. There is an inter-relationship among human smell perceptions, environmental settings and smell quality.

Although the sense of smell is recognized as a “non-spatial” sense, which provides little information of the location of the smell sources, with the combination of other sensory cues, the perception of smells can enrich our interpretation of the physical settings in the environment (Porteous, 1985). Smells in spaces are argued to be abstract forms of the physical world where our daily activities are associated with different smells and smell sources (Zardini & Schivelbusch, 2005), indicating the function, enclosure and volume of space.



*Figure 2.1 Olfactory performance: influential factors in smell perceptions
(Fig3.1, Henshaw 2013: 26)*

Smells in an environment are suggested as an alternative map of a place (Classen et al. 2002), which can refer to the urban cognition system introduced in Lynch's (1960) *The Image of the City*: urban spaces can be defined and recognized through five typical urban elements based on visual memories and psychological impacts. It is suggested that many of the concepts used in this idea of visual urban cognitions can be applied to smell perceptions, such as smell marks and smell events (Porteous 1985). As explained later in this section, our memory of olfactory experience is argued to be the most lasting and emotionally related (Engen and Ross 1973). In this sense, ambient smells may also formulate an urban cognition system through the cues provided by smell perceptions. As Classen, et al. argued (2002: 23) 'different local odours created the effect of an olfactory map, enabling the inhabitants of the city to conceptualize their environment by way of smells'.

At the same time, people's perception of smells can affect their satisfaction with their living environments and life qualities. The experience of 'smell nuisance', refers to

the unpleasant emotional reactions caused by disliked smells, and can largely reduce hedonic degree of olfactory experience. In general, disliked smells tend to be chemical and synthetic smells, such as the smell from chemical industries, food plants, garbage dumps and diesel engines (Henshaw 2013). In some cases, detecting such smells can alert dangers in the environment, i.e. gas leak. Most of chemical and synthetic smells are related to the sanitary conditions, industrial emissions and machines. Some of these smells are from air pollutants, as it is argued that some air pollutants can be detected through either olfactory bulbs or trigeminal nerves (Henshaw 2013: 25). Since air acts as the medium transmitting smells, it is impossible to separate the perception of smells from air quality.

Some chemical air pollutants produce smells that people dislike, such as traffic fumes. Some pollutants cause great damage to the olfactory system and lead to other health problems. Moreover, an increase in the intensity of some pollutants can mask the smell of some fragrant odorants. Thus, such pollutants can largely decrease the hedonic degree of our olfactory experiences. Regarding this, some cities have published odour legislations to get rid of the smells that cause nuisance: for example, in the 1990s, New York urged industries and sewage treatment factories to deodorize their emissions.

People's perceptions of smells in the environment can influence their judgments of the place (Henshaw 2013). In a comparative study between a pedestrian area and a high street, Henshaw (2013) analysed people's perceptions and ratings of smells and the environment. The results showed that people enjoyed more of the smells and environment in the pedestrian area where there was less traffic pollution. Another study was carried out in Germany to evaluate people's living qualities in different urban areas (Rehdanz and Maddison 2008). The results suggested that where there is more air pollution, people felt less satisfied with their living environment and rated their living qualities lower.

Apart from physical factors, smells in public spaces are also influenced by people's behaviour, as Drobnick (2006, p.35) argued:

‘An odour is often a crucial component in the definition of, and orientation to, an environment and is instrumental in generating appropriate activity. While odour settings may be taken for granted in an unreflective manner, they are nonetheless cues to particular modes of involvement within the setting.’

The behavioural impacts caused by smell perceptions are referred to as ‘smell avoidance’ and ‘smell attraction’ (Largey and Watson 1972). Smell attraction and avoidance can be seen in approaching and avoiding behaviour. It is a significantly revealed in marketing studies that pleasant smells can attract more people to visit a shopping mall and increase people’s consuming behaviour (McDonnell 2002; Spangenberg et al. 1996). Smell attraction is a common experience in people’s everyday lives. For example, people are attracted to dine in a restaurant by the nice cooking smells released into the street by the air conditioning fan. Like smell attraction, the experience of smell avoidance is also common. For example, when smelling dangerous chemicals outside a room, like petrol or sulphuric acid, people will refuse to enter. Or, people who do not like the smell of durian³ will avoid spaces which smell of durian.

Another study of smell avoidance researched people’s perception of the smell of smoking in public spaces in Singapore. Most of the fieldwork was done in public squares with people from various ages and background. The author noticed that the space where the smokers were grouped was avoided by non-smokers mostly because of the smell and relevant health concerns (Tan, 2013). The author argued that the smell of smoking caused social segregations in studied public space. Smell avoidance and attraction are related to individual smell preferences and perceptions of smell nuisances, which are also influenced by the social and cultural context. In such sense, the smell perception resulting behavioural influence can change social activities in public space. Perceptions of smells in the environment are often influenced by its physical and social settings, which brings the concept of smellscape.

³ Durian is a tropical fruit which gives a strong and distinct ‘gasoline-like’ smell.

2.2.4 The concept of smellscape

‘Scape’ means a scene or a view. The meaning of “smellscape” can be described as a scene of smells. The concept of smellscape emerged in parallel with the concept of soundscape in the late 1970s. Porteous (1985) introduced the concept of smellscape to describe the fragmented and space-time bounded human experience of places through smells. Like soundscapes, he also suggested smellscapes could be explored through ‘smell walks’ and interpreted with smell maps and smell marks (Porteous 1985). An interrelationship between people, place and smells is indicated but not explicitly explained in Porteous’s work. In a recent discussion of urban smellscapes, Henshaw (2013: 5) suggested that smellscape can be understood as the overall smell environment of a place which can be experienced by humans at one point of time with memory cues and mental images. However, no certain definition of smellscape has been arrived at in existing studies.

From descriptions of smellscape by Porteous (1985) and Henshaw (2013), four essential components of smellscape can be derived: smell environment, human perceptions, place context, and time, as illustrated in Figure 2. Like soundscape, which is defined as the human perceived acoustics environment of a place at a certain time (Brown et al. 2011), in this study smellscape can also be defined as the human perceived smell environment of a place within its context, influenced by temporal conditions. The human individual is the centre of this definition of smellscape, influenced by perceivers’ individual differences, i.e. sensitivity to smells and smell preferences, make smellscape particular and various. As will be discussed in Section 2.3, smellscape influence people’s emotions and memories of a place, varying along lines of past experiences, individual social and cultural contexts (Classen et al. 2002) which also gives personal meanings to the place through smells.

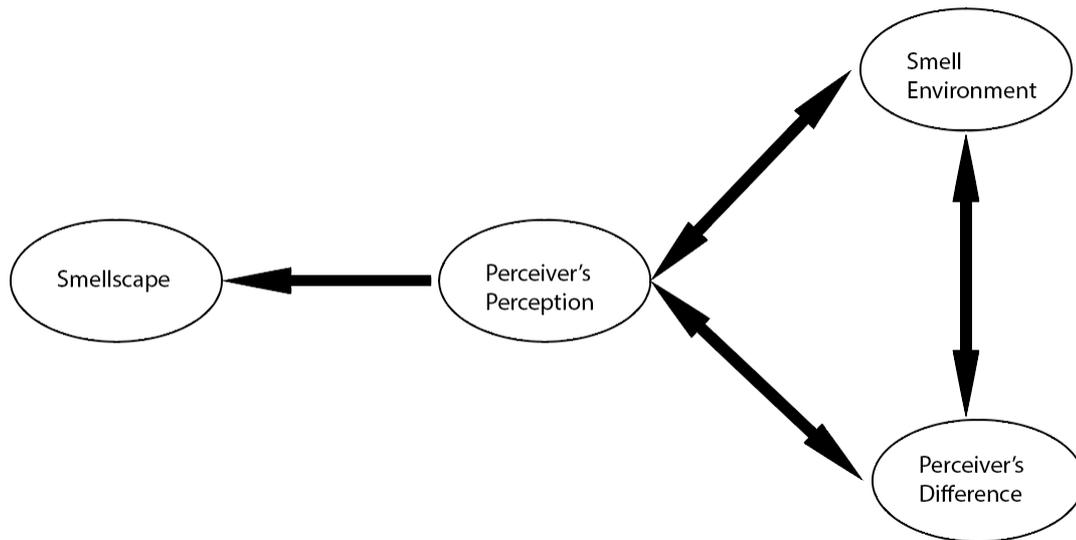


Figure 2. Elements forming the concept of smellscape based on descriptions from Porteous (1985) and Henshaw (2013)

Beyond definition, there are other elements of smellscape to be considered within any exploration. Essentially, ambient smells are inseparable from the physical context of the surrounding environment, such as material, climate, function and so on (Henshaw 2013). Smellscape also cannot be discussed separately from other sensory experiences, since human olfactory perceptions cannot provide specific spatial information, such as location or scale (Porteous 1985). Together with visual, auditory and tactile perceptions, smellscape can be experienced as physical materialized ‘scape’ with spatial dimensions. Henshaw (2013: 172) also suggests that smellscape in cities can be explored at three scales: 1) micro level - a specific site-based scale; 2) midi level - neighbourhood district; 3) macro level - citywide area, revealing the multi-layered features of smellscape. The different smellscape at different levels depends on how the perceiver positions himself/herself in the space when perceiving the surrounding smell environment.

In this sense, the smellscape of a place consists of its smells, physical environment and human perceptions, affected by the contexts of both the people and the place. Exploring the components of a smellscape should involve the following:

- Physical environmental settings, including location, built form, materials, topology, enclosure of space, smell sources, etc.
- Time and weather. The smellscape can be precisely recorded at the time of a day, week and year. Weather includes factors as temperature, ventilation, wind and so on.
- Human perception, including emotional, physiological and behavioural reactions, memory associations and thought processes. Perception is affected by the social and cultural context of the individual and related to personal life experience.
- Characteristics of a place, like, history, culture, public or private, function, etc.
- Unpredictable environmental issues, including traffic flow, events, crowds.
- Other sensory mediation, such as vision, thermal comfort and sound.

The characteristics of smellscape indicate features of a place. There is an interrelationship between smellscape and place concepts.

2.2.5 Place-making with smellscapes

The general aim of any place-making is to enhance the spatial qualities and human experience of a place. Place-making can lead to people thinking consciously about and taking more notice of their surroundings (Tuan 1977), devoted by urban policies, designs and planning practices. However, Relph (1976) argues that some places are so ‘placeless’ they don’t register in people’s memories or attract people to appreciate the surrounding environment. Place-making is emphasised in urban designs to enhance the recognition and identity of places. People’s sensory perceptions of a place not only affect their in-situ experiences, but also influence their aesthetic evaluations and memories of a place (Tuan 1975), and are one of the most important aspects in the perception of a place (Manzo 2003). In this sense, people’s sensory experience mediates between their attitudes and places. Experiences gained by interactions with spaces and others people through human senses, are resources to re-create new spatial forms and cultural identities. This indicates that sensory stimuli in a place can help create place identities and increase place interactions. In other words, people can also

gain a sense of place from sensory cues deliberately designed into the environment by built environmental professionals.

In many cities, smellscape has contributed to local urban identities and the authentic character of places (Henshaw 2013; Tuan 1977). Henshaw (2013: 188) suggested smellscape design as a potential way of place making, which is able attract people to a place and engage people with relevant activities. Smellscape design can be considered as a composition of physical environmental settings, human perception of smells and time. As Tuan (1977: 11) described:

‘Odours lend character to objects and places, making them distinctive, easier to identify and remember. Odours are important to human beings. We have even spoken of an olfactory world, but can fragrance and scents constitute a world? ‘World’ suggests spatial structure; an olfactory world would be one where odours are spatially disposed, not simply one in which they appear in random succession or as inchoate mixture.’

‘Place’ is an important element in constituting people’s perception of smellscape. As discussed in Section 2.2.4, smellscape refers to a certain place. ‘Place’ is a result of people constantly giving values and meanings to a particular space (Najafi and Shariff 2011). A ‘place’ differs from a ‘space’ by involving individual affections, memories, moods and purposes of visiting a certain place. Socio-demographic characteristics, environmental experiences, culture, preferences, activities, and physical structures all contribute to people’s perception of a place (ibid), and this also involves smellscape. To make a ‘place’, there are several key concepts to consider: sense of place, place identity and place attachment. ‘Sense of place’ and ‘place attachment’ emphasize human perceptions of a place, whilst ‘place identity’ reflects the influence of place itself on human perceptions. Place-making concerns positive human efforts in engaging people with places through emotional reactions and particular memories. Two key concepts in place theories are devoting to place-making: the sense of place and place attachment, which also emphasis human perceptions and associates with memories and emotions as smellscape.

Sense of place

Place may be said to have a ‘spirit’ or ‘personalities’, but only human beings can have a sense of place (Tuan 1977). A sense of place exists because of people’s awareness of a place through their moral and aesthetic recognition of its location and environment. There is also an emphasis on the human body as an environmental dimension in a place. Tuan (ibid) indicates that the “spirits” and “personalities” of a place are what a place presents itself to its visitors, like place identity. In contrast, a sense of place is how people interpret a place through their sensory experiences.

‘Sense’ in this concept involves two aspects: visual and non-visual sensory experience, an understanding of the meaning of a place (Tuan 1977). It is argued that non-visual sensory experience, like touch and smell, can create a sense of place with deeper meaning than just seeing (ibid). The emotional reactions caused by our sensory experiences not only interpret the environmental impacts on our daily life routines, but are also reflected in people's perceptions of the city and its physical environment (Pallasmaa 2013; Zardini and Schivelbusch 2005). Such experience is associated with people’s long-term life experiences and emotional bonds. As Tolaas (2010: 153) argued that ‘the study of urban smells provides an additional dimension to our understanding of cities, enriches our sensual experience and provides input for urban design and architecture to communicate and understand the invisible city’.

The sense of smell is a chemical reaction that leads to affective responses. It is also influenced by people’s social and cultural context (Classen et al. 2002). People’s perception of smells enrich their experience and intensify their impressions of a place (Porteous 1985): thus, people can gain a sense of a place through their olfactory experience. For example, the strong smells caused by cooking Chinese food in Manchester China Town can be considered to contribute to the character of the area (Henshaw 2013: 98). That is, people gain a sense of place in Chinatown through their experience of the cooking smells there.

Place attachment

‘Place attachment’ is an important concept of place studied in much phenomenology and environmental psychology research. In general, it is defined as the emotional

engagements people have with a place, creating closeness between people and the place (Hidalgo and Hernandez 2001; Seamon 2013). There are two different types of place attachment: long-time residence in a place; place associated personal experiences and self-identity (Gustafson 2013). Both types of place attachment are associated with strong personal attitudes, changing over time with people's life processes and the development of the place.

People's experiences of smells in a place can result in more durable memories than the visual images (Engen and Ross 1973) and affect people's emotional and behavioural reactions (Herz and Engen 1996). In this sense, human experience of smells contributes to the emotional bonds between people and a place. The emotional reactions aroused by smells contribute to either type of place attachment, interpreting changes of the environment over time or life traditions of the people who live in the place (Tuan, 1977). Although the perception of smells only captures the temporary feature of the place, it links the present and the past through evoked memories and learnt knowledge. The experience of smells can engage people with spaces through activities, emotional stimulations and past experiences that all contribute to attachment to a place.

2.3 Approaches to exploring smellscape

Most of the existing smellscape studies are done in a Western cultural background. Most cases of an Eastern cultural background can be found in written literature are in Japan and Singapore. Hence, most of the smellscape studies discussed in this Section are based on English language publications. In this field, current smellscape research can be divided in three directions: understanding existing smellscape; smellscape quality analysis; exploring smellscape design and planning strategies.

2.3.1 Smell detection, description and categorization

There are two main aspects in understanding existing smellscales: smell detection, description and categorization; and smellscape assessment. The detection and

description of smells are the first step of the on-site research to gain general information of an existing smellscape. However, due to the immediacy and variability of the smell intensity and concentration, there are many limitations in detecting smells. Unlike sound and temperature detection where clear and stable physical features are found and precise technical detection devices are created, smell detection devices are very limited at present. As explained in Section 2.2.1, the human nose is very sensitive to smells. In existing and on-going studies, the most practical and efficient way of detecting and identifying smells in the built environment is by using our nose (Henshaw 2013; Porteous 1985; Tolaas 2010). Due to the limitations of getting device-detected data of smell intensity and dilution, most smellscape studies are carried out using qualitative methods. In many situations, the major task is dealing with people's descriptions.

Although in recent years, some new technical devices have been developed to undertake on-site studies based on laboratory experiments, such as the Nasal Ranger (St. Croix Sensory, St. Elmo, MN) and Odour Meter (Shinyei Technology, Japan), such mobile olfactory devices are able to detect the dilution level of the smell, depending on human justifications of the detection threshold which is identified by the first time the participant detects the smell. As the detection of smell with the same participant can even vary during similar conditions, the data detected by such devices are unlikely to be more sensitive than detection by the nose. The identification of smells as part of smellscape perception, needs to involve personal experiences. In English, there is a shortage of vocabulary related to smells (Porteous 1985). It is suggested that when people come across an unknown smell, they may either ignore it or relate it to similar smells they have known and visual cues (Henshaw 2013). The lack of awareness of, and vocabulary for smells, and lack of training on identifying smells have caused difficulties in identifying smells through participatory qualitative studies.

In early studies of smell classifications, Henning (1916) classified smells in six categories: Flowery/Ethereal, Putrid, Fruity, Spicy, Burnt, Resinous. The descriptions of each category do not share the same criteria, whether referring to the objects or the emotional reactions. Such categories of descriptors can cause difficulties in later processes of analysing the physical settings. Henshaw (2013: 53) categorized the

typical smells in English cities in relation to the smell sources: traffic emissions, industrial odours, food and beverages, tobacco smoke, cleaning materials, synthetic odours, waste, people and animals, odours of nature, buildings and construction, and non-food items. She found that people were found to often use names of smell sources to identify the smells detected (Henshaw 2013). This can be used as a method of identifying smells in the urban environment and directly relate them to the physical settings. However, this still lacks attention to the connections between such object-nominating system and perceivers' emotional reactions.

Some attempts have been made by researchers to create their own languages to label smells in the same way. For example, in site-specific Mexico City smellscape research, Tolaas (2010) collected 200 smells from 200 neighbourhoods and created her unique codes by extracting letters from different smell descriptions to identify each smell, i.e. CAA representing the smell of traffic. She used non-participatory methods by smell walking and collecting smells through a self-made device, using English and German to describe smells in the beginning and then transformed in her unique codes. These nominations of smells involve complicated linguistic re-creations from languages making this research more like an artistic production, which can hardly be applied to the general public. However, it prompts us to think of standardizing the identifications of smells and providing suggestive descriptions of smellscape for further studies.

2.3.2 Smellscape quality analysis

The most important part of smellscape quality analysis is assessment. Referring to the definition given in Section 2.2.4, assessment of smellscapes should consider factors of human perceptions, social context, physical environmental settings and time. However, previous studies have been focused on chemical features of perceived smells rather than surrounding environment, context and perceivers' experiences. Smells are found to have several chemical features: Flowery/Ethereal, Putrid, Fruity, Spicy, Burnt, Resinous (Henning, 1916). In a further study of odour quality, Findley (1921) found that an odour could have multiple features other than just chemical properties. The term 'Pleasantness' is then used to indicate the overall quality of

odours and has been adopted by others, such as Schiffman (1976). A systematic rating method was introduced to evaluate pleasantness of odours with a 5-point scale, ranging from +2 very pleasant, +1 more pleasant than unpleasant, 0 indifferent, -1 more unpleasant than pleasant and -2 very unpleasant. This scale rating method provides a way of measuring smell and smellscape quality through people's perceptions.

In the study of smellscape, rather than smells, Henshaw (2013) used 'like-dislike' to evaluate perceived smells and places with scale-rating method. However, 'likeness' representing preferences seems too limited to represent the overall smellscape. Lang (1969) suggests descriptors of emotions indicate environmental qualities, such as relaxed-bored, excited-irritated and secure-insecure. To assess the quality of the overall smellscape, more detailed evaluations should be made according to different emotions caused by the smells, revealing the co-relationships between smell and the physical environment in people's perceptions. Hence, evaluating smellscape as a composition of human perception and physical environment needs an exploration of all indicators, rather than single smells. There is a need to set out clear criteria for assessing smellscape qualities with identified indicators.

Other methods of smellscape quality analysis involve smell mapping, smell walking and simulations. Smell mapping is an effective method to illustrate and represent smell environment, assisting smellscape analysis by researchers (Henshaw 2013: 55). In particular, the smell-maps created by McLean (2011), present the smellscape in relation to the location of smell sources, and the intensity levels in relation to the airflow movements. This mapping is based on on-site smell detections through the nose, the recordings of in-time weather conditions and GIS. Other smell maps attempt to relate the smell map to spatial functions and urban fabrics by connecting smell sources to spaces and noting smell marks, i.e. Tolaas (2010). Such maps are useful to illustrate spatial information on the relationship between smells and the physical environment. However, based on researchers' personal experiences at certain times of a day, such maps are not for generalisation in directing further research. A recent study developed a method of mapping and predicting types and intensity of smell through analyzing correlation of environmental elements and smells, based on empirical data (Quercia et al. 2015). However, this method excludes seasonal changes

and temporary conditions onsite. Influenced by temporary features in the environment, smellscape seems difficult to predict and record.

A study presented at the 2008 IEEE Virtual Reality Conference showed an interactive olfactory system based on Computational Fluid Dynamics, which provides a possible method for analysing smell dispersions through computational simulations (Ishida et al. 2008). In Ishida's work, there is an assumption that smell dispersion can be represented by air movements caused by the mechanical ventilation systems in buildings (ibid). However, this study was carried out in enclosed spaces with controllable ventilations, which is different from conditions in large or open urban spaces. Simulation methods have been used in architecture and the urban design field, which can assist in the analysis and design process and provide interactive communication between the designers and others. However, the simulation of smells is only practiced in small-scale enclosed spaces rather than urban-scale open spaces. Although smells are invisible, they fill in the space and have their own spatiality. As argued here, an important aspect in studying the olfactory environment in urban spaces is the analysis of smells' spatiality, and simulation of smell diffusion can provide insights of the area of influence of different smells in urban spaces. But, real life situations are less controllable and more unpredictable than computational simulation results, particularly with interactions of human activities.

Another focus of analysis in smellscape studies is analysing human responses to perceived smell environment. As discussed in Section 2.2.3, smells can produce approaching and avoidance behaviours in spaces (Largey and Watson 1972). A recent study explored human behaviour stimulated by smells and other sensory stimuli in two museums by analysing responses such as heartbeats, the walking paths, and the verbal comments (Henshaw and Mould 2013). The result suggested that perceivers' physical responses involve their emotional evaluation and perception of space as well as smell. The interrelationship between smells, the environment and perceivers' behaviours shown in this study sets out an initial framework of designing smellscapes to improve environmental quality and guide users' choices of using spaces. In a study of smell environment in a shopping mall, smells were found to have various effects on people's identification, descriptions and responses to the surrounding environment (Balez 2002). For example, a 'confusing effect' refers to the fact that people's

memories of other times and smells led them to make mistakes in identifying the smells they encountered in the study. These kinds of exploration of human responses can provide more cues for the design process for sensory environments. For example, what activities are associated with the smell of coffee on the platform of the train station, such as reading, eating, chatting with others? What effect does the coffee smell have on people's choices of where to sit on the platform space, such as facing the coffee shop or near people who are drinking coffee. However, few studies have explored people's evaluation criteria of smellscape that lead to their various responses.

Apart from the consumer behaviour studies in marketing, there are very few studies of specific and detailed smell-evoked social activities and human behaviours in public spaces under certain conditions. In the shopping mall study by Balez (2002) mentioned earlier, the participants were not engaged with the main activities designed for such space, which is shopping. Little information has been provided in previous studies on the influence of social activities and the context of the space from the users' perspectives. A more detailed exploration of the relationship between the smell environment, people's perceptions, and the context is needed to provide direction for smellscape design.

2.3.3 Smellscape planning and design

Porteous (1985) discusses a diversity of smells, from the levels of the urban environment to the household. People's preferences and expectations of smells are different from private spaces to public spaces. It indicates the importance of defining the nature of the space in designing a smellscape. Also, in the research on urban smellscape, Henshaw (2013: 172) explored the differences in designing smellscapes at different spatial scales. She classified the urban smellscape into three levels: the micro level, midi level and macro level. In her discussion, she argues for designing smellscapes separately within each scale. Since the difference in spatial scales may result in intensity differences, this can determine the detection of smells. Moreover, at different scales of the urban environment, people's interaction with the environment varies. However, in this study, there is little discussion of the transitional space

between each level or between the general urban environment and Monicrieff (1966) first mentioned four ways of improving the olfactory environment when doing the odour preference studies: separation, deodorisation, masking and dilution. These methods are then applied as principles for re-creating the smellscape by other researchers (Henshaw 2013; Rodaway 2002). In particular, drawn from the basic principles, Henshaw (2013) introduced a systematic urban smellscape design process with a series of smell design tools, such as airflow, topology, vegetation, etc. She divided the design process into four steps: site assessment and stakeholder engagement; determining the odour objectives and setting with a design brief; designing and implementing the scheme; monitoring and evaluation. And she introduced four design tools, categorized as air movement and microclimates, activity density and concentration, materials, and topography (ibid). However, as Henshaw (2013) argued, there are more design tools than those she introduced. Current exploration of each design tool throws further light on smellscape design. But it still needs more studies on how to engage such tools with other urban design practices. Henshaw (2013: 204) also recommended cautiousness in designing smellscape by considering the differences of smell preferences. The variety of individual smell preferences means it is difficult to reach consistency among all people. However, in the field of design and creation, sometimes a good design is not about seeking an agreement.

Existing studies indicate that most urban smellscape practices are aimed at smell control and management. Smellscape practices in urban spaces are still not very common as urban planning and architecture considerations. The only practice Henshaw (2013: 195) identified was in Grass in the south of France, where herbs and flowers for large perfume companies, like Chanel, are grown. There, the smellscape consist of both natural and artificial smells. At the outskirts of the town, the smellscape is dominated by the natural smells from the flower fields. Moving into the town centre, the smellscape is formed by artificial fragrance dispersed through a spray system along streets and fragrance fountains in squares.

Compared to the urban (macro) scale, within architectural designs there are more attempts of designing smellscape at the micro (individual building) scale. A scenting ventilation system developed by the Shimizu Company has been installed in many

large companies in Japan and US. The Company has even combined the scenting system with visual cues to make people feel more comfortable with the artificial fragrance (Damian and Damian 2006). For example, they created a forest smell and injected it into the lounge area of their offices where people also gain a view of the landscape from the window. Similarly, smoking booths are used in some airports to separate and deodorise smokers within waiting areas (Henshaw 2013). Such smell devices have shown a potential approach for improving and creating smellscape in buildings. However, these methods are considered separately from the basic designs of spaces and urban forms, like the structure and materials of buildings, the landscape, the planning of spaces and so on. In other cases, urban smellscape result from the function and landscape and is not originally one of the design purposes. For example, the sweet chocolate smell from the Cadbury World Chocolate Museum, marketing for chocolate, has formed the special smellscape of Bourneville in Birmingham, UK. Such resulting smellscape are perceived as the most significant smell-mark of the place.

Smellscape design and planning are increasingly popular, not only within architectural and urban studies, but also across disciplines such as marketing, tourism, health studies and so on. In particular, fragrant scenting as a marketing strategy is widely explored within marketing and tourism. It is argued that smells are essential and important service clues in the shopping environment (Berry et al. 2006). There are many studies exploring whether scenting in products and shopping environments can enhance people's buying behaviours and evaluation of the service. For example, a comparative experiment has been done on people's buying decisions and shopping time between scented and non-scented environments with both scented and non-scented products (Spangenberg et al. 1996). The results suggested the fragrant stimuli could increase the time people spent in-store and affect their buying decisions. As discussed earlier the Japanese company Shimizu design scenting systems to improve the quality of working environment with different smells aiming for different purposes: in lounge space, created smells of nature for relaxing; in the working environment, created fresh scents to increase people's working efficiency (Damian and Damian 2006). These studies indicate that odour stimulated human behaviour reveals the inter-relationship between smells and the built environment. However, these studies focus on consumption related activities and spaces.

Among reviewed studies of smellscapes, urban streets, squares, markets, rural fields and shopping malls have been included. Such places are with distinct smell features for appreciation. There is not any research into smellscapes in public, where the smellscape is important but in demand of improvement, such as transport services, medical care services. Such spaces are tied to certain activities with particular purposes. It is worth studying one of such spaces to produce more in-depth understanding of people's perceptions of smellscapes and contribute to detailed design processes to improve the smellscape quality.

2.3.4 Debates and limitations in designing smellscape and gaps in current research

Recently, many studies from both architectural and urban studies have revealed smellscape as an environmental dimension important in evaluating the quality of a space (Barbara and Perliss 2006; Henshaw 2013). However, debates arise around the value and justification of designing smellscapes in public spaces, especially in terms of scenting the environment. People who are against environmental scenting argue that the scented environment will manipulate people's behaviours and emotions (Damian and Damian 2006). However, Henshaw (2013: 203) argued in support of environmental scenting, saying that there is no difference between smellscape design intention and the traditional form of design practice. Taking the example of constructed architectural designs in cities, Henshaw explained that people who perceive the visual image are compelled to the aesthetic and spatial purpose given by the architects. Good designs of smellscape, as good practice of architectural and urban designs, can improve people's quality of life and add to distinct features of cities.

Some argue that for people who do not like the scent, it is a deprivation of human rights to have to use scented public spaces, and there are health concerns that some scents may cause allergic reactions in some people (Damian and Damian 2006). For such reasons, in some parts of Canada and the United States, there are laws to prevent environmental scenting in public spaces. However, there are also countries like Japan that have seen scenting as a way to improve environmental quality. Whatever the

arguments, they all acknowledge the point that our olfactory perceptions are compelling and emotionally related. Work in this field to date has provided some fundamental studies in researching smellscape as an environmental dimension. The difficulty in controlling dispersion scales and directions of smells are limitations to studying smellscapes in urban environments that are influenced by uncontrollable factors, such as the weather, wind, crowds and traffic movements. The variation of individual smell preferences also increases the difficulty in generalizing specific design strategies. However, this research will try to explore the potential for dealing with such issues from people's perceptions in order to inform the design and planning process. The value of designing smellscapes lies in the potential to improve the quality of spaces as well as increase individual interactions with spaces to create local identities.

This research attempts to fill some of the gaps revealed in the previous discussion as follows:

There is a demand for a framework to help understand people's perceptions of the smell environment and provide a means of describing smellscapes. As reviewed in Section 2.3.1, existing studies suggest the field (and the English language more generally) lacks a vocabulary for describing smells and smell-related experiences. Current approaches are limited to the description and classification of smells rather than the broader smell environment and people's experiences. The concept of smellscape includes smells and smell sources, the physical environment and impermanent conditions, perceivers' perceptions and context. A framework of people's perceptions of the smell environment is essential to help understand and interpret smellscape.

It is necessary to identify indicators of smellscape quality and set out criteria to assess smellscape quality. Section 2.3.2 reviewed current studies analysing the smell environment, and focusing on the quality of smellscape. However, like the description of smellscape, previous studies mainly focused on people's preferences for smells rather than considering smellscape as integrated into relations between the smell environment, perceivers' perceptions and the context. Although Henshaw (2013) compared smells and place between two sites based on how much people like, this

work still focused on preference rather than people's overall perceptions. Few studies have researched the criteria people use for evaluating smells to measure smellscape quality. In this sense, it is necessary to identify indicators influencing people's perceptions of smellscape and criteria for evaluating smellscape quality.

There is a need to explore smellscape within a specified functional public space in order to provide examples and guidance for planning and urban design practice.

Studies reviewed in Section 2.3.3 demonstrate methods of dealing with smells in the environment through masking, removal, diluting and separation. However, few studies or practical examples can be found of designing the smell environment or including smells in planning and design schemes. Most studies focus on illustrating and exploring the influences of smells on people's responses to the environment in a general sense rather than how to design them in specific contexts and real situations. Henshaw (2013) explored smellscapes in general urban spaces and suggested ways of designing smellscape with several tools and at different scale levels. However, such design suggestions are not explored in detail, such as responding to each scale level, the surrounding context and people's activities. This demands a study of smellscape in a specified public space, which can generate a detailed design framework with design components and methods at different scales to provide as an example and guidance for practice.

2.5 Conclusion

The diverse literature reviewed in this Chapter has illustrated the significance of smellscape in place-making and place-evaluation. Neurological studies explain the olfactory system and the connections between olfactory perceptions and emotions and memories. Studies in human geography have emphasised the influence of perceptions of smells on forming a sense of place and creating place-attachment. In studies from cultural and historical perspectives, perceptions of smells are influenced by and influence social and cultural identities; while, architectural and urban design studies suggest that smells influence evaluations of places and form distinct features of places.

The concept of smellscape has been reviewed and explained based on a definition used throughout this thesis: smellscape is the human perceived smell environment of a place within its context and influenced by the temporal conditions. Current approaches to exploring smellscape have been found to focus on three aspects: detection, description and classification of smells; analysis of smell environments; design and management of the smell environment. Three gaps have been identified in the current approaches that aim to generate a systematic method for exploring smellscape, from understanding to evaluation and design: a framework to understand and describe smellscape based on human perceptions; evaluation criteria for measuring smellscape quality; an example of exploring and studying smellscape in a specific functional public space. The gaps in existing studies have initiated the research questions of this thesis which have been outlined in the Introduction and are set out the research framework.

Developing from the discussions in this chapter, the next chapter discusses the theoretical basis, methodology and methods used to answer the three research questions.

Chapter 3: Methodology

3.1 Introduction

The last chapter reviewed existing studies of smell, smellscape and place-making, which provide a structure for conducting a smellscape study. It also identified gaps in the literature relating to establishing a systematic approach to explore smellscape from interpretation to evaluation and design. In responding to the gaps in theories for exploring smellscape, Section 3.2 of this Chapter sets out a theoretical framework from linguistic and environmental psychology perspectives. Section 3.3 provides a rationale of taking Grounded Theory as a methodological approach and the case study method as a research strategy. Section 3.4 reviews methods designed to collect data and Section 3.5 explains the methods applied to analyse the data collected to answer the research questions set out in the Introduction in relation to urban intermodal transit spaces: How can smellscape best be understood? How can the quality of smellscape be measured? How can a pleasant smellscape be designed?

3.2 Theoretical framework

As summarised in Chapter 2, there are three approaches to exploring smellscape: smell detection, description and classification; smellscape representation and analysis; smellscape planning and design. The understanding of smellscape has been mostly explored from human geographical and cultural perspectives, such as Classen et al. (2002), Porteous (1985) and Tuan (1975, 1977). Such work has delivered an understanding of smellscape from the points of view of context and cultural background and provided a qualitative analytic framework drawn from perspectives on human perception, place and environment combined with language descriptions. Emerging studies of smellscape are taken from architectural and urban design perspectives, such as Barbara and Perliss (2006), Balez (2010) and Henshaw (2013), intending to develop a general framework of designing smellscape to improve environmental qualities. Henshaw (2013) used a participatory smell walking method

and a 'liking' scale rating analysis to inform smellscape qualities in urban spaces. However, her study focuses on preferences of smells and places rather than the concept of smellscape. There is a lack of work to help understand, interpret and evaluate smellscape systematically, in order to guide smellscape design. Taking linguistic and environmental psychology perspectives, this Section constructs a theoretical framework for exploring smellscape drawing on language descriptions, human perceptions and smellscape qualities.

3.2.1 A linguistic perspective

This study takes language descriptions as sources to explore smellscapes in urban intermodal transit spaces by understanding meanings of people's descriptions and interpreting their perceptions of smellscape from their own explanations. Previous work on people's descriptions focuses on their perceptions of the environment and smell as such, rather than how they feel emotionally. The meanings of the words people use to describe a certain smell and their perceptions of the smellscape can be very different, which also affects the understanding of smellscape perceptions. Tuan (1991) highlighted that 'all narratives and explanatory contain at least interpretive and explanatory stratagems, for these are built into language itself'.

Speech has the power to connect people and place-making, and people's natural language speech delivers information about people's emotions and personality (Tuan 1991) describing how they think and feel. Language and the sensory-motor system share the same structure in the human brain, which interrelates language descriptions and sensory experiences (Gallese and Lakoff 2005). For example, a ringing phone is picked up based on previous experience of hearing the sounds of phones ringing and seeing the action of picking up a phone. In order to understand people's experiences of smellscape and the built environment, this study has drawn on people's narrative description. People's natural speaking language is also taken as a source of knowledge for interpreting smellscape and future smellscape improvement strategies.

Tuan (1991) argues people word and sentence with emotions and personalities which gives great visibility to the objects and places they describe. Such language

descriptions mediate between environment and human experiences. In other words, language is a communication and representation tool as well as an imaginative and mental force. People's narrative descriptions of their experience of smellscape in a place can provide data on their responses to both visual and olfactory cues in built environment, e.g. a lake can evoke words like 'watery', 'fresh', 'rainy smell' and 'grass'. A focus on people's natural language speech in this study provides an effective way to explore and understand the ambiguous and complex human experience of smellscape.

However, differing from previous humanistic studies of smellscape, this study focuses on the spatiality and interpretation of smellscape which engages smellscape with urban designs. From understanding how people interpret their experiences, this study explores smellscape designs based on the influence of smellscape on people's choices of using spaces. As explained in Chapter 2, smells have significant influences on people's emotions and memories of a place (Engen and Rose 1973). It is also argued that smells can cause avoidance and approach behaviour (Largey and Watson 1972) and social segregation in public spaces (Tan, 2013), which indicates an interrelationship between smellscape quality in a place and people's choice of using spaces. Smellscape in this sense is an important factor that affects the architectural and urban design of a place and people's behaviour within it. People's descriptions are suggested as useful for designers as an empirical aesthetics basis for evaluating the built environment (Craik 1973). Through people's descriptions of their perceptions and smell environment, detailed information about human emotional and behavioural settings in the space as well as direction to what makes a good quality smellscape and its physical environmental settings can be gained. However, designers often tend to communicate the kinds of smellscape they want to create through abstract visual information, e.g. sketches and diagrams, which need spoken language to help them fully explain the created visual information. This thesis sets out from this point to explore how, from in-depth understandings of people's natural language descriptions, smellscape is engaged with the typology of urban spaces, and the functions and structures of architectural spaces.

3.2.2 An environmental psychology perspective

Environmental psychology is a multidisciplinary approach to exploring the relationships between physical environmental variables and the actions, thoughts and feelings of human beings (Cassidy 2013). This suggests that differences in emotional descriptions reflect people's perceptions of environmental quality. Place and human perceptions, which form the smellscape concept, are also central parts of environmental psychology which not only provides insights into environmental problem solutions, but also develops an understanding of the dual interactions between humans and the environment (ibid). Sensory environmental quality is an important approach in environmental psychology studies (Merhrabian and Russel 1974), including smellscape. As the perceived human smell environment, smellscapes are affected by people's psychological reactions of smells in a place and influencing people's emotions and behaviour and so the mutual influences between human perceptions and smell environments can be studied from an environmental psychology perspective.

Focused on language descriptors, Mehrabian and Russel's (1974) approach provides a way to measure environmental qualities and people's experiences in the environment through understanding the semantic differences in people's words descriptions. This approach is built upon emotion theory developed by Lang (1969), which suggests that people's descriptors indicate their emotional reactions and perceptions of surrounding physical environmental settings. These emotional reactions can be divided into three systems: affective, physiological reactivity, and behavioural acts (Lang 1969), which are interrelated to indicate the overall environmental quality. Drawing on this work, Merhrabian and Russel (1974) showed that emotional reactions can be used to measure people's perceptions of environmental qualities from which the authors developed a way to measure people's emotional reactions by scale ratings of bipolar emotional descriptors, e.g. happy-unhappy, controlling-controlled, excited-calm (Merhrabian and Russel 1974). From empirical work, they derived the most relevant pairs of bipolar emotional descriptors from Lang's (1969) work and categorized them into three dimensions: pleasure, arousal, and dominance, responding to the three

emotional systems. Drawing on the work of Mehrabian and Russell (1974), the three dimensions of the concept of smellscape are explored as follows:

- **Pleasure** is a state of feeling reflecting on the hedonic degrees of perceivers in the smell environment, which is different from preference and positive reinforcement;
- **Arousal** is a state of feeling which involves perceivers' neurological reactions to the smell environment in the brain, varying along a single dimension ranging from sleep to frantic excitement (ibid: 18) and is associated with personal experiences and memories;
- **Dominance** is a state of feeling reflecting to what extent perceivers feel free or restricted to act in a variety of ways (ibid: 19), which is much influenced by the physical settings of the smell environment.

They used quantitative questionnaire to identify most relevant pairs of bipolar descriptors for the three dimensions and made assumptions of relevant behaviour and meanings. These bipolar descriptors were then made into a survey with a seven-point rating scale to measure people's level of agreement of each pair of bipolar descriptors. Analysis of quantitative data collected from scale ratings, predominant indicators of pleasure, arousal, and dominance then can be derived to demonstrate the quality of environment. This provides a theoretical perspective using language as a resource to measure smellscape quality along the three emotional dimensions.

Mehrabian and Russell (1974) took a deductive approach and used quantitative questionnaires to find correlations between descriptors and the three dimensions, asking participants to evaluate and choose from a given list of words. However, this assumes that all participants understand the words in the same way and use such descriptors of their perceptions in real situations, which may not be true with smellscape focused on individual experiences and thinking. It would be necessary to have an inductive approach to derive smellscape descriptors from understanding people's experiences and their own descriptions.

3.2.3 A summary of the theoretic perspective

As discussed in Chapter 2, there is a lack of knowledge framing smellscape studies with in-depth interpretations of meanings of people’s descriptions, criteria and method to evaluate smellscape qualities. The language-focused environmental psychology approach reviewed in Section 3.3.2 can help build a theoretical framework that combines in-depth understanding of people’s perceptions and evaluations of smellscape with urban design strategies.

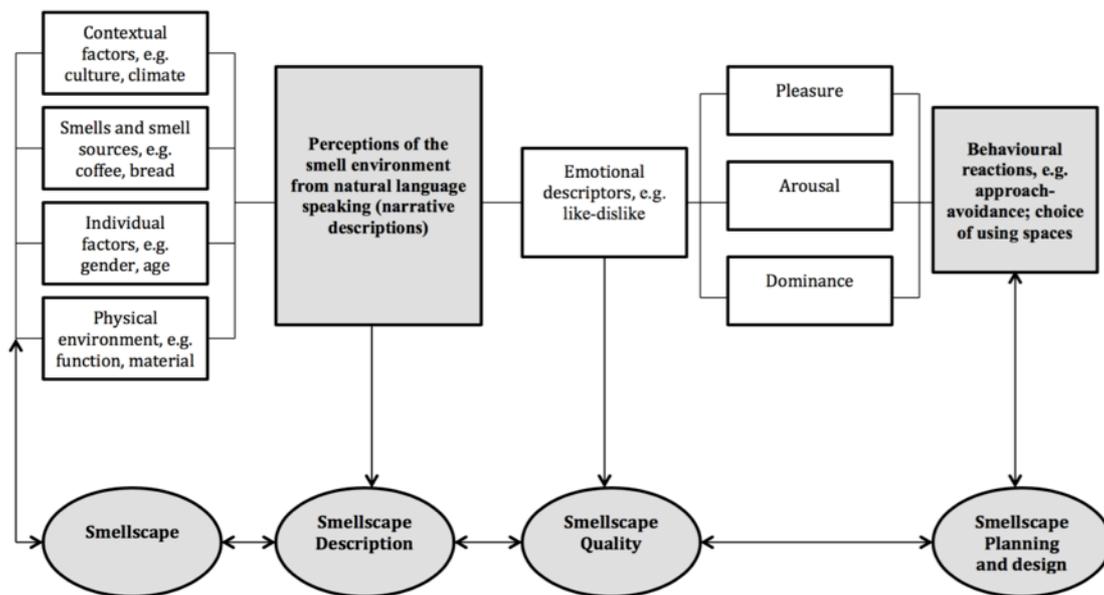


Figure 3.1 Theoretical framework of this study from a linguistic/ environmental psychology perspective

The interrelationship between environment, perceptions and behaviour constructed in the environmental psychology approach suggests smellscape design decision-making should concern people’s perceptions and evaluations of existing smellscape and their behavioural responses, as illustrated in Figure 3.1. People’s descriptions of scapes, i.e. physical environment, smells and smell sources, personal experiences, contextual elements, are sources for deriving emotional descriptors to measure smellscape quality. The three emotional states, i.e. pleasure, arousal, and dominance, are particularly explored and explained within the smellscape concept. Rather than making assumptions about relevant behaviour and meanings of

descriptors given by people, this study explores meanings and rationales behind people's descriptions of perceived smell environments and derives emotional descriptors that fit both the smellscape studies and can also be easily understood by the general public. Smellscape design and planning decision-making will be based on understanding and evaluating existing smellscapes, which can lead to behavioural influence. The process of interpreting people's descriptions will also work as an analytical process to generate a design framework through identifying key components of smellscapes and indicators of smellscape evaluations in urban intermodal transit spaces.

3.3 Methodological approach

After setting out a theoretical framework from a linguistic / environmental psychology perspective, this Section discusses the rationale for the selected methodological approach. Focused on interpreting people's language descriptions, this study is situated in the field of qualitative research. Within this, Grounded Theory is taken as both a methodological and an analytical approach to conduct this empirical exploratory investigation of environmental designs responding to human sensory demands.

3.3.1 A qualitative approach

The conceptual framework identifies this study of using language as a data source to explore smellscapes in urban intermodal transit spaces, based on which the thesis attempts to produce smellscape planning and design strategies in such spaces drawing on understand and interpretations of people's sensory experiences and perceptions. A qualitative research approach can help develop an in-depth understanding of the research issue from people's subjective descriptions, closely related to the participants' culture and the living context (Hennink et al. 2010; Patton 1990). It is widely used in understanding people's experiences (Clifton and Handy 2001), and in exploring the meanings of their interpretations (Wagenaar 2011); and is recognized as useful for exploring new fields and understanding complex issues. Perception of smellscape, as explained in Chapter 2, is a complex physiological, psychological and

mental process, which requires this study to have an in-depth understanding of people's perceptions of the smell environment in urban intermodal transit spaces. Qualitative research is most usually conducted through a specific set of research methods, such as "in-depth interviews, focus group discussions, observation, content analysis, visual methods, and life histories or biographies" (Hennink et al. 2010: 9), which aims to gain a contextual understanding of the details and complexity of the research topic. The intention of exploring smellscape from people's language descriptions requires this study to take a qualitative approach to interpreting smellscapes.

Qualitative research allows the researcher to generate theoretical concepts from the participants' views, and understand the meanings that they give to their behaviour and descriptions (Hennink et al. 2010). Compared to quantitative studies, the qualitative approach emphasizes the richness of data from a small group of respondents to explore the complexity of the proposed field, and aims to collect details of the participants' experience, living context and their attitudes of the research topic rather than overall patterns and trends. It does not aim to make empirical generalisations from the analysis of the small sample to the larger population, but can make theoretical generalisations in the explanation of the specific topic of the research (Mason 2002). Smellscape varies between individuals and contexts, making it difficult, or actually unnecessary, to make empirical generalisations to be applied to a wider population. The emphasis on the exploration of meanings behind people's descriptions and indicators influencing smellscapes in this study aims to generate a theoretical framework to understand smellscape and inform future design strategies.

The validity of qualitative generalisation lies in the rigor of both the research design and analysis that requires the researcher to be clear about the argument, and be strategic throughout the whole process (Mason 2002). The re-stated research questions in Section 3.2 and theoretical framework in this Section give a rationale for taking a qualitative approach and methodological strategies. The methods of collecting and analysing data are designed around the conceptual framework and smellscape concept, explained in the following sections. By using a qualitative approach, this study develops smellscape design strategies from an in-depth understanding of people's language interpretations of smellscape.

3.3.2 Grounded Theory as a methodological approach

This study applied Grounded Theory as a methodological and analytic approach. Emerging in 1967, Grounded Theory was developed as an inductive qualitative research methodological approach to investigate social facts without a pre-conceived hypothesis (Glaser and Strauss 2009). This inductive approach encourages researchers to explore a field without pre-formed predictions and draw their conceptual categories and models from detailed interpretations of raw data. This challenges the argument from quantitative researchers that qualitative research is unsystematic, anecdotal and impressionistic (Charmaz 2006). It differs from normal qualitative research, in that Grounded Theory offers a systematic strategy to investigate participants' main concerns and examine how they intend to resolve them without making theoretical assumptions or normative judgements from preconceived ideas. Grounded Theory provides an inductive methodological approach to explore a process for designing smellscape based on an in-depth understanding of people's experiences.

Grounded Theory suggests that researchers should have no preconceived ideas about the research and should stay open to emerging concepts from data (Charmaz 2006; Glaser and Strauss 2009), and this provides a way to explore smellscape and formulate a hypothesis or theory to explain and design smellscape. However, there are some debates around 'the preconceived knowledge brought by the researcher' since the introduction of the Grounded Theory. Clarke (2007) argues that researchers and participants always have preconceived knowledge, whilst how they conduct their research and what they find from their research are not given. Charmaz (2006, 2014) also argues for the relativity and subjectivity brought by researchers in the Grounded Theory approach and suggests research of this approach is 'constructed' rather than 'discovered'.

This thesis started with a literature review of the smellscape concept and existing approaches to smellscape. Rather than fitting into one of the existing approaches, this chapter sets out a theoretical framework that takes a linguistic and environmental psychology perspective to the study of smellscape. In this case, the researcher has

conducted this study with an understanding of the smellscape concept as the human perceived smell environment of a place within its context, which defines its research realm. However, taking a new perspective to explore smellscape leaves the research with an open question and unexplored knowledge of the smellscape in urban intermodal transit spaces. This then allows an opportunity for taking a Grounded Theory approach to construct a theory of understanding, evaluating and designing smellscape. During the process, the researcher stayed open to emerging concepts and reflected on her actions and decisions all the time to ensure the validity of this study.

As an analytical approach, Grounded Theory provides ‘a close fit with the data, usefulness, conceptual density, durability over time, modifiability and explanatory power’ (Charmaz 2006: 6). This is partly because of the theoretical sampling, which requires researchers seek for participants from emerged categories in previous interviews to elaborate and refine categories to develop emerging theory. The sampling process in this case is parallel with the data collection process, which indicates an analytical process already during the sampling and data collection stage. The sampling stops when there no new properties of defined categories emerge in further interviews. The data analysis method in Grounded Theory is called ‘constant comparative analysis’, which offers a general strategic method for analysing qualitative data through constant comparisons between emerged categories and concepts combined with memo-writing to reflect the thought procedure of the analyst (Glaser and Strauss 2009). It requires the researcher to compare between different categories and properties of each category generated from the data as well as remain open to any new properties emerging (Charmaz 2006). As will be discussed in the following chapters, this analytical approach helps this study to map out the internal and external relations of perceptions, smell environment and the context, and to then systematically formulate a theory for understanding, evaluating and designing smellscape in urban inter-modal transit spaces from a smaller set of higher-level concepts in smellscape perception process.

3.4 Case studies

As explained in the Introduction, this study explores smellscape in the specific context of urban intermodal transit spaces. A case study method is chosen to provide a real-life situation for details of people's experiences of the smell environment in target spaces. This Section discusses the rationale for using a case study method and the selection of two cases.

3.4.1 The case study method

Adopting Grounded Theory as a methodological and analytical approach, this study takes a case study method as a strategy to explore smellscape through people's experiences in real-life situations. A case study can be used to 'investigate a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident' (Yin 2009: 13). Smellscape, influenced by many unpredictable temporary factors such as weather, wind and traffic, needs to be understood within its social and physical contexts (Classen et al. 2002; Henshaw, 2013). Taking a case study method, this research is able to understand how physical elements and temporary conditions in real situations influence the overall smell environment and people's perceptions in urban intermodal transit spaces.

Yin (2009) also suggests using a case study method that makes use of observations, interviews and documents to get a full understanding of a complex social phenomenon. This thesis studies two typical cases to understand how people perceive and describe smellscape, and to identify indicators influencing smellscape qualities in urban intermodal transit spaces in two places, Sheffield and Wuhan. With a Grounded Theory approach, this study generates a framework to interpret, evaluate and design smellscape in urban intermodal transit spaces through analysis of the studied cases.

3.4.2 The selection of cases

- Why a cross-cultural study?

This study chose two cases of urban intermodal transit spaces, one in a (global) Eastern context – China - and the other in a (global) Western context- UK - to address a gap in research on the international dimensions of understanding and designing smellscape in target spaces. As a result of globalization, cities are becoming multicultural places, combining multiple features of different countries (Sassen 1999). Flows of international planning and design ideas now influence traditional norms in both Western and Eastern countries, aiming to attract international tourists and satisfy the increasingly internationalised population (Sanyal 2005). For example, Henshaw (2013: 100) found that ‘Manchester Chinatown’s sensory landscape is promoted by the city authorities with the aim of attracting visitors into the city’. Such changes in urban planning and design cultures also influence the social and physical settings of places, which leads to inquiries into cross-cultural knowledge of place-making and human perceptions.

Influenced by geographical and social differences, significant variations in smellscape are found between West and East, industrialised and non-industrialised countries, e.g. India, Africa, America, Russia and Britain (Classen et al. 2002; Manalansan 2006). Smellscape in international districts have given rise to contrasting opinions of environmental qualities from different ethnic groups (Henshaw 2013), which suggest the need for particular considerations of smellscape from an international perspective in urban planning and design process. A cross-cultural study allows further investigation and enhancement of existing knowledge in understanding experiences, perceptions and the design of smellscape within different international contexts in order to develop more informed smellscape design strategies for the future.

Meanwhile, as Classen et al. (2002) argues, smell vocabularies differ among different languages, and there are likely to be significant differences between a European language and non-European language. However, the most recent and notable studies of smell, culture and places are written in English and have explored Western contexts (e.g. Classen, et al., 2002; Drobnick, 2006; Henshaw, 2013), while few studies in this field are found in Chinese contexts and language. Taking people’s natural speech language as sources of knowledge, this study can provide extra

knowledge of smellscape vocabularies and descriptions in two countries through comparisons of languages used to describe smellscape. Grounded Theory enables a focus on the interviewees' meanings of their descriptions and their own interpretations, seeing the nature of smellscape as a human centralised concept. Being open to people's language descriptions in this methodology also maximised the opportunity to learn and construct a descriptive framework of smellscape.

- Why the selected two cases?

Yin (2009) suggests that a single case study can be used when the case study may represent a typical example of many other cases, such as a typical urban district. This study selected one typical example of an urban intermodal transit space in each country to draw out understandings of the ways in which smellscape is conceived and produced in the UK and China: Sheffield Railway Station and Bus Interchange in Sheffield, UK; and Wuchang Railway Transit Centre in Wuhan, China.

There are over 2500 railway stations in the UK and within the major cities, only a small proportion of those situated outside London are designed as integrated intermodal transit centres (i.e. multi-purpose single buildings). Therefore, dispersed intermodal transit networks are more representative of intermodal transit spaces in the UK. Being a dispersed intermodal transit network as discussed in Section 1.2, Sheffield Railway Station and Bus Interchange is a typical example of intermodal transit spaces in the UK. More detailed information of the environment onsite will be discussed in section 4.2. The Sheffield Railway Station and Bus Interchange are located in Sheffield city centre, forming dispersed transit spaces mixed with other urban spaces in this area such as public square, university space, residential area, main transport road, etc. The built forms vary from open outdoor places to enclosed spaces, including: the Sheffield railway station, Sheffield bus interchange, station tram stop, onsite taxi rank, Sheaf Square and onsite parking space. Within the railway station and bus interchange, there are shops, cafes, toilets and other facilities to provide service to passengers.

Unlike intermodal transit system development in the UK, a model of designing urban intermodal transit spaces as urban complexes has been widely applied to building new

stations and redeveloping old stations in order to achieve efficient land use and meet commercial purposes. The Wuchang Railway Transit Centre is a typical example of an integrated urban intermodal transit centre providing a variety of vertical functional spaces inside the station building for its users. It is located in the central area of Wuchang district in the city of Wuhan, China.

Given its central geographical location in the country, Wuchang Railway Station has been one of the busiest stations national-wide since it was built in 1957. This railway station has been regenerated as an urban intermodal transit centre in 2008, providing various vertical functional spaces inside the station building, including: railway station, underground station, a external and internal bus station, a external and internal taxi centre, West square, East square, shops, restaurants, public toilets, cheap hotels and police stands. More detailed information of the physical environment onsite will be presented in section 4.3.

- Are they comparable?

From the city scope, Sheffield and Wuhan are both inland metropolitan cities in the UK and China. Sheffield has a population of 563,749 with an urban area of 640,720 km². Wuhan has a population of 10,607,700 with an urban area of 8,494.41 km². They are at the similar scale compared to their own country sizes. Historically and politically, Sheffield and Wuhan are important nodes in the national public transport network, linking the northern and southern parts as well as the eastern and western parts within each country. The two cases are both regeneration projects, developed on the original site of the previous station buildings whilst in the central urban area. Such situations may lead to potential limits of urban planning and architectural designs to achieve a pleasant smellscape. More geographical information, i.e. climate and weather data of two cities, can be found in Appendix 2.

Meanwhile, both Sheffield and the Wuchang model provide various but similar functions to meet people's demands within intermodal transit spaces. Although the selected two cases have different built forms, contexts and users, and a comparative perspective can help discover new findings (Lijphart 1975). In particular, the contrast between the contexts of the two cases can help generate knowledge about

international understandings of the smellscape concept, producing new observations of potential use and influence for urban planning policies and design strategies in both countries. Meanwhile, the consistent comparative analysis method in the Grounded Theory allows this study consistently and equally compare concepts and categories identified in the two cases in order to answer the research questions.

3.5 Data collection

The data collection process was the same in both cases: it started with an initial investigation of the physical environment onsite through observations taken while walking. The initial stage was to generate an initial smell walking route and interview questions that fitted with the research objectives and overall questions. With initial route and questions worked out, a pilot walk was conducted with a participant to test the route and questions, which then helped refine the route and questions for data collection. There were three methods used to collect data: onsite observation, smell walking and semi-structured interviews.

3.5.1 Onsite observation

Observation can be used as a stand-alone method, but it is also useful for complementing other methods of data collection. By combining observation with interviews you gain a different perspective on the issues, the situation and the behaviour within a larger social or physical setting. Observation can also be useful to clarify unclear findings from other data sources in a study. (Hennink, et al., 2010: 173)

Observation is often used in fieldwork to gain knowledge of the real-life situation and understanding of people's behaviour. There are two ways of undertaking observations in qualitative research: non-participant observation and participant observation (Hennink et al. 2010). The difference between direct (non-participant) observation and participant observation is that the former aims to avoid interfering with participants influencing their actions (Gobo 2011). The selection of observation type

is determined by the interest and aim of conducting an observation (Mason 2002). As explained in Chapter 2, people's smellscape perception is highly influenced by physical settings. Conducted with the intention of obtaining an overview of the contextual environmental settings, such as building materials, area functions, locations, time and weather whilst undertaking fieldwork, the observation carried out in this research is non-participant observation. The physical settings of the studied cases, involving spatial forms, facilities and people's behaviours, are recorded and represented through the use of photos and notes from the observations. By recording the physical settings of the fieldwork, the resulting insights can be used to design the smell walking route and supplement understanding of the data gained from the interviews. Meanwhile, observation can also draw information from online sources, such as the plan of the station building and the map of selected cases.

3.5.2 Smell walking

Smell-walking used in this study is a method of engaged walking using observations and interviews to collect data, reflecting people's in-situ perceptions of the smellscape. The method of walking has been frequently used to explore people's sensory experiences in urban spaces, which can help gain detailed and immediate responses of people's actual experiences and feelings of the surrounding environment to increase the validity of data (Degen and Rose 2012). This is because people can report immediately of their actual experiences and feelings of the surrounding environment. This method has a theoretical basis in social theories, such as Simmel (1903) and Lefebvre (1991), where cities are argued to be experienced through sensory experiences and mental reactions, both of which are generated by movements of our sensorial bodies in spaces. At the same time, walking is an essential and main transport mode of users within urban intermodal transit spaces, which makes the smell walking method appropriate for exploring users' experiences.

Henshaw (2013: 49) suggests smell walking should be conducted along a designed route with several stopping points for interviews and other activities. Informed by her work, the smell walking in this study involves semi-structured interviews at each stop and a 'pleasantness' rating at the end. Smell walking routes in two cases are both

designed from initial observations onsite and a pilot walk with considerations of the variety of smellscape, timing, length, access, security, shelter, and so on, explained in detail in Chapter 4.

3.5.3 Semi-structured interviews

The semi-structured interview method was chosen in the study to meet the criteria of Grounded Theory research, aiming at an in-depth exploration of smellscape and eliciting participants' interpretations of their experiences of the smell environment in studied cases. Semi-structured interview questions need to be open ended to stimulate detailed discussion of the research topic, and help gain new insights into the existing knowledge (Charmaz 2006). The researcher conducting the interview needs to make constant reflections on what the participants have said to encourage them to give details and further explanations. As the interview proceeds, questions can be more focused and detailed to get the explicit meanings of participants' descriptions. Interviews in this study were conducted during smell-walking at different stops. During interviews, the researcher asked sub-questions about 'what?' and 'why?' to encourage participants give detailed explanations of their descriptions. Each interview was recorded with a hand-held voice recorder and transcribed afterwards.

Participants

Following the theoretical sampling, the sampling process in this study started with an initial sampling to address on the established research questions. However, the sampling criteria changed to respond to emerged categories throughout the process, which is not aimed for representing a population and statistical generalization (Charmaz 2014: 197-200). When the conceptions or categories are fully explored, the collection of data is completed and the sampling stops. Generally, two types of participant were recruited: the general public and built environmental professionals. The built environmental professionals were approached to provide additional suggestions on smellscape design strategies. Smellwalking in the Wuchang case involved 21 participants, including 11 people from the general public and 10 built environmental professionals. In Sheffield case, there were 19 participants involved in

the smellwalking, including 10 people from the general public and 9 built environmental professionals. In both cases, the sampling process started with approaching people onsite and then snow balling through the people interviewed whilst the built professionals are approached through my own professional network. Initial analysis of interview through reflections after each interview was made along the interview process. The sampling process stopped when emerging categories from the initial analysis became saturated.

Characteristics of participants in both cases are illustrated in Table 3.1. Meanwhile, saturating the data, each case involved an extra interview off site with one professional who participated the redevelopment of the project. They were coded as S20 and W22. More details of participants' profiles can be found in Appendix 3.

Wuchang Railway Transit Centre		Sheffield Railway Station and Bus Interchange	
Age	No.	Age	No.
18-29	14	18-29	7
30-39	3	30-39	7
40-49	3	40-49	2
50-59	1	50-59	3
Gender		Gender	
Male	12	Male	10
Female	9	Female	9
Residence		Residence	
Resident	19	Resident	15
Traveller	3	Traveller	4
Background		Background	
Architecture	5	Architecture	5
Planning	2	Planning	2
Landscape	2	Landscape	1
Environmental management	1	Environmental management	1
General public	11	General public	10
Smoking		Smoking	
Yes	5	Yes	4
No	16	No	15
Able to smell		Able to smell	
Yes	21	Yes	19
No	0	No	0
Hay fever		Hay fever	
Yes	3	Yes	4
No	18	No	15

Table 3.1 Characteristics of participants in smell-walking

Interview questions

The interview questions were designed around people's perceptions of smellscape and of the overall environment in intermodal transit spaces, as illustrated in Box 3.1. The same questions were asked at each stop along the smell-walking route in both cases, with additional questions asked before and after the walk. Further additional questions were asked of environmental professionals to explore suggestions for smellscape planning and design in urban intermodal transit spaces. Interview questions in the Wuchang case were translated by the researcher from English and asked in Chinese while remaining open-ended, enabling the same meanings as questions asked in English in the Sheffield case.

<p>Questions before walk</p> <ul style="list-style-type: none"> • Do you have any favourite smells in the city? • Are there any smells you dislike in the city? • Do you often come to the station? <p>Translation:</p> <ul style="list-style-type: none"> • 您在城市里面最喜欢的气味是什么？ • 您在城市里面最讨厌的气味是什么？ • 您经常来火车站或者汽车站吗？ <p>Questions at each stop</p> <ul style="list-style-type: none"> • Do you find any smells in this space? • How pleasant is this smell environment? • How about the overall environment here? <p>Translation:</p> <ul style="list-style-type: none"> • 您有闻到什么气味吗？ • 您觉得这里的嗅觉环境舒适吗？ • 您觉得这里的总体环境怎么样？ <p>After-walk questions (for participants from the general public)</p> <ul style="list-style-type: none"> • How do you describe the overall smell environment through our walk today? • What kind of smell environment you would prefer to have in such space? • Do you have anything else to share with me about smells and intermodal transit spaces? <p>Translation:</p> <ul style="list-style-type: none"> • 您觉得这里的整体的嗅觉环境怎么样呢？ • 在这种交通空间里，什么样的嗅觉环境你会觉得舒适呢？ • 您还有什么希望跟我分享的吗？ <p>After-walk questions (for participants from architecture, planning, landscape, environment management)</p> <ul style="list-style-type: none"> • Do you think the design/planning/management of this intermodal transit space has given any considerations of smell pleasantness? • Do you think other sensory pleasantness has been considered? • Do you have any suggestions for designing better smellscape in intermodal transit spaces? • Do you know any legislations and practices that has accommodated smell environment? • Do you have anything else to share with me about smellscape design? <p>Translation:</p> <ul style="list-style-type: none"> • 您觉得这里的设计管理或者规划有考虑过嗅觉环境吗？ • 您觉得有考虑其他的感官因素吗？ • 您有什么建议来改善这里的嗅觉环境呢？ • 据您所知，有建筑条例或者是设计实例考虑过嗅觉舒适度吗？ • 关于嗅觉环境设计，您还有什么想要分享的吗？

Box 3.1 Interview questions for semi-structured interviews

3.5.4 Smellscape pleasantness scale rating

In addition to smell walking and interviews, this study used a scale rating to measure people's subjective evaluations of smellscape and the built environment. According to Henshaw (2013, p52), this method can enrich their reflection of the situational perception of smellscape and places. Participants were asked to rate the smellscape pleasantness at each stop on a seven-point scale from 1 (very pleasant) to 7 (very unpleasant). More detailed questions were asked after smell-walking, enquiring into the reasons for the given values to improve the accuracy of the findings.

3.6 Data analysis

The Grounded Theory not only provide methodological insights, but also a systematic analysis process and methods to analyse qualitative data collected, i.e. coding, memo writing and sorting, as will be explained in Section 3.6.1. Meanwhile, the quantitative data from the scale ratings of smellscape pleasantness at each stop has been transformed into graphical information to help further analysis of the qualitative data, as will be explained in Section 3.6.2.

3.6.1 Qualitative data

There are two types of qualitative data collected in this study: observation notes with photos, and interview recordings. The observation notes and photos were transformed into charts and diagrams to supplement information of physical environment onsite during the data collection period. The interview recordings were transcribed and then analysed through a comparative analysis process with methods drawing on a Grounded Theory approach. Constant comparative analysis consists of initial coding, focused coding, memo writing, theoretic sampling, situating and sorting, and theorising (Glaser and Strauss 2009). Figure 3.2 illustrates the analysis process applied in this study with two cases, following the constant comparative analysis process.

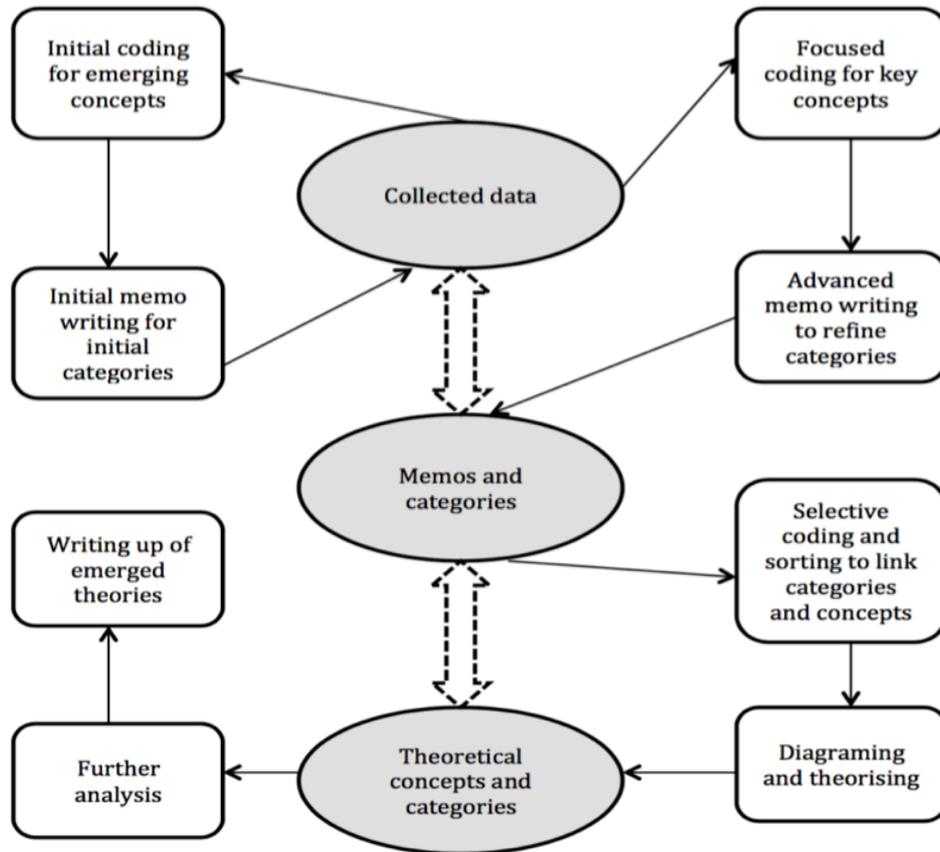


Figure 3.2 Interview data analysis process followed in this study (derived from Charmaz, 2006)

Theoretical sampling, situating, sorting and theorising

The theoretical sampling and situating has been discussed when explaining recruited participants. As Charmaz (2006: 107) suggests, theoretical sampling is ‘a strategy to narrow the focus on emerging categories and a technique to develop and define them’, which helps the researcher fulfil categories and clarify relationships between them. In this study, with research questions of how to understand and design smellscape in urban intermodal transit spaces in mind, I started with an initial sampling of users of selected case and environmental professionals. I followed cues of emerged categories describing the smell environment, people’s feelings and suggestions for designing smellscape, various backgrounds of participants were recruited until no new properties of categories emerge, including the general public onsite from different ages and professionals from built environment backgrounds in architecture, planning, landscape and environment management. Knowing the fact that gender has significant

influences on people's smell preferences, I also kept a gender balance among participants. Categories were identified through sorting the emerged concepts and sketching out their interrelationships. I have generated five generated five categories for comparisons and theorising: types of smells and smell sources; components of physical environment; perception patterns; indicators of smellscape pleasantness; and design components at three levels. Through further analysis by advanced coding and memo-writing, this study developed a perceptual process linking the first three components which then leads to smellscape pleasantness evaluation and a design framework responding the last two themes.

Coding

Unlike general qualitative coding methods, coding in this method repeats at different stages and interacts with memo writing (Charmaz, 2006). This study used line-by-line coding in the initial coding to gain insights into participants' attitudes and experiences and help establish some analytic directions for the subsequent focused coding. The study developed focused codes for further analysis by summarizing the most significant and frequent initial codes. Codes in this study are mixed with the comprehensive codes⁴ and In-Vivo codes⁵ to understand participants' perceptions of the surrounding smell environment as well as keep their own words and the original meanings. In particular, In-Vivo codes are used with a purpose of summarising smells and descriptors people used in the studied cases. An example of coding applied in this study is shown in Box 3.2. Data collected in the WRTC were transcribed and coded in Chinese. All memos were written in English, with included Chinese data translated in English, as shown in Box 3.3.

⁴ Comprehensive codes are phrases and words used to summarise meanings of sentences spoken by interviewees

⁵ In-vivo codes are meaningful and particular phrases and words spoken by interviewees, i.e. words from dialect.

S01 Interview excerpt at Stop 3: Sheffield Railway Station Concourse	Initial codes
<p>J: Do you find any smells in the concourse?</p> <p>P: It is very different since we walk into the station. But as soon as we are in the station I got the smell of food. And there seems a lot warmer air. I'd say this smell environment is slightly positive to me. Coz I can smell food which is nice to me.</p> <p>J: Any dominant smells?</p> <p>P: Yeah, as soon as we walked in here, there is a general smell of food. I can't identify what exactly it was, but I can sense it's a general food smell that you can find every day.</p> <p>J: How pleasant is this smell environment?</p> <p>P: Yeah, I like the food smell. It is definitely positive.</p> <p>J: What makes you think it positive?</p> <p>P: En, I think the food smell is quite appropriate in this space. I think people want the place to smell as clean as well, like in the bus station. I guess it wouldn't smell clean if the food smell is overriding that.</p> <p>J: How is the overall environment?</p> <p>P: Uh, it makes me feel very welcoming, familiar. It is definitely pleasant overall.</p> <p>J: What makes you feel pleasant?</p> <p>P: Uh, I guess this it more familiar with me. I haven't been to the bus station before. But I am very familiar with the train station. I come here every week. So, I think this is definitely more pleasant to me. I think it is because the combination of smell of food and familiarity makes me think so.</p> <p>J: Are there any other aspects in this space influencing your experiences?</p> <p>P: Not that I am aware of. No.</p> <p>J: Thanks. Let's move on to the platform.</p>	<p>Transitional space Aware of change, food smell, Warm air Positive , Personalising</p> <p>Dominant food smell Mixed, can't identify Familiar, everyday</p> <p>Food smell, positive</p> <p>Appropriate Cleanness, Associating, Overpowering/intensity</p> <p>Familiar, welcoming Overall pleasant</p> <p>Familiar Comparing Frequent visits, pleasant Personalising</p> <p>Not aware of</p>

Box 3.2 An example of initial coding in analysis process of data collected in Sheffield

Memo writing

Constant comparative analysis is an iterative process between coding and memo writing, which gradually leads to the creation of new theories. Along with coding, memo writing is the first step in analysing the data through informal analytic notes (Charmaz 2006). It encourages the researcher to analyse data and codes as well as making comparisons and connections between thoughts. As with the coding process, there are also two stages of memo writing: early memo writing and advanced memo writing. Early memos are direct reflections of the process by analysing how the participants think and feel as well as the reasons and consequences of their descriptions, as shown in an example illustrated in Box 3.3. Advanced memos help to

categorize data and make comparisons between initial categories and concepts. Through advanced memo writing, the analytic categories are generated to construct emerging theories in the later stage.

Memo – A perceptual process from ‘Nothing’ to ‘I can smell’

When I started to construct my study, I used people’s language descriptions as source of knowledge to understand their perceptions of the smell environment in two cases. After conducting several observations onsite, I adopt the simple logic of learning from ‘what is it?’ to ‘how do I like it to design my questions?’. So whenever I lead my participant into a space, I will ask two general questions first: Do you find any smells in this space? How pleasant is this smell environment? When coding my interviews, some codes emerged repetitively when people answer the first question, which seems to reveal people’s perceptual process of the smell environment when entering a space. Generally, there are two types of responses to the question: Do you find any smells in this space?

Response 1: ‘no’, ‘nothing really’ or ‘nothing particular’

People answer this question usually without a second thought. They gave their immediate reactions towards the smell environment in a space. There are usually two kinds of responses: no/not really/nothing particular; I can smell ... What do they mean by ‘no’, ‘nothing really’ or ‘nothing particular’? For example, responses in the WRTC are found:

‘基本上没有什么味吧，就是空气比较混浊，但是没有突出的味道。Almost nothing. The air is a bit mixed and not so fresh. But, I didn’t find any dominant smell.’ W02

‘好像没有什么味。就比较接近正常的城市路边的空气的味道吧。Nothing particular. It is close to the smell of air on a normal urban street.’ (W06)

‘好像没有闻到什么气味。我感觉没有什么异味。没有闻到能引起不好的心理感受的气味。Not really. There is nothing smelt strange to make me feel uncomfortable.’ WP05

In most cases, people won’t give a definite ‘No’. It is more often that people say ‘not really/nothing particular’ rather than ‘no’. From their descriptions, ‘not really/nothing particular’ probably mean there is nothing that smells too bad/good or strong or different from their expectations to cause their attentions in the first place. Most of the time, when they say ‘not really/nothing particular’, they are surrounded by ‘background smells’: normal, light and mixed. How about responses in the SRTN? For example:

‘No. Nothing particularly. It’s just the air coming through. I can smell the perfume from people, it is not unpleasant, it is just a hint, not that strong.’ S06

‘Nothing particular, there is nothing like or dislike of this space in my head. It is very neutral. I think the weather is also a contributing aspect to the smell environment, because if it is in summer, it is easier for you to detect more smells. But now, it is winter, it is just neutral.’ S16

Why do people take such smells as ‘not really/nothing particular’? It is argued that people experience a process involving adaptation, fatigue and habituation when encountering repeated smells (Naus, 1984; H. R. Schiffman, 1990). This process may result in less sensitivity to noticing such smells (Henshaw, 2013). People are exposed to the background smells in their living environment on a day-by-day basis. If there is no significant change of smells from one space to another, they will rarely pay attention to these background smells. Or in their terms, they think such smells as too ‘normal’ to

be noticed. Participant S13 commented: ‘if you don’t ask me, I won’t pay much attention to the smellscape’. When asked whether they detected any smells, people turned to find things ‘abnormal (strange, against their expectations)’. If there isn’t any smell that matches their criteria, they will comment as ‘no/not really/nothing particular’. It would be necessary to find out what makes people feel ‘abnormal’ to attract their attention to the smell environment.

Response 2: ‘I can smell...’

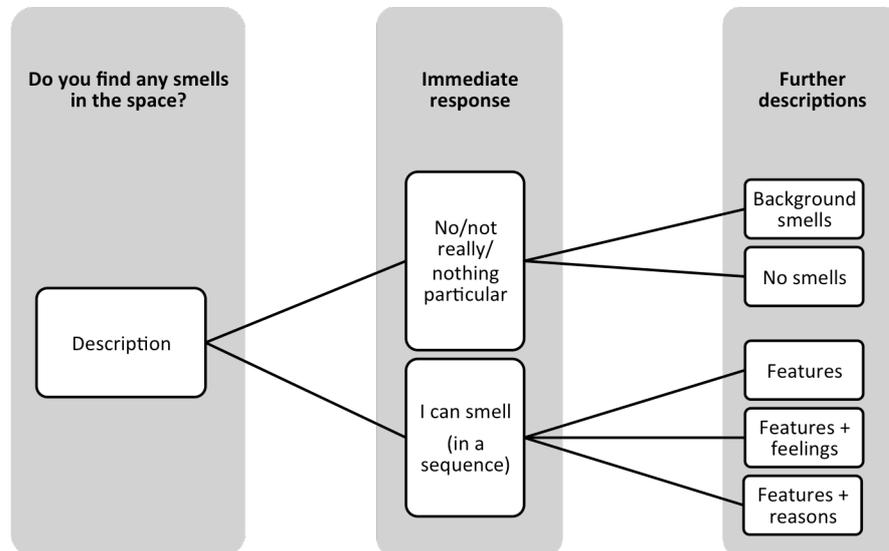


Figure 1 Description of the for process indicating a perceptual process of smellscape

When people found ‘abnormal’ or ‘attracting’ smells, they will respond ‘I can smell...’ which often follows a description of smells. In particular, when the smell environment is more complex, I find that people often describe smells in a sequence, either from the most notable ones to the less notable ones or from the first perceived ones to the last perceived ones. For example, people describe detected smells in the WRTC, at the internal taxi centre:

‘有很浓的汽油味，还有一些尾气排放的味。空气比较混浊，不新鲜，氧气含量太少。I can smell very strong smell of petrol and some exhaust fumes from cars. The air quality is not good. I smells mixed and non-fresh. The oxygen capacity is very low.’ W02

The description starts with the most dominant smell to the less dominant one. The participant then starts to describe the background smell, which in this case is the non-fresh air. It indicates a change of attention from immediate responses to dominant smells to thinking of the smell environment with more detailed information. Another example in the WRTC, at the Tunnel:

‘我刚刚闻到一些沐浴露的味。可能是刚走过的那个人身上的味道。还有一些不知道哪里来的烟味。然后，我还闻到一些人身上的汗味，不是很好闻，跟刚那个沐浴露的味道截然不同。I smelt some shower gel, which might came from that person who walked past. There is also some smells of cigarette, but, I don’t know where it comes from. I also smelt people sweating, which is quit unpleasant, compared to the smell of shower gel.’ W01

This description very informational, and describes the smell sources, intensities of smells, time points, directions of smells, features of smells and feelings. From this description, we know that the perceiver detected two types of smells from two people at different time points: one is the unpleasant sweating and the other one is the pleasant shower gel. There is a comparison process happening in this description. The participant also detected some cigarette smoke and attempted to identify its source. When describing the smells in the space, the participant tended to describe the surrounding

environment, e.g. people walking past, [either ‘walking past’ or ‘passing by’] and explain where and how, and good or bad. As summarised in *Memo- smells and smell sources*, these descriptions are often combined nouns with modifiers. Smells and smell sources are described with nouns. Modifiers are indicating features of smells and feelings of perceivers. For example, in the SRTN, at Sheaf Square:

‘A bit watery smell and less fumes. I can smell the chlorine in the water. Nice, good. It makes me feel clean and reminds me of the smell of the swimming pool. It is a nice chemical smell.’ S04

Modifiers in this description, e.g. less, fresh, clean and chemical, indicate a range of different smell features, like temporal environment, intensity, purity, quality and so on. I found visual assistance is very important when people describe smells they perceived. When people try to describe smells, they often use the name of the smell source, such as the smell of trash bins, toilets and so on. Such descriptions interact with visual perceptions. In some degree, visual perceptions assist people when describing their smell perceptions. For example, in the WRTC, at the underground transit hall:

‘我闻到饭馆的味道了，早餐什么的，然后还有一些垃圾桶的味道。还有一些人抽烟的烟味。 I smelt the smells from the restaurant, which smells of / like ?breakfast. There is also some smells from the trash bins and people smoking over there.’ W06 [where is the visual element in this?]

Some modifiers of feelings are also found when people describe the smell environment, such as comfortable, happy, dislike, unpleasant, relaxing and so on. People often give more descriptions of feelings when asked the second question: how do you like the smell environment? Such modifiers of feelings are a first point for making evaluations of the smell environment. For example, in the WRTC, at internal taxi centre:

‘我闻到一些汽车尾气夹杂灰尘的味道。还有一点尿味。总的来说很闷，不舒服。 I smelt some smells of exhaust fumes mixed with dust. There is also a little bit of urine smells. Overall, it is very stuffy here and unpleasant.’ W13

Another example, in the SRTN, at the station terrace garden:

‘I can smell the trees now. It is nice and clean, like natural smell. Uh, I can smell the trees more than other smells at the moment. It makes me feel happy and calming.’ S05

In this description, the participant used ‘happy’ and ‘calming’ to describe her feelings of smelling the trees. The modifier ‘nice’ and ‘clean’ also indicates features of smells that leads to the ‘happy and calming’ feeling. Overall, modifiers in two cases can be categorised into five types indicating: quality, intensity, nature, environment and feeling of perceived smell environment, as illustrated below:

Quality	Intensity	Environment	Feeling	Nature
<ul style="list-style-type: none"> •Modifiers indicating positiveness of the smell environment •e.g. natural/artificial, clean, fresh 	<ul style="list-style-type: none"> •Modifiers indicating levels of dominance of smells •e.g. strong/slight, a bit/somg 	<ul style="list-style-type: none"> •Modifiers indicating temporal conditions in the environment •e.g. sunny rainy, warm, cold 	<ul style="list-style-type: none"> •Modifiers indicating emotional responses to the smell environment •e.g. happy, calming, relaxing, stressed 	<ul style="list-style-type: none"> •Modifiers indicating the chemical features and smell sources •e.g. grassy, watery, rotten

Table Illustration and classification of description modifiers

Box 3.3 An example of memo-writing in the analysis process

3.6.2 Quantitative data

This study also includes quantitative data from the scale-ratings of smellscape pleasantness made by participants at all stops along smell walking routes. The amount of data collected is not for quantitative generalisation purposes, but is used to support analysis of qualitative data. In particular, the ratings of smellscape pleasantness can help better understand people's descriptions evaluating smellscape qualities and provide a comparative perspective of smellscape qualities at all stops in studied cases. Using the same criteria of rating in the two cases also provides a dimension of comparison of smellscape. The quantitative data are presented in charts, as illustrated in Chapter 4. Similarly, the frequencies of different smell descriptors at each stop along the walking routes are presented in charts and numbers, derived from In-Vivo codes and summarised from the initial coding stage.

3.7 Ethical issues

Permissions were gained to undertake interviews in each case so that the research would not fall foul of the security regulations. All the participants included in the study were aged over 18 and able to actively participate in the interviews and smell-walking. The walking route was designed to ensure a safe environment. In accordance with University Ethics requirements, at the beginning of each smell-walk, a brief and clear introduction was made for each participant to ensure they were aware of their rights: whether the participants decided to take part in this research project or not was completely voluntary; if a participant felt uncomfortable at any point in the study, they could refuse to continue without giving a reason for withdrawing. It was explained that the recorded data was only to be used for academic purpose, including the transcription of recordings into text for analysis. All of the data was anonymised and coded with a given coded name, such as S01 and W03. All personal information was stored securely after completing the research.

3.8 Reflections on the methodology

Undertaking a qualitative research, as Manson (2002) said, researchers are always facing a lot of challenges, questioning its reliability and validity. Existing literature has addressed on two dimensions of validity: rigor which emphasizes the subjectivity, reflexivity and social interactions involved and trustworthiness which examines whether findings are defensible (Golafshani 2003). The reliability and validity of qualitative research is inseparable from researchers' ability and responsiveness of designing the research, analysing data and judging findings (Patton 2001). Although there is no fixed methods of testing the reliability and validity of qualitative research, verification strategies can involve ensuring methodological coherence, sampling sufficiency, developing a dynamic relationship between sampling, data collection and analysis, thinking theoretically and theory development (Morse et al. 2006).

In order to ensure the reliability and validity of this study, I started with methodological coherent. As explained in Section 3.2 and 3.3, a justification has been made of exploring smellscape from a qualitative perspective, taking the Grounded Theory as a methodological and analytical approach. The Grounded Theory provides a systematic way of constructing theories from an iterative process of sampling, coding, sorting and memo writing until all theoretical categories are saturated (Glaser and Strass 2009). The Grounded Theory challenges the argument from quantitative researchers that qualitative research is unsystematic, anecdotal and impressionistic (Charmaz 2006). By conducting this methodology, I constantly questioned emerged concepts, compared generated categories and check from the raw data. The Grounded Theory also requires the researcher to look at data without pre-conceived ideas to ensure the objectivity. However, as Charmaz (2014) argued that researchers inevitably will bring in their preconceived ideas. One way I have taken to minimize my bias is using an investigator triangular strategy by regularly discussing my interpretations of data with two more experienced researchers (my supervisors). Triangulation is a useful way of verifying and increasing the reliability and validity of qualitative research, which may include multiple methods of data collection and data analysis (Golafshani 2003). Apart from interviewing, I have also used onsite observation and a scale-rating survey to collect additional data to verify and assist

interpretations of interviews. However, the method of interviewing participants through smell walking, particularly on their perceptions of the surrounding smell environment will lead them to pay extra attention to smells and their surrounding environment than they do normally in actual situations. Although this method is designed purposely to encourage them to explore as much as they could of the smell environment and their perceptions, the difference of gained knowledge through interviewing and people's experiences in normal situations has been reflectively discussed in the data analysis.

Mason (2002) argued, qualitative research is capable of producing very well-founded cross-contextual generalities. In this sense, although findings from this study, as will be discussed in Chapter 5, 6 and 7, are generated from studying the selected two cases, there can be some generalities from both cases applied to other types of spaces, e.g. the way people perceive the smell environment. Emerged categories from two cases are constantly compared to ensure they are defensible and constructively building up my theory of understanding, evaluating and designing smellscape in intermodal transit spaces.

3.9 Conclusion

In order to study the concept of smellscape reviewed in Chapter 2, this Chapter set out a theoretical framework for taking a combined linguistic and environmental psychology perspective to explore smellscape. It has summarised the design of the research from research questions to methodology and methods used for data collection and analysis. It has also explained the rationale for having two cases from very different contexts and outlined how the case studies were selected. In particular, the Chapter has explained the constant comparative analysis process taken for generating concepts and categories of understanding, evaluating and designing smellscapes in the two cases. The next Chapter discusses smell walking in the two locations, presenting the 'facts' of the physical environment in both cases and people's descriptions at all stops along smell walking routes.

Chapter 4: Descriptions of the smellscapes in the studied cases

4.1 Introduction

Chapter 3 explained the methodology and methods designed to collect and analyse data to achieve the research objectives of this thesis. In this chapter, the collected data is categorised and presented to describe the smellscapes of the studied cases. Section 4.2 describes smellscapes through smell-walking in Sheffield Railway Station and Bus Interchange. Section 4.3 describes smellscapes through smell-walking in Wuchang Railway Transit Centre. Each section starts with smell walking routes and observations with descriptions of important elements of the physical environmental and the smells detected along the route. The last part of each Section summarises people's evaluation descriptions of smellscape at each stop. Section 4.4 compares the smellscapes of the two cases.

This Chapter aims to answer three sub-questions: What is the smell environment in urban intermodal transit spaces? How do people describe their perceptions of the smell environment in urban intermodal transit spaces? What is described when evaluating smellscapes at different functional parts in urban intermodal transit spaces?

4.2 Smell-walking in Sheffield Railway Station and Bus Interchange

In Sheffield, smell walking was conducted between July 2014 and February 2015, with 19 participants in total. Each walk was between 45 minutes and 90 minutes long, with an average duration of 60 minutes. This Section explains the walking route and illustrates people's descriptions and evaluations of the smellscape along the walking route in the Sheffield case.

4.2.1 Introduction to Sheffield Railway Station and Bus Interchange

In the 1980s, the centre of Sheffield experienced a heavy decline in its industries and commercial activities. From the mid 1990s, a series of regeneration projects took place in the city centre to bring back vitality to Sheffield City Centre. A route presenting a pleasing image of the city to its visitors was designed from Sheffield Railway Station to the University of Sheffield. The station was originally opened by the Midland Railway in 1868 and built at the junctions of routes connecting the northern cities to London, is one of the busiest stations in South Yorkshire. The station building is located at the foot of the Norfolk Park residential area. The pedestrianised Howard Street connects Sheffield Station to the Millennium Gallery, leading visitors to the heart of City Centre, as illustrated in Figure 4.1

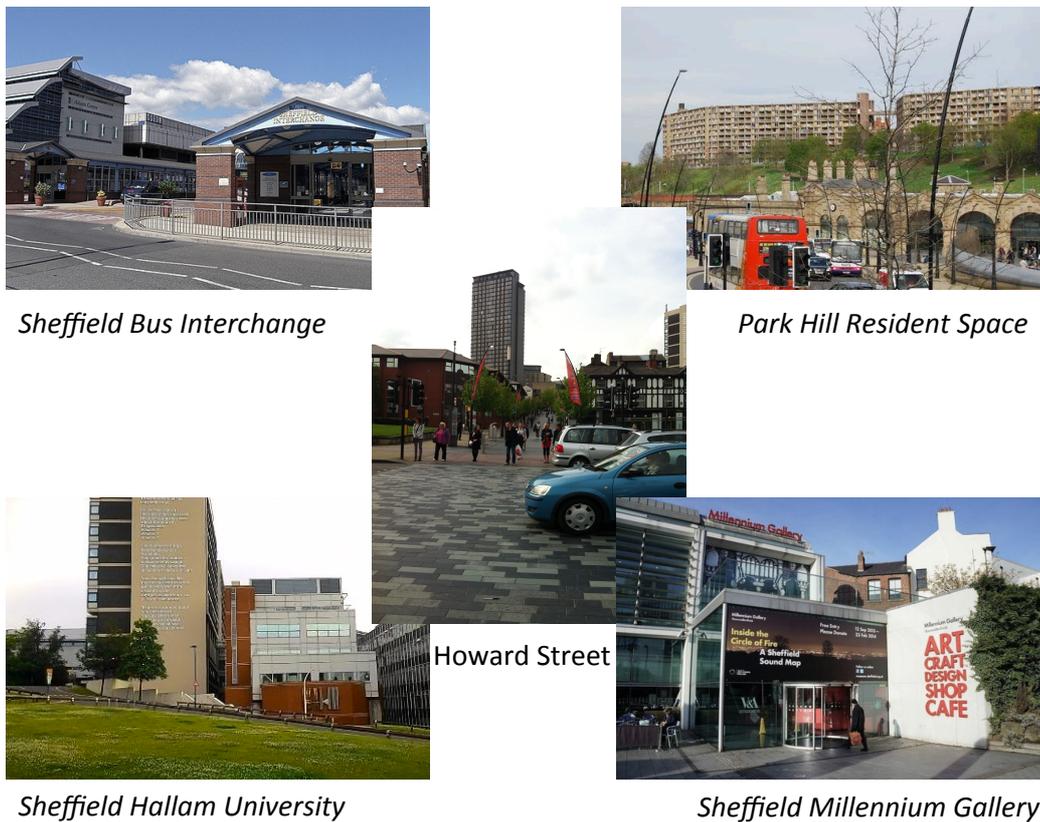


Figure 4.1 Surrounding environment of the Sheffield Railway Station

Sheffield Railway Station and the Bus Interchange provide a diversity of spatial forms, integrating enclosed indoor spaces and open/semi-open outdoor spaces in different ways. Figure 4.2 illustrates the locations and spatial relations of the Railway Station, Bus Interchange and surroundings.

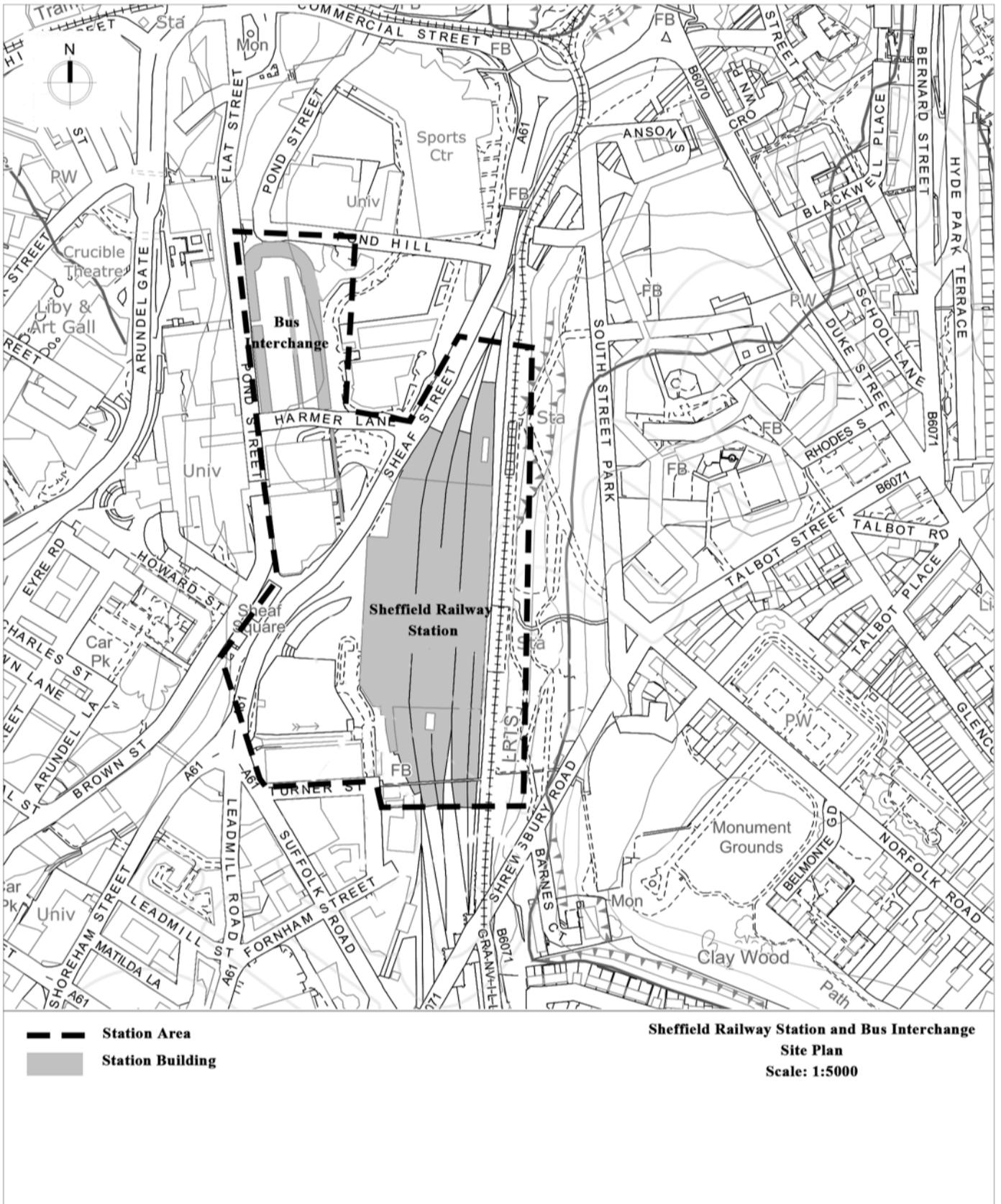


Figure 4.2 Location and Site Map of Sheffield Railway Station and Bus Interchange

The renovations of the Railway station in 2002 retained the original stone façade of the station concourse and filled the arches and awnings with glass, as shown in Figure 4.3. The concourse of the station faces Sheaf Square and covered with high glass roof. The platforms are covered by arched roofs and follow a 19th century Victorian railway station form. Sheffield Railway Station is an open station, providing free access to all platforms. Its open platforms are designed parallel and attached to station concourse to let trains run through. An enclosed pedestrian bridge has been added to connect the concourse to different open platforms and the tram stop at the back of the station.



Figure 4.3 A view of Sheffield Railway Station from Sheaf Square

Sheaf Square, in front of the station, is designed as a symbolic space of Sheffield's steel industry history. It has a large fountain and a 90-metre long and 5-metre high steel wall with water running down along the surface along the Sheaf Street. The pavement between the fountain and the steel wall connects the railway station to Howard Street. Apart from the waterscape, there are also several trees and benches on the square. The tiled space in front of the station also serves as loading space for passengers arrived in taxis. One side of the taxi rank is attached to the station building,

covered with canopies whilst the other half of the taxi rank remains uncovered adjacent to the Sheaf Square.

The Bus Interchange was constructed in 1990s with steel frame and glass walls. It is located at the junction of Pound Street and Harmer Lane, providing both local and regional bus services. The interchange is designed with a main service building hosting information desks, toilets, a café and passenger waiting area. There are three elongated covered coach stands next to the main service building. Within each coach stand, there is a shop, seats and information boards. The entrance to the main service building is on Pound Street. However, each stand can be accessed from the Harmer Lane, as shown in Figure 4.4.



Figure 4.4 A view of the coach stands in Sheffield Bus Interchange from Harmer Lane

The Bus Interchange is linked to the Sheffield Railway Station through a covered walkway across the Harmer Lane, namely the station path, as shown in Figure 4.5. The station path is a distance away from the busy Sheaf Street with designed landscape. On the end connecting to the Bus Interchange, there is a small garden with pavement and a bench, which seems to be a stop for people to have some rest. On the

other end, the station path meets the Sheaf Street and connects to the Sheaf Square leading to the Railway Station.



Figure 4.5 A view in the station path facing the greenery space on the right

Passengers from either direction seem to have a seamless but dynamic route from one transport mode to another in Sheffield Railway Station and Bus Interchange. The changing environment may bring very different experiences to people using the space.

4.2.2 The smell-walking route in Sheffield Railway Station and Bus Interchange

The intention of choosing various interview stops was to include as many characteristics of different transit spaces within this transit network as possible. The smell-walking route in Sheffield was determined after several onsite observations by the researcher recording detected smells on the map, taking photos of the physical environment and making notes of smell experiences and activities onsite. The route was then determined to include various considerations of place characteristics, the surrounding environment, built forms and smells. Other practical issues were also considered, such as the length and time of the walk, open access, shelter and safety:

‘The potential of the route is to provide exposure to a range of different smellscape, and consideration of additional factors including practical issues such as the layout, terrain, site access and the personal safety of the researcher and participants’ (Henshaw, 2013, p49).

Regarding to the specific function of transit spaces, another consideration in this study was connectivity among different transport modes: bus, train, tram and taxi. The route tried to make a natural connection among them according to people’s habits. For example, in Sheffield the route between Stop1 and Stop4 is the most frequently walked route when people change between buses and trains. Considering that people may have limited time to participate, the route was designed to allow about 60 minutes for walking and interviewing. After deciding the initial route, the researcher took a test walk at a slow pace and stopped at each proposed Interview Stop for 3-5 minutes to allow time for asking questions. This turned out to run a bit over time and was too complex. As a result of the test walk, the researcher revised the route and made more direct and shorter connections between the Interview Stops. The researcher re-tested the route by bringing a friend as participant to walk through at a slow pace, which took about 30 minutes for questions. Consequently, the finalised route starts from the Sheffield Bus Interchange and moves on to the Station Tram Stop, then across the Sheffield Railway Station bridge and into the Station, and ending at Sheaf Square.

The conducted smell walking route is designed with seven stops, as shown in Figure 4.6: Stop 1, Bus Interchange, Stand B, enclosed waiting room; Stop 2 Station Terrace, greenery space, outdoor roadside urban space; Stop 3 Railway Station, concourse, enclosed mixed functional space; Stop 4 Railway Station, Platform 5, open platform; Stop 6 Railway Station, tram stop, outdoor pedestrian area; Stop 6 Railway Station, taxi rank, outdoor covered space; Stop 7 Sheaf Square, water feature, outdoor public space.

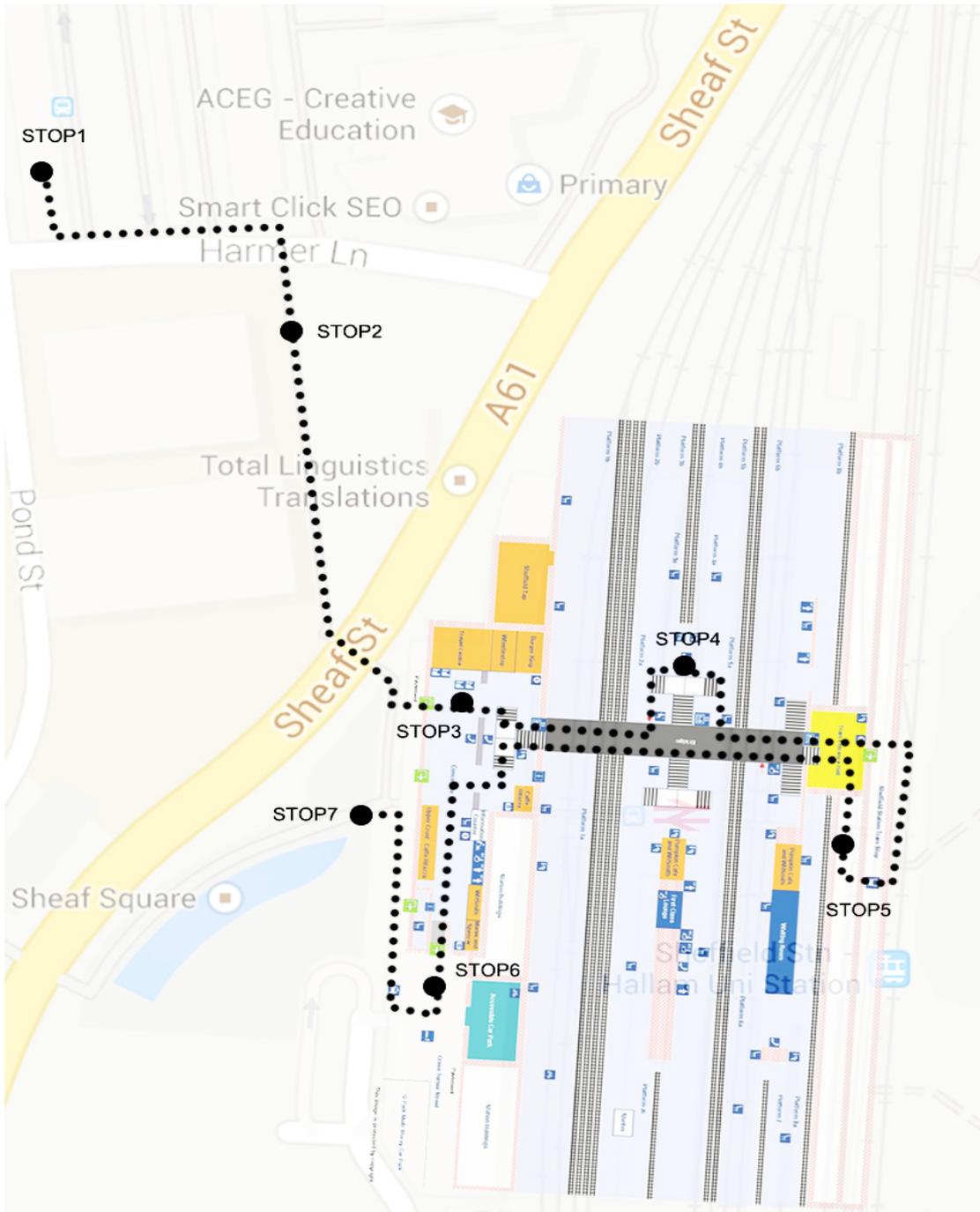


Figure 4.6 The smell-walking route conducted in Sheffield Railway Station and Bus Interchange

Table 4.1 below illustrates the physical features of the environment at each stop with observation Photos and notes.

Stop	Description	Stop	Description
 <p>1) Sheffield Interchange Stand A Enclosed, elongated space</p>	<p>Waiting area, few entertainment facilities, only one small convenience shop inside it, covered by arched roof with several windows, modern steel structure with light materials</p>	 <p>5) Railway Station Tram Stop Open space, large amounts of greenery</p>	<p>Bottom of Park Hill residential area, greenery pedestrian area, low population flow</p>
 <p>2) Station Terrace greenery space Small scale, outdoor space</p>	<p>Passing-through area, isolated from other areas, with a few trees, some surrounding bushes.</p>	 <p>6) Railway Station Taxi Rank Covered, semi-open space</p>	<p>Walking-through area, few facilities, no separation of taxis and private cars</p>
 <p>3) Railway Station Concourse Enclosed, large space</p>	<p>Mixed functional space, heavy population flow, with shops and facilities inside, 19th century architecture style, stone structure, high ceiling and arched glass roof</p>	 <p>7) Sheaf Square Water Feature Large scale, outdoor space</p>	<p>Square with designed water feature, heavy population flow, waiting and passing through area, occasional entertainment activities</p>
 <p>4) Railway Platform Covered, semi-open space</p>	<p>connected to the concourse by stairs and bridge, functional spaces are placed in the middle i.e. toilets, café, waiting room</p>		

Table 4.1 Descriptions of physical environment at each stop along the smell-walking route in Sheffield

Table 4.2 illustrates different environmental elements observed at each stop along the walking route including openness, typical facilities, physical elements and functions in urban intermodal transit spaces, which were recorded during onsite observations. Together with Table 4.1, it gives the physical environmental conditions observed along the smell-walking routes and the architectural features of Sheffield Railway Station and Bus Interchange.

	Stop1	Stop2	Stop3	Stop4	Stop5	Stop6	Stop7
Open		•			•		•
Enclosed	•		•				
Semi-open				•		•	
Natural ventilation		•		•	•	•	•
Food court / restaurant			•	•			
Seats	•		•	•			•
Trash bins	•					•	•
Toilets			•	•			
Traffic		•		•	•	•	

Table 4.2 Observation notes for each stop along the smell-walking route in Sheffield

4.2.3 Smells detected along the smell-walking route in Sheffield Railway Station and Bus Interchange

With a particular purpose of identifying smells and smell sources, descriptors were coded in In-Vivo codes in the initial coding stage. Overall, forty-seven types of smells and smell sources were detected and described in the Sheffield case. The smells classified into ten categories in relation to their smell sources, as shown in Table 4.3. In particular, in the analysis of interviews, specific descriptions of the air quality in

the space were found, which are included as a new category of smells in this case. In comparison with Henshaw's (2013, p53) categorization of urban smells in English and European cities, this categorization is more specific to the context of urban intermodal transit spaces.

Category	Smells	Category	Smells
<i>Traffic related</i>	Fumes, exhaust/car/diesel fumes, pollution, cars, petrol, diesel, train, tram, dust	<i>Waste</i>	Bins, toilet
<i>Food and beverages</i>	Coffee, food, pasty, pastry, Burger King, sandwich, warm food, crisps, engine, oil, train tracks	<i>People and animals</i>	Body odour/sweat, perfume, people
<i>Tobacco</i>	Cigarette smoke	<i>Building materials</i>	Drains
<i>Air quality</i>	Normal air, clean air	<i>Cleaning products</i>	Cleaning liquid, chlorine
<i>Nature related</i>	Pollen, plants, grass, flowers, ground/earth, trees, lavender, wet soil, rose bushes, fresh air, sun, vegetation, greenery, water	<i>Fabrics and other materials</i>	Rubber

Table 4.3 Categorization of smells detected on the Sheffield walks

A summary of the smell frequencies derived from In-Vivo code totals for various smells and smell sources at each stop, is illustrated in Chart 4.1. The chart shows that traffic-related smells were detected most frequently along the route. However, at each stop, the most frequently detected smells varied among all the categories. Several smells were detected frequently at different stops, such as smells related to people and cigarette smoke. It indicates a variety of smells and smell sources across the site of SRSBI, which will be illustrated in the following section.

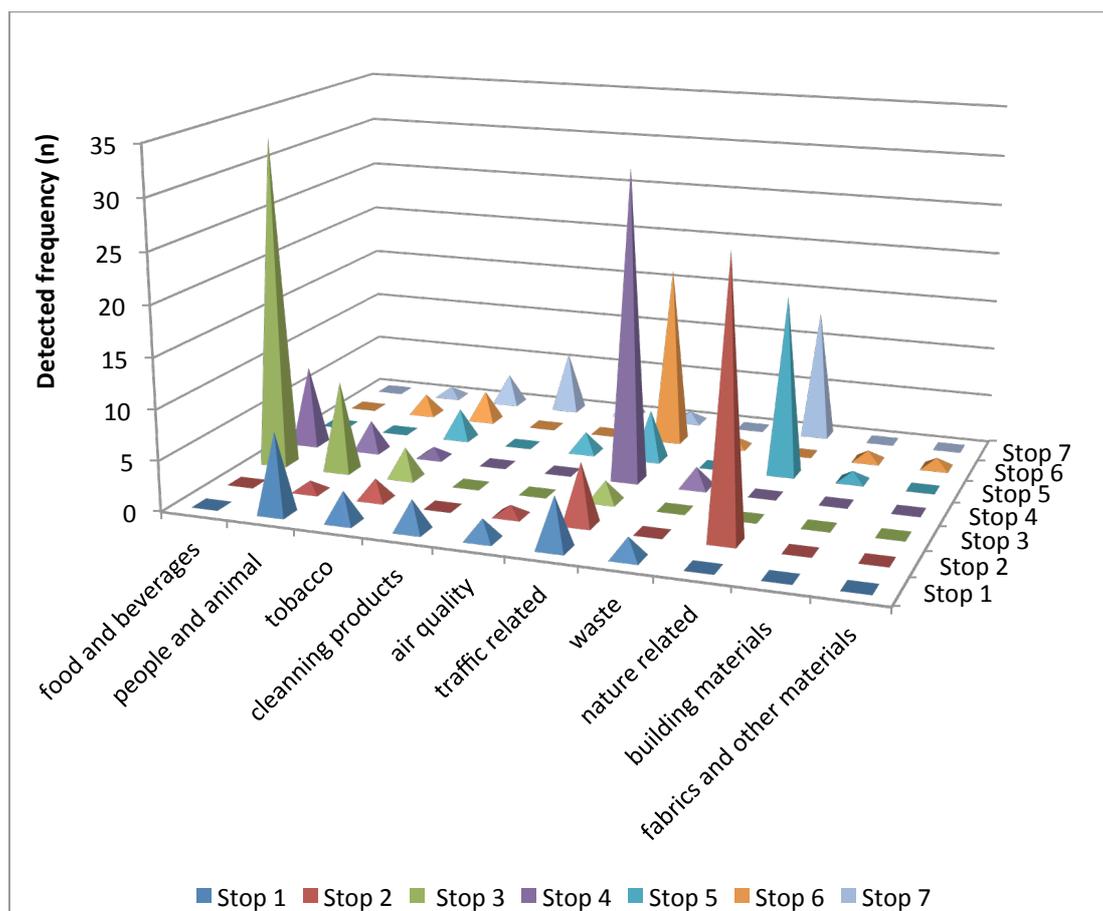


Chart 4.1 The number of times that a smell was detected at different stops on the Sheffield walks

4.2.4 People’s descriptions of the smell environment in the Sheffield case

Smell Walk Stop 1: Sheffield Bus Interchange

The smell-walk started from Sheffield Bus Interchange Stand A, which was a modern steel-glass structure. It is located between two bus lanes with glass walls on each side. A number of smells were detected with a low number of times across all participants, like smell of people, cigarettes, cleaning material, bins, fumes, cleaning products and so on. Among these smells, the smell of people was most frequently detected. Generally, people described the smell environment as clean and normal and as

expected. However, some people described the perceived smell environment as being like an old house that hasn't been used for a while. For example:

'I didn't smell a lot, the environment smells generally and fairly clean. I can smell some perfume from the passing people, but not that much.' S01

'...sometimes it has an old smell. How can I explain this? You know modern buildings, it always associates with the clean smell. But here, it has a bit dusty smell. It not that dusty, but, for now, it is kind of humid and dusty feeling.' S09

'It smells like a little bit like body odour, sweat, a little bit like musty smell, like an old smell, you know, like old books.' S07

Smell Walk Stop 2: Station Terrace

Unlike the Interchange Stand, the Station Terrace is covered with an arched roof, located outdoors with a green space beside the entrance. It connects the Interchange to the Railway Station. Most frequently, people detected smells of plants, grass, flowers and fresh air, all from natural elements. However, some people were influenced by the road traffic and detected some traffic fumes. For example:

'I've got such a smell of the city, hah, normal city smells with the traffic. I can smell people passing by. It is like a soapy type smell, probably like deodorant to something. It is not overpowering, but you can smell it.' S06

Occasionally, people sensed smells of cigarette and perfumes from people passing by. In general, most people described the smellscape at this stop as being quite relaxing, calming and familiar. Some people associated the natural elements of this smellscape with places where they had grown up. For example:

'I can smell the grass and flowers, it is a little bit overpowering. It is a bit like a park. I like to smell grass, it smells nice. I think it is because I live close to green fields. Like when I used to walk to school, like my primary school, there is a really big field, it has two parks. And where I live now, it is suburbs, in the

green belt, there are more open spaces and grass lands, I think it associates with home, my association.’ S07

Smell Walk Stop 3: Station Concourse

Compared to the Interchange Stand, the Railway Station Concourse is much busier with more functions. People frequently detected various food smells in the Concourse, like crisps, burgers, sandwiches, pasty, coffee, and so on. Among these smells, coffee was the most dominant. For example:

‘...it is like a mixture of smells. I can smell the food, you have a coffee shop, a pasty shop there. I don’t know how to describe this generic smell of this kind of space. What I get a lot is the smell of coffee, pretty dominant.’ S18

Apart from food smells, people also detected smells from people, like perfume and body odours. Occasionally, people detected smells of the trains. In general, people described the smell environment here as inviting and welcoming, which was also more familiar and pleasant than in the Interchange. For example:

‘I can smell coffee, sandwiches, toast - uh, not toast, but like warm food. I can’t smell any smells. Very nice, very attempting, hah, it is like a pleasant smell, welcoming.’ S05

Smell Walk Stop 4: Railway Platform

The platforms in Sheffield Railway Station are all open platforms, separated from the Concourse. On the platforms, the most frequently detected smells were related to trains, like diesel, fumes, engine and oil. The train traffic-related smells were very dominant on the platform. For example:

‘I absolutely hate the smell of trains, gas coming from the engines...I went past Starbucks, I smelt some coffee which is nice. But then, the smell from the train is absolutely overwhelming...’ S12

Occasionally, people detected smells of food and people. Very few people detected toilet smells or cigarette smoke. People's perceptions of the general smell environment at this platform stop varied widely, from very unpleasant to a good personal experience associated with it. For example:

'Very strong train smell, the trains are coming in, I can smell it very strong...I don't mind the train smell, because it reminds me of going away. I don't use trains for business or work. Mine would be for pleasure. All I remember is pleasurable journeys. So I quite like the smell of the train, it is not something that I experience everyday either. For me, I'd be going for a trip on a train, which is a pleasurable experience anyway, so I don't mind smelling the train.'
S06

Smell Walk Stop 5: Railway Station Tram Stop

The Station Tram Stop is located outside the secondary entrance of the Railway Station, at the foot of Park Hill. The most frequently detected smells were from natural elements, like plants, grass, trees, flowers and fresh air. Some people detected train fumes and cigarette smoke. Generally, people described the smellscape at the tram stop as like the countryside, fresh, clean and natural. The surrounding vegetation had a strong influence on people's perceptions of the smellscape. For example:

'Nothing particularly, it is just the air coming through. I can smell the perfume from people, it is not unpleasant, because it is just a hint, not that strong... the woody, park type smell, the trees, grass and pollen. I like the natural kind of smells, woods and gardens, the smell is fine to me.' S06

'Here, natural elements are more obvious, actually, that is the only element I can smell here. It is an open space, no cars, no trains and a few people. It is like the second point, the sense of nature, clean air and very pure smells. Nothing particular, just the sense of fresh smell.' S13

Smell Walk Stop 6: Railway Station Taxi Rank

The taxi rank is beside the main entrance of the Railway Station Concourse. It is an outdoor space, covered with canopy. The traffic-related smells were very dominant at this stop and there was a high frequency of detection by participants. Occasionally, people detected other smells, like people, cigarettes, garbage, rubber and drains. Generally, people described the smellscape at the taxi rank as mixed, unhealthy, non-fresh and unpleasant. For example:

'It is the exhaust fumes from the taxis...It is not a nice area and it is polluted. There is no reason for me to like this smell environment.' S02

'I smelt diesel. I think all these taxis use diesel. I am kind of used to it, because I have a car myself and use diesel. It is a common smell that you get from a city. If you live here, you probably won't pay attention to that any more.' S17

Smell Walk Stop 7: Sheaf Square

The smell-walk ended at Sheaf Square, a designed waterscape in front of the Railway Station. People frequently detected smells related to water, like humid air, water and chlorine. At the same time, some people detected smells of cigarettes, people and the weather, like sun and rain. Generally, people described the smellscape at Sheaf Square as fresh, relaxed and pleasing. Some people associated this kind of smellscape with their memories of a swimming pool or vacations at the seaside. People were strongly influenced by the view and sound of the running water. For example:

'I quite like the water smell, it reminds me of the swimming baths, so, it makes me feel like going swimming. It is also quite nice to look at, I can stay here for a long time. I wouldn't mind waiting here. it is a soothing and calming environment here. It is very pleasant, I don't smell anything bad around, it is just like a clean and nice environment.' S05

'A bit watery smell and less fumes. I can smell the chlorine in the water. It makes me feel clean and reminds me of the smell of the swimming pool. It is a nice chemical smell... It makes me feel happy. I love water features. Actually,

I like the sound of running water. It makes me feel free. Well, the smell, of course, plays a part of it. But the sound itself is very soothing.’ S08

‘It smells like the water, maybe it is not the water. But I can sense the humidity in the air. The sound here is so prominent, which makes me think that water has a smell. It makes me feel fresh and nice.’ S06

Summary

From people’s descriptions, it can be concluded that the perceived smell environment at different stops varied with the physical environment. There is a significant difference between smells detected at each stop, particularly between indoor and outdoor spaces. In open outdoor spaces, the most frequently detected smells were from natural elements. In enclosed indoor spaces, the most frequently detected smells were related to food and people.

4.2.5 People’s evaluations of smellscape pleasantness in the Sheffield case

This Section presents an overview of people’s descriptions of the smell environment in the SRSBI and people’s ratings of smellscape pleasantness at each stop along the smell-walking routes, as shown in Chart 4.2. As explained in Chapter 3, a smellscape pleasantness survey is included in the smell-walking process, asking participants to make scaled rankings of their perceptions of the pleasantness of the smell environment at each stop. The scale ranged from 1 (very unpleasant), 2 (unpleasant), 3 (slightly unpleasant), 4 (neither pleasant nor unpleasant), 5 (slightly pleasant), 6 (pleasant) to 7 (very pleasant). Collected ratings from all participants were converted into Chart 4.2, which includes two types of information: the average rating (mean value) of smellscape pleasantness at each stop, and the variation of people’s ratings of smellscape pleasantness at each stop. According to the mean value, the overall smellscape in the Sheffield case is rated above neutral, being slightly pleasant. There are only two stops that are rated negatively: Stop 4, the Railway Station Platform and Stop 6, the Railway Station Taxi Rank. Stop 7, Sheaf Square, is rated as the most pleasant along the smell-walking route, where people’s ratings varied between 4

(neither pleasant nor unpleasant) and 7 (very pleasant). With the information provided in Chart 4.2, the following part of this Section will illustrate people’s language descriptions in answer to the question: ‘How pleasant is this smell environment?’

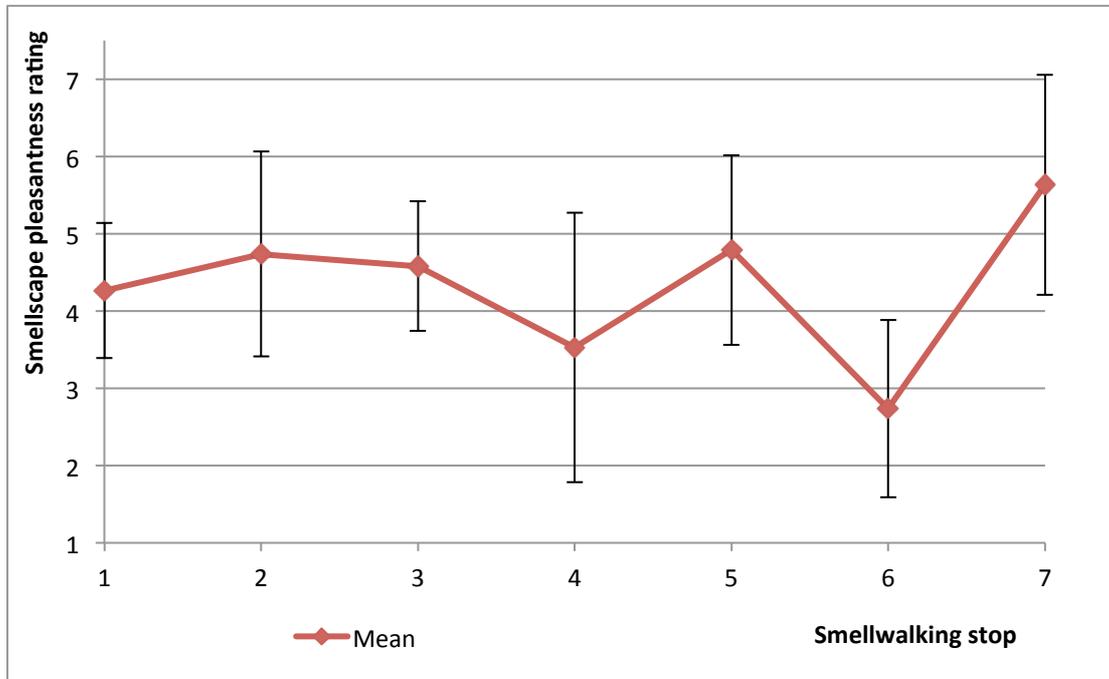


Chart 4.2 Mean value of participants’ smellscape pleasantness ratings at each stop in the Sheffield case, with error bars indicating standard deviation around the mean

People used words, such as ‘not very nice’, ‘not fresh’ and ‘unpleasant’ to evaluate the smellscape. Similar words were used at the Taxi Rank, like ‘very bad’, ‘not fresh’, ‘unhealthy’ and ‘not very pleasant’. People showed more tolerance for train fumes on platforms, because ‘expected’, ‘clean’ and ‘fresh to look at’. However, the variation around mean value shows that people’s pleasantness rating at the Railway Platform fluctuated widely between pleasant and unpleasant. Some participants found the smellscape at the railway platform more pleasant and personally meaningful, associated with travel memories and past experiences. For example:

‘It is like an internal smell. But it is but quite intense. It is like the underground smell... Personally I like this smell. As I told you, I used to live in such environment. I am familiar with the smells of train stations.’ S04

The most pleasant smellscape was rated at Sheaf Square, where the smell of water and fresh air dominated. The higher ratings were found at the Station Terrace, Tram Stop and Sheaf Square, which indicated that people tended to experience smellscapes as more pleasant in outdoor environments where natural elements occur. People frequently used words like ‘fresh’, ‘nice’, ‘clean’ ‘happy’, ‘calming’ and ‘relaxed’ at these three places. For example:

‘I think it is quite clean because it is water. It associates with cleanness. And quite fresh. It reminds[me of], not a pool, but swimming pool, I can smell a little bit of the chlorine. It is quite clean smell. I do like swimming, so I don’t mind smelling chlorine. But I know some people hate the smell of chlorine.’S07

The Railway Station Concourse, where food smells were dominant, was also rated as relatively high for smellscape pleasantness.. The STD bar indicates that people tended to share a common perception of smellscape as being slightly pleasant at this stop. People frequently used words like ‘familiar’, ‘inviting’, ‘welcoming’, ‘tempting’, ‘expected’ and ‘relaxed’ to evaluate it. At the same time, people were very influenced by the architectural form and atmosphere in the Concourse. For example:

‘The smell of coffee kind of dominates here...it is like a nice and relaxing smell. I probably go over and buy a coffee when I smell it. Well, it is kind of making me walking through the direction towards it...I am calm, my mood doesn’t change, I am calm and relaxed...I feel more familiar here than the Bus Station, I think sometimes it is what you are more familiar with...’S05

Compared to the Railway Station Concourse, the Bus Interchange Stand was rated as less pleasant. Smells were detected less frequently and nothing was dominant. The mean value and STD bar of people’s smellscape pleasantness at this stop suggests that people shared a common evaluation of such a smell environment as neutral. The most frequently used words to evaluate the smellscape in the Interchange Stand were ‘normal’, ‘expected’, ‘clean’ and ‘neutral’. For example:

'Fairly neutral. Nothing smells very strong. They are sort of background. Nothing dominant. It feels like the environment is generally clean. I suppose it is hygiene, things like that would be more pleasant to be in.' S01

Generally, people's descriptions and ratings of smellscape pleasantness in the Sheffield case suggest that the smells of natural elements could be preferred in all functional spaces in urban intermodal transit spaces, whilst traffic fumes and cigarette smoke are mostly perceived as unpleasant. When evaluating environmental qualities, people's smell preferences have a significant influence. Food smells and some smells associated with cleanness can increase overall smellscape pleasantness. Potentially, air quality related health concerns also have direct influence people's perceptions of smellscape pleasantness. In addition, it is indicated from people's descriptions that good visual and auditory interactions can increase their sense of pleasantness of the surrounding smell environment. Further analysis of components influencing people's perceptions of the smell environment will be discussed in Chapter 5 and indicators influencing people's evaluations will be discussed in Chapter 6.

4.3 Smell walking in Wuchang Railway Transit Centre

Smell-walking in the Wuchang case was conducted between August and September in 2014, with twenty-one participants in total. Each walk was between 55 minutes and 90 minutes long, with an average duration of 70 minutes. This section explains the walking route and illustrates people's descriptions and evaluations of the smellscape in the Wuchang case.

4.3.1 Introduction to Wuchang Railway Transit Centre

The Wuchang Railway Transit Centre is located in a busy transport junction of two main motorways that lead to the central part of Wuchang district. The railway station has been redeveloped into an intermodal transit centre on its original site which was not planned to accommodate such a large passenger and traffic flow. Facing constraints of site and the design trend, the final solution turned out to be a compact form with vertical development above and below the ground.

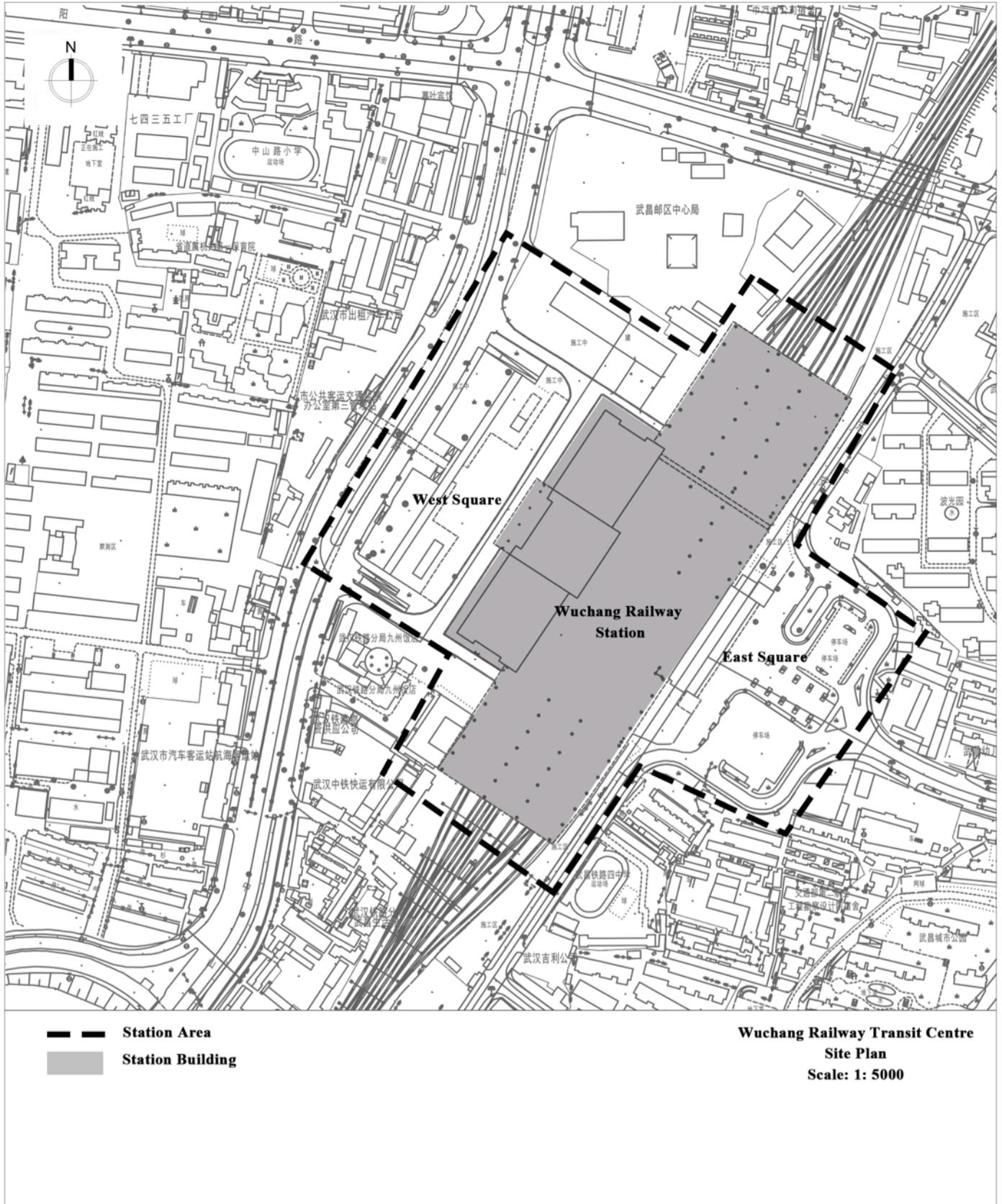


Figure 4.7 Location and Site Map of Wuchang Railway Transit Centre

To remain its historical meaning and local identity, the design of Wuchang railway station refers to traditional Chinese built forms, representing the ‘Chuhan Culture’ (Li and Luo 2006). In history, Wuchang used to be the capital of Chu during the Han dynasty. The station is a local landmark in the city, and the architecture emphasizes the visual perceptions to create a sense of historical meanings with large mushroom-like roofs and dark brown paint from the Han Dynasty, as shown in Figure 4.8. This has certain impacts on its building form, i.e height of the space, column grids, materials and space layout. However, the architectural style has also made the station itself a local attraction.



Figure 4.8 A view of Wuchang Railway Station building from the West Square

The planning concept of the new Wuchang Railway Station is ‘the station as city’ (Li and Luo 2006), providing multi-transport modes and various commercial services. The transit centre can be considered as two major parts: the station building and two station squares- West Square and East Square. The main entrance to the Building is located on the West Square, which is lifted to one floor high above the street level. The main service spaces for the railway station, i.e. ticket hall, main concourse and platforms, are located at this level, which can be considered as the

ground level for the transit centre. Other services are mainly located within the building at the lower ground level, i.e. the transit hall, commercial zone, toilets and cheap hotels. Figure 4.9 shows the environment in the transit hall on the lower ground floor. There are access within the transit hall to the Metro station and Internal taxi centre located on underground level. The Transit hall is a large semi-open space opened up at both ends. There are also two courtyards opened up towards the West Square on the ground level.



Figure 4.9 A view of the transit hall at lower ground level in the Wuchang case during daytime

The East square at the other side of the building is at the normal street level, which is considered as the lower ground level. Each square takes up around 1,5000 m². There are fixed seats and designed landscape on the West Square where only licenced police and service vehicles can access. However, on the East Square, there are less space for people to wait and rest whilst most spaces are used for a bus interchange, a taxi rank and parking.

Unlike the Sheffield Railway Station, platforms in the Wuchang Railway Station are only accessible to passengers with valid tickets on the departure day. There are 12 railway platforms with a length around 750 metres running through the station, which can only be accessed from the railway station concourse. Passengers also will have queue to pass the security checkpoint to get into the concourse. There are two exits of the railway station: one is located at the lower ground level in the transit hall, where people can access to the commercial zone, metro station, bus station and internal taxi centre; another one is located at the East square, where people can directly change for buses and taxis. Passengers' routes of exchanging different transport modes are mostly within the building and much less interacted with outdoor spaces. However, the diverse functions and vertical spatial plans within the building can make people's experiences complex and different.

As a local landmark as well as an interface between visitors and the city, the environmental quality seems particularly important to the image of the city and users' experiences. In an environmental investigation conducted by the government of all the transport stations and station squares in Wuhan, the overall quality of environment in Wuchang Railway Transit Centre was ranked eight out of the sixteen stations and surrounding areas surveyed (Wei 2013). However, the Wuchang Station Western Square was rated as the worst among all the assessed sites, with many people smoking inside the station buildings, rubbish all around in the Western Square, and many illegal traders selling tickets and food (ibid), as shown in Figure 4.10. This indicates a complex environment onsite and a demand of improving the environmental quality in the Wuchang case, particularly the open spaces around the station building. Smells, in this case, may be very different and dominant to people in the Wuchang Railway Transit Centre.



Figure 4.10 A view of waiting space on the West Square in the Wuchang case

4.3.2 The smell walking route in Wuchang Railway Transit Centre

Most considerations for planning the walking route in Wuchang Railway Transit Centre were drawn from the previous route design in the Sheffield case study. However, Wuchang Railway Transit Centre was designed as an urban complex with more functions and facilities than the dispersed transit network of the Sheffield case, which means all transport modes and service spaces are accommodated within one building. It is at a much larger scale where connections among different transport modes are made both horizontally and vertically. These differences created some difficulties in designing the route in the Wuhang case, especially considering the time limits on the research. The route design tried to include all the different types of spaces and it was tested with friends, but it turned out to be too long and confusing to follow.

In order to get a comprehensive understanding of the smell environment in Wuchang Railway Transit Centre, the researcher decided to keep the most important nodes

related to different transport modes and the main service space, and cut out stops in less frequently used areas or with lower population flows. The finalised route, as shown in Figure 4.11, was tested by bringing a friend to walk at a slow pace, which took around at least 30 minutes allowing time for interviews.

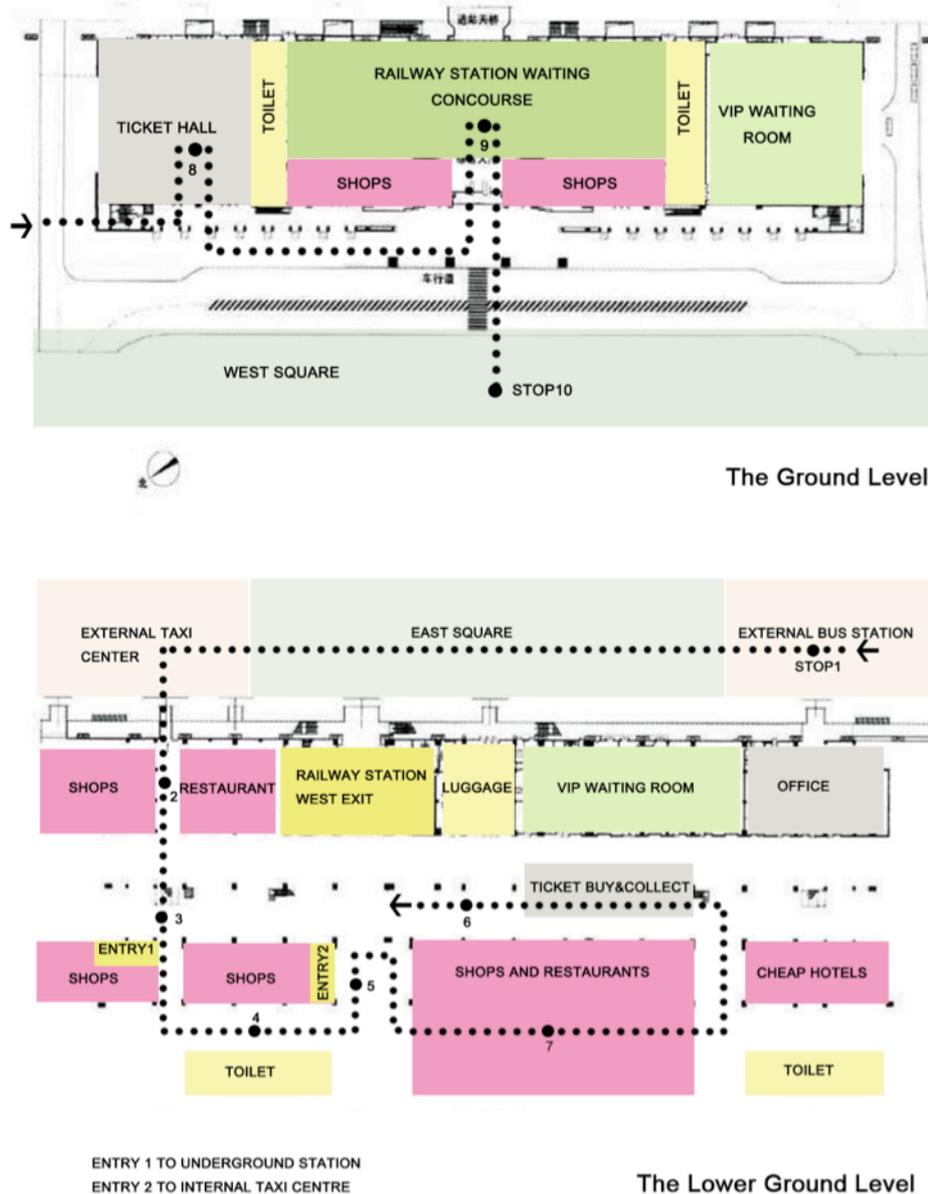


Figure 4.11 Map of smell-walking route conducted in the Wuchang case

The route covered the underground service space and ground level main waiting space, connecting different transport modes, from the metro station to the bus station to the taxi rank to the railway station. Table 4.4 describes the physical environmental features observed at each stop on the walk, providing physical environmental context for understanding the smellscape.

Stop	Description	Stop	Description
 1) East Square Bus Station Large scale, outdoor space, hard surface	<p>Located on the east square of the transit centre. Provides bus services with some greenery and a covered waiting stand.</p>	 6) Commercial Zone Semi-open, underground space	<p>Provides mixed services, including restaurants, shops and cheap hotels.</p>
 2) Connection Tunnel Enclosed, elongated space	<p>A walkway connecting the East Square and the Transit Hall.</p>	 7) Transit Hall Semi-open, lower ground level	<p>Accommodates large flows of people between railway, metro and buses. And provides mixed services, like restaurants, shops and ticket machines.</p>
 3) Metro Station Enclosed, underground	<p>Provide metro services, connecting to the urban networks</p>	 8) Railway Station Ticket Hall Enclosed, ground level	<p>Provides ticket services: buy, change and refund</p>
 4) Waiting Space Semi-open, lower ground level	<p>Provides waiting space, access to facilities, like toilets and shops.</p>	 9) Railway Station Concourse Double-level, enclosed space	<p>Provides waiting space with facilities, like toilets, seats and some shops.</p>
 5) Internal Taxi Centre Enclosed, underground	<p>Provides taxi services.</p>	 10) West Square Large scale, outdoor space, landscape	<p>Provides waiting space with some greenery and seats.</p>

Table 4.4 Descriptions of physical environment at each stop along the smell-walking route in the Wuchang case

The environment in Wuchang Railway Transit Centre is similar to the Sheffield transit area, combining both indoor and outdoor spaces. However, because of the large population and high demand for public transport in Wuhan, Wuchang Railway Transit Centre is much larger and busier. Regarding the general features of intermodal transit spaces, Table 4.5 below illustrates different environmental elements observed in the Wuchang Railway Transit Centre, providing information relating to people’s behaviours and smell perceptions.

	Stop1	Stop2	Stop3	Stop4	Stop5	Stop6	Stop7	Stop 8	Stop9	Stop 10
Open	•									•
Enclosed			•		•			•	•	
Semi-open		•		•		•	•			
Natural ventilation	•			•		•	•			•
Mechanical ventilation			•					•	•	
Food court / restaurant						•			•	
Seats				•						•
Trash bins	•	•	•	•			•		•	•
Toilets				•					•	
Traffic	•		•		•					•

Table 4.5 Physical environmental features observed at each stop on the Wuchang walk

4.3.3 Smells detected along the smell walking route in Wuchang Railway Transit Centre

As in the Sheffield case, with a particular purpose of identifying smells and smell sources, descriptors were coded in In-Vivo codes at the initial coding stage. The overall smell environment in Wuchang Railway Transit Centre was perceived to be a mixture of different

smells, dominated by smells related to food, cigarette smoke, traffic, people and waste. In total, thirty-five smell descriptors were found in the Wuchang case and were categorized in the same way as the Sheffield case, as shown in Table 4.6. The words people used to describe smells were closely related to their everyday life experiences and visual perceptions, referring to smell sources (objects/people/animals) or places where smells came from.

Category	Smells	Category	Smells
Traffic-related	Car fumes, petrol, dust (汽车尾气, 汽油, 灰尘)	Waste	Bins, rotten rubbish, something rotten, urine, toilet, cooking smoke (油烟味, 垃圾桶, 腐烂的垃圾, 腐烂的东西, 尿味, 厕所味)
Food and beverages	Restaurant, food, meal, bento, oily food, Zhou He Ya ⁶ , McDonald's, Zao Dian ⁷ , deep fried chicken, instant noodles (餐厅的气味, 食物, 饭味, 油腻的食物, 周黑鸭, 早点, 炸鸡块, 泡面)	People and animals	Perfumes, body odour, sweat, smelly feet, shower gel, animal (香水, 体味, 汗味, 脚臭味, 沐浴的气味, 动物的味道)
Fabrics and other materials	Luggage (行李散发的气味)	Building materials	Construction materials, paint, drains, air conditioner (装修材料, 粉刷味, 下水道味, 空调味)
Air quality	Humid air, turbid air, non-fresh air (潮湿的空气, 混浊的空气, 不新鲜的空气)	Cleaning products	Cleaning liquid (消毒水味)
Nature related	Humid rain (潮湿的雨水)	Tobacco	Cigarette smoke (烟味)

Table 4.6 Classification of detected smells in the Wuchang case

⁶ Zhou Hei Ya is a popular local chain shop selling cold dishes, like duck's neck, duck's wings, tofu, etc, which is a kind of snack. Zhou Hei Ya has a unique taste of spicy and sweet, which makes it very identifiable to people.

⁷ Zao Dian is a local dialect for breakfast, which includes various kinds of food, like noodles, bao zi, dumplings and so on. Zao Dian can be seen as one kind of street food, convenient, quick and simple. In Wuhan, Zao Dian is a very important local culture. Now, Zao Dian is not only just breakfast, but also a 'fast food' you can have anytime.

Similar as in the Sheffield case, Chart 4.3 summarizes the number of times that each smell detected at each stop according to people’s descriptions. Smells of waste, food and traffic were most frequently detected in the station. Contrary to the Sheffield case, smells of nature were barely detected.

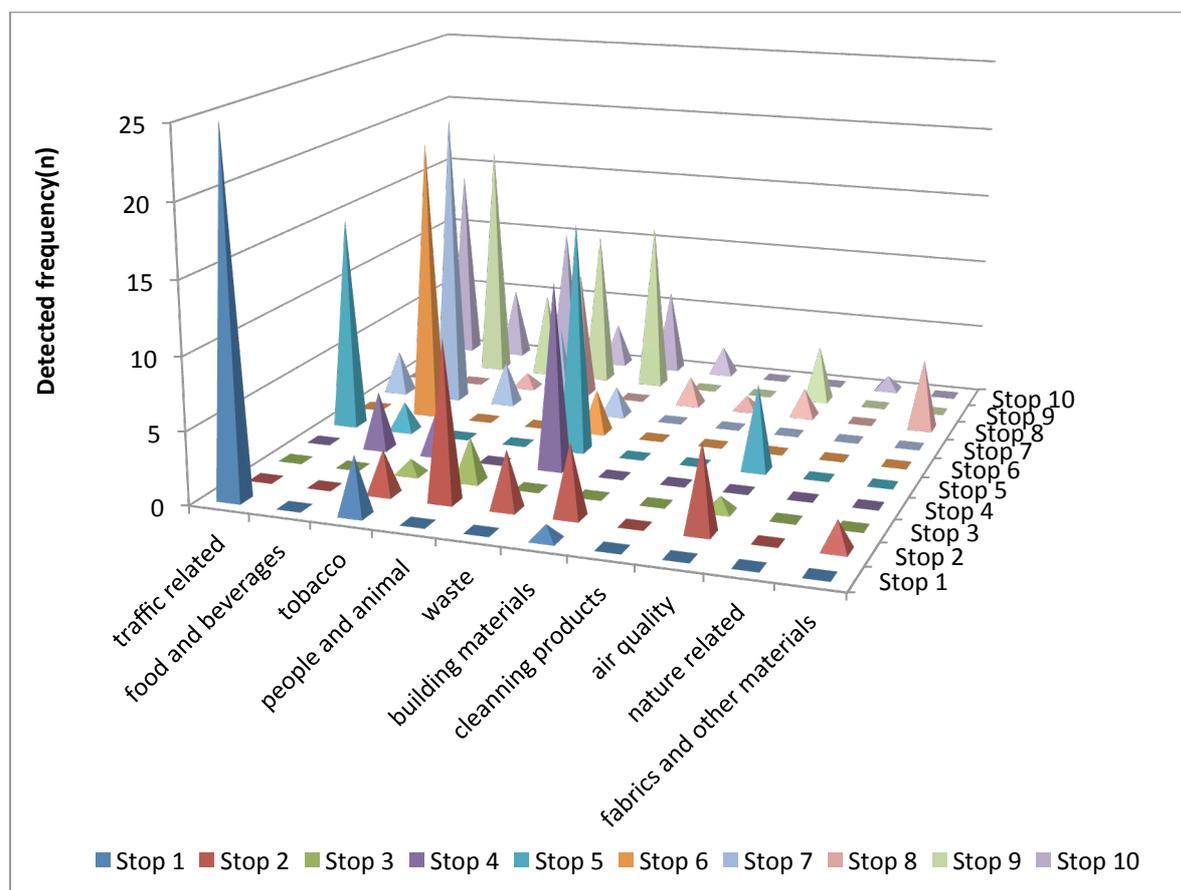


Chart 4.3 Detected smells with frequencies at each stop in Wuchang case

4.3.4 People’s descriptions of the smell environment in the Wuchang case

Smell Walk Stop 1: East Square Bus Station

The East Square Bus Station is located outdoors on East Square at Wuchang Railway Transit Centre. The smells perceived most frequently here were traffic-related smells, like car fumes, dust and petrol. Occasionally, people detected smells of cigarette smoke and dust caused by traffic. Generally, participants described the smell environment at this stop as normal urban smells. For example:

'Car fumes, dust and some smells of petrol, which you smell on the road every day. Though I don't like such smells, I am not bothered as well. (汽车尾气, 灰尘, 还有一些汽油味。怎么说呢, 肯定是不喜欢的。但是, 每天在大马路上都是这样的气味, 所以也没有特别难受的感觉。)' W16

'There is definitely some smells of car fumes, since so many buses are parked there. It is like the normal daily urban smells on the road. (这里这么多公交车, 自然是有一些尾气的味道。就是那种比较日常的城市道路的味。)' W20

Smell Walk Stop 2: Connection Tunnel

Unlike the last stop, smells detected in the Connection Tunnel were quite mixed. Smells of people and animal were more obvious in this narrow and long space. In addition, smells of humid air, building materials and waste were quite often detected. Cigarette smoke was also detected occasionally. People often described the smell environment at this stop as stuffy. For example:

'There is some rotten smell and a little bit of stuffy. Uh, I feel that the air is a bit turbid and smelly in there. (有一些发霉的味道。然后, 有一点闷闷的感觉。恩, 就是感觉空气有一点混浊, 有一点臭味。)' W02

Smell Walk Stop 3: Metro Station

Much fewer smells were detected in Metro Station but participants noticed smells of people, cigarette smoke and non-fresh air. Most people described the smell environment in the Metro Station as nothing particular. For instance:

'It seems that there is nothing particular in this Metro station at this moment. I mean there is no distinct bad smells. (这个地铁站, 我现在感觉好像没有什么味, 就是没有那种突出的臭味。)' W01

Smell Walk Stop 4: Lower Ground Waiting Space

This Waiting Space is a semi-open space located at the lower ground level beside the Commercial Zone and Transit Hall, with seats and toilet facilities. A few different smells were detected, but the smell of toilets was obvious and frequently noted. Occasionally, people perceived smells of food and cigarette smoke. Differences were found in the ways people described the general smell environment there. For example:

'Though it is close to the toilet, I don't get much smell of toilet. The air quality is quite good here, since it is open to the yard with natural ventilation. The general smell environment is not bad, much better than the last few stops. (虽然离厕所很近, 我没有闻到很浓的厕所的味。但是, 空气质量感觉还是比较好。接近露天的地方嘛。有风吹过。所以大体上还行吧。这比刚去的那几个地方都好。)' W09

'Bad smells of urine, like toilet smells, not constantly, occasionally with wind. Generally, it is not a good smell environment. (尿臭味, 就是厕所那种味道。不过并不是持续不断的, 就是偶尔一阵风吹过来就闻到了。总的来说气味并不是很好。)' W12

Smell Walk Stop 5: Internal Taxi Centre

The Internal Taxi Centre is located at the underground level, under the Lower Ground Waiting Space. The most dominant smells detected here were traffic-related smells and waste. A few people detected some food smells, too. People frequently described the smell environment at this stop as being of mixed and turbid air. For example:

'Very strong smell of petrol and some bad smells of car fumes. The air is very turbid and non-fresh with low capacity of oxygen. The smell of car fumes is very dominant here. (有很浓的汽油味。还有一些尾气排放的臭味。空气比较混浊, 不新鲜, 氧气含量太少。主要就是汽车尾气的味道。)' W02

Smell Walk Stop 6: The Commercial Zone

Catering industries are predominant in the Commercial Zone, most of them selling fast food or street food. During the smell walks, people frequently detected food smells, which were very dominant in this space. Very occasionally, people detected cooking smoke from the extraction fans. Some participants described the general smell environment as familiar and tempting. For example:

'There are some food smells, like Zao Dian. Smelling these smells, I will feel like buying something to eat. Very tempting. But, nothing bad, they are smells that you find in daily lives. (这边有一些食物的味, 像热干面啊之类的早点。闻到这样的味道, 我就会想要买点吃。没有什么不好闻的, 都是平时生活中经常闻到的味道。)' W06

Smell Walk Stop 7: The Transit Hall

The Transit Hall is located at the centre of the lower ground level, connected to all transit and service spaces. Like the Commercial Zone, the Transit Hall is also dominated by food shops and restaurants, like McDonald's and Zhou Hei Ya. For example:

'A lot of food smells. The smell of Zhou Hei Ya stands out, maybe it is just me, hah, I like the smell of Zhou Hei Ya very much. It is a very popular local food and very familiar to me. Uh, I can also smell some fast-food, like deep fried chicken. (很多食物的味道, 周黑鸭的味道很明显, 可能是因为我比较爱吃周黑鸭吧, 哈哈。很多人对这个味道都会比较敏感, 或者说熟悉吧, 这是武汉的一个特色。我还闻到一些快餐的味道, 比较像是炸鸡块。)' W12

However, the Transit Hall is much more crowded with large numbers of people coming out from the west railway exit. Participants perceived mixed types of smells at this stop. Food smells were the most frequently detected, but smells of people, waste, cigarette and traffic were also noted several times. The overall smell environment was frequently described as mixed and crowded. For example:

'Mixed smells, nothing particular. Still, smells of sweating from people, car fumes from the buses over there, and some smells of food. (还是混合的味道。没有什么特别突出，人身上的汗味啊，还有那边公交站飘过来的汽车尾气的味道，还有有就是一些食物的气味。)' W08

'There is not enough airflow. It is a mixed smell of petrol, people, cigarette and food. But nothing dominant, just mixed. (空气不是很流通。有一种混杂的味道：汽油味啊，人味啊，烟味啊，食物啊，不过都不明显，混在一起了。)' W06

Smell Walk Stop 8: Station Ticket Hall

Up on the ground level, the Railway Station Ticket Hall is located next to the waiting concourse. It is an enclosed space with an opening towards the West Square. There are 18 counters open all day to meet passengers' demands. An automatic ticket machine area is located separately in the Transit Hall. The general smell environment at this stop was dominated by smells of people and their luggage. A very few participants detected other smells of cigarette, air conditioner and cleaning products. Some people described the smellscape as not fresh in general. For example:

'Smells like the air conditioner. Basically, the air quality is not bad, except there is a rotten smell. Probably, it is because of the weather. (感觉有一股空调的味道。基本上空气质量还是不错的，但是，有一点那个发霉的味道，可能是这个天气的缘故吧。)' W08

Smell Walk Stop 9: The Waiting Concourse

The Waiting Concourse is also enclosed with an opening towards the West Square. It has two floors with a high roof. Platforms are located on the other side of the Concourse, and people are only allowed to go to platforms 15 minutes before train departure times. Facilities, like toilets, shops and restaurants, can be found within the Concourse. The most dominant smells detected in the Concourse were smells of waste and people. Smells of cigarette smoke and certain food were also frequently detected. Some people perceived smells of non-fresh air.

Mostly, people described the smell environment in the Waiting Concourse as mixed smells and lack of ventilation. For example:

'Very mixed smells, like smell of instant noodles with toilet smells, body odours, very unpleasant. If there is only smell of toilet or instant noodles or body odours, it won't be so unpleasant. When they mixed up, it is terrible. Besides, it is very crowded here, and hot, and stuffy, and unventilated. I really don't like to be in here. (有一种很混杂的味道, 像是泡面加厕所再加汗臭味, 特别不舒服。其实, 如果只有厕所的臭味, 或者泡面的味道, 或者汗味也还好, 混杂在一起以后就特别难闻。而且, 这里特别拥挤, 很热, 也很闷。空气流通不好, 我很不喜欢待在里面。)' W12

Smell Walk Stop 10: West Square

The last stop, West Square is a large-scale tiled open space with some greenery and benches, located in front of the main station entrance. This stop was observed as one which many people used for waiting when it was not wet outside. Many activities take place there, like street businesses, eating and smoking, and private cars are allowed to drop off passengers there. Participants at this stop frequently detected smells of cigarette smoke, traffic and waste. The smell environment was considered a bit complex. For example:

'This is an outdoor space, which should have a better air quality. Occasionally I can smell some cigarette smoke. Smoking is not banned here, you can see many people smoking around. Also, I do smell some car fumes from those cars, come and go. (这个地方, 完全露天, 整体空气会好很多, 但是偶尔会飘来香烟的味道。因为这里是不禁止吸烟的, 到处都有吸烟的人。然后, 来来往往有接送朋友的汽车, 会有一些汽车尾气的味道, 一阵一阵的。)' W04

'Outdoors, though I can smell some car fumes, smells of people and relevant activities are dominant, like sweat, cigarette smoke, perfume and food. (这是个室外空间, 虽然还

是可以闻到一些汽车尾气的味道。我觉得还有就是那种人聚集的味道吧：汗味，烟味，香水味，食物的味道。)’ W18

Occasionally, people detected smells of people, food, rain, building construction and materials. Some people described the perceived smellscape on West Square as normal urban smells in cities. For example,

‘The smellscape here is OK to me, very similar to the normal smells perceived on the road. The Square is next to a busy road. Well, the air quality in Wuhan is not good in general. Today is stuffy, which also affects, I think. (这里，这个气味还好吧，比较接近这个正常城市路边的空气的味道吧。对面就是马路了，车来车往的。武汉的空气质量本来也不是很好，现在也比较闷热。)’ W06

Summary

It can be summarised that the smell environment in the Wuchang case was dominated by mixed smells of traffic, food, waste and cigarette smoke across all stops. Air quality were frequently described, i.e. stuffy, stale and polluted. Meanwhile, the crowds of people were found as a distinct feature in the Wuchang case, producing behavioural smells, i.e. smells of instant noodles, smelly feet and sweating. Such smells were very different from the Sheffield case and made the overall smell environment in the Wuchang case more complex and unpleasant.

4.3.5 People’s descriptions of smellscape pleasantness in WRTC

As in Sheffield, participants in the Wuchang smell walks were asked to do a smellscape pleasantness scale-rating survey at all stops. The data has been converted into Chart 4.4, which demonstrates the average rating (mean value) of smellscape pleasantness and the variation of people’s ratings (error bar indicating standard deviation around mean) of smellscape pleasantness at each stop in Wuchang. From the mean values, it can be concluded

that the overall smellscape quality in Wuchang Railway Transit Centre was rated as unpleasant.

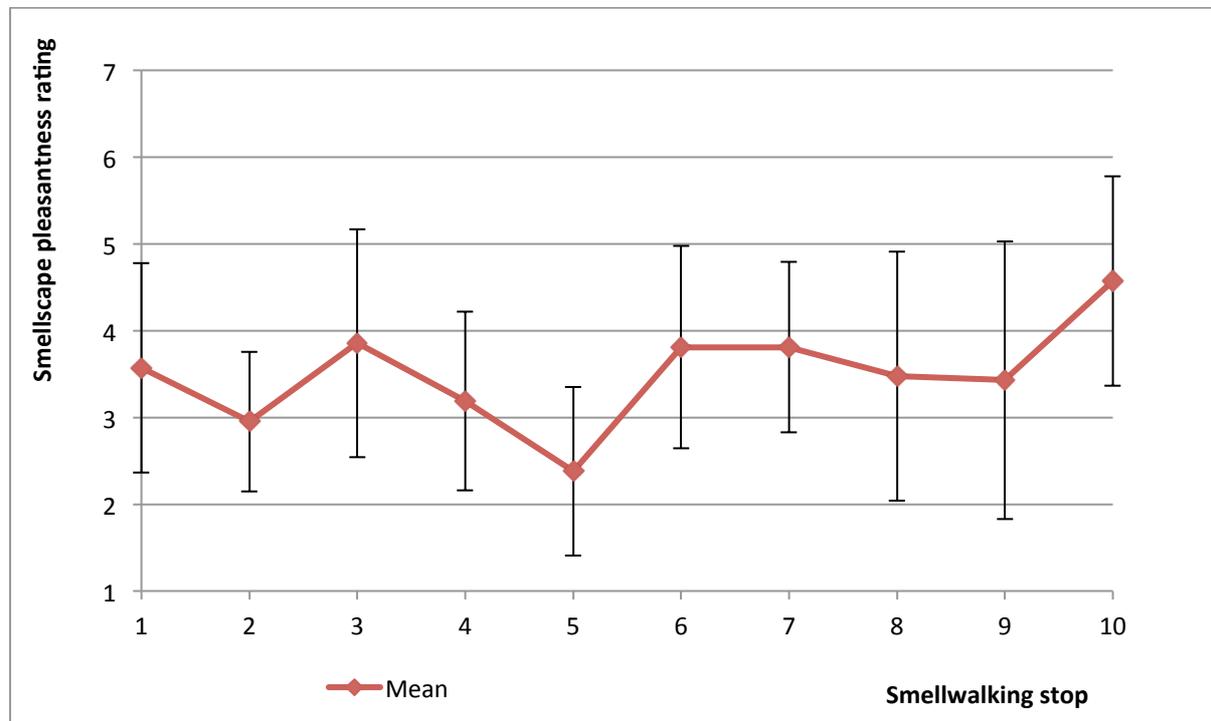


Chart 4.4 Mean value of participants’ smellscape pleasantness ratings at each stop in the Wuchang case, with error bars indicating standard deviation around the mean

Comparing mean values of pleasantness ratings at all stops, most participants felt the smellscape on West Square was more pleasant than any other places on the walk. In their descriptions, most people used words ‘not bad’ and ‘good’ to describe the smellscape quality on West Square. The surrounding environment and people’s behaviours on West Square were often included in their rationales for it being ‘not bad’ or ‘good’. For example, one participant said:

‘It’s not bad. There are too many people in the station, but too few waiting spaces and seats. Look, places with seats are all full of people. The smell environment is no good. And there are various kinds of people passing through who make me feel unsafe. (这个还行，火车站还是人太多了，提供的休息场所太少了，座位也少，你看这里，有座位的地方都积满了人，那个味道不好闻。然后来来往往的人特别多，也不是很安全。)’ W04

As described, there are some planting and landscape elements on West Square, such as bushes, trees, flowerbeds and benches. These elements were found to have a positive influence on people's perceptions of the overall smell environment. For example:

'With these plants, I feel the air quality and smellscape here will be better, at least psychologically. (我觉得心理上的吧。因为多了这些植物, 我感觉这里空气质量会比较好一些。嗅觉上也会好很多。)' W01

The smellscape at the Metro station, Commercial Zone and Transit Hall were rated nearly neutral. The smellscape in the Metro station was frequently evaluated as 'no smells/nothing really/nothing particular' or 'good'. Unlike the other stops, only a few smells were occasionally detected in the Metro station. However, the ratings fluctuated, ranging from very pleasant to very unpleasant. People who gave a low rating were influenced by their preconceptions of unpleasant smellscapes in underground spaces. For example:

'Generally, smellscapes in underground spaces are not very good. In particular, when there are many people in a warm weather, you can smell the mixed smells from people. Very unpleasant. (一般来说地下空间的嗅觉环境特别不好。特别是人多, 很热的时候, 人身上各种气味交叉, 很难受。)' W20

However, in the Commercial Zone, where the dominant smells detected all related to the catering environment/activities, most people used words 'it depends' when evaluating the smellscape. In this case, people valued most the appropriateness of the perceived smellscapes for personal and physical contexts. For example:

'I think this smell environment quite pleasant, probably because I feel a bit hungry now. If I was very full, I would feel unpleasant be in this smell environment. (我现在可能是有点饿, 所以觉得这样的嗅觉环境比较好闻; 要是我现在很饱, 闻到这样的气味, 就不是很舒服。)' W04

Compared with the Commercial Zone, more smells were detected in the Underground Transit Hall, resulting from various kinds of smell sources, like people, restaurants and cars. People frequently described the smellscape in the Underground Transit Hall as “mixed smells”. Similar descriptions were also found when evaluating the smellscape of Railway Station Ticket Hall and Waiting Concourse. People seemed to dislike mixed smells in an environment. The purity of smell environment could be a factor that influences people’s evaluations. For example:

‘Honestly, I don’t hate food smells. But when they are mixed with car fumes, I found it really unpleasant. I would like simple smell environment which won’t mix good smells with bad ones. (本来我并不讨厌食物的气味的，但是跟汽车尾气的气味混在一起，我就觉得很难闻了。我觉得这里的嗅觉环境简单一点会好很多，不要把好的跟不好的气味混在一起。)’

W13

People’s evaluations of smellscape pleasantness at the East Square Bus Station, Railway Station Ticket Hall and Concourse were similar in finding them slightly unpleasant. When evaluating the smellscape of the East Square Bus Station, people frequently used words like ‘all right’, ‘not bad’ and ‘no particular feelings’. The smell environment at this stop was considered normal and non-intrusive, as commonly perceived in urban environments. People were used to such smellscapes and consider it a background level. For example:

‘I am used to this kind of smell environment. It’s not something that makes me feel so unpleasant. And I can feel the wind there. It’s all right.(感觉习惯了。没有什么特别不舒服的感觉。这里毕竟是室外，有风吹过去。还行吧。)’ W07

‘It’s ok, no particular feelings. It is just what you can smell everyday in cities, traffic. But, it is nothing bad or good. (还行吧。没有什么特殊感觉，就是平时城市里到处能闻到的，汽车味什么的，也没有什么好不好闻的。)’ W12

People's evaluations of smellscape pleasantness in the Railway Ticket Hall fluctuated between 'smelly' and 'not bad'. People who disliked the smellscape there were influenced by the lack of fresh air, which was also frequently described by people in the Concourse. Both places are enclosed space and depend on air conditioning systems. The naturalness and freshness of air was again indicated as important factors in evaluating smellscapes. For example:

'Well, the smells are quite mixed. Although they have air conditioning here, I still think the ventilation is not good. Since it is an enclosed space, the air quality here can't be as good as outdoors. So is the smell environment. (怎么说呢，气味比较混杂，虽然有空调，但是就是感觉气流不流畅，因为这个四面都是封闭的，就跟那种露天的空旷的操场的感觉肯定是不一样的。空气质量没有那么好，嗅觉环境也不可能很好。)' W09

The physical environment in the concourse is similar to the Ticket Hall, accommodating large number of people in an enclosed space. People's ratings were generally very similar at these two stops - a bit unpleasant. The Concourse differed from the Ticket Hall, and the smells detected were more various and mixed. When evaluating smells, people were highly influenced by the crowded environment and other people's behaviours. For example:

'It is still the smell of air conditioners. The air quality is similar to outdoors. But, the smellscape is very chaotic in general. I don't know whether it is the smell of people or smell of rubbish or smell of food that makes it worse. The smell is so mixed. This concourse is just a huge box, where the ventilation definitely won't be so good. The air conditioning system, at least, makes no difference from the perspective of the smell environment. (还是那种空调的味道，空气质量跟外面没有太大差别。总的感觉很乱，不知到是人的味道啊，还是生活垃圾的味道，还是食物的气味，反正就是那种很混合的气味。这个大厅就是一个大棚子，你就知道这个空气流通性有多差。这个空调有也跟没有差不多，嗅觉上感觉没有起到什么改善作用。)' W08

The smellscape of the Connection Tunnel and Underground Waiting area were similarly rated as unpleasant. People used words ‘stuffy’, ‘dirty’, ‘crowded’ and ‘unpleasant’ to evaluate the smellscape. They were very influenced by the air quality and spatial scale in the Tunnel. For example:

‘The space is too narrow, which makes me feel that I can’t breathe properly. It is so stuffy that gives me headache. I don’t think it is an acceptable smell environment. I really don’t like it. It is too stuffy and unventilated. (我觉得这个空间好狭窄啊，有种不能呼吸的感觉了。我觉得我的头好闷。我觉得不能给它及格也，很不喜欢这个嗅觉环境，太闷了，空气不流通。)’ W01

Compared to the Connection Tunnel, people’s pleasantness ratings in Underground Waiting area was relatively more pleasant but there were variations. People were influenced by both positive and negative elements making up the smellscape at this stop, such as natural ventilation and lighting, plants, restaurants, seats and toilet smells. For example:

‘I think nobody will like such a smell environment, particularly, in public spaces. I don’t think toilets should be so central. Though there are some trees around, they are just visually more decent, but, nothing to do with the air or smells. (我觉得应该没有人喜欢这样的气味。更何况是在这样的公共休息区域。我觉得厕所不应该修在这么中心的位置。虽然厕所周围也有一些树木，但是，这些树木更多的是视觉上的美观，并没有净化空气，也没有让气味好闻。)’ W03

‘Except the smells from the toilet, other stuff is fine with me. I would like to rest here since there is an open yard at the side. It is less depressing than the inside. And they also have trees around. (我觉得除了这个厕所的位置不是很满意之外，其他都挺好的，我还是愿意在这里休息一下的，毕竟这个旁边是露天的，没有压抑的感觉，而且这旁边还有树木。)’ W08

The Internal Taxi Centre was rated as having the most unpleasant smellscape. Most people evaluated it as ‘very bad’, ‘intolerable’ and ‘annoying’. The dominant smells of traffic and

waste were most disliked by participants. Other elements at this stop were also negatively perceived, such as poor lighting, ventilation and location. For example:

'Very bad. Firstly, these smells are very unpleasant. It is very stuffy here. Then, the lighting is not good, very depressing. And you have to hear the noise from taxi engines and people around. When waiting in such environment, I will easily be irritated. (很不好, 首先这些气味本身就很难闻, 很闷。然后, 灯光很昏暗, 很压抑。噪音很大, 出租车发动机的声音啊, 人说话声啊, 本来等车心情就很烦躁, 这样就让我感受更不好。)

)' W10

To conclude, people's evaluations of pleasantness and ratings of smellscape in Wuchang were greatly influenced by the crowded environment and other people's behaviours. People's preconceptions of and preferences for smells have significant influences on their evaluations of smellscape, and natural elements, like wind and greenery, have positive influences.. The smell-walks indicated that spatial types, scales and layout have indirect impacts on people's evaluations: participants considered the function and convenience of the physical environment when evaluating smellscape. Meanwhile, poor lighting and noise have indirect negative impacts on people's evaluations of the overall smellscape.

4.4 Conclusion

In-depth descriptions of smellscape in the two cases, Sheffield and Wuchang, have been presented in this Chapter to provide raw materials from people's own descriptions to help understand people's perceptions and evaluations of the smell environment. The Chapter started with an introduction to the selected cases, including history, functions and space layout, as well an explanation of the smell walking routes, with descriptions and photos of the physical environmental features observed.

Ten categories of smells have been detected and classified in the cases with frequencies of detecting each category of smell at each stop along the smell-walking route in each case, indicating a diversity of smell environments across different functional spaces and varied

types of smells and intensities. Traffic-related smells and cigarette smoke are found dominant in both Sheffield and Wuchang. Nature-related smells are found to be a distinct feature in the Sheffield case, while mixed smells of waste, food and people are found particular in the Wuchang case.

People's ratings and descriptions of smellscape pleasantness have been summarised, and indicate that the overall smellscape quality in Sheffield Bus Interchange and Railway Station is much better than in Wuchang Railway Transit Centre. . The mean value of pleasantness ratings in Sheffield is around 4.5, whilst in Wuchang it is around 3. People described the smellscape in Sheffield mostly as 'neutral', 'clean' and 'fresh'. In contrast, the smellscape in Wuchang was described mostly as 'stuffy', 'mixed' and 'annoying'.

The next Chapter begins to explore ways of understanding and interpreting smellscape through discussing components influencing people's perceptions of the smell environment in the studied cases.

Chapter 5: A component and perceptual model for understanding smellscape

5.1 Introduction

The last Chapter described the two smell-walks, illustrating the characteristics of smellscapes at each stop along the smell walking routes. It provided an overview of people's descriptions of the surrounding smell environment, their perceptions and evaluations. This chapter draws out components of the smellscapes and maps out interrelationships between them through different perceptual patterns, from which to construct a perceptual framework for understanding smellscape. It begins with a set of components identified as influencing people's descriptions in the studied cases, including categories of individual differences, smells and smell sources, physical environmental settings and the context. This produces a component model of smellscape in the context of urban intermodal transit spaces, which is summarised in Section 5.3. Section 5.4 discusses the perceptual patterns shaping perceivers' thinking process of the perceived components from different categories, which finally leads to evaluations of the perceived smell environment. In conclusion, Section 5.5 discusses a generalised perceptual process of smellscape derived from the studied cases to help understand and interpret smellscapes.

5.2 Components of smellscapes in two cases

Smellscapes are influenced by many aspects, like culture, context, time, people's preferences and social status and past experiences (Henshaw 2013: 26). It is essential to emphasize that the discussion of smellscape indicators has to be considered within the general context of intermodal transit spaces studied in two cases. Previous studies have confirmed that social and physical contexts are essential influences on people's experiences of smellscapes (Classen et al. 2002; el-Khoury 2006; Henshaw 2013). However, few explorations have examined specific aspects, like location, scale and built form, or within specific contexts like

intermodal transit spaces. From the initial coding and memo-writing in the two case examples, components have been derived to construct smellscapes. These components are classified into four categories: perceivers, smells and smell sources, physical environment and the context.

5.2.1 Perceivers

People's perceptions of smells are influenced by their gender, age, personal experiences, working/living environment, physiological differences and other contextual factors (Henshaw, 2013; Moncrieff, 1966). There is clear evidence that women are often more sensitive to smells than men and that the ability to detect smells decreases rapidly among older people (Schiffman, 1990). However, few studies have explored out-of-laboratory experiments in the context of function-specific spaces to see how different individual factors influence perceptions of the smell environment in a real life situation. Even allowing for the influence of gender and age in the studied cases, six components of perceivers' differences emerged to be particularly important in perceiving the smell environment within the context of urban intermodal transit spaces, as illustrated in the following discussion.

Smell preference and nuisance

'Smell preference' and 'nuisance' are found very important components of the smell environment that participants naturally brought into their descriptions in both cases. When asked of what smells they detected, people gave immediate responses when smelling their liked and disliked smells. For example, on the train platform in Sheffield:

'Coffee. I am a coffee drinker. I do quite like the coffee. It is like a nice and relaxing smell. I probably go over and buy a coffee when I smell it.' S05

From the pleasantness ratings illustrated in Chapter 4, people in both cases rated as 'unpleasant' smell-walk stops where smells of waste, traffic fumes and body odours were frequently detected, such as the railway station platform and taxi rank in Sheffield, or the underground waiting area, internal taxi centre and waiting concourse in Wuchang.

People were strongly against smells that would make them feel inappropriate to the context of their surround environment. The inappropriateness may result from various aspects, such as smell intensity, smell source and seasonal changes. For example, at Sheaf Square, people preferred the freshness of the watery smell in the warm summer, but it would only make them feel colder to smell the water outside in winter, as one participant said:

'It smells like water. I guess it is some chemicals that clean the water. It is fine, I like the smell of water, especially, in summer...The fact that you have water, it is nice. But your nose won't feel that much comfortable to have such a strong freshness in a cold winter. I always wonder they forgot that they have long winters.' S05

As well as the nuisance of waste and traffic-related smells, some people also found smells of oily and greasy food, like burgers and chips, to be a nuisance. For example, one participant described the smells of Burger King in the Sheffield Railway Station:

'I often can smell Burger King, it smells like burgers, fries and something like that. I prefer the smell of sandwiches than Burger King because it won't smell so oily and unhealthy.' S07

Although smell preference varies individually, people of the same social and cultural background may share some common preferences towards certain smells, but tend to agree more on nuisance smells (Herz 2006). In the studied cases, people seem to share similar evaluations of the nuisance smells as unclean, unhealthy and inappropriate.

Hay fever, breathing issues and nerves

In the two cases, some physiological issues emerged. For example, in Sheffield, several participants who suffered from hay fever were particularly sensitive to smells related to flowers, even though they do not always detect pollen. For example:

'It is quite nice, but at first, it was a bit over powering, but now I am used to it. But I think I am extra sensitive to flowers, because I sometimes suffer from hay fever, you know, pollen makes me sensitive to the smells.' S07

In some other cases, people are allergic to synthetic smells, such as perfume and air freshener. There is a dual interaction between smellscapes and physiological reactions in the studied cases. For example, breathing problems were particularly prevalent in Wuchang, For example:

'It doesn't smell good here and makes me feel hard to breathe. My body is very hard to adapt such smell environment. (感觉不好闻。我觉得呼吸比较困难。很难适应这样的嗅觉环境。)' W02

But even in Sheffield, a few comments about breathing problems were noted on parts of the smell walk, such as on the connecting bridge in Sheffield Railway Station and the taxi rank.

Words, such as 'hard to breathe', 'stuffy', 'fusty' and even 'vomiting', were frequently used, indicating physiological reactions to the smell environment. Because of such issues, smells in some countries are prohibited in public spaces, because certain chemicals contained in some odours can cause allergies to some people or even death (Damian and Damian 2006). Such physiological influences on smellscape perceptions are fundamental to perceivers. However, in the studied cases, there are also some positive influences found in physiological reactions to natural elements, such as water and plants, particularly in the Sheffield case. Words, such as 'soothing', 'refreshing', 'calming' and 'fresh', indicate a positive bodily response to the surrounding smell environment. For example:

'It is nice and clean, like natural smell. Uh, I can smell the trees over than other smells. It makes me happy and calming.' S05

Past experiences of travelling

As discussed in Chapter 2, odour-related memory lasts longer and has higher accuracy than other sensory-related memories (Engen 1991). The odour-related memory can also cause direct emotional responses (Herz and Engen 1996). Memories of past experiences of travelling by train or bus were found to significantly influence people's perceptions of the surrounding smell environment in urban intermodal transit spaces. For example, several people in Sheffield enjoyed the smells of diesel from trains on the platform as a result of

good experiences travelling by train, but most people in the studied cases were bothered by the smells of traffic. For example:

'I love trains and travelling by train. I like the rhythm of trains... I can't explain it fully. But I do like trains. I tolerate coaches and buses. But I just love trains. I like to smell the train, although it is also diesel and oil smell. But when I see the train or I know consciously I am in a train station, I won't dislike them [smells of the train]. I like smelling them on the platform. I expect to smell those in a train station. If I don't smell it in there, I probably think it [the train station] missed something.' S05

Travel experiences in different types of railway and bus stations in different cities or countries can also influence people's evaluations of smellscapes in intermodal transit spaces. People seem to unconsciously compare the perceived smell environment with other experienced smell environments in such spaces. In particular, people in Wuchang, where the smell environment is rated as overall unpleasant, would often compare it with the 'better' stations they have been to. For example:

'For example, in many underground stations, which are connected to a shopping mall, there is not a feeling of air pollution like in this station. It is like a feeling in a hotel, where you can smell the aromas in the air. It is probably aroma oils in the air conditioning system. But, overall, the smell environment makes you feel comfortable. (像香港那种地下商场与地铁衔接的地方，给人的感觉不仅是空气很清新没有污染，更像酒店一样，空调里面好像是有香氛或者是精油的味道。那个感觉会让你感觉很舒服。)' W21

'I used to study in Liverpool, so I went to the station quite a lot. In Liverpool, you always smell the petrol, it is stronger because there is a roof over all of the platforms, and there is only one end, kind of closed, and you go to where the shops and food is, it is kind of separate. They separate the platforms from the entrance and other parts, because it has a roof on it, you can always smell petrol and engines in it. It is a lot more stronger and warmer. It is not nice.' S07

Preconceptions and expectations

People's knowledge of smells and places are not born with whilst are learnt from later experiences and activities, including preferences (Engen 1991; Henshaw 2013). It is likely that people will more or less have some preconceived ideas of smells and places that they have known. All the participants in this study have been to at least one type of public transit space before. They come to the interview with preconceived knowledge of urban intermodal transit spaces, which influences their perceptions of the surrounding smell environment. In particular, people in both cases were found to have preconceived ideas of the concept of an intermodal transit space, associating it with heavy traffic flows and poor sanitary environments. For example, in the Wuchang case:

'Normally, I didn't pay attention to the smell environment since there would always be smells of toilet, traffic and people. I don't care for the environment in stations that much. (平时我来的时候也没有太注意过嗅觉环境这个方面。车站嘛，总有汽车尾气，厕所味。人多空气不流通。因为来车站就是候车，也不会有太多的讲究。)' W01

Such preconceptions of smells, environment and activities would send out an alert or expectation of perceived smell environment. However, when people's expectations matched the perceived smellscape, there appeared to be less emotional change that could influence their evaluations. For example, in the case below, the participant expected smells in railway stations to be unpleasant with mixed smells. The smellscape in the wuchang case actually matched his expectation, which makes it acceptable:

'The ventilation is not good. There is a mixed smell of petrol, people, cigarettes and food. It is kind of background, but mixed. Generally, the smellscape is all right, since it is in a station. Unlike other places, you can't expect more from it. (空气不是很流通，有一种混杂的味道，汽油味啊，人味啊，烟味啊，食物啊，不过都不明显，混在一起了。总的来说，还好吧，还能接受，因为本来就是车站。跟其他地方不一样，不能要求这么高。)' W06

Another example, in the Sheffield case:

'Well, it is a train station, I expected to smell the smells of trains. So, it is not that unpleasant to me, because I know what it will smell like.' S17

Visual and auditory perceptions

People's perceptions of smells are inevitably influenced by other sensory mediations, like vision and sound (Porteous 1985). Visual and auditory perceptions were found to significantly influence people's perceptions of the smell environment in urban intermodal transit spaces. For example, in Wuchang where the overall smell environment is considered as very 'mixed' and 'non-fresh' as a result of crowding (see Figure 5.1) and lack of ventilation, the noise of people and broadcasting from shops made participants feel even worse about the smellscape there. Quote one participant's description:

'It is too noisy here and too many people from various backgrounds. The smells of sweating people around me are not comfortable. The ventilation is also not good here, too. I feel a bit stressful in such an environment... (噪音太大了，人流动也太多了。

人身上的那个汗液就不太好闻，而且感觉空气不是很流通。而且这里各种各样的人都有，心里上也有一些压抑。)' W10



Figure 5.1 Crowd in the transit hall at the lower ground of Wuchang Railway Transit centre

Sense of smell is considered ‘non-spatial’, and has to refer to other sensory perceptions to identify the location, direction and type of smell sources in the space (Porteous 1985). The influences of visual and auditory perceptions on the two smellscape examples are found in four ways: interaction, distraction, disturbance and indication. Interaction with visual and auditory perceptions brings extra information and enriches experiences of the smell environment. For example, a sensory *interaction* occurred between the smellscape and visual perceptions when people walked past the greenery at the Station Path in Sheffield. An interactive sensory experience means that people are not distracted from the smellscape whilst reinforces the smell environment. Compared with interaction, *distraction* means that overpowering information offered by visual and auditory perceptions distracts people’s attention from the smell environment. However, sometimes distraction can become *disturbance*, a strong sense of annoyance and awareness of nuisance in perceivers. Disturbance of visual perceptions are often seen in people’s inappropriate behaviours, i.e. taking off shoes and throwing food waste on the floor, in reaction to unpleasant smell sources, such as trash bins, buses, cars and food waste.

Indication is when people indicate the smell environment from visual and auditory perceptions whilst not able to detect any smells in the environment. For example, in West Square at Wuchang where greenery is located a long distance away from passengers’ resting area, one participant said:

‘Although I can see the greenery in front of me, I can’t smell any plants. Psychologically, I feel the air quality is better with this greenery, which naturally makes me think of a better smell environment. If I only saw the highway in front of me with all these buildings and traffic, I would definitely feel the smell of traffic fumes was stronger. (虽然我能看到前面有一片绿化，但是，我闻不到有植物的味道。我觉得心理上的吧，多了这些植物，我感觉这里空气质量会比较好一些，如果这里没有这些植物，我看到的都是对门的建筑和马路，我肯定会感觉汽车的气味更突出，自然心理上觉得嗅觉感受会更差一些。)’W01

That is, on perceiving a nice view and pleasant sounds in the space, people would be given an indication of a better smell environment. For example, one Sheffield participant described seeing plants from a distance at the tram stop:

'You can see the plants over there that makes you feel fresher. Even I cannot smell the plants, but it does make me feel better and think the air much fresher.' S03

Often, the influences between smells, visual and auditory perceptions are two-way, which constitutes the overall experience of the smell environment, just as one participants said:

'I think we should consider in a more holistic way, our sense of smell shouldn't be isolated when thinking of the smell environment. I think it is better that we smell what matches what we see. I wouldn't like smell something that doesn't match the environment.' S18

Movements and activities

Perceivers' movements and activities were found to have an influence on their perceptions of the surrounding environment in the studied cases, which relate to how much attention they pay to the smell environment during different movements and activities. People had lower sensory detections with active movements (e.g. running and cycling) than passive movements (e.g. sitting and standing) (Chapman et al. 1987). Involvement in active movements distracted people's attention from smells, resulting in lower sensory detections (ibid). For example, most people interviewed had experiences of feeling less influenced by the surrounding smell environment when they were in a rush, running or fast walking to platforms and exits:

'Normally, I come to the station in a rush. I won't pay any attention to the smell environment when I am in a rush to platforms, unless there is a distinct smell. (平时来火车站都很匆忙，着急赶路。没有注意过这些气味，除非有很刺激性的气味。)' W10

Participants knew the purpose of the research, which made them pay attention to the smell environment during the smell walks. Thus, participants generally all found themselves to be

noticing more smells during the smell walks than in their actual daily experiences. For example:

'You know when I am walking I don't really take notice of smells. I just take care about the surroundings, what I see, you know. So, now, when you tell me to smell something, it's more different... Normally I just take notice of the scenery but not the smells.' S08

Even when not actively moving, as when sitting, people can have different activities, e.g. eating instant noodles, people watching, smoking, reading newspapers and talking on the phone. People's attention to the smell environment in this case is also related to their activities. For example, one participant in the Wuchang case responded to the detected food smells in the Underground Transit Hall:

'I think it depends on what kind of activities I am doing. If I am going to eat now, it would be nice to have such food smells. But, if I just want to wait in a clean and neutral environment, I won't want to smell any other smells. If I detect smells that makes me uncomfortable about what I am doing, I would definitely change place. (我觉得这个要分情况，这个跟我在干什么有很大的关系，比如我去餐厅吃饭，我闻到食物的气味我是很开心的，但是有时候我想要干净的舒适的等待的环境，我就不期待有很多异味的情况发生。要是闻到那种不舒服的气味，我肯定就会选择另外的地方休息来避开这个气味。)' W14

5.2.2 Smells and smell sources

Smells and smell sources are core components of a perceiver's smell environment. The type, location and scale of smell sources influence the nature of a smellscape (Henshaw, 2013). Drawing on data presented in Chapter 4, smells of traffic, food, cigarette smoke and people are frequently detected in both cases, while smells of natural elements are only found frequently in the Sheffield case. Some of these smell sources are fixed on site, like cafés, trees and water features, while others are flexible, like smokers, trains and buses. This

Section discusses four major categories of smells and smells sources in studied cases that influence people's perceptions of the smell environment in urban intermodal transit spaces.

Traffic-related smell sources

The nature of intermodal transit spaces is commuting among different transport means, such as trains, buses, cars and trams. Traffic related smells and smell sources are essential components of the smell environment in such spaces. In the studied cases, cars, trains and buses are found dominant on site and mostly powered by petrol and diesel. Smells of petrol, car fumes, trains, oil, dust, diesel and pollution, were frequently detected and described in both cases. People generally had a negative attitude towards a traffic-crowded environment and associated traffic with pollutions and poor air qualities. Even visual detections of large flows of traffic were found to have a negative influence on people's perceptions of the surrounding environment, indicating smells of traffic and traffic pollutions. For example:

'I can sense a machinery, like oily sort of smell. I am not sure whether it is coming from the inside of the station or it is the cars on the outside... It's unpleasant. I don't like to smell such things. It makes me feel unhealthy, because it associates with pollution.' S06

However, some people thought it acceptable to smell diesel from trains on platforms and car fumes on taxi ranks, which matched their expectations and the physical contexts. When close to urban roads or in open outdoor spaces, people generally had neutral attitudes towards traffic-related smells. Descriptions, like 'normal urban smells' and 'used to' were given. People tended to have more tolerance of traffic-related smells in intermodal transit spaces as a result of their habituation to such smells through everyday experiences in cities. For example:

'I detected the smells of buses and smoke from buses, smells like, maybe petrol. Uh, not petrol, it is just smoke. It is a normal city smell. To be honest, I have no particular feelings about it because I grew up in a city, I am used to it. I think it is not a nice smell to some people, but to me it is neutral. It could be nicer without the smoke. But, I think I am just used to it.' S09

Comparing the two cases, a dispersed transit model integrated in the urban road network like Sheffield, is more likely to have a continuous smell of traffic because people are more frequently exposed to urban environments with large traffic flows. For example, along the walking route from Sheffield Interchange to Sheffield Railway Station, there are two stops where people have to cross the busy motorway, encountering buses, cars and other vehicles, as shown in Figure 5.2. Traffic-related smells were detected almost at all stops across two stations, as illustrated in Chapter 4. However, in the compact model of Wuchang Railway Transit Centre, traffic-related smells were found at places where transport modes could be accessed, such as West Square and the Internal Taxi Centre.



Figure 5.2 People who are waiting to cross the road from the Station Path to the Railway Station in Sheffield

There seems a conflict between the function of intermodal transit spaces and having less traffic and fewer traffic related smells in such spaces. Professionals interviewed suggest that fuel sources for trains and cars, such as diesel and petrol, can be replaced by cleaner power, like electricity. For example:

'Actually, this is quite different from other European countries, even from Italy. Cozmost of trains here are with diesel engines, while, in other countries, trains are normally powered by electricity. So, you don't actually smell this gas. It is better. They probably should electrify trains in the UK.' S12

Food-related smell sources

Smells of food were frequently detected in both cases, as illustrated in Chapter 4. Most people enjoyed a background level food smells in concourse and catering spaces. Descriptions of 'tempting', 'inviting' and 'familiar' were given to such smells, particularly when people were hungry. Most people felt quite familiar with the surrounding smell environment when they detected food they often eat or they like. As Henshaw (2013, p.85) argues, food plays an essential role in people's daily experiences in cities, and forms an important part of a city's smellscape. In this sense, it is arguable that people in a given culture have similar preferences towards food. For example, Sheffield participants enjoyed smells of coffee and sandwiches from cafés, but psychologically and physiologically disliked meaty and oily smells:

'I can smell coffee, sandwiches, toast, uh, not toast, but like warm food. It is very nice, very tempting, hah, it is like a pleasant smell, welcoming... I am a coffee drinker. So I do quite like the coffee. Uh, it is like a nice and relaxing smell. I probably go over and buy a coffee when I smell it. Well, it kinds of making me walking through the direction towards it. Uh, it is different from the pasty shop smell, it is also a nice smell, but I wouldn't go over and buy one. I can just acknowledge it is there, it is a pleasant smell but not overpowering.' S05

The catering environment in urban intermodal transit spaces is characterised by fast and convenient food outlets, such as McDonald, KFC and Burger King. According to observations at both sites, restaurants and food stalls are usually located where large flows of people pass through or where they wait. In Sheffield, cafés and shops are mainly located on the Station Concourse and on the platforms, as shown in Figure 5.3. In Wuchang, food stalls and restaurants are very dominant and can be found across the waiting and commercial spaces, as shown in Figure 5.4.



Figure 5.3 Café located in the centre of Sheffield Railway Station Concourse



Figure 5.4 Restaurants and food stalls around waiting spaces in the lower ground Transit Hall in Wuchang Railway Transit Centre

Different types of food were found to be important in people's perceptions of the smell environment. There is a big difference between food types in two cases. In Sheffield, the main type of food is pre-made food, such as sandwiches and bread, which can be eaten cold or warmed in microwave, producing fewer smells; whereas in Wuchang, food is preferred hot and is mainly prepared on site by stir frying, frying and boiling with various spices, producing more smells with heat. Wuchang participants enjoyed smells of local food and considered them as smell marks of the city and station, such as Zhou Hei Ya (see Figure 5.5) and Re Gan Mian⁸. Smells of such local food have a great attraction to people in the station.



Figure 5.5 Zhou Hei Ya shop opened towards the Transit Hall at the lower ground level of Wuchang Railway Transit Centre

For example, one participant described his feelings of smelling Re Gan Mian in the transit hall at Wuchang Railway Transit Centre:

'I also smelt Re Gan Mian, the smell of sesame sauce and sesame oil. Whenever I smell this, it makes me happy and satisfied. I know it is not a good description. But, it

⁸ Re Gan Mian is a local food in Wuhan, made of noodles, sesame sauce and sesame oil. Rather than put boiled noodles in soup, it mixes noodles in sesame sauce and sesame oil, which gives a strong and distinct smell of sesame.

is just like that kind of feeling. You cannot smell it anywhere else apart from Wuhan. Normally, on my way to work in the morning, I will definitely be attracted to buy one when smelling this. (还有热干面，芝麻酱的味道啊，香油的味道。闻到这种香味，会让我心里很饱满，那种很幸福的感觉，这个不是很好措词，但是就差不多这种感受了。热干面这个气味那是别的地方都闻不到的，只有武汉有。如果是平时的话，特别是早上上班的路上，很饿的话，闻到这个味道，那我肯定会毫不犹豫地冲上去吃一碗。) W15

In general, people tended to have a more positive attitude towards pure or unmixed smell environments. When food smells are mixed with intrusive and unpleasant smells, such as smells of traffic and waste, people no longer find food smells pleasant. For example, one participant in the Wuchang Railway Station concourse commented:

'The smells are very mixed. It smells like instant noodles with smells of toilet and people sweating. It is very unpleasant. Actually, either smell of toilet, instant noodle or people sweating, smells ok on its own. But, it smells extremely unpleasant when they mixed together. (有一种很混杂的味道，像是泡面加厕所再加汗臭味，特别不舒服。其实，如果只有厕所的臭味，或者泡面的味道，或者汗味也还好，混杂在一起以后就特别难闻。) W12

Similar conflicts of smells and people's activities were found in the Sheffield case, as one participant said:

'I think if you are waiting around, you just want neutral and non-intrusive smell environment. I think it is probably something that is very much background. But just sort of smells that imply cleanness and also maybe warm and inviting... if you are not actually eating food it is not as pleasant as when you are eating.' S01

People-related smell sources

As described in Chapter 4, the smell of people were among the most frequently detected smells, as one distinct feature of intermodal transit spaces. People as smell sources can be categorised in two ways: the body and activities. The most common and frequently detected

smells from ‘the body’ were ‘body odour’, ‘sweat’, ‘perfume’, ‘shower gel/shampoo’ and ‘smelly hair/ feet’. Participants generally showed positive attitudes towards light smells of ‘perfume’ and ‘shower gel/shampoo’, which are associated with clean bodies. In contrast, other ‘body’ smells were disliked and associated unclean bodies. For example, one participant said:

‘... it smells like shampoo or similar, I feel clean I suppose. It will make me think people washed themselves and put on clean clothes.’ S04

In intermodal transit spaces, the influence of people’s activity-related smells were significant, particularly eating and smoking. Most smoking was found at entrance areas in the Sheffield case, such as outside the doors to Sheffield Railway Station Concourse. In this case, cigarette smells came into the concourse constantly through the doors. However, the smell of cigarettes was detected both indoors and outdoors in the Wuchang case. Overall, participants in both cases considered cigarette smoke negative to the smell environment. Most participants were annoyed by others smoking around them. For example, one participant in Wuchang commented:

‘I don’t like smelling cigarettes and I don’t smoke myself. So, I really hate people smoking beside me. The smell of cigarette smoke itself is not nice. But taking in second hand smoke is very bad for the health. (我不喜欢闻到烟味。我自己本身也不抽烟，也讨厌别人在我旁边抽烟，本身烟的味道就不好闻，然后吸二手烟对身体健康很不利。)’
W01

‘I can smell people smoking cigarettes. It is not a very pleasant environment for smellscape... smoking is not allowed in the closed space. After a while, when you come out from the indoor space, you smell the cigarettes, it becomes quite annoying. But this is not something you can prevent from happening.’ S13

Particularly in Wuchang, crowds were observed and experienced during all the smell walks, which strongly influenced people’s perceptions of the overall smell environment. In this case, people were in close proximity to each other and were more affected by other people’s

inappropriate behaviours, such as lying around with shoes off, eating instant noodles, smoking indoors and throwing rubbish on floors, as shown in Figure 5.6.



Figure 5.6 People waiting on the benches outside the Waiting Concourse on West Square in the Wuchang case

The influence of crowds was more obvious in places where people stayed and waited, like the West Square and Waiting Concourse. For example:

'This smell environment is very unpleasant. It is too crowded with people coming from all directions. The smells are mixed and mostly unpleasant. You can see people eating instant noodles and Zhou Hei Ya everywhere. And some people are even smoking there. It makes me very unpleasant. (我觉得这个嗅觉环境很不好，这里人特别多

特别杂，很拥挤，味道比较复杂，不好闻的气味偏多。你看很多人在里面吃东西，泡面啊，鸭脖子啊，还有抽烟的。感觉不舒服。)’ W14

Cleaners and street sellers move around in stations, bringing temporary smells. Figure 5.7 shows a cleaner in the Sheffield case with his trolley of all the cleaning tools and products on the platform. On seeing this, the participant said:

‘I can probably smell something like chlorine. I can smell that they may just cleaned the floors or from the trolley. A little smell of that. It is quite clean.’ S12

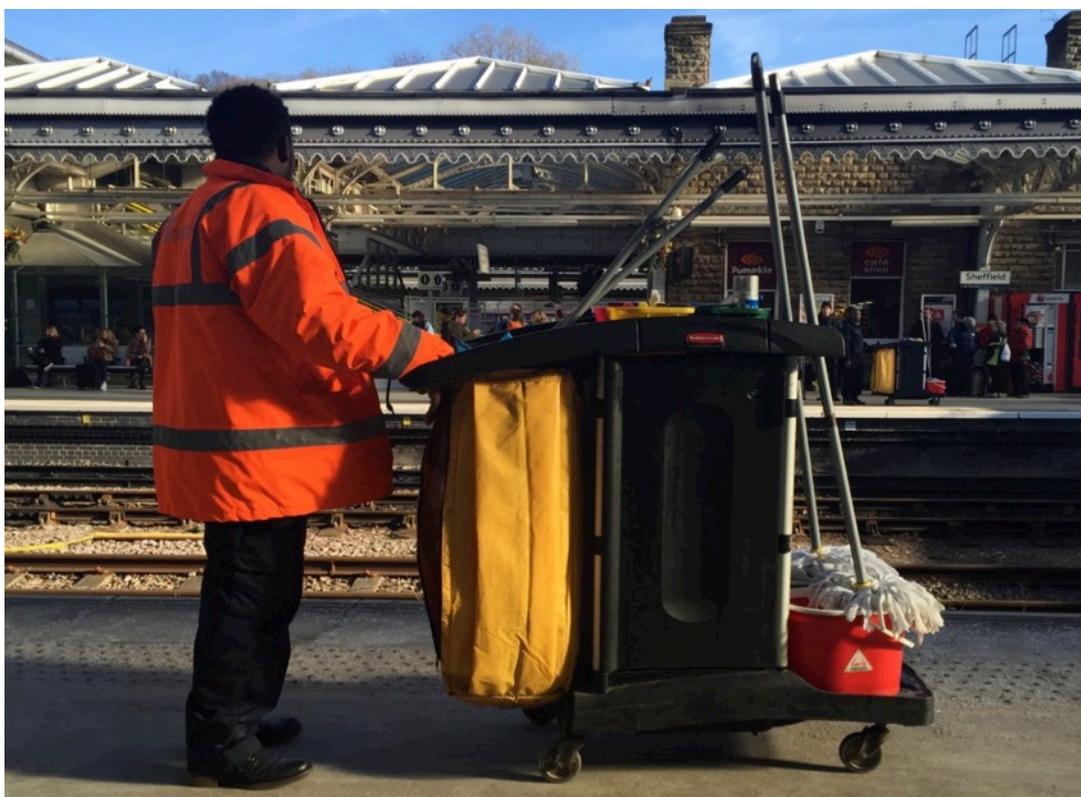


Figure 5.7 A cleaner on the platform with his cleaning tools in Sheffield Railway Station

On the West Square in Wuchang, one participant described her experience influenced by the smell from street sellers (see Figure 5.8):

'Sometimes, I smelt cooked corns from street sellers and some other food, like pineapple and tofu screws. It is a good smell. (偶尔还会闻到一些小摊贩卖的蒸煮的玉米的香味。还有一些小商贩卖别的食物，臭豆腐啊，菠萝啊之类的小吃，也会有一些香味。)' W17

The activities by cleaners and street dealers were an influence on perceptions of smellscapes in addition to other passengers' behaviours, smellscapes in intermodal transit spaces.



Figure 5.8 Street dealers chatting with passengers on the West Square at Wuchang Railway Transit Centre

Waste-related smell sources

Smells of waste were significant negative influences on people's perceptions of the overall smell environment. Unlike the traffic-related smells discussed earlier, all participants expressed a strong dislike of waste related smells. In Sheffield, the smell of waste was not found to be a dominant factor, but people occasionally detected some smell of 'bins' in Sheffield Interchange and 'toilets' on Railway platforms, which had a negative influence on the smell environment:

'The smell here is quite pleasant, except from the bin,'coz, we are pretty close to it. But, there is no nasty smell, no scented smells coming out, no horrible smells neither. It is just like I am walking around my house, nobody cooked anything. It is non-existent. You don't get the feeling: oh I can smell fish we had last night, or I will start to think what that smell is.' S06

In Wuchang, smells of waste were found to be dominant and were frequently detected from trash bins, toilets and sewage. For example, at the Lower Ground Waiting Area, one participant described:

'There is some food waste near the trash bin, like unfinished noodles, kind of rotten, very smelly. ... It is very close to the toilet, too smelly. Although they put some plants there, it doesn't help or look good. (垃圾桶附近有些没有及时处理的食物垃圾，像吃剩的面啊什么的，那种发霉了，馊了的味……这里离厕所这么近，太臭了。外面虽然做了一点绿化，一点作用也没有，也不美观。)' W06

However, in some corners in the Sheffield case, smells of waste and trash can still be detected:

'You know, when we are on the platform someone just opened the backdoor of Burger King, the smell of rotten food almost made me vomit. And when we get out of the station, the cleaner parked the trash bin there, again, I smelt the rotten food. It is easy to smell something like that in the summer, if they don't hide them well.' S10

Nature-related smell sources

Natural elements, such as plants, grass, water and soil, were found to have significant positive effects on people's perceptions - both visual and olfactory - of the smell environment in the studied cases. Particularly, smells of vegetation and water were frequently detected and formed a distinct feature in the Sheffield case, such as 'plants', 'vegetation', 'wet soil', 'fresh air' and 'water'. Positive emotional responses were indicated by descriptions given to such

smells, such as ‘relaxed’, ‘happy’ and ‘pleasing’. Figure 5.9 illustrates the scene at the Station Tram Stop, where one participant described their feelings on smelling the vegetation:

‘Now, I can smell flowers and grass in the air, a little bit. It is a very nice smell. You know, another thing about the tramline is that you don’t smell the oil like the trains, it use electricity as power. Yeah, I can smell the trees, too. The wind is coming towards my face. A very nice feeling.’ S04



Figure 5.9 View of the Sheffield Railway Station Tram Stop and its surrounding vegetation

Particularly, in Sheaf Square, most participants were positive towards the water feature and the naturalness brought by it. Quote one participant’s description at this stop:

‘It smells like the water, maybe it is not the water. But I can sense the humidity in the air. It makes me feel fresh and nice. You kind of share the energy with the running water, which make me feel good and energetic...’ S16

In Wuchang, although large-scale vegetation is found on both Squares, it is not well integrated into people’s routes in the station. In this case, people barely noticed smells from

the plants, and the visual impacts of the greenery influenced their perceptions of the overall smell environment. For example:

'There are some green plants, which make me feel a bit refreshed and think of nature. It will make me feel better and ignore the other awful smells. (这里有一些绿色植物, 感觉还是让人觉得清爽一些, 会使人联想到一些自然环境, 会让人心情比较好, 可能就不会那么去在意这个不好闻的气味了。)' W09

The positive influence of natural elements on people's perceptions of the smell environment mainly comes from the freshness and cleanness associated with them. From people's descriptions, there is a demand for more natural elements in such spaces to enhance the smellscape, such as small-scale greenery in concourses or on platforms, more trees on Squares and some flower baskets in waiting area:

'I think it is good to bring greenery into transit spaces. they have some containers of plants in the concourse, which makes it more lively. But they need to be more or better plants.' S18

5.2.3 The physical environment

This Section discusses nine physical environmental components which influence people's perceptions of the smell environment, by comparing different built forms and environmental settings drawing on the walks and interviews. It starts with the layout of functions and spaces at different scale levels, which provides a structure of other elements involved in the physical environment.

Layout at three scale levels

The layout and functions in the intermodal transit spaces influenced people's movements and the sequence in which smells were perceived. Henshaw (2013: 172) suggests exploring urban smellscape at three levels: macro, the cityscape; midi, the district level; and micro, the street scale and the influences of layout can also be analysed at three levels: the macro level - how

different components and spaces of the transit centres were arranged in relation to the city scale; the midi level - how a series of spaces were arranged within the whole of the centre itself; the micro level - different components were arranged in, and shaped, a single form of space.

At the macro level, Sheffield Railway Station and Bus Interchange is a dispersed model with a sequence of indoor and outdoor spaces, which makes it possible to provide a more refreshing environment and have a repetitive feature of natural elements. As shown in Chapter 2, there is a smell adaptation effect in which most people, having been in a room for a few minutes, will not notice the smells they detected at first (Moncrieff 1966). But they will be refreshed and able to notice the smells again after walking out of the room to an outdoor space and coming back in. In this sense, the variety of indoor and outdoor environments in the Sheffield case helps people refresh their sense of smells when walking through the various stops. However, in Wuchang Railway Transit Centre, all spaces are arranged in a single building where people's routes from one space to another are within the building itself. There is not such a refreshing effect as in the Sheffield case.

At the midi level, within buildings, the layout of different functional spaces has a strong influence on the sequence of smells along people's routes. In Sheffield, spaces are more organised and provided with signs to direct people to different functional spaces, and participants less frequently described the smell environment as 'mixed'. In Wuchang case, the midi level layout at each vertical level is well organised with clear signs and different functional spaces are not well separated, which creates perceptions of a 'crowded', 'mixed' and 'unpleasant' smell environment.

The micro scale layout defines the distances between perceivers, smell sources and people's activities within each functional space. Chapter 7 presents more detailed discussions of the influence of layout with different physical elements at the three levels, to support design suggestions for improving the smellscape quality of the studied cases.

Ventilation and air quality

The movement of air determines the duration and strength of smells people can perceive in a space. Ventilation and airflow in a space produce the movement of smells. As shown in

Chapter 4, air quality emerged as one category of people's descriptions of smells from descriptors such as 'fresh', 'healthy', 'clean', 'polluted' and 'poor air quality'. It indicates consensus among people that air quality is an important component of the smell environment. One key factor of air quality is the ventilation conditions. Participants considered ventilation conditions as prior elements for having good air quality and smellscape pleasantness. For example, in the Wuchang Railway Concourse, a participant noted:

'There is a very mixed smell... very crowded and warm here. It is stuffy, with poor ventilation inside. I really don't like it. (有一种很混杂的味...这里特别拥挤, 很热, 也很闷。空气流通不好。我很不喜欢待在里面。)' W03

Good air quality, from people's descriptions in the studied cases, involves continuous airflows, fresh air exchange and a comfortable temperature. In understanding urban smellscape, Henshaw (2013: 170) suggests airflow as a key factor, but it is difficult to control airflows in the urban environment. In urban intermodal transit spaces, the main functional spaces are mostly indoors. In this case, ventilation can be controlled with opening and closing windows or operating mechanical ventilation systems. However, people tended to have more pleasant perceptions in spaces with more openness to allow natural ventilation. As shown in Chapter 4, people generally rated outdoor smellscapes as more pleasant than indoor smellscapes in both cases. In Wuchang, some people could even smell the 'air conditioning' from the mechanical ventilation inside the concourse:

'It is still the smell of air conditioning. The air quality is not as good as outdoors. I feel quite messy inside. I don't know whether it is from the smell of waste, or the smell of food. It is that kind of mixed smells. (还是那种空调房的味道啊。空气质量没有外面的好, 感觉很乱, 不知道是人啊, 还是生活垃圾, 还是食物的气味, 反正就是那种混合的气味。)' W08

When there is more natural ventilation in an indoor space, people perceived smellscapes as more pleasant. Elements of openness, such as windows, doors and large openings in walls can be indicated as determining factors of general smellscapes in any physical forms.

The scale of spaces and crowding

As discussed earlier, the smell of other people is one of the main categories influencing the overall smellscape in the studied cases. The ‘crowding’ effect produced various negative elements in people’s perceptions of the smell environment. One typical example is in the Connection Tunnel in Wuchang, which is an enclosed and elongated space with a height around two meters (see Figure 5.10). People frequently commented on its inappropriate scale and the influence of this on the air quality and psychological impact. For example:

‘I don’t like it. It makes me feel hard to breathe. Probably it is because the ceiling is too low that gives a feeling of constriction. And it looks a little shabby. There is much rubbish on the floor that makes me feel this place is not clean... (不喜欢，感觉不好问呼吸比较困难。可能是因为空间太矮了，有一点压迫的感觉，而且看起来比较破旧，地上有很多垃圾，感觉比较脏乱 ……)’ W02



Figure 5.10 Internal view of the Connection Tunnel at the lower ground level of Wuchang Railway Transit Centre

In some cases, the scale of space is a subjective concept, relating to people's demand for space. Physically, the concourse in Wuchang is much larger than in Sheffield. However, the people interviewed in Wuchang frequently described the space as 'small' and 'crowded', and feeling less comfortable and more disturbed by other passengers' behaviours around, as shown in Figure 5.11. One participant described the crowded situation in the concourse of Wuchang Railway Transit Centre:

'The scale of this concourse is relatively small. There are not enough seats. I often can't find a seat and have to stand waiting. It makes me feel more annoyed. (我觉得这个候车厅相对来说还是太小了。里面坐位不够，经常就是没有地方坐，只能站着等车，那心情就会更烦躁了。)' W10



Figure 5.11 Crowds of people sitting in the ground floor waiting space within Wuchang Railway Station Concourse

These descriptions indicate that a comfortable scale of space should provide a personal comfort zone, within which people's perceptions of the surrounding environment is less likely to be disturbed by other people nearby. However, in urban intermodal transit spaces,

there are large flows of people, sharing a limited space. In order to achieve a pleasant smell environment, it may be vital to consider and define a personal comfort zone.

Toilets and trash bins

Toilets and trash bins, indicating the sanitary conditions, are found to directly influence participants' perceptions of the surrounding environment. As discussed earlier, people shared a common perception of nuisance from smells of waste. In the studied cases, people described smells related to toilets and trash bins as 'disgusting', 'smelly' and 'pungent'. In Wuchang in particular, smells of toilets and trash bins are very dominant across the station. The poor sanitary condition inside a toilet cubicle in the public toilets in the underground transit space, as shown in Figure 5.12, indicates poor management of the station, i.e. uncovered bins, low cleaning frequently and lack of maintenance.



Figure 5.12 Poor sanitary condition of the public toilet at the underground level in the Wuchang case

However, there are many large easily accessible trash bins in Wuchang. The large number of people using toilets and trash bins in Wuchang requires a more frequent cleaning strategy.

However, no sensible controls are observed taken over smells of waste in Wuchang. For example, most trash bins are found uncovered and not emptied frequently and the food waste has strong effect on the smell environment. Particularly in summer time, food waste rots quickly in the high temperatures. Smells of rotten food disperse quickly into the space from uncovered bins.

Seats

Seats emerged as an important factor influencing people's perceptions of the smell environment in the studied cases, closely related to people's waiting behaviours in urban intermodal transit spaces. The location of seats determines the surrounding environment of people who sit there. Seats are also important elements to gather people in the space, offering opportunities for interactions between passengers. As discussed earlier, people are important smell sources in transit space, and in this sense, indicates a relationship between seats and smellscape perceived in the space.

Examples are found in both cases, particularly, in Railway Transit Centre where inappropriate locations and insufficient numbers of seats were obvious. For instance, in the Underground Waiting Area, there were large numbers of seats located around toilets, as shown in Figure 5.13. Smells of waste were dominant in this location, but nevertheless, seats were found to be fully occupied. Facing the dilemma of sitting in an unpleasant smell environment or standing in a more pleasant smell environment, most participants were frustrated but chose seats in the unpleasant environment. For example, one participant at the Underground Waiting Area said:

'I don't think this is a good resting space because there is a dominant smell of toilets nearby. However, many people are still sitting there. I guess they must have struggle before they chose to sit there. Sometimes, in order to have a seat to rest means more than a pleasant environment. (我觉得并不是一个很好的休息环境, 因为厕所的这个气味很明显。但是, 这个空间使用的频率还是很高的, 乘客心里肯定有一个权衡, 为了有个地方可以休息一下, 能够克服外界环境的不良影响。)' W19



Figure 5.13 People sitting on the benches under the fans of the toilets in Wuchang

People generally prefer to sit while waiting, especially if they have to wait for a relatively long period. In Sheffield Railway Station where large numbers of passengers pass through every day, participants constantly complained that there were no proper seats for people waiting there. This may be something to do with trying to stop homeless people sleeping in stations or making people having to buy a drink to sit in commercial café spaces. Although they have seats and waiting rooms on platforms, some participants in the Sheffield case pointed out this issue as a matter of ‘caring’:

‘I think they could improve by increasing the amount of seats and having better shops... They could make it more spacious, not only for profits, but for people to sit while waiting rather than leaving spaces only for people walking through. This is not a space for people to wait and sit without any consumption. It is very sad here, these containers of plants, not nicely placed and well cared.’ S15

It is interesting that the station operators have notes on their flowerbeds saying: ‘Please do not sit on the planters’, as shown in Figure 5.14. It is observed that many people sit on the planters in the Concourse, which indicates a frequent demand for seats. Similarly, in Wuchang, people were also found sitting and lying on the floor. Considering the influence of seats on people’s perceptions of the smell environment, seats, as an essential element in such spaces, need to be designed well to achieve a good environment.



Figure 5.14 A ‘Please do not sit’ notice on a flowerbed in Sheffield Railway Station

Surroundings and barriers

The people’s surroundings in a place can have significant influence on their perceptions of the smell environment. For example, Sheffield, people at the Station Terrace, surrounded by two busy urban streets, were frequently annoyed by the traffic noise and smells:

‘Basically, it is all the cars around here, and I guess because it is very cold, one smell that reaches your nose is the petrol that’s being burnt. It is not particularly bad, because from where we are standing, it is quite far, but you can tell.’ S17

People at the Underground Waiting Area in Wuchang, surrounded by public toilets, shops and restaurants, perceived mixed smells of toilets and restaurants and felt unpleasant overall. For example:

'We are next to [and] surrounded by toilets and restaurants. The toilets are open towards where we stand, the resting area. There are also cooking fans producing cooking fumes into this area. It is unpleasant. (厕所周围还是餐馆。这个厕所的门是敞开的，直接对着这边休息区，那个后门对着餐馆的是排气扇，那气味肯定不好闻啊。)' W08

In the above case, there are no solid boundaries to separate the underground waiting area from its surrounding, which resulted in a mixed smell environment. As suggested, 'separation' can be an effective way of changing the smell environment (Moncrieff 1966). A list of different boundaries can be found in the studied cases: soft boundaries, such as bushes, trees, roads and pathways, short walls; solid boundaries, such as glass walls, concrete or brick walls and roofs; or no barriers. Types of barriers between different functional spaces indicate the quality of the smell environment. In particular, as discussed in Section 5.2.1 visual perceptions can influence smellscape, and a glass wall that allows visual perceptions can have different effects from other solid barriers.

Activities around barriers can also have strong influence on the smellscape in transitional areas. In Sheffield, benches are located along the external entrance façade of the railway station, beside both doors. People were found sitting on the benches and smoking all the time, which had a significant influence on surrounding smellscape. For example, cigarette smoke was among the detected smells both at Sheaf Square and Sheffield Railway Concourse. There were unpleasant experiences from smells of cigarette smoke when people walked past the doors of Sheffield Railway Station. For example:

'I smelt cigarette smoke. I think it is problem of all public buildings, when you walk out from the building, you will find people smoking outside by the doors, which is a disgrace. Because the smell of smoke for people who dislike it is very unpleasant. This makes it impossible for other people to wait outside by the door.' S16

On site landscaping

There is a big contrast between the Sheffield and Wuchang Transit Centres from landscape perspectives. In Sheffield, the landscape feature is a dominant attraction onsite. There is also more greenery distributed in and around the intermodal transit spaces, such as the garden at the Station Terrace, Park Hill Garden and flowerbeds in Railway Station Concourse. Particularly, there is also a large-scale water feature on Sheaf Square as landmark, as shown in Figure 5.15.



Figure 5.15 Designed water feature in Sheaf Square in the Sheffield case

As discussed in the last section, people have positive attitudes to natural elements, both olfactory and visual. Comparing the two cases, landscape features, like plants and water, were found to be more positively associated with perceived smellscape. In particular, when there is a continuous occurrence of natural elements, people tend to have more interactions with such elements to have more positive attitude towards the overall smellscape. For example, at Sheaf Square where the large-scale water feature is constructed, people enjoyed sitting by the water feature, playing with water and taking photos there. The short distance between them allows them to touch water and smell it. From the smell perspective, people

felt it was more pleasant with increased humidity and airflow created by the running water. Smells of nature were an important characteristic of smellscape in Sheffield.

In contrast, few people detected smells of nature in Wuchang case. The landscape features are not perceived as a well-integrated part of the station. The large-scale greenery onsite is very detached from the main functional spaces and is rarely used by people. People appreciated the greenness at a long distance without interactions. The greenery in Wuchang case was considered ‘not functional’ and ‘not attractive’. For example:

‘They have some plants outside the toilets. But it doesn’t work or look good. I think they should have plants that give nice smells. These trees are too tall to cover toilet smells down there. How could it help! (厕所外面虽然做了一点绿化，一点作用也没有，也不美观。我觉得他们应该种一些散发香味的植物。你看这些树叶这么高，厕所的味儿都在下面，这哪能起到缓冲作用呢!)’ W06

It can be suggested that diversity and types of plants are influential in smellsapes in intermodal transit spaces. Some trees and flowers give fragrant scents, that can mask some smells from traffic; while colours of plants can distract people’s attention from unpleasant smells.

Lighting environment

Perceptions of smellscape cannot be discussed separately from other sensory mediations (Porteous 1985; Henshaw 2013). Indirect influences of light, sound and temperature on people’s perceptions of smellscape pleasantness were found in both cases. When in a poor lighting and acoustic environment, people were found to be more depressed or irritated and aware of more unpleasant smellsapes. For example, in Wuchang, the poor lighting in the Transit Hall and Internal Taxi Centre were constantly described as having negative psychological effects to the smellscape. For example:

‘I don’t like the overall environment. It is an underground space with poor lighting environment. This environment makes me feel stressed. The ventilation is poor, too. I

feel quite unpleasant to be here. (我不是很喜欢。因为这里是个地下室，灯光很昏暗，给人压抑的感觉，感觉空气也不流通，不是很舒服。)’ W08

In contrast to the negative situation in Wuchang Railway Transit Centre, people enjoyed more positive effects of the sound of running water at Sheaf Square, which increased the positive elements of their general experience at this stop on the walk, including smellscape:

‘Actually, I like the sound of running water. It makes me feel free. Well, the smell of course plays a part of it. But the sound itself is very soothing. One of my favourite things about this train station is sometimes about 10-11 pm, when most people have caught the trains, when they turn the lights on around the fountain, I found it very soothing. I can sit on the bench and enjoy myself. I always had such feelings about rivers, streams and around lakes. They make me feel close to nature and free.’ S04

Weather

Occasionally, participants in the two cases described detected smells with words related to weather, such as smells of sun, rain, humid air and temperature. The influence of weather on people’s smellscape perceptions in intermodal transit spaces can be observed from two aspects: the use of outdoor spaces; and background smellscape.

Sheffield and Wuchang both provide people with choices of waiting inside or outside. The smellscapes in Sheaf Square and West Square were both rated the most pleasant among all stops in each case. Many people were more interested waiting outside at Sheaf Square and West Square when the weather was appropriate. They enjoyed a more pleasant smellscape outdoors and with fewer nuisance smells indoors from other people. However, responses to interviews showed that people’s use of outdoor spaces largely depends on the weather.

The impact of weather on people’s use of outdoor spaces can influence their general experiences of smellscape in intermodal transit spaces. In addition, weather has an effect on the background smellscape at midi level scales. Most people learn different features of smells within different weather conditions through the change of complex interactions between

temperature, humidity, wind and materials, plants and human bodies. It was found in both cases that people were sensitive to weather-associated background smells. For example:

'It is raining today, there is a humid smell in the air. Although it is raining, a summer rain, I can also get some smells of people and perfume. (今天是下雨，空气里面有一种潮湿的味。虽然是下雨，但是是夏季的雨，冥冥中还夹杂着人的汗味，然后还有一些人身上喷的香水味。)' W01

It is easier to perceive more and stronger smells in an environment with a higher temperature, because when the temperature increases, it accelerates the molecular movement of odours (Schiffman and Williams 2005). Henshaw (2013: 25) also emphasizes the function of the trigeminal nerves in the nose, which includes sensing changes of temperatures and smells. When the temperature is too low outside, people will not be able to smell properly. It was found in both study cases that when there was a significant change of temperature, people immediately felt a change in their perceptions of smellscape. Generally, people tended to prefer a cooler environment associated with freshness.

5.2.4 Contextual components of the two cases

As set out in the introductory Chapter, there is a big difference between public transport systems in UK and China, which are influenced by the cultural, social and geographical background and, have effects on designs of stations, people's travel habits and timetabling. Comparing people's perceptions of the smell environment in the two cases, four contextual components emerged as influencing people's experiences: security control in stations, travel habits, cleaning frequency and public smoking policy.

Security control in stations

Unlike UK, security has always been a serious issue in transit spaces in China. Security control is an important part of transit spaces in China, and can be found in all kinds of stations, such as bus stations, underground stations and railway stations, as shown by the example in Figure 5.16. In railway and bus stations, people are not allowed to get onto

platforms until fifteen minutes before departure and access to platforms is controlled. For these reasons, many people prefer waiting close to the platform entrances inside the concourse or outside at the waiting space on West Square near the security control points.



Figure 5.16 People queuing for security check outside the Wuchang Railway Station Concourse

Security controls in Wuchang limit people’s flexibility and choices in using spaces. By comparison, in Sheffield people have much more freedom and flexibility in choosing places for waiting, and so they have more opportunities for experiencing better smellscape than people in Wuchang Railway Transit Centre:

‘Often, I will come earlier to pass the security check. I am quite afraid there might be many people queuing. After the security check, I’d prefer waiting inside the concourse to make sure I don’t miss my train. (我一般会提前来就是要过门口的安检，怕排队时间太长。我怕会误车，所以一般都会会在候车厅等。)’ W09

Travel habits

Another big contrast found between Wuchang and Sheffield was the number of people waiting in the buildings. The general smell environment in Wuchang, much influenced by people's activities, is partly results from people's travel experiences and habits. In China, people have a preconception that they are likely to miss their trains or buses because of traffic congestion and the long queues for security checks. They feel more comfortable if they can arrive at stations at least one hour before the train departure time. Some people even go to the station three or four hours before the train or bus departure to make sure they do not miss the train or bus. For example, one participant described this situation:

'Many people would come to station two hours earlier or more...It is true that queues for security checks are always long, which makes people worry about missing their trains. Actually, half an hour is enough. People always worry too much and come early just in case unexpected things happen. (很多人会提前两个小时或者更长的时间到火车站来等车...现在检票的时候总是排很长的队,所以大家担心赶不上车都会提前很长时间来火车站等。实际上提前半个小时来就够了,但是大家总是担心赶不上车啊,或者有什么突发事情,所以提前很长时间过来。)' W15

A long time spent waiting in the station will involve more waiting activities, influencing the overall smell environment, particularly, eating. People in the Wuchang case, people normally will have their 'travel foods' with them when waiting, i.e. instant noodles and Zhou Hei Ya. Such food can be eaten anywhere anytime in the station, producing smells across the space. This is a marked contrast with the UK, where most people arrive at the station only fifteen minutes before the departure time. This results in fewer people waiting in the station and fewer waiting activities, resulting in lower influence on the overall smell environment in urban intermodal transit spaces.

Responding to people's travel habits, the concept of designing stations in China is 'accommodating' rather than 'efficiency' as in the UK. In this sense, the different design concepts result in the functional diversity and spatial difference of stations. Different concepts of designing stations also lead to different development around the station. Such

differences in physical environmental settings also result in differences in the smell environment, as discussed earlier.

Cleaning frequency

The management of stations can make a significant difference to the smellscape in intermodal transit spaces. In particular, the management of waste directly influences people's experiences of smellscape pleasantness, like clean up trash bins, managed food waste and well-maintained toilets. Poor management of waste in Wuchang had a negative effect on participant's evaluations of the smellscape. For example:

'I can smell some rubbish. It is not pleasant. Smells of rubbish can disperse around quickly outdoors. I think they should have some covered trash bins. Actually, if they cleaned it more frequently, it won't be a problem. (我觉得有一些垃圾的味道，不是很好闻。室外天气的缘故，垃圾的气味散发的很快。我觉得他们应该增设一些封闭式得垃圾箱。其实，加强下卫生打扫也是可以避免这个问题的。)' W16

Creating a clean and inviting environment can increase people's perception of the pleasantness of the general smellscape in intermodal transit spaces. For example, in Sheffield Railway Concourse, most participants described the atmosphere as inviting and welcoming, which had a positive influence on their evaluations of smellscape within it. The station authority has put a lot of effort to manage the environment in the Concourse:

'A lot of things we have to have in the concourse, such as information screens, timetables and leaflets. All the things that you expect to find in a railway station. We also get plants in and hanging baskets of plastic flowers in. Although you can't smell the plastic flowers, it looks nice. So, what we are trying to do is to make it welcoming and bright. Coz, we've got lots of glass in the roof which is nice, particularly on sunny days, you gets really warm in here, it is good for my plants as well. But, yeah, we get lots of customers, particularly, customers who don't live in Sheffield to say that this is one of their favourite stations, they love the concourse because it is nice and bright, clean. We are just trying our best to accommodate people.' S11

Public smoking policy

Cigarette smoke was frequently detected and found to influence people's evaluations of smellscapes in both cases. Public smoking can cause social segregation in public spaces (Tan 2013). China and UK both have a large population of cigarette smokers. Smoking indoors in public spaces has been banned in England since the Health Act 2006, including pubs and restaurants, which has resulted changes to the smellscapes of public spaces. For example, Henshaw (2013: 119-124) discusses the change of smellscapes in pubs before and after smoking ban: smokers after the ban starts to line up the streets outside pubs, making sounds and smells of cigarette smoke mixed with alcohol.

Public smoking was banned in China according to the Ministry Health guidelines published in 2011. However, no effective controls had been enforced. Recently, this has been turned into a law (June 2015) to ban smoking indoors in all public places, including offices, restaurants and hotels. The local authorities in Beijing have taken action in responding to this legislation, by publishing a set of fines for breaking the smoking law and putting up smoking ban signs in public spaces. However, in the Wuchang case, smoking was found almost everywhere, particularly dominant on West Square and the underground waiting area, which was negatively perceived by participants. In Sheffield, people were annoyed by others smoking by the entrance to the railway concourse, on railway platforms and Sheaf Square. In intermodal transit spaces, smoking outdoors where people gather and wait can cause equally negative impacts on people's assessment of the pleasantness of a smellscape. Many commented that smoking in public spaces should be banned, not only indoors but also outdoors, at least in places where there are large numbers of people, such as the Squares in front of stations:

'I think they might be trying to remove smells from the space rather than adding. Like, people are not allowed to smoke indoors to make sure that we have a better air quality. In Switzerland, we have laws to ban smoking outdoors as well in public spaces for people to have a cleaner and better air.' S14

5.2.5 Summary

Components emerged in the Sheffield case and Wuchang case have sketched out a picture of smellscape in intermodal transit spaces from smells and smell sources, individual, contextual and physical environmental aspects. Within the context of intermodal transit spaces, there are many common smellscape components in two cases, i.e. types of smells, layout of space and public smoking, etc. However, there are also distinct features of smellscape composition in each case, i.e. smells of nature in the Sheffield case and smells of people and food in the Wuchang case. Such differences are grounded in the context of intermodal transit space within each country, as discussed in section 5.2.4. These contextual components generated very smellscape compositions. However, the way participants perceive the smell environment in two cases showed much in common. The next section will discuss on how people perceive the smellscape components.

5.3 Perceiving smellscape components

5.3.1 The perceptual process of smellscapes

Smellscape, as discussed earlier in chapter 2, refers to people's perceptions of the smell environment of a place in its context. Perception, according to Rodaway (2002), involves both sensation and cognition. Henshaw (2013) further explained that the olfactory sensation refers to physiological and neurological processes in which sensations are registered by olfactory receptors and transmitted by trigeminal nerves to the limbic system. However, cognition of the smell environment is a thinking process, providing analysed information, understanding and evaluation of smell environments in the general context of places and perceivers. Waskul and Vannini (2008) conceptualised the perception of smells as a somatic work similarly constructed among people, which is a process of the perceiver making sense of his/her olfactory experiences through identifications, evaluations, reflections and activities. Perception of the smell environment in this sense is a process conducted by the perceiver through detection, interpretation, evaluation and action to the components constituting smellscapes. However, what initiates and constitutes the perception of the smell environment in a place has not yet been discussed in existing literature.

The enquiry of participants' perceptual process starts with an interview question at the beginning of each conversation: 'Did you smell anything?' Similar and immediate responses were found among all the interviews in both studied cases to this question: 'Not really...' or 'I can smell...'. People would mostly not give a definite 'No', but were more likely to say, 'Not really/nothing particular' instead. For example:

'Nothing particular, there is nothing like or dislike of this space in my head. It is very neutral. I think the weather is also a contributing aspect to the smell environment, because if it is in summer, it is easier for you to detect more smells. But now, it is winter, it is just neutral.' S16

From their descriptions, 'not really/nothing particular' mostly meant that there is nothing that smells too bad/good or strong or different from their expectations to catch their attention in the first place. For example, at the platform, one participant answered: *'Really really strong train smell, I can smell the fumes.'* S06

Most of the time, when they say 'Not really/nothing particular', they are surrounded by 'background smells': normal, light and mixed. However, why do people take such smells as 'not really/nothing particular'? It is argued that people experience a process that involves adaptation, fatigue and habituation when encountering repeated smells (Naus 1984; Schiffman 1990). This process may result in less sensitivity to noticing such smells. People are exposed to the background smells in their living environment on a daily basis. If there is no significant change in smells from one space to another, they will rarely pay attention to these background smells. Or in their terms, they think such smells as too 'normal' to be noticed. For example:

'Nothing particular. It is close to the smell of air on a normal urban street. (好像没有什么味, 就比较接近正常的城市路边的空气的味道吧。)' W06

'Not really, it is just a hot day, I can just smell a bit of cars. But it is really mixed with the hot weather and I feel it is normal. I can't really tell. It is nothing bad really. Yeah, nothing else.' S05

In the last example above, the participant explained of detecting ‘only a bit of cars’ after saying ‘not really (detecting any smells)’. The immediate response of ‘not really’ lies behind her familiarity of detecting a bit cars mixed with other environmental background smells in the hot weather. Such smells to her is ‘normal’, which explains her not paying immediate attention to the smells of cars at the beginning. Normal smells in this sense are smells as expected, commonly and frequently perceived in participants’ daily experiences. When asked whether they detected any smells, people tended to find things ‘abnormal’. If there are no smells that match their criteria, they will comment as ‘No/not really/nothing particular’. However, this would also bring to the ethical issue of taking a participant onsite to make them aware of the smell environment and their subconscious reactions to the smell environment. This ‘a bit car smell’ would probably not be noticing in her daily routines. As many participants have said after the walk:

‘Normally, I won’t notice such smells when I am in the station. Usually, I would be rushing to the station. Unless the smells are too strong or pungent, I won’t be able to notice. 我觉得赶路的时候其实很少会注意到这些，除非是有很刺激性的气味。’ W10

‘It is a different experience through to experience through smells. But I won’t notice any difference if I am alone.’ S03

‘You know when I am walking I don’t really take notice of smells. I just take care about the surrounding, what I see, you know. So now, when you tell me to smell something, it’s more different. I begin to take notice of smells.’ S08

This ‘not noticing’ response is very commonly found when smells in the environment are at a background level with appropriate exchange of air, and there are no liked or disliked smells. However, as illustrated in the first example above, people also may not notice smells when they are in active movements, i.e. running and walking fast. It is likely that people have lower sensory detections with active movements (walking and running) than passive movements (sitting and standing), which is influenced by their attention to movement or the surrounding environment (Chapman et al. 1987). However, when there are smells that catch people’s attention, or at a high intensity, people will immediately notice the smell environment with further cognitive processes, involving evaluations, psychological and behavioural reactions, such as like-dislike feeling, approaching and avoiding behaviours (Largey and Watson 1972). The behavioural responses may lead to changes to the general context or the positions of

perceivers in the environment, such as emptying or covering trash bins and changing the walking route. For example :

'If I smelt something really unpleasant, I would definitely leave for some place without such smells. However, if I smelt it when I was queuing for boarding, it wouldn't be possible to change my position. In this case, I have to ignore it purposely.

要是闻到那种不舒服的气味，我肯定就会选择另外的地方休息来避开这个气味。如果实在是没有办法的情况下，比如时间来不及了啊，你要上火车了，没办法避开，那就只能忍着了。'

W16

However, as also shown in the above example, participants sometimes had psychological reactions to perceived smell environment whilst did not always have a behavioural response as a result that people chose to ignore the smells. This 'ignoring' happened after evaluating the influence on people's activities and purposes of using the space. For example, at the Lower Ground Waiting Area in Wuchang where the smellscape was rated as very unpleasant, there were still many people sitting there waiting (see Figure 5.13). In this case, people did detect strong smells of toilets but preferred a seat with an unpleasant smellscape to no seat with a better smellscape. Response to the smell environment depends on people's evaluations and their purposes for using the space, which stimulates an iterative process of perceiving the changing smell environment.

Figure 5.17 illustrates the perceptual process found in the studied case which moves from sensation to cognition to response in perceiving the smell environment, involving the components of perceivers, smells and smell sources, physical environment and context. In the perceptual process, people are making sense of what they perceived in the environment: smells, smell sources, the physical environment, temporary elements onsite, context and themselves. The ways of interpreting the smellsapes will be discussed in the next section through perceptual patterns emerged in from advanced coding and memo-writing to map out the relationships between components from different categories.

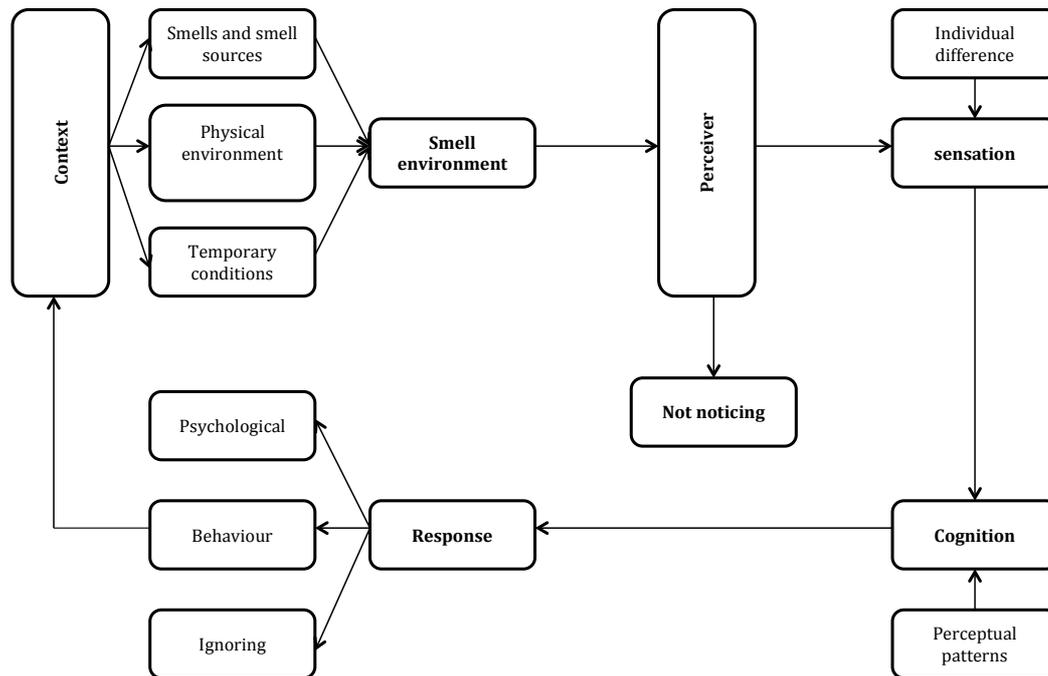


Figure 5.17 A smellscape perceptual process generated from the studied cases

5.3.2 Perceptual patterns: ways of interpreting smellscape

Marr (1982) argued that perception is an observer-centred process in relation to objects in the space. Participants in smell walking in both cases were interpreting the relations between themselves and smellscape components in the environment. A number of perceptual patterns were generated from the data, as shown in Figure 5.17, illustrating people’s different ways of thinking to make sense of various components in the perceived smell environment. In this Section, each perceptual pattern will be defined and explained with examples.

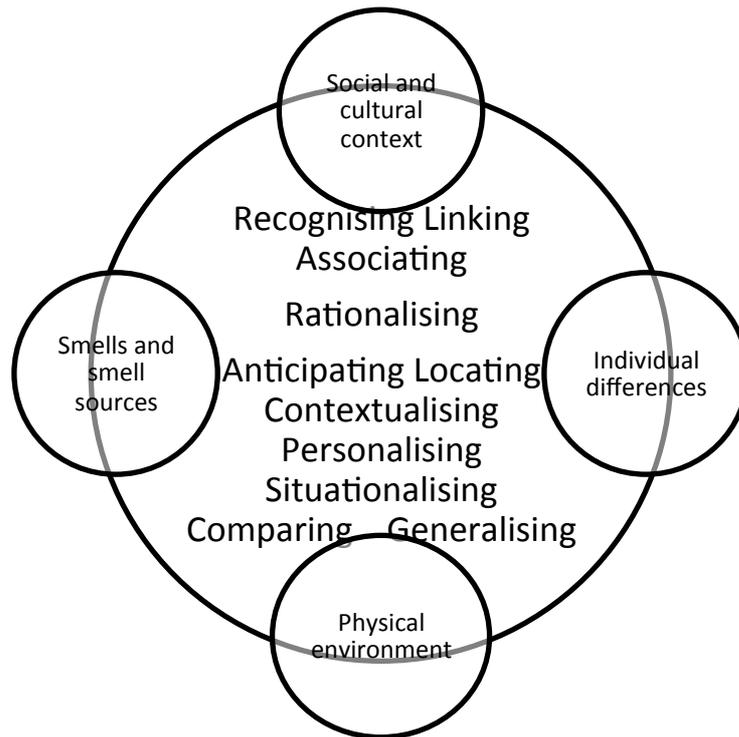


Figure 5.18 Circle of people's perceptual patterns of interpreting smellscapes

Recognising

Recognising is the most essential pattern involved in all types of perception, and refers to the process by which people try to identify elements compositing the smell environment, such as smell and smells sources, types of buildings, according to their knowledge. For example, when asked what smells detected, one participant in the bus interchange described the smell as an old smell:

'It has an old smell. How can I explain this ... You know modern buildings? They always associate with the clean smell. But, here, it has a bit dusty smell. It not that dusty, but, for now, it is kind of humid and dusty feeling.' S09

In another example, the participant tried to identify detected smell and explain what he meant by the 'smell of toilet' by recognising the dominant smell as ammonia:

'It is the toilet smell, like the ammonia gas. I smelt it outside from the toilet area. There is also some cigarette smoke, from people who are smoking outside the toilet.' (

厕所的味道。那种氨气，排泄物的气味，在厕所的外面就可以闻到。其他还好，有一些烟味。
很多人都在厕所外面那排地方抽烟。)’ W16

In this description, the participant also recognised the ‘cigarette smoke’ from people smoking outside the toilet. It is arguably similar that people’s immediate interpretation of the smell environment would be identifying sources of detected smells and the connotative meanings of their descriptions (Waskul and Vannini 2008).

Recognizing is a self-explanation of the perceived smell environment, involving detection of smells, identification of smell sources, built forms and other environmental settings. As shown in the above two examples, recognising starts with a general concept and then moves on into more specific concepts.

Rationalising

Rationalising is when people try to find out a logical reason to explain their descriptions of the smell environment, particularly in relation to personal feelings and evaluations. For example:

‘There is a bit smell of cleaning liquid. It is not pungent. I think the cleaners just have cleaned this area. However, this smell makes me think of the toilet, which I don’t quite like. (这里有一些消毒水的味，不是很刺激的那种，我觉得应该是刚环卫工人有打扫过，不过这个味道总会让我想起厕所，所以，我也不是很喜欢。)’ W03

In this example, the participant detected some smell of the cleaning liquid but was not able to identify the source. She then started to rationalise the possible reason she detected this smell. In another example, in Sheffield, the participant rationalised the reason she could not detect any smell from the surrounding environment, where she saw many smell sources and so expected lots of smells:

‘It is rather neutral, I don’t sense the food here, even [though] I can see them. It is the faint smell of someone smoking. I can see people drinking coffee. But, I can’t smell that. Mostly, it is rather neutral from this point. I suppose this space is a little bit too

large for smells to be really concentrated. If there are smells here, they are dissolved into this volume of space. I don't really sense them. If you have a tree like this at home, you would definitely smell it. And, maybe the temperature is cold now, not warm enough to help you smell these easily. They also have these boxes of plants. But they don't smell much neither.' S14

Another example, where the participant tried to explain why the smell was not particularly bad and why he detected petrol:

'Basically, it is all the cars around here, and I guess because it is very cold, one smell that reaches your nose is the petrol not fully burnt. It is not particularly bad, because from where we are standing, it is quite far, and you can tell...' S17

From the above examples, rationalising involves many other patterns to help the perceiver explain what they smell: identifying key components and features, trying to look for sources and thinking of relevant experiences, etc. The overall aim of rationalising is to help explain, which differs from the aim to identify in the recognising pattern.

Linking

Linking refers to people making connections between smells, smell sources, physical elements and other facts in the environment in their descriptions. For example:

'The ventilation is not very good here. The space is narrow. People in there are walking fast to pass through. I detected smells from people. Some are good and some are not. Overall, the environment is not bad. It is relatively clean without much residential waste. The smell in this space is relatively acceptable. At least there isn't any distinct bad smell. (我觉得这个空气流动不是很好，空间比较狭窄，人都在匆匆而行，我闻到的都是人身上的味道，有好的也有不好的，总的来说这里环境还可以，比较干净，没有什么生活垃圾，这个气味相对来说还可以，至少没有明显的臭味嘛。)' W09

In this example, the participant at the Connection Tunnel in Wuchang linked ventilation, the scale of the space, people in there and the floor conditions together to give a full illustration

of the smell environment with the facts in the space. Linking is a collective process of identifying different components in the smell environment, which happens quite often with smells, smell sources and physical components. The action of linking is based on direct observations of the surrounding environment onsite without connotative interpretation (Waskul and Vannini 2008).

Personalising

Personalising refers to the way people evaluate the smell environment drawing personal preferences and habits. As synnott (1993:187) argued the smells are integrated in to peoples' personal lives with memories and meanings. The individual difference in this case makes more influence than physical and contextual components. When personalising, people often associate with their past experiences and memories, try to use such associations to explain their perceptions of the smell environment. This thinking pattern makes ones' perception of the smell environment unique with personal meanings. In the two study cases, people were often aware that the reasons they gave might be their personal opinions and not like those of other people's. For example:

'I can smell the meat in the pasty, it is a quite strong smell, but it is not quite pleasant. I am not really a big fan of pasty, maybe it is my preference.' S07

'I often buy Zhou Hei Ya here myself. I am very familiar with the taste and smell. And I like it very much. (我自己经常就在这里买周黑鸭吃。所以对这个味道很熟悉，也很喜欢。)'
W03

Personalised smellscapes may produce emotional responses, expressed in terms like 'familiar', 'homey' and 'annoying'. Such emotional responses can influence people's evaluations of smellscape pleasantness. Personalising happens quite often in the studied cases and involves recalling participants' happy or unhappy memories of themselves. For example:

'I smelt a bit smell of drains. I am very sensitive to this smell. This reminds me the last summer when I went to work in a factory in Shenzhen. It was raining the whole summer. I smelt very strong smell of drains. It was a long summer with such unpleasant smells. So, I became very sensitive to the smell of drains. (我有闻到一点下

水道的味道。我对这个味道特别敏感。之前暑假，我去深圳打工，那些工厂周围一下雨，就有很浓的下水道的味道，然后，下雨的时间又很多，整个暑假都好像是下水道的味道，很难闻，所以我对这个味道很敏感。)’ W01

'I don't mind the train smell because it reminds me of going away. I don't use trains for business or work. Mine would be for pleasure. All I remember is pleasurable journeys. So I quite like the smell of the train, it is not something that I experience everyday neither, for me, I'd be going for a trip on a train, which is a pleasurable experience anyway, so, I don't mind smelling the train.' S06

Associating

Associating is different from linking the facts in the smell environment: it refers to people interpret connotative meanings of perceived smell environment an abstract concept or known issue in perceivers' minds, based on common sense or past experiences. For example:

'I like travelling by train. And believe it or not, I like smelling the oil from the train. It reminds [me] of holidays. And it feels soothing.' S02

In the studied cases, perceiver often associated cigarette smoke with health problems, car fumes with air pollution and toilet smells with poor sanitary conditions. For example, participants associated detected traffic fumes with poor air quality and negative smellscape:

'This is the bus interchange, I would naturally associate it with traffic fumes, dust and crowds of people walking around, which makes feel a bit negative about the air quality and smellscape.' S19

Locating

The perception of smells is also ocular-centric (Henshaw 2013; Porteous 1985), which involves visual cues in interpreting the smellscape. As Marr (1982) argued observers in the process of perception are always locating themselves in relation to distances and orientations

of objects in the environment. This locating patten emerged frequently in people's descriptions in the studied cases. For example:

'Now we are in the concourse, I smelt someone's perfume in front of us. I can smell cigarette [smoke] from the door where people are smoking by the door. Uh, I can also smell some food here from the pasty shop and a little bit smell of coffee from the café in the middle. But it is not overpowering.' S09

Locating refers to how people describe their own positions and the locations of smells and smell sources with directions and distances to provide detailed spatial information of the smell environment. Participants often orientated themselves by referring to recognisable physical components of the environment. Locating can be regarded as a way for perceivers to know about and describe their locations and surroundings in relation to smellscape.

Contextualising

Contextualising refers to the way that people associate smellscape with the context of place. Perception of smells is argued as a negotiated structure of context and detected smells (Waskul and Vannini 2008). Context can be a set of background conditions or facts of the place or a particular event within the place. For example, one participant in Wuchang contextualized the smellscape around toilets in stations from several aspects: short distance between participant and toilets; spatial structure; sanitary problems caused by large population flows in stations; and his personal perception of smells coming from the toilet:

'In China, there are many people using stations every day. It is hard to guarantee a good sanitary environment of toilets in stations which produce a strong smell. But they have an open space there. So, the toilet smell is not that strong. (中国人比较多嘛, 车站的厕所使用的人特别多卫生状况很难得到保证, 所以这个气味比较重。这个地方, 其实也还好厕所味道不是特别重, 毕竟是个露天的地方。)' W04

For the particular social context in Chinese stations, the perceiver in this example considered it acceptable and understandable of such a smell environment. When contextualizing, participants valued most the congruency of perceived smells within their contexts.

Situationalising

Perception of smells is argued to be situational and responding to the temporary conditions onsite (Porteous 1985; Waskul and Vannini 2008). Situationalising refers to the way people often describe a set of events happening around them onsite at a particular time point, emphasising the influences of active activities on their perceptions. They usually position themselves as a part of the situation. For example:

'There is a trash bin beside me, which is quite smelly. And there is some water coming from the trash bin on the floor, which also smells bad. On the Square in front of me, there are many people sitting on the benches, eating and smoking. It is a very mixed smell. On my other side, there are cars coming through, producing fumes. I can smell that. All these smells are not pleasant. (我旁边就是垃圾桶嘛，有点臭。然后地上有一些污水，应该是从垃圾桶里面漏出来的，也有一些不好闻的气味散发出来。另外的话，这个广场上有人在抽烟啊，有人在吃东西啊，有人在坐着休息啊，还是人的体味吧比较重，各种味道混杂。这边，还有汽车的味，都不是很好闻。)' W06

In the above case, the perceiver described the smellscape, by situationalising through a series of activities happening around. When perceivers start to situationalise, they pay more attention to dynamic changes caused by other people's activities in the environment. However, in some cases, situationalising can also be about changes in the smell environment with perceiver's own movements in the space:

'It is very different since we walk into the station. But as soon as we are in the station I got the smell of food. And there seems a lot warmer air. I'd say this smell environment is slightly positive because I can smell food which is nice to me.' S01

Anticipating

As discussed earlier, people's expectations and preconceptions influence their perceptions of the smell environment. This perceptual pattern is termed 'anticipating' which refers to how

people anticipate the smellscape they are going to perceive on the basis of familiarity and previous experiences of similar physical environment, smells and smell sources. For example:

'It is just the train smells over the platform. I thought I will be able to smell the coffee, but I can't at all. It is just the trains. Quite strong smell.' S05

People often set out an expectation and a standard of an acceptable smell environment through anticipating. When the actual smellscape is different from what they anticipated, people will notice the difference and make a response. For example:

'Not that much. But, it is tolerable. Because the time you see many cars there, you can imagine that you will smell a lot of car fumes. (不太喜欢。但是，可以接受把，看到这么多车在这里，就能够想像到会闻到汽车尾气的味道。)' W03

'It is always a lot of people in the waiting hall, crowded. I thought there would strong smell of people sweating. But, it turned out not so smelly when I came here. (候车厅主要是人多嘛，比较挤。我以为有汗臭味。但是进来过后，并没有那么难闻。)' W08

Comparing

Comparing provides perceivers with references for evaluating smellscapes. People identify differences between smellscapes at different stops and explain their evaluations from a critical point of view. For example, one participant in compared perceived smellscapes at the West Square with smellscapes of previous stops:

'I feel the air is fresher compared to the taxi centre. It seems that I suddenly escaped from a smelly place and came to a fresh one. I never felt good about the environment in the underground transit hall before I came to the taxi centre. Now I think the smell environment in the transit hall is much better. (感觉空气变得很清新了，相比之下，就好

像从一个很臭的地方，突然来到一个清新的地方，之前对这个地下空间的评价不是很高，但是去了下面那个出租车区域后，现在感觉到这个嗅觉环境好了很多。)’ W08

People also compare a perceived smell environment with their past experiences. As Fine (1995: 256) argued in a comparison people are likely to use their past experiences as basis for judgement and evaluation. For example, one participant compared Sheffield with other UK stations:

‘Actually, like London St Pancras, they have a high roof covered, maybe because of the height of the roof, I don’t feel much oppressive like in here. You don’t have the feeling of being close to the trains which is better. I think they have more trains there, but because of the configuration of the space, you don’t feel that oppressive. In terms of smells, I don’t experience such a bad smell environment like here. I think the only worst station I’ve experienced in the UK is Birmingham New Street Station.’ S12

In the study cases, participants often made comparisons, not only of differences, but also similarities. For example:

‘I feel refreshed, more comfortable, because we were inside the bus station. It is an enclosed space that you don’t smell fresh air in it. But here, it’s more open area. I can easily sense the difference. It was too warm inside the bus station and there is no airflow. And you smell people inside it. But, outside there, I can feel the breeze. And it doesn’t smell like people. I prefer the outdoor smell.’ S04

When comparing, people’s social and cultural background, past experiences and living environment become more dominant in the perception process.

Generalising

Generalising refers to the way people try to conclude and summarise features and evaluations of the smell environment according to common sense and personal experiences. For example:

'Obviously, with the clean smells, you associate with clean things. I think it is just everybody likes clean things. If you cleaned your room, it would be a fresh smell and quite nice.' S07

In this example, the participant generalised two things based on her own experiences: clean smell associate with clean things; everyone likes clean smells. Generalised rules for evaluating smellscapes indicate environmental, social and cultural background, which people commonly agreed of influencing smellscapes. For example:

'Generally, places like the waiting hall, where it is crowded, enclosed and lack of natural airflows, all depend on air conditioning systems. The smellscapes in such spaces won't be very pleasant. (一般来说, 像候车厅这样人员密集空间封闭的地方, 自然通风不好, 只能靠机械通风设备。这样的嗅觉环境肯定不会很好。)' W17

Summary

The perceptual patterns are different pathways in perceivers' minds, consisting of the sensation and cognition process, which then lead to responses to the smell environment. However, it is essential to stress that our perceptions of a smell environment involve a combination of perceptual patterns rather than depending on a single pattern. For example, recognising, associating and personalising works together in this description:

'I can smell the grass and flowers. It is a little bit overpowering. It is a bit like a park... I like to smell grass, it smells nice. I think it is because I live close to green fields. Like when I used to walk to school, like my primary school, there is a really big field, it has two parks. And where I live now, it is suburbs, in the green belt, there are more open spaces and grass lands, I think it associates with home, my association.'
S07

5.4 Conclusion

From the studied cases, this Chapter has drawn out key components of smells and smell sources, the physical environment, perceivers and context that influencing people's perceptions of smell environment in urban intermodal transit spaces. Eleven perceptual patterns have been found illustrating how people perceive different components together to react to the smell environment: recognising, linking, associating, locating, contextualising, situationalising, comparing, personalising, rationalising, anticipating and generalising. A component and perceptual model of understanding smellscape has been constructed through mapping out people's perceptual processes with components of the smell environment and people's perceptions of the smell environment through sensation, cognition and responses, influenced by the perceptual patterns. Different patterns of reactions to the smell environment are also found in the studied cases and integrated into the perceptual process, i.e. not noticing and ignoring. Through interpreting people's sensational and cognitive process, this provides new insights into the smellscape concept. Based on understandings of essential components and perceptual processes in the studied cases, the next Chapter will discuss indicators found to influence people's evaluations of smellscape pleasantness and create a model to measure smellscape quality and classify smellscapes.

Chapter 6: A framework for measuring smellscape quality and classifying smellscapes

6.1 Introduction

Chapter 5 discussed the components that influenced people's perceptions of the smell environment in the studied cases to provide a comprehensive understanding of individual perceptual processes, involving different perceptual patterns and responses on which to base a component and perceptual model of smellscape. This Chapter will discuss people's emotional responses and the criteria people used to evaluate smellscape pleasantness, to generate a framework to measure smellscape quality and classify smellscapes accordingly. Section 6.2 starts with a reflection on the theoretical framework discussed in Chapter 3 and an analysis of the descriptors found in participants' descriptions, categorised into five aspects related to their perceptions. It then discusses an evaluation system for smellscapes based on eight factors of smellscape pleasantness that were identified in the studied cases: cleanness, preference, appropriateness, naturalness, cleanness, freshness, familiarity, calmness, intensity and purity. Section 6.3 illustrates a smellscape notation tool developed from these eight factors, which can be used for analysing smellscape features in specific contexts and for comparing differences between smellscapes. Section 6.4 discusses using pleasantness as a way to classify a smellscape according to its features, linking people's descriptions with the derived indicators. A four-type smellscape classification is summarised, which can be used for identifying key elements/features of desired smellscapes for different purposes relating to place-making.

6.2 A language-based evaluation system for smellscape

Previous studies have focused on smell preferences and used a preference-rating as an evaluation method (Ayabe-Kanamura et al. 1998; Henshaw 2013; Moncrieff 1966). As discussed in the last Chapter, there are more components influencing smellscapes than just smell preferences. The method of using preference as an evaluation criterion is quite limited. This study took 'pleasantness' as indicating an overall satisfied emotional and physiological

state to indicate smellscape qualities in studied cases, which will be further explained in Section 6.2.3. ‘Pleasantness’ is not a new concept but evaluations of smellscape through people’s assessments of pleasantness have not been discussed in existing literature. With focused coding and memo-writing on people’s evaluation descriptions, a subjective evaluation system of smellscape qualities is generated, reflecting of the components of smell environments along the smell walks in the studied cases.

6.2.1 Modifiers in people’s descriptions of smellscape

As discussed in Chapter 5, in the studied cases, when asked what they could smell participants’ immediate responses to the smell environment were either ‘No, not really...’ or ‘I can smell...’. In the first case, people would normally ‘not notice’ the smell environment, and the perceptual process would not continue to cognition and response. In the second case, people would have more detailed descriptions of perceived smells and the following perceptual process. Knowledge of people’s further perceptions of the smell environment was gained by asking ‘How pleasant is this environment?’ and a set of sub-questions on ‘What’ and ‘Why’. In their descriptions, people often used some modifiers with descriptors of components to explain the perceived smell environment. For example:

‘A bit watery smell and less fumes. I can smell the chlorine in the water. Nice, good. It makes me feel clean and reminds me of the smell of the swimming pool. It is a nice chemical smell...It makes me feel happy. I love water features. Actually, I like the sound of running water. It makes me feel free. Well, the smell of course plays a part of it. But the sound itself is very soothing...’ S04

In this example, the participant used modifiers ‘less’, ‘fresh’, ‘clean’, ‘chemical’ to describe detected smells, ‘clean’ to describe the overall environment, ‘nice’, ‘good’, ‘happy’, ‘free’ and ‘soothing’ to describe her feelings. Such modifiers indicate people’s evaluations and reveal different features of smellscape. Language descriptions of emotions can be used as one way of measuring people’s perceptions of environment (Bradley and Lang 2000). Such modifiers involved in people’s descriptions provide extra information on smellscape components indicating participants’ evaluations of smellscape pleasantness. Through

comparing the differences and similarities, there are mainly five features of smellscape represented by the modifiers participants used:

- **Quality of the smell environment:** modifiers indicating positive/negative elements of the smell environment, e.g. natural/artificial, clean and fresh;
- **Intensity of smells:** modifiers indicating levels of dominance of smells, e.g. strong, slight, a bit, some;
- **Smell properties and smell sources:** modifiers indicating the chemical features and smell sources, e.g. grassy, watery, rotten;
- **Environmental conditions:** modifiers indicating environmental conditions onsite influencing the smell environment, e.g. weather, outdoor/indoor, enclosed space;
- **People's feelings in response to the smell environment:** modifiers indicating psychological responses to the smell environment, e.g. happy, calming, relaxing, stressed.

However, there are some modifiers used in different situations representing different features, i.e. 'good', 'fresh', 'clean'. For example, at the Sheaf Square, participant S03 said *'in general, this is a good smell environment. I didn't smell anything that bothers me. The smell is fresh'*, 'good' here refers to the quality of the overall smell environment and 'fresh' refers to the quality of the smell perceived. However, when asked about the experiences at the tram stop, he also used 'good' to describe his feelings: *'Good, not bad. It makes me feel like in countryside. Very calm.'* Similarly, in the railway station concourse, participant S03 said *'I like the smell of food. And you can see the plants over there that makes you feel fresher.'* The word 'fresh' in this situation is a feeling rather than the quality of smells. However, as a feeling, 'clean' is different to 'good', indicating specific physical features of the environment like good air quality, cleaned floors, etc. 'Good' as a feeling has a more focus on personal experiences like preference, mood and memories. Table 6.1 summarized modifiers people used in the Sheffield case, based on the five features above.

Feature	Modifiers	Feature	Modifiers	Feature	Modifiers			
Quality	Fresh	Negative	Environment	Warm	Intensity	Distinct		
	Clean	Positive		Cold		Strong		
	Healthy	Neutral		Sunny		Slightly		
	Unhealthy	Artificial		Rainy		Background		
	Old	Appropriate		Countryside		A little bit of		
	Normal	General				Faint		
	Outdoor	Mixed	Property	Grassy	Feeling	Happy	Soothing	
	Sanitary	Pure		Watery		Metal	Familiar	Pleasant
	Good	Bad		Musky		Mechanical	Relaxing	Unpleasant
				Wooden		Dusty	Annoying	Strange
				Soapy		Sweet	Good	Pleasing
				Natural			Bad	Bothered
							Calming	Free
							Clean	Fresh

Table 6.1 Modifiers people used to describe smellscape in the Sheffield case

Similar to the Sheffield case, Table 6.2 summarize different modifiers involved in people's descriptions of smellscapes in Wuchang Railway Transit Centre. As clarified in chapter 4, interview in the Wuchang case remained in Chinese during the analysis process. The modifiers in Table are translated in English with coded Chinese modifiers in brackets.

Feature	Modifies	Feature	Modifies	Feature	Modifies
Feeling	Stressed (压抑的)	Environment	Humid (潮湿的)	Quality	Mixed (混合的/混杂的)
	Calming (平静的)		Hot and stuffy (闷热)		Normal (正常的)
	Happy (开心的)		Rainy (雨水的)		Strange (奇怪的)
	Soothing (心旷神怡)		Enclosed (封闭的)		Natural (自然的)
	Pleasing (赏心悦目)		Underground (地下的)		Artificial (不自然的)
	Pleasant (愉悦)		Outdoor (室外的)		Fresh (清新的)
	Annoying (烦躁)		Indoor (室内的)		Stuffy (混浊的)
	Relaxing (放松)		Air-conditioning (空调的)		Appropriate (和谐的)
	Bad (糟糕)				Inappropriate (不和谐的)
	Uncomfortable (无奈的)				Good (好闻的)
	Familiar (熟悉的/亲切的)				Bad (不好闻的)
	Comfortable (舒服的)				Choking (窒息的)
Property	Pungent (刺鼻的)	Intensity	Dominant (明显)		Disgusting (恶心的)
	Rotten (发霉的)		Distinct (突出)		Stale (不新鲜的)
	Fragrant (香的)		Strong (浓的)		
	Smelly (臭的)		A little bit of (一点)		
	Tempting (诱人的)		Some (一些)		

Table 6.2 Modifiers people used to describe smellscape in the Wuchang case (with English translations)

Modifiers summarised in the tables above illustrate a rich content of smellscape characteristics in intermodal transit spaces across two countries, which are not explored in previous literature. At the current stage, a frequent analysis is not considered to investigate are the weighting of various characteristics. However, this can be conducted in the future work through large quantitative surveys. Aimed at exploring the meanings of people's descriptions of smellscape in this study, more focused analysis of modifiers summarise in the two cases are discussed in the following section to identify key features influencing smellscape pleasantness.

6.2.2 Indicators of smellscape pleasantness

Although a general question was asked on 'how pleasant is the smellscape' at each stop along the smell walking route in both cases, words indicating evaluations were also found when participants describing the smell environment. In the perceptual process of smell environment, participants were found consciously and unconsciously evaluated their perceptions according to similar criteria: cleanliness, freshness, purity, intensity, naturalness, appropriateness, preference, familiarity and calmness. Each indicator discussed in this section represents a spectrum between the positive and negative ends, i.e. high level cleanliness of cleanliness contribute to pleasantness whilst low level of cleanliness (unclean) decreases pleasantness or cause unpleasantness.

Cleanliness

Cleanliness was the most frequently mentioned aspect when participants evaluated the pleasantness of a smellscape. In medieval Europe deodorisation of unpleasant sanitary smells in cities were considered as an action to deal with diseases transmission and unhealthy environment (Largey and Watson 1972). The cleanliness of smells and the physical environment indicates good sanitary conditions and reduce health concerns, which is particular significant in intermodal transit spaces. For example:

'The clean and neutral environment that smells like a healthy environment is the most pleasant in such spaces. ' S01

Some people even preferred smells of cleaning products and hospital smells because they felt this indicated a clean environment. People's perceptions of cleanliness are strongly influenced by their visual perceptions, of things like dirty water or trash on floor. For example:

'I think, sometimes, when it is been cleaned and you are the first people entered the station, you can smell the cleaning liquid, that clean smell. I think I like smelling the cleanness.' S07

The sense of cleanliness in perceiving smellscape is also related to good air quality as a background. On smelling polluted smells like traffic fumes, dust, cigarette smoke and cooking fumes, and stale air, people would have less sense of cleanliness. For example:

'I don't like the smell environment. You can see the drains and the walls are dirty. There isn't any ventilation facility, even a fan. When cars passed from the entrance, you can smell traffic fumes in the tunnel. Very unpleasant. (不是很喜欢 [这个嗅觉环境], 你看这个地上下水道的盖子是露在外面的, 墙壁上也很脏, 顶上也没有通风的风扇什么的, 你看外面有车过去的时候, 通道里面还可以闻到汽油味, 很不舒服。)' W06

The level of cleanliness is influenced by cleaning frequencies, conditions of sanitary facilities, intensity of activities and people's behaviours in the environment which have been discussed in Chapter 5. Henshaw (2013: 152) also suggested cleaning and maintenance practice in public spaces can help remove unwanted smells from waste to make people's perceptions of smellscape more positive. The feeling of being in a clean environment in such sense is a prior indicator of achieving smellscape pleasantness.

Freshness

In both Sheffield and Wuchang, people rated pleasantness much more positively at places where freshness was perceived, like Sheaf Square in Sheffield and West Square in Wuchang. The modifier 'fresh' is often used to describe natural smells and outdoor air. For example:

'It smells cleaner and fresh. The smell of water really helps and the running water makes the air clean. I like it. Physically, it is nice and open, you can move freely around it. And, in terms of smells, I like the freshness.' S18

In Sheffield, 'fresh' was often used to describe smells from natural elements, such as wind, trees, water and rain. People associated high freshness with positive emotions, such as 'relaxing', 'soothing' and 'pleasing'. Henshaw (2013:171) also argued smells of vegetation and water can greatly improve the quality of freshness of air and bring restorative effects to people in the environment. However, in Wuchang, where smells and nature were not detected, people were found frequently describing the smell environment as 'stuffy' or 'not fresh' which is the opposite of 'fresh'. For example:

'Nothing smells distinct here. It is a light and mixed smell of instant noodles and Hot-dry noodles. It smells not fresh there. (没有什么特殊的气味，就是有一种混合的味道，淡淡的，像热干面啊，泡面的味道，还有空气不流通的味道，就是不新鲜的那种味道。)' W02

'The smell environment is not very pleasant here. There are restaurants on both sides. The smell of food dispersed quickly into the transit spaces. When I walked pass them, I could sense the air is not fresh. I got a feeling of stuffy and warm. I don't quite like it. (嗅觉环境不是很好，因为两边有很多的快餐，这种快餐的气味就直接散发到交通空间里面。不是很喜欢，在我走过的时候会觉得空气不是很新鲜，然后会带来一定的热量，我会觉得比较闷热。)' W18

As shown in the above examples, the issue of 'lack of ventilation' in enclosed spaces cause less freshness of smellscape to participants. People generally felt more 'fresh' in outdoor spaces than indoor spaces which indicates ventilation or airflow is a key element contributing to freshness. The issue of crowding of people, scale and openness of the space as discussed in chapter 5 were also influencing the quality of smells and capacity of oxygen in the space.

Purity

Purity and intensity (discussed next) indicate the variety and scale of smell sources. Although they are subjectively perceived, people's perceptions of these two indicators are more influenced by the nature of smell sources rather than personal experiences. However, people's sensitivity difference on detecting smells can have significant influence on the measurement of these two indicators. As Henshaw (2013) documented, people with smoking habit or are frequently exposed to strong chemical smells are less sensitive to detect smells. People tended to prefer simpler smellscapes in any conditions, either of liked or disliked smells. As discussed in the previous chapter, a mixed smell environment of both liked and disliked smells will reduce hedonic degrees of liked smells and increase the nuisance of disliked smells. For example, in Wuchang, where smell sources, both good and bad, were mixed under the same roof with less ventilation, purity had a great influence on people's perceptions of pleasantness. Descriptors of 'mixed' were found at most stops, along with evaluations of 'smelly' and 'unpleasant'. For example:

'I like smells of food in general, but when they are mixed with car fumes, I will be very unpleasant. It seems to me the food is polluted, not clean. I would like a smell environment less mixed, particular, no bad smells with good smells. (本来我并不讨厌食物的味道。但是跟汽车尾气的味道混在一起，我就觉得很难闻。这让我感觉食物不干净。所以我觉得这里应该让嗅觉环境更简单一点，就不要有这么多好的不好的气味混杂在一起。)' W13

However, mixed smells of negative smells, like cigarette smoke and traffic fumes, can be acceptable when they are at a background level. When a smell has different features mixed in, particularly a positive and a negative, it will quickly attract people's attention and influence their evaluations. For example:

'...When you smell coffee mixed with trains, you won't feel like you smelt a proper coffee. I think coffee smell is good when the smell environment is more neutral I guess. For the moment, I am bothered by the mixed environment of pleasant and unpleasant smells. The pleasant smells won't smell pleasant to me in the mixed environment.' S12

Intensity

Intensity is an important and essential feature of smells found in most people's descriptions of smellscape. As Waskul and Vannini (2008) argued, perception of aromas can become unpleasant when it is too overpowering. People's sensitivities to smells can influence their perceptions of intensity of smells in the environment (Henshaw 2013). Intensity of smells in this sense is also a subjective indicator. A high intensity of smells can be experienced as nuisance, whereas a low intensity of bad smells may not cause annoyance. For example, people enjoyed smells of food in the background in transit spaces. However, when the intensity of food smells increased to a distinct level, people would feel this was unpleasant. In contrast, while people in both cases disliked smells of traffic, like car fumes, petrol and diesel, they were less bothered if these were at a background level. For example:

'I think when come to space like this you wouldn't like to smell too much. There are some smells in the background when you walking through. But you wouldn't like something overwhelming you when you walk into the door.' S14

In both cases, people preferred smells at a background level in all functional spaces within the intermodal transit spaces. Being at a background level (low intensity), people will be more likely to not notice the smells in the space as discussed in Section 5.3.1. This background level intensity may possibly end the process of perception of smell environment which leads to a neutral status of smellscapes.

Naturalness

Naturalness and appropriateness (discussed next) indicate people's own interpretations of congruency between their expectations and onsite observations. However, naturalness emphasizes sensationally congruent whilst appropriateness emphasizes contextually and behaviourally congruent, which are both measured based on people's past experiences and memories. Naturalness has a double meaning here: on one hand, it refers to whether perceived smells are from artificial sources, such as perfumes, air fresher and scented products, or from natural elements, such as grass, flowers and soil; on the other hand, it refers to whether the smells perceived are made artificially that do not match people's visual and auditory perceptions. For example:

'When I was young, I worked at Disney world, we have scents for everything, popcorn machine have a smell of fresh popcorn, even if they don't have them. And we have smells of cookies and cakes everywhere. I know a friend who buys baby smell for his private clinic to make people feel relaxed. I think it is good as long as you don't notice it is been scented and you feel it is natural. If somebody jets the popcorn smell into the air, that's weird. But if you have a popcorn machine in the corner, which actually makes fresh popcorn, that's good. It will remind you of childhood and happy places. Uh, I think the smell shouldn't be so strong, just a little bit would be enough for you to remember this place.' S17

In another example, some people detected smells of chlorine from the water at Sheaf Square. While some participants liked this smell and the memories it evoked, others associated smells of chlorine with swimming pools and chemicals, which they considered unnatural and did not match the preconceptions about flowing water. For example:

'I don't expect chlorine, it usually associates with swimming pool, it is an indoor environment, obviously, outside tends to be more natural water smell. It is now I can smell chlorine, I don't expect that, I'd wish to smell more natural water, maybe not sea water, but just not artificial smell.' S07

Appropriateness

Appropriateness refers to whether smells or smell sources are appropriate to the physical and social context as well as perceivers' activities. High level of appropriateness can increase acceptance of an environment with bad smells, like car fumes at taxi ranks. As Miller (1997: 247) suggested, unpleasant smells can be made tolerable if the circumstances are appropriate. Inappropriateness of good smells in the environment can also devaluate the general smellscape. Expectations of smell environments can make a big influence on appropriateness of smellscape. For example:

'I know I said I love the smell of plants. But I don't expect to have gardens around train stations or bus stations unless it is outside the city centre at suburbs. You know.

It is normal to me to smell fumes around bus stations. But I'd like it to be neutral if possible, without any smells or with a bit smell of some nice cleaning liquid.' S04

As discussed in Chapter 2, the sense of smell is an arousal sense which recalls memories and evoke emotional experiences (Herz 1998). Congruency between memories, smells and behaviours can enhance people's emotional experience towards perceived smells (Herz and Cupchik 1995) which turns to increase the level of pleasantness (Russell 2003).

Liking

Liking and familiarity (discussed next) are very subjective and personal factors influenced by individual differences, i.e. past experiences, living environment and social background. People learnt their smell preferences and nuisance through everyday-life associations and know whether they like or dislike detected smells immediately on perceiving them (Herz 2006). Smell preference and smell nuisance play important roles in people's perception of smell environment. For example:

'I don't get a overpowering smell except the smell from the coffee shop where we are standing right next to it. I like it. It is a food or drink that I like. I'd think it is a nice smell environment...' S11

However, participants did not particularly rely on how much they liked detected smells and the physical environment when evaluating smellscape. In many situations, participants' evaluations of smellscape pleasantness varied with different levels of acceptance towards disliked smells. For example:

'I can detect some smell so f traffic fumes, rubbish and food. It is not a pleasant smell environment... but as a path for passing, it is fine and acceptable. (我觉得这里有一些尾气的味道, 还有一些垃圾和食物的味道。这样的嗅觉环境局对谈不上舒适……但是也不是个长期停留的地方, 所以还行吧, 可以接受。)' W15

Contextualising plays an important role in the above example where the participant was still aware of his preferences of the detected smells whilst evaluated the overall smellscape quality

within its contextual nature of being a walkway for passing. Participants in the two studied cases were found having similar nuisance towards smells from waste, cigarette smoke and traffic fumes, as discussed in Chapter 5. However, Participants only shared similar preferences towards smells of natural elements such as fresh air and vegetation. As Moncrieff (1966) found, smell preference varied from individual to individual whilst people are more likely to have similar nuisance towards certain smells. Many participants in both cases were also found preferring a neutral smell environment while waiting in intermodal transit spaces rather than having their favourite smells:

'I would prefer a clean and comfortable waiting environment. If there isn't any bad smells, I would feel pleasant. I won't prefer and expect to have my favourite smells here. (我希望有一个环境舒适干净的候车环境。至于嗅觉环境,我并不希望到处都是我喜欢的气味。我觉得只要没有什么不好闻的味道就可以了。)' W15

'I just wish to have some everyday normal smells except the bins and toilet smells. I don't want them to pipe some false non-existing smells. I don't mind smelling light coffee smell, the flowers, but not the air fresheners or sprays so often to hide the train smells. I just want natural. If I walk past a café, I am fine with the coffee smell, if I walk past the flowers, I am fine with the floral smells because it is nice fresh smell, but I wouldn't mind smell nothing, either.' S06

It is arguably to say that people's senses of smellscape pleasantness are naturally and unconsciously influenced by preferences and nuisance, but are not determined by this indicator.

Familiarity

Like preference, familiarity is another subjective factor, relating to people's individual differences. Positive correlations have been found in laboratory experiments between familiarity and hedonic degrees of perceiving smells (Destel et al. 1999). Similar findings are found in the studied cases that participants tended to feel more pleasant when they are familiar with the environment and smells within it. A typical example was found in Sheffield,

in which people who used the Railway Station more frequently than the Bus Interchange felt that the railway station concourse had a more pleasant smellscape:

'I guess this it more familiar with me. I haven't been to the bus station before. But I am very familiar with the train station. I come here every week. So, I think this is definitely more pleasant to me.' S01

'I like it here [the railway station concourse]. It is more welcome and familiar to me. I like to smell food in stations, though it sometimes makes me feel hungry. But it smells somehow a bit like home.' S04

'I can smell Re Gan Mian and Zhou Hei Ya here, which I eat frequently, almost every day. It is a familiar feeling. I really think, such smells of food can make people realise there are restaurants and food stalls selling their familiar cuisines, which will immediately make them feel homey and inviting. (这些食物的味道会让人觉得“哦这里有餐厅有商店”，特别是闻到那些日常的食物，那个感觉就不一样了，让这个地方亲切一些。就像这里，有热干面啊，呀脖子啊，都是平时吃的东西，让人有一种熟悉的感觉。)' W03

Familiarity is associated with feeling safe, calm and at ease (calmness is discussed next). People will feel tense and alerted when they detect unfamiliar smells in a familiar context. When coming across unknown smells, participants would refer to smells they know about. As discussed in Chapter 5, people differentiate 'normal' and 'abnormal' smells in the environment. Familiarity within the perceived environment can be arousal and non-arousal. Arousal familiarity comes from meaningful personal experiences and memories whilst non-arousal familiarity comes from repetitive perceptions of similar smell environments, i.e. the physical environment, smells or atmosphere. The non-arousal familiarity in this sense is a result of habituation of smells. Habituation to negative smells can reduce level of unpleasantness. For example:

'I detected the smells of buses and smoke from buses, smells like, maybe petrol. En, no, not petrol, just smoke. To be honest, I have no particular feelings about it, because I grew up in a city, I am used to it. I think it is not a nice smell to some people,

but to me it is neutral. It could be nicer without the smoke. But, I think I am just used to it.’ S09

As Henshaw (2013:26) and Engen (1991:25) argued, people will no longer pay attention to registered smells in the environment which they are habituated to and feel no threat any more. This also partially explains the ‘not noticing’ reaction in the perception process discussed in last chapter. Overall, either arousal or non-arousal familiarity can both contribute to smellscape pleasantness.

Calmness

Among people’s descriptions of smellscape in both cases, words like ‘relaxing’, ‘soothing’, ‘stressful’ and ‘calm’ were frequently found. Such modifiers are found important in understanding people’s evaluations of smellscape pleasantness, representing two status: being stressful and anxious; the opposite, being calm and relaxed. Comparing two cases, high level of pleasantness were rated where participants felt more ‘relaxing’ and ‘calm’ or less ‘stressful’ and ‘anxious’, i.e. Sheaf Square and West Square. Calmness, the state of being free from stress, undisturbed and relaxed, is both physiologically and neurologically related, which then leads to psychological and emotional influence (Russell 2003). Hensaw (2013:14) argued that annoyance to smells in the environment can cause discomfort and health risks to people, which decreases the pleasantness. Annoyance may also cause stress and anxiety, the opposite state of being calm and relaxed, which reduces level of calmness. Annoyance can be caused by detecting negative smells, overpowering smells or unfamiliar smells as well as the environment, i.e. lack of ventilation, dirty floors and crowds in the space. For example:

‘I feel not pleasant to be here. The air quality is very poor. When the wind blows, I can smell the mixed smell of trash bin, car fumes and body odours. I feel very annoyed to be here. I don’t think I will stay here for even one minute. (我感觉特别不好，感觉这个空气质量很差。风刮过来，就闻到垃圾桶啊，汽车尾气啊，还有人身上的味道。这个外面就有焦躁的感觉。要让我坐在这里的话，我肯定坐不住。)’ W08

Participants experienced high level of calmness when smelling natural smells, i.e. plants, water and fresh air. For example:

'I can smell the grass and flowers, it is a little bit overpowering. It is a bit like a park. It feels nice, and quit relaxing, quit pleasant ... I like to smell grass, it smells nice... I live close to green fields. Like when I used to walk to school, there are two parks...'

S07

Smells of nature, particularly vegetation, can bring restorative effects to reduces stress and improve well-being (Henshaw 2013: 174) which then enhances the level of calmness of smellscape. However, people suffered from hayfever may not find the smell of vegetation as calm and relaxing as other people. As the participant shown in the above example who declared to have hayfever, she used 'quite' to modify her experience of feeling relaxing and pleasant to the 'a bit overpowering' grass smell. However, as also shown in the above example, there seems to be an interrelation between intensity, liking, freshness and calmness. Meanwhile, as discussed earlier, familiarity can help reduce the feeling of being threatened (Engen 1991). High level of familiarity is also found contributing to the emotional state of being calm and relaxed. For example:

'I am calm, my mood doesn't change, I am calm and relaxed, but I just feel safer in the bus station. I don't know why, but maybe it is too hustle there and too many people walking through, and the space is much larger, I am afraid I would get lost. Well, I think sometimes it is what you are more familiar with. I used the bus station more often than the train station. So, I might feel more safe and comfortable with the bus station.' S05

Summary

Overall, the first four indicators are more related to the physical environment, smells and smell sources, whilst others are more influenced by the perceivers' individual differences and perceptual patterns. However, participants' pleasantness of smellscape in the studied cases is also influenced by other sensory stimuli, such as weather, visual interactions and sounds. Porteous (1985) emphasized that the perception of smells in the environment cannot separate from the other sense. As also discussion in Chapter 5, the indication, distraction and interaction between the sense of smell and other senses are inevitably involved in participants'

perceptions of the smell environment. The indicators summarised in this section need to consider influences of other sensory stimuli. As one participant at Sheaf Square said:

'It (the smellscape) is quite nice. I think more with water. I think it is the sound and scene, or maybe it is not the smell, but listening to the sounds and watching it can be quite relaxing.' S07

The sounds of running water and watery smells at the Sheaf Square in the Sheffield case, they together brought pleasantness of smellscape to participants at this stop, contributing to the calmness, freshness, naturalness and cleanness. Meanwhile, not all indicators will be involved in participants' evaluations of smellscape pleasantness, which will be further discussed in section 6.3.

6.2.3 A scale-rating system with emotional descriptors

As discussed in Chapter 3, descriptors of emotions indicate the environmental quality from three essential dimensions: pleasure, arousal and dominance (Mehrabian and Russell, 1974). As shown in the previous chapters and particularly Section 6.2.1, a range of emotional descriptors is found in people's descriptions of their perceptions of the smell environment in the studied cases.

Among these three dimensions, the state of pleasure and arousal are tend to be correlated, whilst the state of dominance is relatively independent (ibid). In the research cases, the pleasure and arousal states are more likely to cause psychological responses, while the dominance state is related to behavioural responses in the perceptual process discussed in Chapter 5. This study takes the 'pleasantness' as a general term to indicate perceivers' self-reports of their overall satisfactions and evaluations of the perceived smell environment, and involves reactions from pleasure, arousal and dominance.

Taking the theoretical perspective of using emotional descriptors to measure environmental quality, to explore people's perceptions of the smell environment from their own language descriptions, descriptors of the three dimensions are derived from people's own descriptions and an in-depth understanding of people's evaluations of the perceived smell environment. The last Section discussed the criteria people used to evaluate the pleasantness of a

smellscape: purity, intensity, freshness, cleanness, preference, familiarity, naturalness, appropriateness and calmness. As suggested, purity, cleanness, intensity and freshness are objective factors reflecting the physical environmental settings, which contribute to the dominance state of smellscape. Meanwhile, appropriateness and naturalness, related to the context of smell environments, also contribute to the assessment of physical environment and perceived smells, which also belong to the dominance state. However, indicators of preference and familiarity are determined by personal experiences and memories, which give meanings and attachment to the smell environment, contributing to the arousal state, as defined earlier. However, calmness indicates people's pleasure state of smellscape, which is found of two types in the studied case: anxiety and stress. The most frequent terms they use are 'relaxing', 'stressful', 'pleasing', 'annoying' and 'bothered'.

Feeling State	Bi-polar Descriptors	Translations of bipolar descriptors in Chinese
<i>Pleasure</i>	Relaxing – Stressful	放松-焦躁
	Pleasing - Annoying	愉悦-烦躁
<i>Arousal</i>	Familiar-Unfamiliar	熟悉的-陌生的
	Like – Dislike	喜欢-不喜欢
<i>Dominance</i>	Pure- Mixed	纯净的-混杂的
	Strong-Background	气味很重-没什么气味
	Clean-Unclean	干净的-脏的
	Natural-Artificial	自然的-不自然的
	Appropriate-Inappropriate	和谐-不和谐
	Stuffy-Fresh	闷/空气不流通的-清新

Table 6.3 Descriptors of three dimensions to measure people's perceptions of the smell environment in urban intermodal transit spaces

Comparing meanings of each indicator discussed in Section 6.2.2 and descriptors summarised in Section 6.2.1, using people's own descriptions to remain the authenticity and be easily understood by the general public, the bipolar pairs of descriptors representing the indicators: are familiar-unfamiliar, like-dislike, pure-mixed, strong-background, clean-unclean, natural-artificial, appropriate-inappropriate; stuffy-fresh, relaxing-stressful and pleasing-annoying, as shown in Table 6.3. A scale-rating system of smellscape quality in urban intermodal transit spaces can be generated with the bipolar pairs of descriptors summarise in Table 6.3 with a suggested seven-point rating Taking relaxing-stressed as an example, 7 means strong feelings

of relaxing, 4 means neutral (no particular feelings of this emotional response) and 1 means strong feelings of stress. This scale applies to ratings of all the other pairs of bipolar descriptors.

6.3 Pleasantness as a way to classify smellscape

As discussed in the last section, various indicators contribute to the quality of but not all indicators contribute at the same strength. Such indicators also indicate different features of smellscape. Pleasantness, in this sense, can be used as a way to classify smellscape. Comparing people's ratings and evaluation descriptions across smell walk stops in the studied cases, four general types of smellscape pleasantness emerged with emphasis on different indicators: smell preference-led, healthiness-led, life experience-led and context-led pleasantness. Each type of pleasantness includes the opposite end of the scale as well (e.g. healthy / unhealthy, preference / aversion, etc. Types of pleasantness can be identified with a smellscape notation tool developed from the evaluation indicators.

6.3.1 Preference-led

The smell preference-led pleasantness is the most common type. When there are distinct and dominant smells in spaces, people's sense of smellscape pleasantness will be more influenced by their preferences for particular smells and places. Participants in the study were found to have an immediate recognition of liked and disliked smells in a space. Their preferences for smells in the space influence their immediate reactions to the smell environment. For example:

'Nice, I like coffee smell anyway. Well, some people might put off coffee smell because they don't like drinking coffee. But I quite like it, it is quite pleasant to me.'
S06

'I like it actually. I don't know whether it is related to my personal preferences, but the fact of arriving and smelling the coffee makes me feel good and relaxed.' S05

However, when the smell environment is complicated with mixed smells at a high intensity, smell preferences do not produce pleasantness. In the studied cases, people preferred purer and lighter smellscapes in any situation. For example:

'For the moment, I am bothered by the mixed environment of pleasant and unpleasant smells. The pleasant smells won't smell pleasant to me in the mixed environment.' S12

The high ranking of pleasantness in this preference-led case is associated with strong positive preference and purity with smells at a low intensity. There are two other indicators associated closely with preference in the studied cases: familiarity and calmness. However, they are not necessarily essential to determine preference-led smellscape pleasantness. Studies also found that people within a common cultural context may share positive or negative evaluations of everyday smells (Classen et al. 2002; Mncrieff 1966), which suggests a possibility for achieving preference-led pleasantness in public spaces. Taking preference-led pleasantness into account, a design method of using typical preferable smells as background level could contribute to increasing people's sense of the pleasantness of a general smellscape.

6.3.2 Healthiness-led

Another type of smellscape pleasantness that emerged from the studied case is the healthiness-led pleasantness, which seems particularly important in the context of urban intermodal transit spaces with crowds and large traffic flows. Evaluations of healthiness / unhealthiness are particularly associated with hygiene and pollution, dominated by the indicator of cleanness, freshness and calmness. Both the hygiene-led and pollution-led pleasantness are strongly influenced people's visual perceptions of the surrounding environment.

Hygiene- led

In the two cases of this study, people based their sense of pleasantness on the hygiene conditions of the smell environment. It was often related to smells coming from sanitary facilities, sanitary products and crowds of people. This type of pleasantness is highly associated with cleanness and calmness. For example:

'Very strong smell of people, like sweat and smelly feet. I feel that people around me are not clean and haven't washed themselves. It makes me not want to be there. (很浓厚的人味，就是汗味，脚味什么的。我就感觉周围的这些人都不干净啊，好久没洗澡了啊，我就不想在这里停留。)' W06

The visual impact of seeing clean or unclean environments was found to be significant for participants' pleasantness ratings. Hygiene-led pleasantness was commonly demanded in both study cases. Smells of cooking fumes were also found to reduce hygiene-led pleasantness.

Pollution-led

Pollution, including traffic fumes, cigarette smoke and other unhealthy chemicals, has significant negative influence on people's perceptions of the pleasantness of smellscapes, particularly when the smell is strong and people see the sources. For example:

'I don't like the smell of fumes. It is not nice. I don't find it pleasant waiting here while smelling that. You will have the feeling that you are smelling something that will make you sick. Yeah, I don't like it.' S15

'It is very unpleasant. Every time when I smell it, I feel like I have to protect my lungs. Because it is something I believe is unhealthy for my respiration system.' S14

Most participants have negative attitudes towards smells of traffic fumes and diesel. Where such smells were detected, e.g. taxi rank and pathway, the smell environment was often rated as unpleasant. In these instances, it can be helpful to separate or remove bad smells from the general smell environment. Public awareness of the cleanliness of the environment and enforcing non-smoking in public spaces was indicated as important to achieve healthiness-led smellscape pleasantness.

In this category, people's health concerns play an important role. Many of the smells people disliked were related to pollution and waste, which are considered harmful to human health.

For this reason, people rated the smellscape in Sheffield Interchange pleasant for its cleanness. This type of pleasantness was frequently described as the idea smellscape for intermodal transit spaces and general public spaces. Cleanliness, therefore, can be regarded as one key factor for designing smellscape in public spaces.

Several physical factors were included in people's explanations of hygiene-led pleasantness, such as airflow, air quality and sanitary conditions. Air quality influences the smellscape at the macro level and can be perceived as a background smell in an urban environment. In other words, good air quality is the basic requirement for achieving hygiene-led smellscape pleasantness. At the macro level, as Henshaw (2013: 81) suggested local government should monitor air quality in public spaces where there are large numbers of people passing through or waiting, and control traffic flows and carbon emissions at such spaces. At the midi level, authorities responsible for these spaces may need to put more effort into maintaining the cleanliness of the physical environment.

6.3.3 Life experience-led

The life experience-led factors in assessing pleasantness were found to be associated with people's memories, past experiences and habits. There are two types of life experience-led influences on pleasantness: memory-led pleasantness, and habitation-led experience. They are mainly associated with familiarity and calmness, which is not necessarily related to preference. In the two cases, people's life experience-led pleasantness was found to vary among perceivers, different environmental settings, smells and smell sources.

Memory-led

There is a type of pleasantness caused by memories of a particular experience in the past, which is meaningful to the perceiver. For example, in Sheffield, most people evaluated the smellscape on train platforms as being poor quality, but some participants gave it a high rating based on their good experiences of travelling by train in the past:

'I don't mind the train smell, 'coz it reminds me of going away. I don't use trains for business or work. Mine would be for pleasure. All I remember is pleasurable

journeys. So I quite like the smell of the train, it is not something that I experience everyday neither, for me, I'd be going for a trip on a train, which is a pleasurable experience anyway, so, I don't mind smelling the train.' S06

Habituation-led

In some cases, it is not a particular experience from memories but a repeated habituation that leads to people's perceptions of the pleasantness of certain smells. For example, most of the non-smoking participants disliked the smell of cigarette smoke, but a few thought it was all right, because they were used to it. Similar responses were found in relation to traffic fumes. For example:

'I have couple of friends smoke quite a bit. I guess I am just used to it. I know some people are strongly against it. And I guess, the traffic smell, I am just used to that as well. I quite like to walk around Sheffield. Inevitably, you can smell quite a lot of fumes. But, if you compare some place like London, Sheffield is not so bad. I don't mind to smell fumes here.' S01

For this type of pleasantness, people personalised their perceived smells from their life experiences, and it is difficult to identify physical factors that influence people's responses to smellscape pleasantness. However, it can be indicated from people's experiences that familiarity with smells and surrounding environments plays an important role in assessing smellscape pleasantness. For example:

'Well, I don't really like the smell of coffee. It is a strong smell because I always associate coffee with work, or my old school, it is a work smell. My teachers at the old school always smelt like coffee. And now, in work, someone always walk pass by with a coffee smell. I think it is like a work or school smell.' S07

6.3.4 Context-led

Context-led pleasantness emphasises the naturalness of smells, which involves other sensory experiences in evaluations of smell pleasantness, such as vision, sound and temperature. This

kind of pleasantness closely relates to spatial functions and physical environmental settings, like layout, landscape, and so on. There are two types of context-led pleasantness: the activity-led and expectation-led.

Activity-led

Sometimes, people's perceptions of smellscape pleasantness depend on the activities related to the smell environment. Activity-led pleasantness was influenced by participants' preconceptions of the smell environment when doing an activity. For example, people did not feel it was pleasant to smell their own perfume when they were having food. It is important that the smellscape matches people's activities. As one participant said: *'if you are not actually eating food it is not as pleasant as when you are eating.'* S10

To achieve activity-led pleasantness, designers have to fully consider people's behaviours and ways of using such spaces:

'I think, to make more sensory fit environment, in general, you have to think of the activities and how people use the space first. And the space has to support the activities. And thinking of different types of experiences, walking, sitting, waiting. In each type of activity, think of the key elements, what kind of smell environment people appreciate.' S15

Expectation-led

As discussed in Chapter 5, expectations influence people's perceptions of various aspects of the smell environment, such as their purpose for visiting and their past experiences in such spaces. Such expectations would set out a number of conditions to achieve smellscape pleasantness in target spaces. Expectations of the smell environment in target spaces also came from people's visual perceptions of the physical environment. For example, seeing a café in the middle of the space, people would expect to smell coffee. An expectation of pleasant smells produces positive evaluations of the smell environment, whilst an expectation of unpleasant smells lowers people's evaluations. For example:

'I just wish to have some everyday normal smells except the bins and toilet smells. I don't want them to pipe some false non-existing smells. I don't mind smelling light coffee smell, the flowers, but not the air freshness or sprays so often to hide the train smells. I just want natural. If I walk pass a café, I am fine with the coffee smell, if I walk pass the flowers, I am fine with the floral smells, because it is nice fresh smell, but I wouldn't mind smell nothing, either. ' S05

6.3.5 A smellscape notation tool based on derived indicators

The smellscape notation tool is derived from sensory notation tool (Lucas 2009), using a radar chart to illustrate the dominance of each factor included on the diagram, as illustrated in Figure 6.1. The smellscape notation tool has been developed to analyse smellscapes based on the nine factors of smellscape pleasantness derived from the studied cases. Mean values of people's ratings of bipolar descriptors can be interpreted on the notation tool to help identify smellscape pleasantness types. This notation tool has the same rating scale as the rating system from 1 to 7, as shown in Figure 6.1.

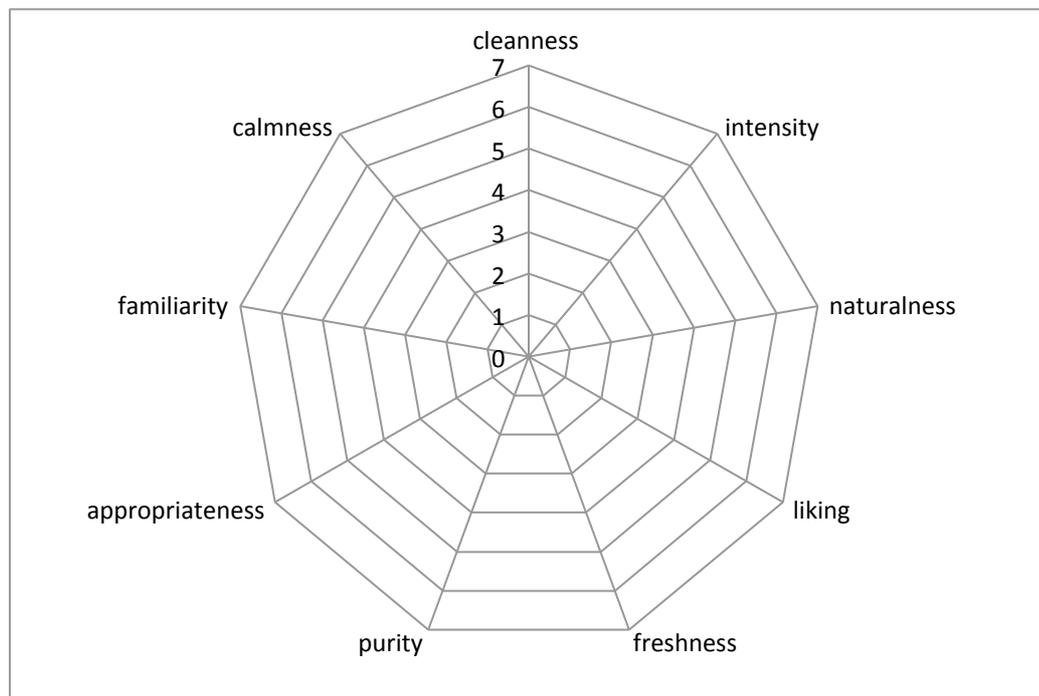


Figure 6.1 A notation tool developed for classifying smellscapes with pleasantness indicators adapted from Lucas (2009, p.180)

Each indicator shown on the radar diagram scaled from 1 to 7 shows a spectrum from negative to positive, including both bipolar ends. Take calmness for example, 1 means very stressful or annoyed, and 7 means very relaxing or pleasing. 4 means participants are aware of this factor whilst not having a particular feeling on either side. However, as discussed earlier, in the studied cases, some indicators were sometimes found not described by participants at certain investigated stops. In the radar diagram, it includes 0 to reflect the fact that an indicator is not experienced. The indicator 'calmness' has two contributing bipolar pairs: pleasing- annoying and relaxing-stressful. The mean value of calmness includes ratings of both pairs.

The mean value interpreted on the notation tool can show the tendencies and emphasizes of people's evaluations and can be used in identifying types of smellscape pleasantness in the studied cases: preference-led pleasantness, most associated with liking, purity and intensity; healthiness-led pleasantness, most associated with cleanness, calmness and freshness; life experience-led pleasantness, most associated with familiarity, preference and calmness; and context-led pleasantness, most associated with appropriateness and naturalness.

As from the discussion in Section 6.2.2, each indicator of smellscape pleasantness relates to different components discussed in the previous Chapter. For example, cleanness indicates the state of station management and sanitary conditions. These features are key analytic elements of smellscape qualities and indicate the types of pleasantness people demand in the investigated environment. The use of a smellscape notation tool to identify types of pleasantness would be helpful to illustrate features of the smell environment, identify key design components and establish design objectives.

The smellscape notation tool can illustrate various conditions of smellscapes at different levels of pleasantness. Participants' evaluations of smellscape pleasantness varied in different situations in studied cases and their emphasis varied among the different evaluation factors. In order to illustrate how this smellscape notation tool works, two examples will be given in the following discussion to show smellscape pleasantness at two stops on the smell walks with potential ratings of each indicator based on people's descriptions and ratings of overall pleasantness.

The first example is the smellscape in the Railway Station Concourse in Sheffield , where the smell environment was described as appropriate to its context, being ‘inviting’, ‘bright’, ‘clean’ and ‘familiar’ to most participants. A number of smells were detected at background level, such as smells of pasties, perfumes from people, cigarette smoke from the door, smells of sandwiches and coffee. Among all the smells, the smell of coffee from the café in the centre of the space was slightly dominant. Many people noticed the plants in the planters and flowers hanging in the space while not detecting any smells from them. A low sense of naturalness was found in this case. The mean value of people’s ratings of the overall pleasantness at this stop is around 4.5, which is slightly positive towards pleasantness, mainly relating to indicators of intensity, familiarity, appropriateness, cleanness and preference. In this case, some participants experience preference-led pleasantness while others participants experience context-led pleasantness. A possible way of using the smellscape notation tool would be as shown in Figure 6.2.

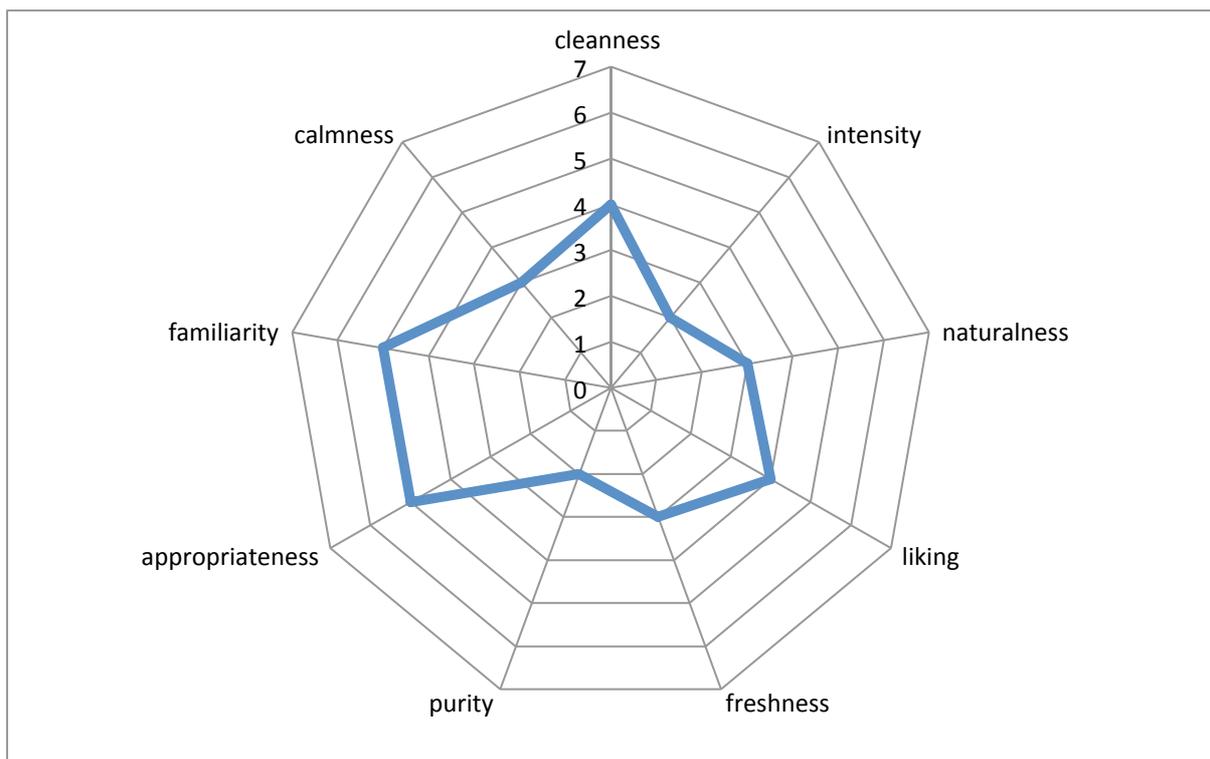


Figure 6.2 An example of using the smellscape notation tool to identify smellscape features and pleasantness types in Sheffield Railway Station Concourse

Another example shown here is the Internal Taxi Centre in Wuchang, where the mean value of people’s ratings of overall pleasantness is the lowest at around 2.5, meaning significant

negative experiences. The Internal Taxi Centre in Wuchang is an enclosed underground space, where people frequently detected strong smells of traffic fumes mixed with smells of toilets, trash and rotten food. Most participants described their experiences of the smell environment at this stop as ‘stuffy’, ‘poor air quality’, ‘smelly’, ‘intolerable’ and ‘annoyed’. Some participants were influenced by poor lighting conditions and noise from cars. People’s evaluations at this stop are associated with preference, intensity, cleanness and freshness, and are also related to preference-led and healthiness-led pleasantness. According to above the discussion, a possible way of using the smellscape notation tool at this stop would be as shown in Figure 6.3.

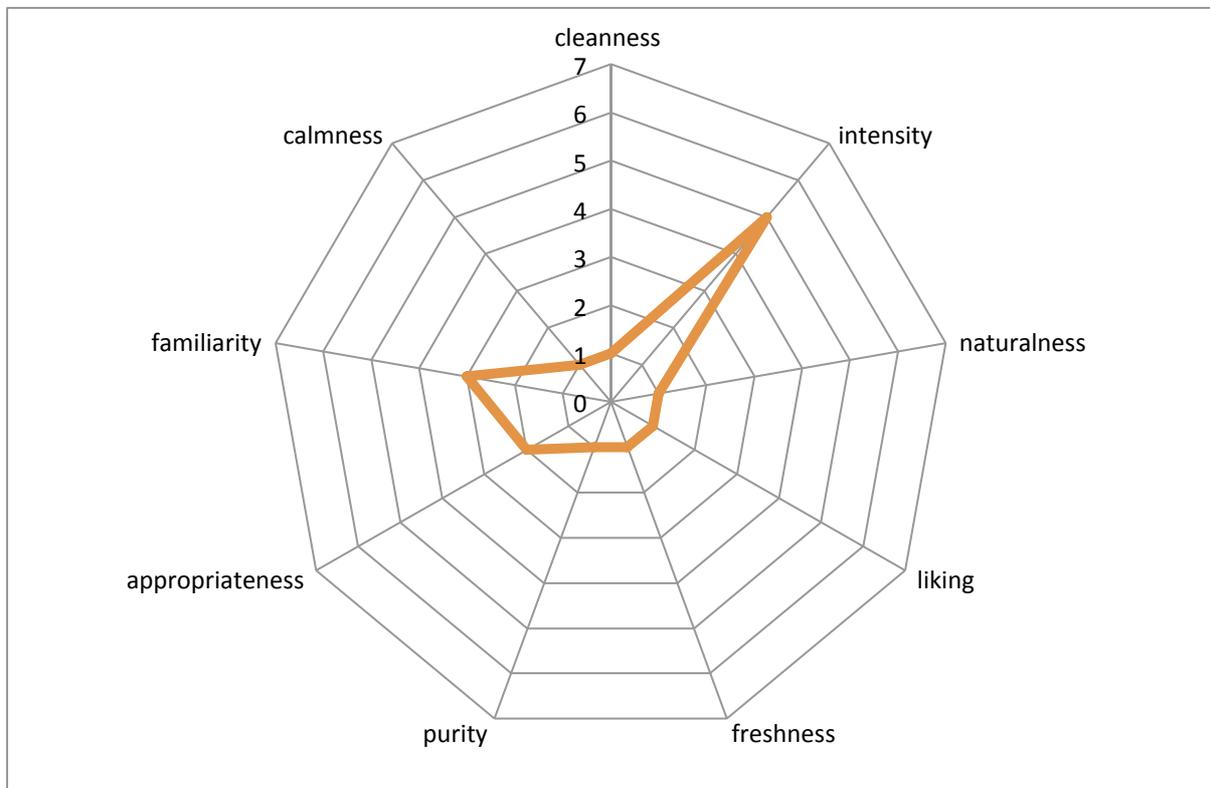


Figure 6.3 Smellscape pleasantness evaluated through the notation tool in the Wuchang Railway Station Internal Taxi Centre

6.4 Conclusion

A framework for measuring smellscape quality and classifying smellscape has been constructed in this chapter using identified indicators of people’s evaluations of smellscape

pleasantness derived from the studied cases. Nine indicators were found: cleanness, freshness, calmness, preference, familiarity, appropriateness, naturalness, purity and intensity. Cleanness and freshness were found more related to the physical environmental settings. Purity, intensity and calmness were found to be more related to features of smells and smell sources. However, preference and familiarity were more related to perceivers' individual differences. Appropriateness and naturalness were more related to people's preconceptions, expectations and the physical environmental settings. Based on the theoretical framework in Chapter 3, a scale rating system has been developed to measure the smellscape quality with relevant bi-polar emotional descriptors derived from people's own descriptions, by referring to the identified indicators.

It was found that the nine indicators of smellscape pleasantness work at different strengths within different activities and environmental settings, i.e. context, function and layout. Altogether, four types of smellscape pleasantness have been found in the two urban intermodal transit spaces studied: preference-led, healthiness-led, life experience-led and context-led pleasantness. In particular, healthiness-led pleasantness, associated with cleanness, freshness and calmness, was found to be favoured by participants in the urban intermodal transit spaces. A smellscape notation tool has been developed to help identify types of smellscape. Together with the individual, environmental and social indicators identified in the previous Chapter, it builds up the foundation of a comprehensive approach for planning and designing smellscapes in intermodal transit spaces.

The following Chapter draws on suggestions made by the professionals interviewed in the two cases, as well as practices and theories of urban planning and design, to explore a systematic planning process and practical design method for smellscapes in intermodal transit spaces.

Chapter 7: A framework for designing and managing smellscape in urban intermodal transit spaces

7.1 Introduction

Smellscape perception as a thought process was analysed and discussed in Chapter 6. A number of perception patterns emerged from the research data, allowing interpretation criteria for people's descriptions of, and reactions to perceived scapes. The perception process leads to a circular model of understanding and generating scapes within the key components discussed in Chapter 5. As part of the perception process, evaluation of scapes pleasantness was then discussed in detail, in relation to derived indicators: cleanness, freshness, likeness, familiarity, purity, intensity, naturalness and appropriateness. A notation tool developed from these indicators was tested and applied to the cases studied, suggesting a method of analysing scape characteristics and evaluating scape qualities. Four categories of scape pleasantness were summarized and discussed in Chapter 6. Each category indicates a set of requirements for achieving scape pleasantness building on the components discussed in Chapter 5. These discussions are drawn from the data collected and set out a framework for scape design in urban intermodal transit spaces. Chapter 7 begins with a discussion of conflicts between current design framework of urban intermodal transit spaces and scape pleasantness in such spaces. Drawing on planning and design principles of intermodal transit space and discussions in previous chapters and suggestions gathered from interviews with built environmental professionals, guidelines are produced to plan and design satisfying scapes in intermodal transit spaces. The suggested design framework includes the scape components, spaces and pleasantness indicators discussed in previous chapters, in line with design contexts and principles of intermodal transit spaces.

7.2 Conflicts between intermodal transit spaces and scape pleasantness

In the two cases in this study, pleasantness of scapes mainly depended on a range of factors including healthiness, preferences, contexts and life experiences. However,

intermodal transit spaces are places of conflicts between the main functions and good smellscape quality. The most dominant smells in such spaces are related to traffic. As found in Chapter 5, traffic-related smells are the most disliked smells associated with pollution and an unhealthy environment. However, traffic smells seem inevitable on platforms and in areas surrounding intermodal transit spaces. One main conflict here is the function of intermodal transit spaces as hubs of traffic and people's dislike of traffic related smells.

In core areas of intermodal transit spaces, where people spend most time waiting, multiple functions are designed to meet passengers' demands, like restaurants, shops and toilets. Such functional spaces are normally located within short distances of waiting areas. In some cases, restaurants and cafes are purposely open towards sitting areas to attract people to these commercial activities. In the studied cases, mixed smells of food, people and waste were detected in such spaces. However, not everyone enjoyed smells of food at anytime of the day. In particular, few participants enjoyed smells of food when mixed with unpleasant smells of sweat, toilets and food waste. Purity and cleanness, indicating a healthy environment, are highly valued when perceiving smellscapes in these places. The convenience of approaching to different functional spaces in core areas seems to cause conflicts of smellscape pleasantness in this case.

One typical characteristic of intermodal transit spaces is that they accommodate large passenger flows and act as public spaces. As this study has shown, people are important smell sources and indicators of smellscapes. They come with their own smells of body odours, shampoo, clothes and perfume, and they also produce smells through activities, like eating, drinking, smoking and using toilets. Intermodal transit spaces, as common spaces, allow passengers to have freedom to engage in various kinds of activities. Many banned activities, such as smoking by the door, urinating in dark corners and taking off shoes in waiting rooms, were found to cause unpleasant smellscapes for other. The conflict between perceivers' smellscape pleasantness and other passengers' behaviours seems to be part of the nature of intermodal transit spaces.

Another conflict may arise from the particular architectural forms of intermodal transit spaces. In principle, intermodal transit spaces require large-volume spatial forms and seamless connections between different transport modes. Particularly for larger transit spaces, like Wuchang, designers tend design urban complex building. Air circulation in such spaces

mostly depends on mechanical ventilation systems, which consume large amounts of energy. As found in Wuchang, station operators may reduce operational frequencies of fresh air handling units to control energy consumption, which delays the exhaust of smells and causes poor air quality indoors. Smellscapes were frequently commented on as being ‘non-fresh’, ‘smells of air conditioning’ and ‘not natural’ indoors. As discussed, freshness and naturalness are two important indicators of smellscape qualities. These side-effects caused by architectural forms of intermodal transit spaces and ventilation systems conflict with achieving smellscape pleasantness.

7.3 Design and planning principles of intermodal transit spaces

The studied intermodal transit spaces in this research are both regeneration projects on sites of old stations. Redevelopments of railway stations in many British and European cities tend to produce multimodal and multifunctional transit spaces (Bertolini 1998). The situation of redeveloping railway stations in China also appears to design multi-transport hubs with various functions in an integrated space (Zeng 2009). Typical designs of railway transit spaces include basic elements of railway tracks and signalling, platforms, circulation areas, ticket sales and retail spaces, post and parcel areas and station forecourt (Edward 1997). The simplified design principles divide transit spaces into a core area and the platform area (ibid), around which all facilities, transport and service spaces are arranged, as shown in Figure 7.1.

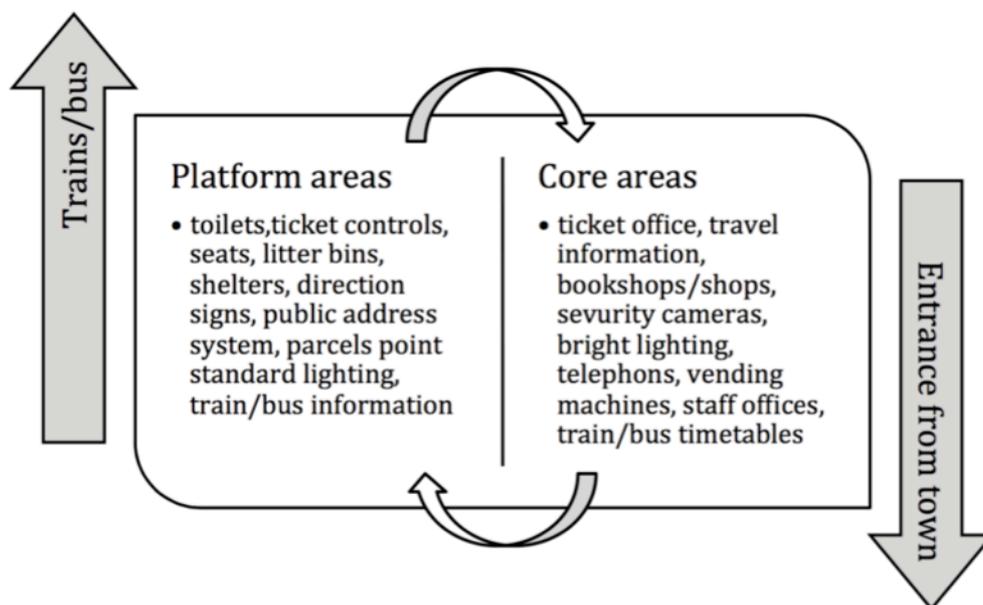


Figure 7.1 Design components for centralised railway transit spaces (derived from Edwards 1997: 76 - 77)

Intermodal transit spaces in contemporary cities should be considered as both ‘nodes’ and ‘places’, providing connections between transport and public spaces, and places for the use of passengers and local residents (Bertolini 1998). In this sense, as ‘nodes’ in cities, urban intermodal transit spaces need to fit into the general urban fabric and perform as bridges connecting surrounding spaces and providing transport convenience. As ‘places’, urban intermodal transport spaces need to be for users, providing social and interactive functions. To achieve the ‘node/place’ model in contemporary society, designs of intermodal transit spaces need to achieve multiple uses (Bertolini 2006): 1) in terms of activities and flows; 2) allowing plentiful opportunities of interaction between life inside and outside buildings; 3) with high visibility to people at all times; 4) sufficient, legible points of access to and exchange between different foci of activities; 5) an internal structure favouring the overlap of mobility flows in space and time; 6) links with the wider surroundings. This design structure takes intermodal transit spaces to be both functional and social for the general public.

Apart from functions, the access environment designed for movement, such as route, distance and connections between different transport modes, influences passengers’ satisfaction and the frequencies with which they will use public transport infrastructures (Givoni and Rietveld 2007). General planning and design of intermodal transit spaces should work on the rationale of passengers’ routes and behaviours between different transport modes to achieve a good access-environment in a multi functional station. As discussed in Chapter 5, passengers’ evaluations and requirements of smellscapes are found influenced by their movements and activities, such as rushing to the platform, wandering around in shops and resting in waiting rooms. Perception, as a thinking and sensational process, is also suggested as a skilful bodily activity, through physical movements and interactions (Noë 2004). Smellscape, as the human perception of the smell environment, is inseparable from passengers’ movements in the surrounding environment. The planning of routes and layouts of intermodal transit spaces should consider the influence these on smellscapes.

In order to achieve a satisfying smellscape, the smellscape needs to be considered as an essential element that fits a general planning and design process of urban intermodal transit spaces, including four main stages: establish goals and objectives; make predictions and draw up designs; implement the plan/design; evaluate outcomes (Hall Tewdwr-Jones 2010). As discussed in Chapter 2, existing planning and designs of intermodal transit spaces consider

many other sensory aspects at the design and evaluation stage, like lighting system design to enhance the security at night, and auditory designs to reduce noise interference. In the European directive on Environmental Assessment (85/337/EEC), there is instructive information for large infrastructure projects on how to assess environmental quality: at the operation stage, environmental assessment should consider noise, vibration, pollution, journey disruption, and impact upon effective land-use (Edwards, 2013). However, smellscape is not often considered in any stage of the planning and design processes for intermodal transit spaces, which causes conflicts between designs and smellscapes. An initial consideration of smellscape at the goal and objective stage of design seems necessary to guide the following stages in a planning process to achieve a pleasant smellscape in intermodal transit spaces.

7.4 A smellscape design framework for intermodal transit spaces

Moncrieff (1966) summarises four principles for dealing with odours: masking, separation, removal and dilution, which were then developed by Henshaw (2013: 144) into four basic rules for controlling and designing urban smellscapes, through a sequence of separation, deodorisation, masking and scenting. Definitions were given to the four actions: 1) separation, the spatial or temporal separation of odours through planned activity or displacement; 2) deodorisation, the planned removal of odours of dirt or waste of one form or another; 3) masking, the overlaying of one odour with another which focuses on hiding or changing the original odour; 4) the introduction of a new odour for its specific odour qualities or characteristics. In this case, masking and scenting are similar in both using the ‘masking’ effect. ‘Dilution’ in the general urban environment seems hard to control, but within indoor spaces, it could become an important method of improving smellscapes through both passive and active designs. In relation to urban intermodal transit spaces, - indoor and outdoor areas - design principles may include all five methods derived from Moncrieff (1966) and Henshaw (2013): masking, removal, dilution, separation and scenting.

Such principles are applied in response to features of smell sources, such as type, intensity, purity and location. In practice, the idea of controlling smellscapes seems quite widely accepted and used, such as limiting odour emissions from chemical plants and providing covered trash bins to collect residential waste. Drawing on the four principles, one main

strategy Henshaw (2013: 170) suggests is to manipulate wind and airflows in urban spaces to reduce odour concentration thus creating a freshening effect. As a carrier of smells, the movement of air is considered a key indicator in designing smellscape, through ventilation systems and controlling wind movements. Apart from wind and airflow, smellscape can be designed with plants, waterways and topology as well as considerations of vehicular stopping points and activity densities (ibid). A number of cases can be found in public spaces, such as waste management, cleaning activities, using air fresheners and installations of smoking booths (Henshaw 2013: 147). However, there appear to be very few cases of consideration of smellscape more generally in architectural and urban design, and the idea of integrating smells with design schemes, built forms, structures and materials seems quite limited. Designing smellscape should always be relevant to the context, as well as knowing and considering the different perceptions of smells among different people and places (Classen et al. 2002). It is key to this approach that the views of various users of the site need to be included beyond those of the design team (Henshaw 2013: 220). Designers also have to be aware that some smells can cause allergies to certain groups of people and smell nuisance in certain conditions; for example, perfume smells would be unpleasant while eating. Responding to different movements and activities in intermodal transit spaces, smellscape may be designed with different characteristics to produce a general pleasant quality.

Henshaw (2013: 211) outlines a circular urban smellscape design process in four stages: site assessment and stakeholder engagement; determining odour objectives and settings within the design brief; designing and implementing the scheme; monitoring and evaluation. In this process, odour objectives are determining factors for the design outcomes. However, Henshaw (2013) does not explain in detail what an 'odour objective' could be. In a soundscape design framework, Brown (2011) suggests to identifying wanted and unwanted sounds to help determine acoustic objectives, referring to sound preferences and sound-masking effects. Examples of acoustic objectives for soundscape design can be 'hear, mostly, (non-mechanical, non-amplified) sounds made by people'; 'suitable to hear amplified speech (or music)'; and 'sounds conveying a city's vitality should be the dominant sounds heard' (Brown 2011). In this sense, when establishing odour objectives it is necessary to identify wanted and unwanted smells, taking into account smell preferences, masking effects and other characters discussed in Chapter 6, including intensity, freshness, cleanness, familiarity, purity, naturalness and appropriateness. Odour objectives need to be defined within the context of the purposes of the spaces being designed. Examples of odour objectives could be:

- Smells of nature in outdoor waiting spaces (intensity + naturalness + preference);
- Absence of smells of waste and cigarette smoke in enclosed waiting areas (preference + intensity);
- Suitable to smell food and coffee in waiting concourses and commercial areas (appropriateness + preference);
- Suitable to smell background fresh smells of cleaning liquid in most areas (appropriateness + freshness + intensity).

As discussed in Chapter 2, Henshaw (2013: 172) suggests that designing urban smellscapes should be conducted at different spatial scales: macro (city), midi (district) and micro level (street) level. In this sense, designing smellscapes for urban intermodal transit spaces can also be considered at three levels: macro level, including site, transport, landscape planning and design; midi level, including architecture design, indoor scenting and waste management; micro level, including interior design, behaviour control and facility maintenance. The design principles, tools and management methods need to be explored separately at these scales in relation to determined odour objectives. In line with the indicators influencing smellscapes in urban intermodal transit spaces discussed in Chapter 5, designing and controlling smellscapes in such spaces can be considered as shown in Figure 7.2.

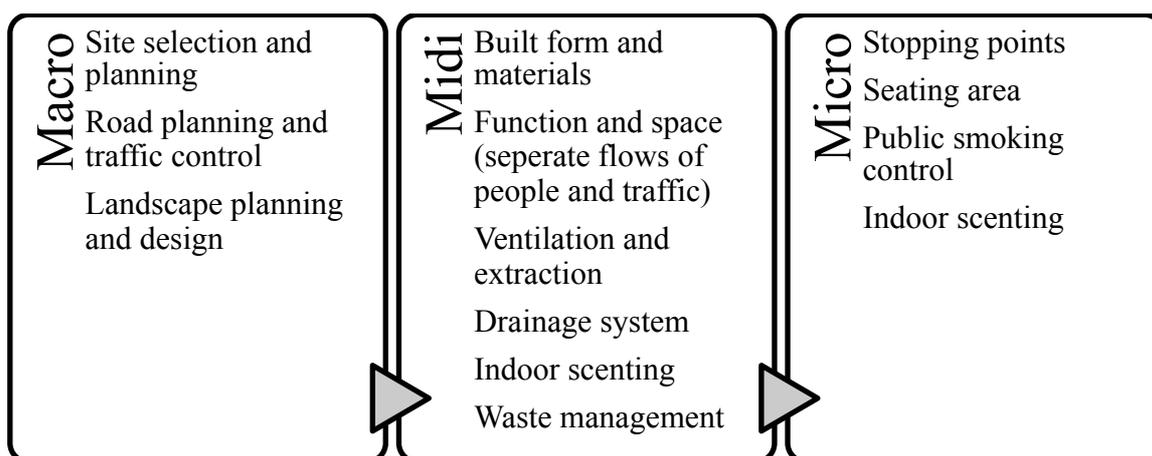


Figure 7.2 A conceptual framework for smellscape design and control urban intermodal transit spaces

Overall, designing for pleasant smellscape need to make balance between all the indicators. As discussed in Chapter 6, healthiness-led pleasantness is appreciated by most participants in

the studied cases. It would be idea to control smells in the environment at a background level and remain a good air quality. Whatever scents introduced into the space need to be non-intrusive and logical to the environment:

'I would suppose people would like smells not too intrusive. I think people don't mind it smells a little bit or neutral. What we don't want to have is to be overwhelming. People don't like to be manipulated. We know that some that provide smells of bakeries that make you feel homey to make you buy more. If you noticed you are manipulated, you will be angry. So, I think that needs to be taken into consideration that what we do should be natural and logical to the environment. The smellscape should match that the environment is, so that people wouldn't take it as artefacts.'
S12, Environmental psychologist

Rather than introducing smells, it would be more useful to limit negative smells, as one professional suggested:

'Generally, I think it is good to limit bad smells. For example, when you design a restaurant, you will need to pay attention to the toilet area and make sure the smells doesn't influence people who sit near to it. For such things, we do have in practices. But, we never think that our smell experiences can be enhanced from other strategies. I think it might be interesting to bring in something, like pots of plants, which enrich people's smell and visual experiences. But, also, it is something you won't feel wired in the place. So, I think, if you want to bring in smells, make sure it natural and people don't notice it and don't feel manipulated.' S18, Landscape architect

7.5 Design at the macro level

At the macro level of a city's master plan, intermodal transit spaces as can be regarded as key smell sources. Urban intermodal transit spaces have large volumes of traffic every day, producing intensive traffic fumes in the surrounding environment. Smells related to traffic are found to significantly influence smellscape quality in urban spaces (Henshaw 2013) and were the most disliked in the studied cases. Intensive emissions of traffic fumes around such nodes can have a negative influence on local air quality and people's perceptions of smellscapes. In

this sense, smellscape design for intermodal transit spaces at the macro level should aim to minimise the negative influence of traffic on the general smell quality of the environment. Separation and removal of traffic smells from the surroundings can be taken as main design strategies at this level, such as using prevailing wind, separating residential areas, pedestrians and main traffic roads, reconstructing road systems and controlling traffic.

7.5.1 Site selection and planning

The first thing to consider at the macro level design is site selection. A site design response to the landscape and topography can influence the way people perceive the onsite smellscape, particularly as a result of wind forces, temperatures and landscape features. Sheffield Railway Transit Network and Wuchang Railway Transit Centre are typical examples of urban intermodal transit spaces developed on sites of old railway stations (see Figure 7.2) in which there is limited opportunity for dealing with particular environmental aspects, such as road structures and locations (Bertolini 1996), and this also limits smellscape design strategies at the macro level. In contrast, sites that can easily remove traffic smells through use of prevailing wind and provide buffer zones between intermodal transit spaces and surrounding areas allow for good smellscape design at the macro level. In designing a new site, the existing wind environment can be analysed to inform the preliminary plan. Spaces with strong smells should not be placed in an upwind location and urban forms around the transit spaces could be designed to provide ventilation corridors to help the constant removal of traffic fumes. A good use of prevailing wind combined with urban forms in the preliminary planning stage can help dilute and remove traffic smells in and around intermodal transit spaces.

Sites determine the general contexts of smellscape designs of intermodal transit spaces, including many environmental aspects that also influence design strategies at the midi level, such as prevailing wind, landscape and topography. For instance, The site of the Sheffield Railway Station and Bus Interchange is situated in a valley and the choices of planning station buildings, roads and landscape are more limited than a flat location. However, Sheffield Railway Station has provided a good example of achieving a clean and fresh smellscape at the macro level. The general environment around Sheffield Railway Station presents three separate zones, which help separate smells in general. The busy vehicular road

near the station is separated with a one-storey height steel wall with water running down. This barrier effectively separate pedestrians walking into the station and traffic on the road, reducing the amount of traffic fumes.

Wuchang is located on flat land where choices of deciding station types, orientations and general layout are more flexible but nevertheless, the design still resulted in an inefficient smellscape. Professionals in this study raised the issue of the location of Wuchang Railway Transit Centre because of the traffic problems in surrounding areas and negative effects on the general air quality and smellscape:

‘The underground transit hall in Wuchang station is directly attached to the main road, which is of dense traffic. This kind of planning is definitely not good for removing traffic fumes. The selection of location and site plan is difficult for improving overall air quality and creating a good sense of smellscape. (武昌站的地下空间就直接连着主干道的隧道，这一块的车流量是非常密集的，地下空间本来也补易于汽车尾气的排除。这个选址是很不利于改善整体的空气质量 和营造良好的嗅觉景观的。)’ W21, Planner

Recently, cities over the world have proposed new high-speed railway stations, integrating multiple transport modes. Due to constraints of existing rail systems and structures, these new high-speed railway stations are mostly proposed in newly-developed urban districts. This provides opportunities for the surrounding environment to be planned to achieve a better smellscape at the macro level. For example, the newly-built high speed train station Wuhan Station is located in the outskirts of Hongshan District, near Yangchun Lake, is much less polluted with traffic fumes. Most of the surrounding area remains undeveloped and green, which gives more flexibility for planning buffer zones along stations, separating pedestrian spaces and vehicle spaces and keeping residential development in an appropriate distance. In such a sense, making use of topography and landscape of a site to combine planning of intermodal transit spaces with controlling wind directions and separating traffic flows can help remove or dilute traffic fumes easily from the macro level environment.

7.5.2 Road planning and traffic control

As part of people's daily routines in cities, intermodal transit spaces should provide convenient access to different transport modes and be integrated with other infrastructures and urban spaces. Road networks link spaces, people and traffic in intermodal transit spaces. Good road planning allows natural ventilation to remove and dilute traffic smells and reduce influence on surrounding areas. Appropriate combinations, distances and barriers between motorways, cycle lanes and sidewalks are an essential consideration in the planning stage to achieve good smellscape at the macro level.

The studied cases have presented examples of both vertical and horizontal transport links. In Sheffield, pedestrian and traffic flows are well separated at ground level. There is a pedestrian pathway connecting the Bus Interchange and Railway Station, separated from vehicular traffic. The pedestrian route from the city centre to the Railway Station is mostly within pedestrian areas with only two short road crossings, and the main traffic route runs parallel to the Railway Station. The steel water wall on the boundary of Sheaf Square provides a solid separation between the Square and the main traffic route. Together with the freshness of water and visual distraction, the smellscape of Sheaf Square achieves high pleasantness as shown in pleasantness ratings in Chapter 4.

Wuchang Railway Transit Centre, on the other hand, is a complex building at the junction of two busy roads. Movements of traffic and pedestrians are designed at both ground and underground levels. At the ground level, there are no physical boundaries at most parts to separate people and traffic. Participants in this study perceived traffic fumes in surrounding open spaces, West Square and East Square. At the underground level, subways are separated from traffic with concrete walls, but these are enclosed and lack airflow. Road planning around Wuchang Railway Transit Centre reduced general smellscape pleasantness and was ranked low for freshness and healthiness. In compact forms of intermodal transit spaces, pedestrians and motorways can be separated and developed with multi-levels above the ground to achieve better smellscape, such as the new design of West Kowloon Railway Station (see Figure 7.3).



Figure 7.3 Design rendering of West Kowloon Terminus in Hong Kong by Aedas (Source: <http://www.aedas.com/en/architecture/express-rail-link-west-kowloon-terminus>)

Separation of traffic and pedestrians, residential areas and outdoor resting spaces can help reduce chances of detecting unpleasant traffic smells. Separations along roads can be formed of plants, bushes and trees, but can also be voids, such as squares, waterscapes and grasslands. In particular, some fragrant plants which absorb traffic fumes and reduce dust in the air can significantly improve the smellscape at macro level, which will be discussed in detail in the following section. Apart from road planning, traffic control during peak time may help reduce the negative influence of traffic fumes on general smellscape. At Sheffield Railway Station, private cars were observed stationary in the same queues as taxis at the taxi rank, producing extra fumes. It is important to separate lanes for private cars and taxis. As one professional suggested:

‘A lot of smells coming out from the taxis while they are stuck in the rank. There is a high concentration of gas coming from the cars and cabs. Moreover, since there is not

enough circulation of the air, this kind of smell is like a cloud stuck here. It is very very bad. I think they should not allow such a high concentration. Here, you can see both public vehicles and private cars. I think it is better to split them. Another thing, I think the drivers should stop their engine while waiting.' S13, Architect

Compared with Sheffield Railway Station, Wuchang Railway Transit Centre is better because it separates taxis at the underground level from private cars at the ground level. Private cars are also controlled with time limits on site to avoid long queues. However, the ground level drop-off area is not well designed and is not separated from outdoor waiting spaces. As discussed in Chapter 4, smells of traffic fumes are found to be dominant on West Square outside the main entrance to the waiting concourse. Designs of drop off areas, pedestrian and vehicle routes need to give flexibility to station operators to have more options for traffic control measures. For example, during peak times, only allowing approved private cars into the station for passengers with disabilities, heavy luggage and emergencies, which would require a large drop off space alongside the pedestrian walkways.

Targeting traffic in intermodal transit spaces, as discussed in Chapter 5, and especially controlling traffic fumes emissions within such spaces is important. There is an environmental regulation in the UK that buses or taxis need to stop their engines if they are stationary for more than five minutes in order to reduce the emissions of fumes. This potentially contributes to improving general air quality and background smells in intermodal transit spaces. However, the government and station operators need to put more effort into making this work: taxis outside Sheffield Railway Station were observed keeping their engines running for as long as 10 minutes, when there were no passengers; a similar situation was observed at Sheffield Bus Interchange, where signs saying 'stop engine' are clearly placed on the window walls outside the Interchange waiting rooms, facing the driving spaces of buses.

7.5.3 Landscape planning and design

Landscape planning of intermodal transit spaces in terms of smellscape should primarily consider with the human scale and natural landscape elements. In Wuchang Railway Transit Centre, there was large-scale of greenery, yet despite this the overall landscape did not

counteract the unpleasant smellscape. As suggested by interviewed professionals, there may be several reasons:

- main greenery space on West Square is separate and a long distance from waiting area;
- the connections between the main greenery space, pedestrian walkways and the main entrance are quite weak; oversized scale;
- lack of interactions between people and designed landscape elements.

In contrast, landscaping of on Sheaf Square in the Sheffield case has provided a good example to improve smellscape, as shown in Figure 7.4: the steel water wall separates traffic fumes from the Square at the ground level; the large fountain in the centre, of the area at the front of railway station provides freshness along the route; and the visual and auditory mediation also help enhance general experience. Landscape elements to improve the quality of smellscape are not necessarily needed to be plants or greenery.



Figure 7.4 View of landscape design at Sheaf Square in front of Sheffield Railway Station

As discussed in Chapter 5, people’s visual perceptions of the water feature and the greenery in the studied cases are found to indicate a fresh and relaxing smellscape. Such distraction and indication (as discussed in Section 5.2.1) of landscape elements have significant positive

influence for designing a pleasant smell environment. Designers need to know how different landscape elements influence smellscapes and interact with people. For example: water cleans air and increases humidity; sounds of water attract people to visit and interact; when in blossom, plants, such as jasmine and roses disperse attractive scents in the air and could help to mask unpleasant smells. Planning of landscape in urban intermodal transit spaces need to combine with the access-environment along both pedestrian and traffic routes. For example, Figure 7.5 illustrates an example of using landscape elements to design a pleasant smellscape for people waiting in open areas. It has a baffle zone with mostly evergreen trees and bushes to separate taxis from waiting areas, which prevents people in the waiting areas constantly seeing traffic and helps to absorb some of the traffic fumes. Cherry trees on the edge blossom pale pink small flowers between February and April. The second section is the ground water feature, which cleans the air and increases humidity. This type of water feature gives a continuous sound to mask some from the traffic and distract people's attentions. The third area is a quieter resting area with rose bushes and apple trees, which offers a pleasing smell during the blossom and harvest time. The sizes of the three area are controlled to allow interactions between people and landscape elements as well as making smells of water and plants noticeable. Design with landscape elements needs to consider seasonal changes, local species and combinations of different elements, responding to visual interactions and activities.

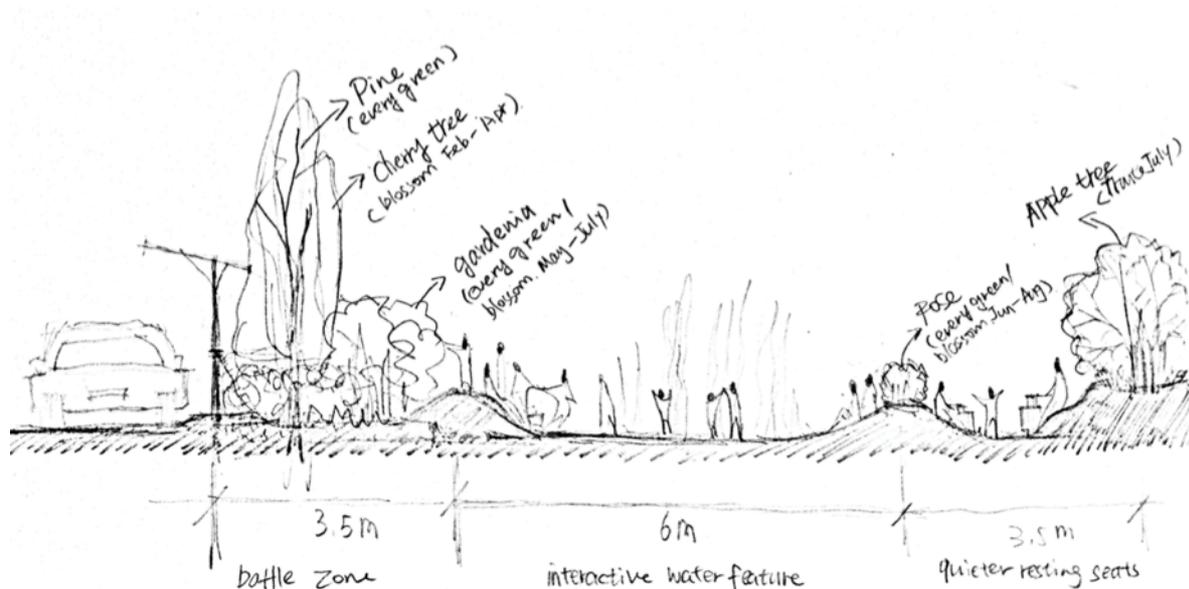


Figure 7.5 An example of designing a smellscape with landscape elements in open waiting areas in front of urban intermodal transit spaces suggested by author

7.6 Design at the midi level

Smellscapes at the midi level are informed by the built form, functions, layouts, ventilation and drainage systems designed in intermodal transit spaces. In particular, the layout of spaces with different functions can guide passengers' routes and activities, resulting in various smellscapes. In Sheffield, the layout of the Railway Station creates a sequence of smells from watery smells on Sheaf Square to coffee smells in the Concourse and train smells on platforms.

As discussed in Chapter 5, passengers' movements in stations include both passive and active modes. It is likely that people have lower sensory detections with active movements (walking and running) than passive movements (sitting and standing), which is influenced by their attention to movement or the surrounding environment (Chapman et al., 1987). At the midi level, smellscape design in intermodal transit spaces needs to consider how functions and spaces can be designed to provide pleasant smell experiences along appropriate routes, responding to different activities. As a respondent designer in Wuchang commented:

'I am thinking of how to make space more transparent and directive. This can help to separate passenger flows and avoid crowds. Smells become worse when the intensity of people increases in crowds. This breathless stale air brings a feeling of helpless in the space, which needs to be improved. Technically, the dispersion simulations of smells could help guide design process. I truly believe smells can significantly influence our perceptions of spaces, which leads to change of spatial forms and our design forms. Unfortunately, smellscape is seldom considered in current design process. (我在考虑气怎么把这个空间做得通透, 对人群有引导性, 对人群的疏散起到一定的作用。因为当人群聚集的时候, 这个气味儿很差, 空气流通性又很差的时候会给人产生一种无助感。我觉得也可以考虑一下做这个气味儿的扩散的模拟。我觉得嗅觉啊, 能够从感知上影响空间形态, 设计思维方式。这个方面目前考虑的还比较少。)' W22, Architect

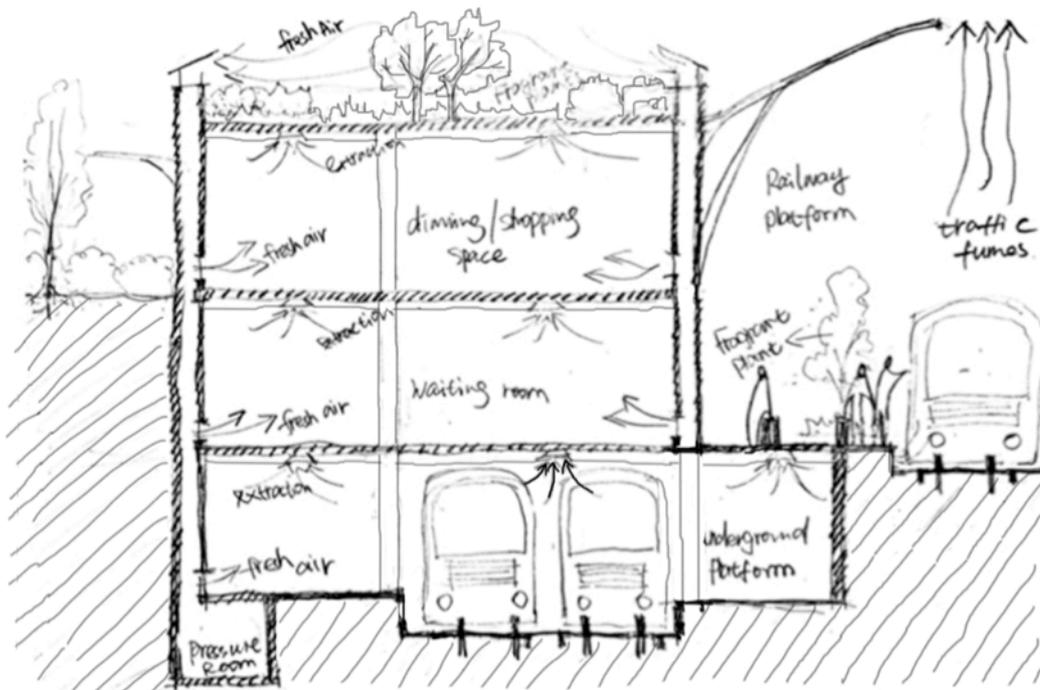


Figure 7.6 One example of integrated design for better smellscape in intermodal transit spaces at midi level suggested by author

7.6.1 Movements and routes

People's movements in spaces are decided by their purposes. Their activities in intermodal transit spaces are generally associated with transit, resting and services, which are also the main functions provided in these places. People's purposes for using different functional spaces determine their time, attention and activities, which influence perceptions of smellscapes. It is necessary to clarify here, as discussed in Chapter 5, that there is a cultural difference relating to waiting in stations between China and UK. A short wait, in Chinese terms may be 30 minutes, whereas five minutes is considered a short wait in UK. Long waits in the Chinese case may be two to five hours, but, in the UK case, it can be 30 minutes to one hour. However, in both cases, people have similar movements and interactions with smells in spaces of passing through, catching transport and resting. It seems necessary to consider intermodal transit space as both a place of functions and a place of movements. Spaces along the conducted smell walks in this study are categorised in Table 7.1 according to how most people use these spaces. From a general perspective, it seems that spaces of passing through normally have fewer functions, whilst spaces of transit/short stay are mostly service-related,

and space of resting includes various recreational functions. People were found to have much higher requirements for pleasant smellscapes in spaces of resting than in spaces of transit and passing through.

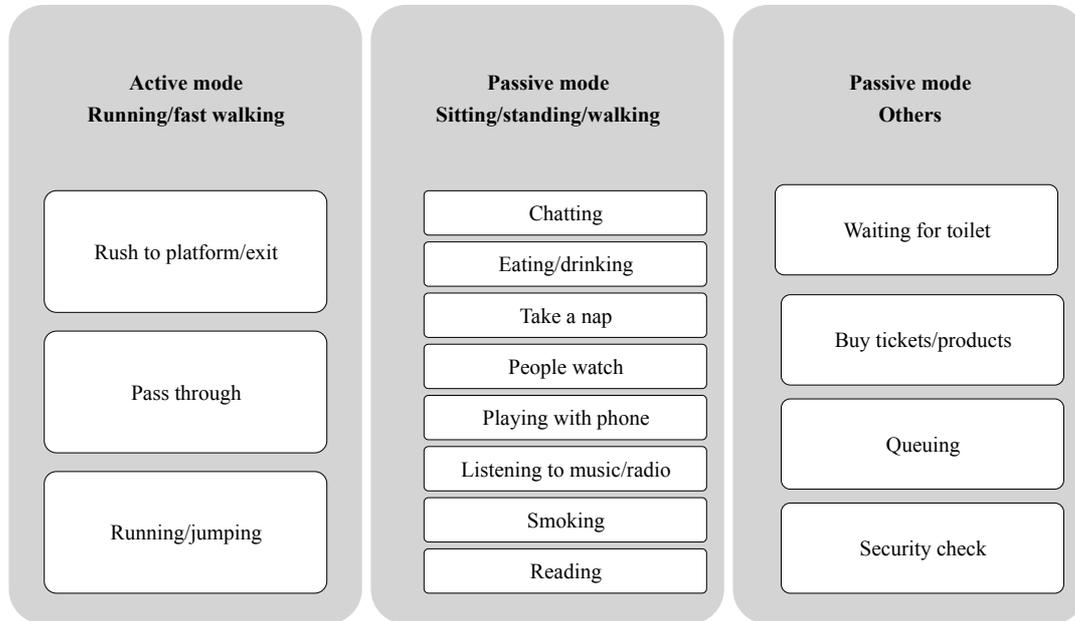


Table 7.1 Passengers' movements and activities in urban intermodal transit spaces

In spaces of passing through, people mostly just quickly walk through the space without staying. In this case, people were found to pay little attention to the environment and barely noticed any smells. In spaces of transit, people's activities are mixed of walking, sitting/standing and others. However, the time spent in such spaces is normally short and not fixed, depending on frequencies and schedules of transport services. Smells in such spaces are normally associated with traffic, people and non-fresh air. The general smellscapes of such spaces were found to be unpleasant in the studied cases. However, with a preconception of staying only for a short time, people mostly chose to ignore the unpleasantness caused by perceived smellscapes in such spaces. Some people were observed entertainment themselves while waiting, listening to music, reading books, people watching or playing with their phones. In spaces of resting, people reported spending more time because they chose to arrive early and make use of such spaces. Activities were mixed, but mostly done when sitting and standing. The purposes of these activities were generally to kill time and keep themselves entertained. Some activities involve other sensory stimuli that help distract people's attention from unpleasant smellscapes, like hearing and vision.

In both studied cases, spaces of resting included indoor spaces, like concourse waiting areas, waiting rooms and commercial spaces, and also outdoor spaces, like squares. Smells in resting spaces are more obvious and more frequently detected. Particularly indoors, smells of food are perceived as dominating - for instance, smells of coffee and sandwiches in Sheffield Railway Station Concourse. According to participants' descriptions, a background level smellscape of cleanness would be preferred throughout all types of spaces in intermodal transit spaces. However, in spaces of passing through, people would prefer naturalness over other characteristics. Participants reported that they would only notice smells when they were intrusive or strange smells that did not match the context of the space.

In spaces of transit, participants were found to prefer freshness. Smells in such spaces are mostly from traffic and people, especially since some of these spaces are located underground and have poor ventilation. The crowded feeling and stale smellscape are generally unpleasant to perceivers. Freshness in this case becomes a key characteristic that people preferred to have in spaces of transit. However, in space of resting, people pay more attention to their surroundings and have greater requirements for pleasant smellscales. In the studied cases, people would prefer the spaces to feel welcoming, inviting and familiar. Smellscape in this case may need to have more distinct features or pleasing smell marks. For example, in Sheffield most people liked smells of coffee and food in the Station Concourse -a spacious and well-lit environment. However, people have different preferences for smells of food, and in Wuchang in particular, smells of food were not preferred in the waiting concourse. Types of food and passengers' moods vary in different contexts and people's smell preferences are the most important factors in such cases, but are difficult to control and design with. Providing simple, separated and optional smellscales in spaces of waiting seems necessary to achieve pleasantness.

Meanwhile, intermodal transit spaces are also spaces of transport movements. In Sheffield, where there are mostly open platforms, the influence of movements of buses and trains is obvious. When train or bus arrives, there is an immediate change of smellscape, with heated airflow of traffic smells. The arrival of trains, especially, blocks the airflow on platforms. However, this situation, improves when trains pull out of the station. The consideration of transport movements in intermodal transit spaces seems necessary, including stopping points, pull-in and pull-out time, which are related to locations and operation of extraction fans, scenting vents and smell barriers.

7.6.2 Built form and scale

Different forms of intermodal transit spaces, whether on a dispersed or integrated model, influence the overall environment of the sites, including smellscape. Wuchang is a typical compact model, while Sheffield is a typical dispersed model. The access-environment in a dispersed model is often in an open urban environment and likely to be influenced by urban context, road traffic, weather and landscape. For example, transport facilities in the Sheffield case are connected by roads and surrounded urban spaces, which enables a dynamic changing and refreshing smell environment. However, the spaces in a compact model are mostly indoors and barely interact with outdoor spaces and natural elements. In Wuchang, all functional spaces are located in a single building. The refreshing effect of an alternating sequence of indoor and outdoor spaces is not obvious here. As discussed earlier, one conflict arises from the requirements of large-scale built forms and seamless connections of transit spaces. To simultaneously achieve seamless connections between different transport modes and good quality smellscape in large scale built forms, it seems necessary to combine beneficial features of both the dispersed model and compact model.

Contemporary designs and regeneration of stations tend to emphasise the possibilities of built structures and enrich passengers' visual perceptions, such as the King's Cross Station in London. Structural elements, like sequences of columns or patterns of light and shade can help define routes, axes and movements (Edwards 2002). The design of concourses, platforms, waiting rooms and canopies over platforms, taxi ranks and bus stops should consider smell sources, and people's requirements for smellscape and ventilation. For example, in Sheffield, the design of the canopies at the taxi rank is not good for removing traffic. The space itself is converted from a corner space, and does not create more general air movements. The smellscape at this taxi rank were the most disliked for intensive smells of car fumes mixed with cigarette smoke. However, Sheffield Railway Station is a renovated 19th century Victorian building and there are only opportunities for consideration of smellscape. In such situations, designers need to be even more creative with structural elements and separation methods.

Visual aesthetics of architectural forms (discussed in Chapter 5) can influence smellscape pleasantness in general. In the case of Sheffield, participants were pleased with the visual architecture style of Sheffield Railway Station, and this had a positive influence on its smellscape: *'the station is nice and bright. It is a bit warm to stay inside in the summer. But it doesn't really bother 'coz you won't stay there for long.'* S03

However, in Wuchang, the building itself has not been designed to be aesthetically pleasing or attractive to its users, none of the participants felt positive about its built form. Overall, designers may also need to consider designing visually 'bright' and 'warm' architectural forms appropriate at a human scale to achieve a good smellscape in intermodal transit space.

7.6.2 Layout of spaces and functions

As discussed earlier, general functions in intermodal transit spaces include concourses, platforms, connection spaces and waiting areas, in which facilities like shops, restaurants, cafes and toilets are present. It is therefore essential that separation of different functional spaces producing conflicting smells such as food court, taxi rank, bus stops and toilets, should be considered. In particular, poor location and design of toilets can directly produce an unpleasant smellscape. For example, in Wuchang, many respondents found it inappropriate to have toilets in a central location of a food-dominated commercial space. To solve this problem in this case, it could be suggested that toilets should be located further away from the food areas. However, it still needs to be easily accessible from the food area, and well-signposted. Conversely, good location and design of restaurants and kitchens can have a positive influence on the general smellscape in transit spaces and become smell-marks of the city. However, the selection of commercial types producing smells needs to be appropriate within the context of intermodal transit spaces:

'The exit hall of Beijing South Station is like a shopping mall rather than a railway station. The smells in there make you feel you are in the wrong place. This may lead to a confusion of cognition. The scale of shopping mall is relatively smaller than a large station with similar number of people, in this case. You will feel very crowded and feel misled. This makes me think of the commercial types in complex stations. Particularly, restaurants or food smells can have great influence on passengers'

experiences. It is the most important commercial type in transit spaces. However, we haven't considered that in current designs. (北京南站里面，一出站你感觉就像一个商场，不像一个车站。那个气味就会让你感觉不像是再出站厅，这个会有什么问题呢。因为商场的尺度跟车站还是有一定察觉的，这就会导致人对空间尺度的认知有问题，会给你的心理产生拥挤感，这样导向性会比较差。这个是我觉得在车站的商业开发，特别是餐饮对旅客的嗅觉感受带来的影响。在交通建筑里面，商业开发是一个重要的部分，嗅觉这个因素肯定是会影响旅客的行为，现在的设计中没有考虑过这个问题。) 'W22, Architect

The layout of spaces and functions can be considered as sequences of smell sources influencing the way passengers' perceive the general smellscape and their activities. For example, in Wuchang, the commercial and dining spaces are mostly located in the underground level; the Metro station and taxi centre are located in the second underground level; while the ticket office and concourse are located on the ground level. Passengers who come to take Metro trains, have to take a vertical route through the underground transit hall commercial and dining spaces onto the waiting concourse, as illustrated in Figure 7.7.

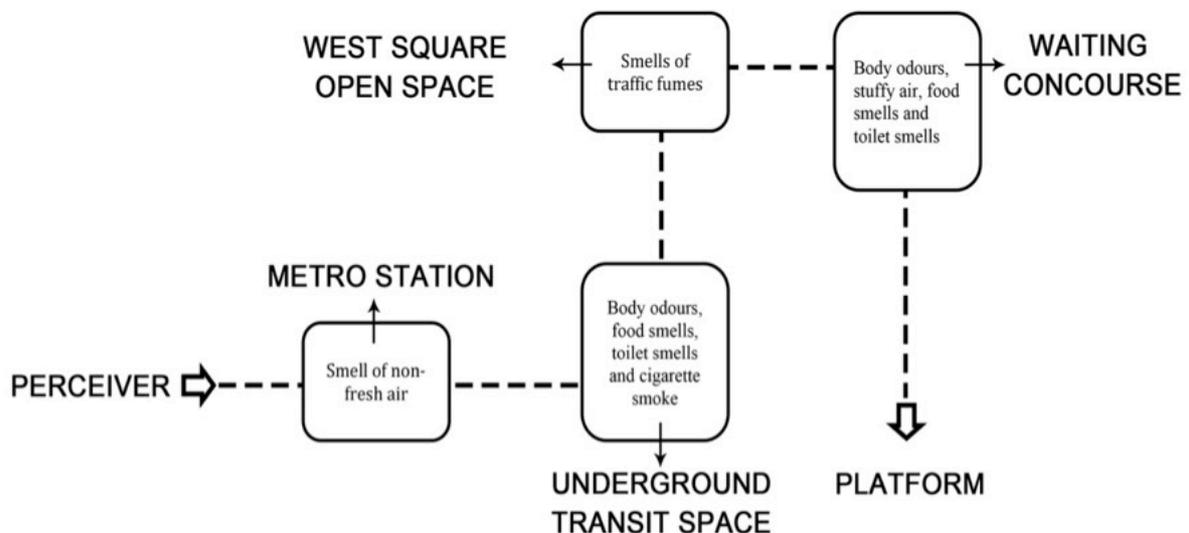


Figure 7.7 An example of smells along a path connecting metro and railway in Wuchang Railway Transit Centre

Considering intermodal transit spaces as defined by movements, the layout of space informs sequences of passenger's routes and behaviours. With different activities in different functional spaces, people's requirements of smellscape vary among the eight indicators of smellscape pleasantness discussed in Chapter 6: naturalness, intensity, familiarity, appropriateness, cleanness, freshness, likeness and purity. In the studied cases, people required a higher quality of smellscape when they were eating, in which indicators of cleanliness, preference, appropriateness and purity were strong influences. Smells and behaviours need to be matched in their context. As discussed in Chapter 5, people particularly disliked having non-food smells, like car fumes, smoking and perfumes associated with eating behaviours. Meanwhile, people sitting in waiting areas disliked overwhelming food smells or other non-ambient smells. Indicators of naturalness, intensity, familiarity and cleanness were valued more highly than other indicators. Traffic smells and cigarette smoke were found tolerable only when briefly perceived at a background level. However, sanitary smells were found unpleasant under any conditions.

In the Sheffield case, the situation is quite different. The possible route from the Bus Interchange to the Station may be similar to the smell walk from Interchange, then Station Path and Sheaf Square, into Concourse and then Platform. The smellscape along this path was generally perceived as much more pleasant than a similar route from bus to train in Wuchang. It seems important to make connection spaces between different functions a smellscape-friendly sequence in intermodal transit spaces. It can be suggested that designing the sequence of functions should also consider passengers' routes taken for different purposes. Drawing on the discussion in Chapter 5, passengers' waiting behaviours in intermodal transit spaces were frequently observed as sitting listening to music, eating or drinking, smoking, going to toilet, shopping, wandering around and playing with their phones. Within a limited space, a mixture of behaviours may increase the chance of perceiving smells resulted from others' behaviours. In order to increase smellscape quality and reduce influences from others' behaviours, it is necessary to consider passengers' different purposed routes in intermodal transit spaces. Such differences between behaviours should to be considered in designing routes and layout of spaces in intermodal transit spaces at midi level. Separating different behavioural routes and grouping people by similar behaviours can make a difference to smellscape quality.

7.6.3 Ventilation and extraction systems

Ventilation is an essential element in designing smellscape, both from the point of view of natural ventilation and of mechanical ventilation systems. In intermodal transit spaces, most indoor spaces, such as concourses and waiting rooms, depend on mechanical ventilation. As discussed, one conflict arises from inefficient and unnatural ventilation within intermodal transit spaces. It seems that the design of ventilation systems needs to be considered in more detail as a mechanism for achieving better smellscape. There are two concepts in achieving good ventilation indoors: convection, and fresh air handling systems. From an architectural design perspective, better natural ventilation can be achieved by methods such as designing more windows on roofs to increase convection, and introducing courtyards to core areas to allow natural ventilation. The design of natural ventilation needs to be considered in relation to spatial forms. Movements of airflows in different spatial forms vary and require different types of openings at different positions for good air circulation. Simulations of indoor ventilation may be useful to assist design at the midi level.

Making full use of natural ventilation in intermodal transit spaces can be beneficial both for creating good smellscape and for saving energy. However, in underground spaces, natural ventilation can be difficult to achieve. In large complex stations, passive ventilation is not often a possible principle strategy for supplying fresh air, particularly in Winter when buildings need to be sealed for better thermal performance. When there is not enough fresh air, the air quality would be too poor to create a healthy smell environment to perceive smells, and in the studied cases poor air quality significantly reduced smellscape pleasantness. Mechanical ventilation needs to be designed to draw fresh air in continuously for a good quality smellscape in intermodal transit spaces. In the meantime, designers can consider introducing scents in ventilation systems to mask unpleasant smells at places such as platforms, taxi ranks and toilets. One example has been given by one of the professionals interviewed:

'You know, the smell in some Metro stations in Hong Kong connected to the underground entrance of shopping malls is very nice. It is from the ventilation system, but it smells very fresh and natural, giving a really positive impact on the smell environment there. Although people can generally notice artificial perfume smells in

these stations, they seem to prefer such scents to normal Metro smells. It makes you calm and relaxed. (香港那种地下商场与地铁衔接的地方, 给人的感觉不仅是空气很清新没有污染, 更像酒店一样, 空调里面好像是有香氛或者是精油的味道。那个感觉会让你感觉很舒服, 一出地铁站就有这种清新的感觉, 特别是旅途劳累嘛, 闻到这种舒缓神经的味道, 我觉得是挺好的。)’ W21, Planner

Using scents in ventilation systems has been applied in public spaces in some countries, particularly Japan. Scenting needs careful selection to ensure it is not harmful and is accepted by the general public. The intensity of scents needs to be at a soothing background level in intermodal transit spaces to reduce irritation and the fatigue of waiting and rushing.

An extraction system is different from a ventilation system for introducing in fresh air because it uses mechanical techniques to extract polluted air from one space and release it to another space. Extraction fans are commonly used to remove residential smells, i.e. smells of cooking and swage. Residential smells, like smells of cooking and toilets, were the main targets for removal from the urban environment of Paris in the late eighteenth century (el-Khoury 2006). In contemporary cities, residential smells seem still problematic in public spaces. One architect interviewed in China shared an interesting experience:

‘Smellscape is not usually considered in design schemes. But I did a commercial residential building design, where the ground level was designed as a restaurant. The client particularly asked me how the cooking fumes would be extracted from the building, which I think is for smellscape purposes. In China, such case happened frequently: residents who live above restaurants would complain a lot about the cooking fumes. (我曾经做过一个住宅的方案, 住宅的下面是食堂的厨房, 甲方会文油烟怎么排出去, 这个应该就是在考虑到嗅觉问题。因为像这样的商住楼, 下面如果是餐厅的, 那上面几层的住户经常就会投诉, 这样的案子还是经常发生的。)’ W15, Architect

As discussed in Chapter 5, in Sheffield, food-related smells were considered to be mostly pleasant at a background level. However, unpleasant cooking fumes were detected frequently in Wuchang, arising from Chinese stir-fry cooking style. Many extraction fans vented cooking

fumes towards open spaces including resting areas. Similarly, fans to extract smells from toilets also vented directly towards people in food areas, causing unpleasant smells. As Henshaw (2013: 102) found extraction fans of cooking fumes are often left undersigned over back yards and alleyways hidden from the public. It is inappropriate to have emissions of cooking fumes and toilet smells directly to open spaces. Specific extraction systems need to be designed in intermodal transit spaces, as an essential method to remove toilet smells and cooking fumes: another essential action is to separate kitchens and serving spaces in. A central fume- handling unit could be designed and connected to all extraction fans in kitchens with specific pipes above the cooking area. Sustainably, heat from cooking fumes could be collected to heat fresh air drawn into the building in wintertime. A similar extraction system for sanitary smells could be designed to provide a better smell environment in and around toilets. The idea of extraction can also be applied to traffic fumes, which were frequently detected and evaluated as unpleasant by participants in this study. In particular, extraction can be efficient for removing traffic fumes in enclosed underground transit areas. Considering that emissions from vehicles are close to the ground and then rise, extraction fans in such spaces can be designed at both lower and upper levels, as shown in Figure 7.8.

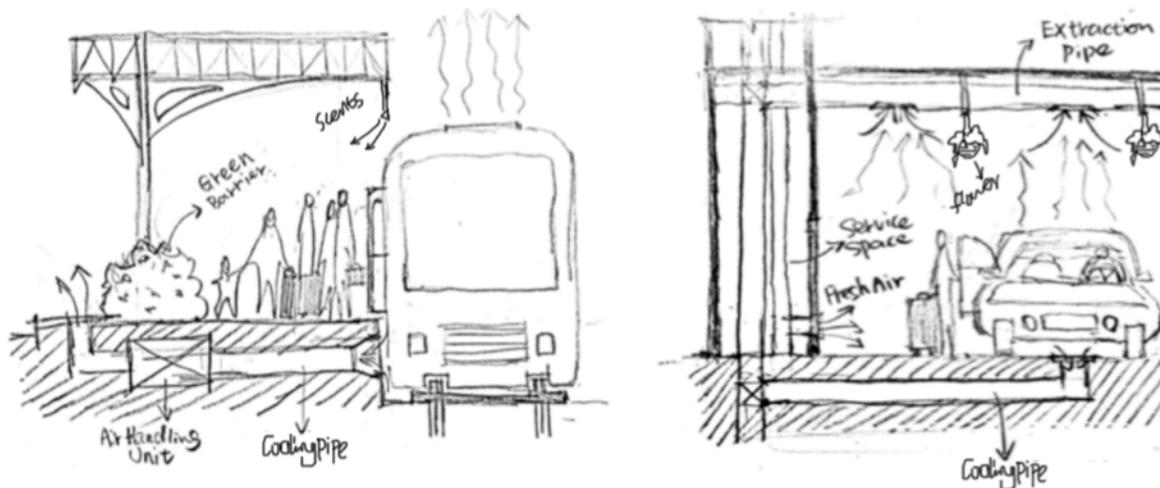


Figure 7.8 Examples of extraction system on railway platform (left) and enclosed taxi centre (right)

7.6.4 Drainage system and waste management

The drainage system is equally as important as the ventilation system in achieving a good smellscape in intermodal transit spaces. Unpleasant smells from drains were detected in the background smells during wet weather in Wuchang. There are drain openings with grated covers throughout the Wuchang Transit Centre which tend to flood in wet weather and was something that participants were particularly annoyed about. The negative influence of the poor design of the drainage system in Wuchang also led to inappropriate uses of it. Trash, food waste and cigarette ends were often found in and around these drains (see Figure 7.9), which also reduced smellscape qualities by giving visual indications of unpleasant smells.



Figure 7.9 Photos of drains exposed to passengers on West Square (left) and Connection Tunnel (right) in Wuchang

A well-designed drainage system should function properly during wet weather and the drain covers should be hidden from sight of passengers. Drain openings and covers need to be located away from trash bins and seats to prevent them being used as waste receptacles. Detailed designs, such as the scale, number and types of hatches, can also contribute to reducing their negative influence on smellscapes.

Waste management is as important as other design methods in achieving better smellscapes. Sources of waste, such as food waste, trash and grey water, can have significant direct and indirect negative impacts on smellscapes through noses and eyes. In particular, uncovered trash bins in both the cases studied were found to be distracting in intermodal transit spaces when people perceive smellscapes.

Three main aspects to be considered designers emerged from this research: finishing material, types, numbers and locations of trash bins, and routes of transporting waste. An appropriate

cleaning frequency is a priority for achieving health-related smellscape pleasantness in intermodal transit spaces. A large number of uncovered and uncategorised trash bins were found, indoors and outdoors, in Wuchang. Smells of 'waste', 'rotten food' and 'trash' from bins were frequently detected and described by participants. It is necessary to have all bins covered and cleaned more frequently. In the Sheffield Bus Interchange, there are several trash bins in waiting rooms but few people have detected smells of bins. However, some of them had negative visual reactions and preconceptions of bad smells from trash bins. In this case, the locations of bins next to seats along the main path were often questioned for producing unpleasant smells in central areas of this intermodal transit space. Trash bins need to be covered and placed in a convenient distance from seats. People waiting on seats there would not be able to detect trash bins easily either visually or from smells.

7.7 Design at the micro level

At the micro level, smellscape design focuses on individual behaviours and how spaces are used. Compared with macro and midi level smellscapes, people's perceptions are mostly gained from micro level interactions with smell sources in spaces. For example, in Sheffield Railway Concourse, there are several cafés, of which two are located in the centre of the space. This fills the whole area with smells of sandwiches, bread and coffee, and positions all passengers on the Concourse a similar distance from the smell sources. In this case, the cafés in the centre produce a concentric effect of smells in the Concourse. A different micro level situation was found in Wuchang Railway Concourse, where buffet food shops were located on one side of the space. People at the other end of the space, were not able to perceive smells from the shops. Instead, the central space of the Concourse was arranged with large number of seats and people then become the main smell sources at the central position in space. Smells detected there were mainly from other passengers sitting around, like sweat and body odour. People's behaviours, such as eating, chatting and smoking, had strong negative influences at the micro level. From this it seems essential to consider the scale of space, distances between perceivers and smell sources, types of smell sources and people's relevant behaviours at the micro level of smellscape design.

7.7.1 Stopping points and sitting area design

As discussed in Chapter 5, the scale of space at the micro level is defined by people's personal 'comfort zone'. As one professional in the Sheffield case said:

'I was thinking, people all have their own comfort zones. And I think it is the same of the smell environment, some kinds can make you feel relaxed and comfortable. You know, it is same when you sense the smell in its environment. As you go from one place from another, you find smells not in your comfort zone, which I think it is important, like an alert.' S17, Planner

This comfort zone in the studied cases refers to people preference for their personal space to be less influenced by other people's activities in intermodal transit spaces. A 'safe' distance between perceiver and others emerged as an important consideration in micro level smellscape design:

'The influence between passengers is quite obvious and strong. From the point of view of environmental psychology, there needs to be a safe distance between people, which forms a defensible space. When people are influenced by smells resulting from other people, the sense of defence will increase. It often happens in high intensity spaces. However, from the perspective of smellscape, it is caused by the short distances between passengers and their inappropriate behaviours. (旅客之间的互相影响也是很明显的，环境心理学里面讲的人的安全距离和防卫空间，这个有气味的影响后，人的防卫感就会增强。这都是属于人的密度大，旅客的行为所造成的。)' W15, Architect

A 'safe' distance needs to be considered in both active and passive movements, such as walking and sitting. Respondents in both cases frequently perceived smells from people passing by, like perfume, body odour and cigarette smoke. As discussed in Chapter 2, smells of cigarette smoke can cause social segregation in public spaces (Tan 2013). Non-smokers generally have a smell nuisance reaction towards cigarette smoke and so it is necessary to have a 'safe' distance between smokers and non-smokers. Although, sometimes people have positive attitudes to perfumes from people walking by, they can still label such smells as 'others' and 'unfamiliar'. The discussion of familiarity in Chapter 6 found it to be a key indicator of smellscape pleasantness. The annoyance of others' smells in situations where passive movements dominate is found more obvious in the studied cases. For example, in the

Waiting Concourse in Wuchang, people disliked others taking off their shoes and sitting next to them. A ‘safe’ distance between people in such waiting areas can be achieved by controlling the distance between seats. It is suggested smells of skin, cloth and hair from people can be detected within one metre whilst smells of perfume on people can be detected within two to three metres (Gehl 2011: 64). A social distance in public places like intermodal transit spaces, for having normal conversations and interactions with others is between 1.3 and 3.75 metres (ibid: 69). This can be taken into account when perceivers and others are in sitting in a space where the freshness of air is ensured and not influenced by temporal conditions, i.e. wind. However, it is difficult to quantify and ensure a ‘safe’ distance in active movements and outdoor spaces. The nature of having intensive passenger flows in intermodal transit spaces also seems to be a cause of conflicts and difficulties for ensuring enough ‘safe’ distances.

According to on-site observations, people were always looking for more flexibility to choose walking routes, standing points and seats, in order to create their own ‘safe’ spaces. Designers need to consider an appropriate number and locations of stopping points and seats along different routes, regarding the likely behaviour of target groups and activities, like smoking, eating, shopping and walking. Passengers were often observed stopping and looking around for directions at crossings of routes. A short stop to look for directions at those points can draw passengers’ attention to their surrounding environment, including smellscape. Stopping points, as nodes in routes in intermodal transit spaces, need to be planned in a sequence with walking distances and distinct features as guides. A smellscape with a ‘refreshing’ effect can be helpful to improve passengers’ general experiences. As one professional in the Sheffield case said:

‘I like the change of smell environment here. This is actually a great difference between indoor and outdoor spaces. when you first come to the train station from outside, you will not like the smells from inside the station. And then, you come out of the station, you have this kind of fresh outdoor smells. I like this natural but somehow artificial smells. It might be a good idea to have such a sequence of indoor and outdoor spaces in stations.’ S13, Planner

As discussed in Chapter 5, seats in intermodal transit spaces are essential to people’s waiting behaviours and surrounding smellscapes. The layout, number and location of seats are key

design elements. It is important to consider whether the layout of seats has people facing towards wanted or unwanted smell sources, e.g. a coffee shop, fast food outlet, toilet, or flower shop. In the case of positive smell sources, designers may consider how to maximize the number of seats facing them. In the case of unwanted smell sources, designers may need to minimize the number of seats facing in that direction and design separation barriers between perceivers and negative smell sources. It is also useful to consider whether seats are designed with people facing interesting activities or good views of external scenery. Positive distractions from other sensory stimuli, like sight and sound, can reduce the negative influences of unpleasant smells and increase perceived general smellscape quality. Designers may incorporate TV screens or indoor planting combined with the layout of seats.

It is necessary to consider influences of other people's behaviour on individual perceptions of smell environments. A good smellscape can be achieved by increasing distances between rows and splitting long rows into several sections. However, designing several clusters of seats can be more interesting and flexible. Each cluster can be designed in a circle layout or a triangle layout, which is helpful for achieving a good smellscape quality than a normal parallel layout, as illustrated in Figure 7.10.

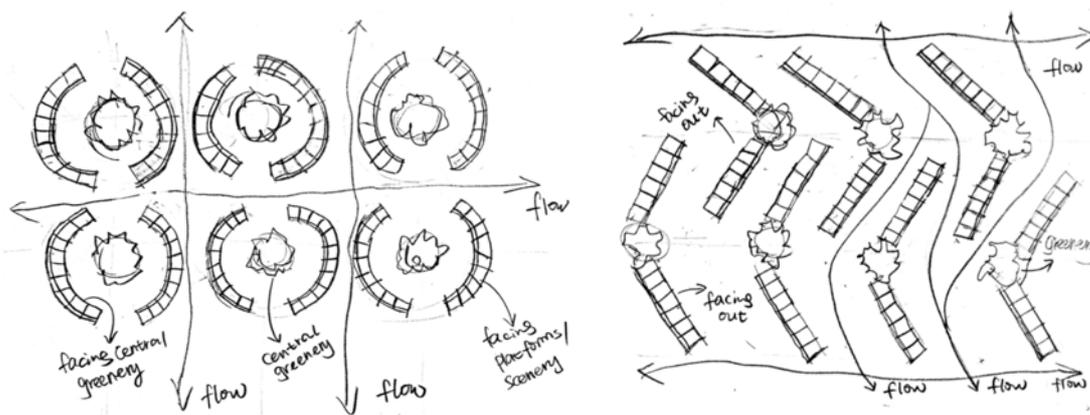


Figure 7.10 Two examples of seats layout design to achieve a pleasant smellscape in intermodal transit spaces

7.7.2 Materials and lighting design

Designing with appropriate materials can have positive influences on smellscape at micro level. For example, in Sheffield, people associated contrasting experiences of smells in the

Bus Interchange and Railway Station by referring to construction materials. The exposed steel and glass structure of the waiting room in the Bus Interchange made participants feel ‘cold’ while the historical stone and glass of the Railway Station felt ‘warm’ and ‘familiar’. Apart from visual interactions, some finishing materials are more easily ‘scented’, such as wool, textile and timber. Other materials, like tiles, marble and stone can also have negative influences on smellscape when used inappropriately. A bad example was found in Wuchang, where the public toilets and the surrounding area are all tiled with a smooth finishing. Spilt water from the hand basins was observed all over the floor and was carried from inside the toilet area to outside it by the movements of users (see Figure 7.11). This visual distraction and the smells coming from spilt water marked such smellscape as ‘unclean’ and ‘disliked’. As discussed in Chapter 5, visual distraction in smellscape pleasantness is a key indicator that influences smellscape quality. Materials of floors and walls need to be cleaned easily and easy maintained. In the studied cases, particularly around trash bins and restaurants, materials were found heavily stained. This may due both to infrequent cleaning and theto the nature of selected materials. These visual marks representing waste, uncleanness and disease can be as negative as actually smelling waste.



Figure 7.11 Exposed materials inside (left) and outside (outside) public toilets in Wuchang Railway Transit Centre

7.7.3 Indoor scenting

Although there is some debate about whether scented products and a scented environment are manipulating perceivers’ behaviours (Damian and Damian 2006; Henshaw 2013), some

slightly-scented cleaning products and background levels of fresh smells in intermodal transit spaces were perceived to be positive and pleasant:

'I think, sometimes, when it is been cleaned, and you are the first people entered the station, you can smell the cleaning liquid, that clean smell. I think I like smelling the cleanness.' S07

As discussed in Chapter 5, smells of cleaning liquid were liked by many participants in the studied intermodal transit spaces. The scents of the bleach contained in cleaning liquids indicated to them that this was a hygienic environment, and also contributed to the factor of 'cleanness' in achieving smellscape pleasantness. Cleaned floors with scented products particularly help the smellscape in the Concourse and waiting spaces at times of reduced activity like the early morning and late evening when restaurant and cafes are closed. These smells of 'cleanness' are particularly important in and around toilets. To achieve a healthy and clean smell environment, toilets in intermodal transit spaces need to be cleaned frequently with unpleasant sanitary smells extracted continuously. Scented hygienic hand wash gels and toilet cleaning liquids can help produce a masking effect for the unpleasant smells from waste, which also can be controlled at a low cost and are easily manageable:

'Have you been to Shanghai station? I don't know what's different, but it smells really nice. It is much cleaner. They have more windows and airflows. I don't know what that it is. But it is like sticks you light. It gives the scents. They have them everywhere and even in the toilets. It really helps.' W07

However, indoor scenting with artificial smells, can be applied only on the basis they are not harmful to human body and the general environment is clean. Compared to artificial scents, smells of nature are suggested to be more 'natural' and 'liked' (Henshaw 2013; Moncrieff 1966). As discussed earlier, landscape elements, such as fragrant plants and waterscapes, can effectively improve smellscapes in open spaces with fresh and natural scents as well as giving visual pleasure. Small-scale planting indoors may also be a way of indoor scenting to help create a pleasant smellscape.

7.7.4 Public smoking control

As shown in Chapter 4, in both study cases, smells of cigarette smoke were found to be the most frequently detected smells apart from traffic fumes. Most participants found cigarette smoke unpleasant for its pungent and unhealthy nature. As discussed in Chapter 6, health-related pleasantness is a main category of smellscape found in intermodal transit spaces, and control of public smoking is nearly as important as controlling traffic. In Wuchang, people were observed smoking both indoors and outdoors, in restaurants and toilets. Although the central government of China has pushed local government to pass regulations preventing smoking indoors, smoking was observed frequently and was dominant, including indoor smoking. It seems necessary for station operators in China to put more effort into controlling indoor public smoking by increasing public awareness of the negative impacts of smoking and the dangers of second-hand smoke, and placing appropriate 'No Smoking' signs in smoke-free areas, installing cigarette smoke detectors, establishing a system of sanctions and taking real actions upon people who violate it.

In contrast, public smoking indoors is banned by law in the UK and the rule is generally upheld. People smoking at Sheffield Station station were only observed outside doors, e.g. the front door near Sheaf Square and the side door towards the taxi rank. An interesting comment was made by one professional interviewed:

'I think it is problem of all public buildings, when you walk out from the building, you will find people smoking outside by the doors, which is a disgrace. Because the smell of smoke for people who dislike it is very unpleasant. This makes it impossible for other people to wait outside by the door.' S16, Architect

This smoking situation at barriers between indoor and outdoor spaces was found to influence people's experiences when walking through transitional spaces. Station operators in UK transit spaces might be able to minimise the influence of smoking on the general smellscape by simply placing cigarette discharge points (bins with receptacles for butts) a distance away from the doors and reducing the number of cigarette discharge points. However, in Sheffield, different parts of the transit network are connected through public open spaces, where smoking was also frequently detected and rated as unpleasant. It can be argued that whether

smoking also needs to be banned outdoors in the realm of intensive public spaces, such as intermodal transit spaces and hospitals. However, the smoking booths (Henshaw 2013: 147) could be introduced into transitional spaces, particularly in China, where indoor smoking is currently not well controlled.

7.8 Conclusion

This Chapter has reviewed the traditional design framework of urban intermodal transit spaces and revealed the main conflicts and challenges to achieving a pleasant smellscape in such spaces. A design framework for designing smellscapes at three scale levels has been generated, responding to the components and indicators summarised in the previous chapters, in line with design principles for transit spaces and smell environment.

Smellscape design for intermodal transit spaces at the macro level should aim to minimise the negative influence of traffic on the general quality of the smell environment by planning road networks to separate traffic flows and designing landscape elements to mask traffic fumes and distract people's attention from them. At the midi level, the main focus is the layout of different functional spaces and passenger flows to separate different smell sources and activities. At the micro level, it has been found that the design and control of a 'safe distance' is important to reduce negative influences from smells resulting from other people's behaviours and body odours, i.e. seat layout and smoking points. More specifically, detailed design and control methods for each component of the three scale levels have been discussed with examples, showing that designs of smellscapes can be well integrated with architecture and urban planning frameworks.

Designs at the macro and midi levels define the on-site background smell environment and also guide and limit designs at the micro level. It suggests that planners and designers should consider smellscape at the very start of the design process and the importance of early stage planning in midi and micro level designs. Smellscape, as a secondary environmental dimension, needs to be designed within a general urban planning and architectural design framework to balance sustainability and smellscape pleasantness.

Chapter 8: Conclusions

8.1 Introduction

This study started with the intention to explore smellscape in urban intermodal transit spaces from the perspective of place-making and environmental quality. Taking a qualitative approach, it has explored smellscape in urban intermodal transit spaces by interpreting people's descriptions of in-situ and past experiences of smells and their surrounding environment. Chapter 2 provided an overview of the scientific background of the human sense of smell and current approaches to exploring smellscape, from interpretation, and evaluation to design. Attempts have been made to label and classify smells by their chemical properties and sources as well as exploring smellscape quality through people's smell preferences. However, previous work has not formed a systematic approach with clear criteria to help researchers and practitioners understand, measure and design smellscape in urban intermodal transit spaces. A theoretical framework of language description, smell environmental quality and human experience was set out in Chapter 3 by using an environmental psychological approach to evaluate smellscape by analysis of descriptors that indicate people's emotional reactions. Taking Grounded Theory as a methodological approach, this study compared smellscales in two typical urban intermodal transit spaces in a Western and an Eastern context. People's perceptions of the smell environment along smell walks were interpreted through their own language descriptions and analysed through a consistent comparative analysis process with concepts and categories derived from the studied cases.

This chapter summarises the findings from the two cases – Sheffield and Wuchang - and presents the study's contribution to knowledge and theory. It also discusses possible applications of the findings of this study in architecture and urban design practice. The last section of this chapter discusses future work that could be developed and reflects on the limitations of this study.

8.2 Findings

The thesis began by reviewing current approaches to exploring smellscape and identified several gaps in research into constructing a systematic approach, from understanding to evaluating and designing. The three research questions are set out here and the findings (from Chapters 4, 5, 6 and 7) are summarised as answers the questions.

8.2.1 Understanding smellscape

This question sets out an inquiry into features and components of smellscape in urban intermodal transit spaces, exploring people's perceptual processes in relation to these components. This question is answered in Chapter 4, which described the smellscapes along the smell-walking routes; and in Chapter 5, which summarised the components of smellscape and interpreted the perceptual processes of smellscape in the studied cases. In the Wuchang case, the overall smellscape was perceived as mixed, stale and stuffy, with smells mainly caused by human activities, e.g. eating, smoking and taking off shoes. However, in the Sheffield case, the overall smellscape was perceived as neutral and clean, with smells mainly from the physical environment, e.g. grass, traffic, water and cleaning liquid. This study found smellscapes in the two cases were different, responding to the different public transport situations in the two countries.

However, in both cases, a diversity of smellscapes were found at different stops along smell-walking routes involving various combinations of components. As also suggested by other studies (Classen et al. 2002; Henshaw 2013), there are a number of components that can influence people's perceptions of the smell environment in which vary by context and perceivers. It would not be enough to interpret and understand smellscape by just listing the key components involved in the explored spaces. Further inquiries on how these components work together to form our perceptions is necessary. A perceptual process mapping out the interrelationships between different categories of components is essential to help understand the smellscape concept.

Smellscape, as the human perceived smell environment in place within its context, emphasises human perceptions. The perceptual process through sensation and cognition is fundamental to making sense of how people perceive various components and lead to their responses to the smell environment. Initiating the inquiry into the perceived smell environment, each interview at each stop along the smell-walking routes started with a question: 'Did you smell anything?' People's immediate reactions were either 'No, not particularly' or 'Yes, I can smell...' Through further exploring the meaning and reasons for giving such descriptions by asking 'What?' and 'Why?', it was found that participants' perceptions stopped processing further sensation and cognition when they defined the smell environment as 'normal' and 'background'. In such situations, people were found not attracted to paying attention to the smell environment - they were 'not noticing' it. When participants started to describe the smells they had detected, the perceptual process proceeded further. Through analysing participants' ways of bringing in different components into their descriptions of the perceived smell environment, a number of perceptual patterns emerged which show how different ways of thinking occurred when people try to evaluate and respond to the smell environment. This involves three essential patterns: recognising, linking and associating; and eight sub-patterns: comparing, situationalising, locating, rationalising, contextualising, personalising, anticipating and generalising, which are defined and discussed with examples in Chapter 5. These perceptual patterns link components from the four categories in perceiving the smell environment.

Different sub-patterns work differently with the main patterns, which depend on perceivers and the components in the smell environment and lead to different psychological and behavioural responses. In particular, it was found in the studied cases that an 'ignoring' response frequently occurred when people thought the perceived smell environment did not have a significant influence on what they were doing in the space. In this case, participants often contextualised and generalised the smell environment to bring in contextual components, compared to their purpose of using the spaces and tried to rationalise their perceptions and choices of avoiding and approaching. In other situations, the perceived smell environment would cause psychological and behavioural responses. The differentiation here between psychological and behavioural responses is that the psychological response does not lead to a behavioural change, whilst a behavioural response would definitely be determined by significant psychological response. In both situations, sub-patterns of personalising, anticipating and situationalising frequently came about to bring in individual differences and

physical components. Behavioural responses to the smell environment can lead to changes of smellscape and then iterate another round of the perceptual process. For example, if perceivers decide to change their location, their smell environment surrounded will also change. This component-based perceptual process can be used to help researchers and practitioners understand the smellscape concept and interpret people's descriptions of the perceived smell environment.

8.2.2 Measuring smellscape

In response to this question, a seven-point scale rating system of ten pairs of bi-polar descriptors from three feeling states was generated to measure smellscape quality based on identified evaluation criteria in the studied cases. Pleasantness is used as a general term to indicate people's evaluations of perceived smell environments, and was the basis of the second interview question: 'How pleasant is this smell environment to you?' By comparing people's explanations of pleasant and unpleasant experiences across the on the smell walks, a set of indicators was identified as forming people's evaluation criteria (see Chapter 6): cleanness, freshness, calmness, familiarity, liking, intensity, purity, naturalness and appropriateness. People's self-assessment on these indicators would lead them to decide how to react to the surrounding smell environment: ignoring, approaching or avoiding.

Taking a language-based environmental psychological perspective, smellscape quality can be measured through scale-ratings of bi-polar emotional descriptors derived from people's own descriptions indicating their perceptions of the smell environment (Lang 1969; Mehrabian and Russel 1974). Such emotional descriptors relate to three essential feeling states: pleasure, arousal and dominance. With the understanding of evaluation criteria research participants used, the bi-polar descriptors were derived in line with definitions of the three dimensions of the smellscape concept: pleasure, arousal and dominance. Pleasure is a feeling-state reflected in the hedonic degrees of perceivers in the smell environment, which is found mainly associated with calmness. In the studied cases, participants described states of anxiety and stress, implying that their desired, preferred environment would ideally induce calmness. Calmness in this sense involves descriptors related to anxiety and stress in this study: relaxing-stressful and pleasing-annoying. The arousal state involves perceivers' neurological reactions to the smell environment, varying along a single dimension ranging from sleep to

frantic excitement, found to be mainly associated with liking and familiarity in bi-polar descriptors of like-dislike and familiar-unfamiliar. Unlike the other two dimensions, dominance is a feeling-state reflecting whether perceivers feel free or restricted to act in a variety of ways, which is much influenced by the physical settings of the smell environment. In the studied cases, dominance is mainly associated cleanliness, freshness, naturalness and appropriateness, with bi-polar descriptors of clean-unclean, fresh-stuffy, natural-artificial and appropriate-inappropriate. All pairs of bi-polar descriptors are assessed on a seven-point scale from -3 to 3, where negative feelings are given negative scores and positive feelings are given positive scores. Taking relaxing-stressed as an example, 3 means strong feelings of relaxation; 0 means neutral (no particular feelings of this emotional response); and -3 means strong feelings of stress. The same rules applied to ratings of all the other pairs of bipolar descriptors.

This scale-rating system can be used for on-site investigations. The quantitative data can help illustrate the quality of investigated smellscape with different features. As also discussed in Chapter 6, each indicator is particularly influenced by different individual factors and physical environmental components. Analysing ratings across the ten pairs of bi-polar descriptors would indicate key components influencing the smellscape, which can be included in further design processes.

8.2.3 Planning and designing smellscapes

This question sets out an inquiry into the kinds of pleasant smellscapes design can achieve. Aiming at different types of pleasantness, how can we design a satisfying smellscape?

There are four types of smellscape pleasantness that emerged from the studied cases according to the emphasis on different indicators: preference-led pleasantness, which is most associated with preference, purity and intensity; healthiness-led pleasantness, which is most associated with cleanliness, calmness and freshness; past-experience led pleasantness, which is most associated with familiarity, preference and calmness; and context-led pleasantness, which is most associated with appropriateness and naturalness. In the two cases of this study, healthiness-led pleasantness and context-led pleasantness are found dominant in urban intermodal transit spaces. Drawn from findings of this research, key components and

indicators of smellscape have been used to construct a design framework to achieve healthiness and context-led smellscape pleasantness in urban intermodal transit spaces, aiming at a fresh, clean and appropriate smell environment. In this sense, it is essential that smells of waste perceived as unhealthy and unclean need to be removed from the environment, such as cigarette smoke, toilet smells, cooking fumes and traffic-related smells. Design elements producing smells perceived as fresh need to be considered and integrated with the main functions and structures of urban intermodal transit spaces, such as water features, greenery and fresh air. At the same time, layout of spaces and the smells in them need to be considered in terms of people's activities and purposes for using urban intermodal transit spaces to make the overall smell environment appropriate to its context.

At the macro level, smellscape design needs to alert planners, landscape designers and transport engineers to making use of prevailing wind and topography to remove traffic smells and separate people from traffic fumes to create a good surrounding smell environment. Odour objectives at this level would not be as specific as at the midi level or micro levels but would aim to minimise the intensity of traffic fumes on the site and separate pedestrians from vehicles by careful design of the access environment. Design at the midi level would focus on architectural scale, involving architects, ventilation engineers and station operators. Odour objectives at this level need to be defined for each functional space, such as main concourses, dining spaces, outdoor areas and enclosed waiting spaces. The main design strategy at this level would be to spatially separate different smell sources and passenger flows to reduce inappropriate mixing of smell environments, and aiming at designing for good ventilation and air quality to produce a healthy background smell environment. Waste management to remove unpleasant smells, i.e. smell of urine, waste food and rotten trash, from the general background smell is also essential at this level to improve smellscape quality in terms of liking, purity, intensity and cleanness. Architectural aesthetics relating to space volume, colour and acoustics also need to be considered. Midi level design of smellscapes focuses on the influences of physical forms, such as space layout, architecture style and ventilation.

Smellscape design at the micro level needs to pay attention to perceivers' positions in the space and relations with the surrounding environment, including others' behaviours. Smell objectives at this level would be to minimise the influence of others' behaviours and mask particular unpleasant smells with background level fresh smells accepted by the general public. Interior designers, architects and station operators need to work together on selecting

materials, designing seat layouts and controlling inappropriate behaviours to achieve smellscape pleasantness. Users' demands and preferences, such as a 'safe' distance for personal space, and smell nuisance avoidance of cigarette smoke, are essential to consider at the micro level for limiting unwanted smells and introducing new smells into intermodal transit spaces.

8.3 Contributions and applications

This study sets out a theoretical framework from a linguistic- environmental psychology perspective, which contributes to a theoretical basis for using language as a source to explore smellscape. Findings of this study have filled in the gaps identified in existing research in order to establish a systematic approach to studying smellscape, from understanding to evaluation and design. In particular, at the midi level, the focus is on the layout of different functional spaces to guide and separate different passengers' routes and activities. A smellscape investigation protocol and practical guidance for smellscape in urban intermodal transit spaces can be derived from this study to benefit practitioners, researchers and ultimately, the transport-using public

8.3.1 Contribution to theories of smellscape

A wide range of studies have emphasized the difficulty of studying smellscape because it is subjective, complex and not easy to describe and measure. Many studies have taken a qualitative approach to exploring smellscape, reviewing people's experiences related to smells through first hand interviewing, and historical studies (Classen et al. 2002; Reinartz 2014). However, there is no clear theoretical structure to illustrate the interrelationship between words, perceptions and the perceived smell environment. Porteous (1985) pointed out that there was a lack of vocabulary to describe smells and smell-related experiences and this situation does not seem to have changed twenty years later as seen in Classen's (2002) and Henshaw's (2013) work. However, in these works, words are still used as a main source to understand the smell environment and people's perceptions of it, and this demands a theoretical framework to draw out the interrelationships between language, perceptions and the smell environment.

In the beginning of this study, Chapter 3 took a linguistic/ environmental psychology perspective and constructed a theoretical framework for exploring smellscape from people's natural language. People's natural language delivers information about their emotions and personality (Tuan 1991), sketching out people's minds or how they think and feel. This is because the language and sensory-motor system share the same structure in our brain, which interrelates language descriptions and sensory experiences (Gallese and Lakoff 2005). In this way, an understanding of smellscape can be gained through analysing: (1) people's descriptions of their experiences, including emotions, memories and feelings; and (2) the smell environment, including physical features, components, smells and smell sources. At the same time, clear evidence has been found in neurological and psychological studies of connections between smells, emotions and memories (Engen 1991; Herze and Engen 1996; Schiffman 1990). Emotional descriptors indicate people's perceptions of the physical environment, and so can be used as a measure environmental quality (Lang 1969; Mehrabian and Russell 1974). Analysing the emotional descriptors in people's descriptions enables an understanding of the quality of smellscape and identifying key components influencing people's evaluations, which then can be developed into a design framework of smellscape, as discussed in Chapter 3. This theoretical framework provides a basis for using people's natural speech to understand, evaluate and design smellscape. It also provides validity for the qualitative methods used to collect and analyse data so that it can be applied to other smellscape studies.

8.3.2 Contribution to the understanding of smellscape concept

As discussed in Chapter 2, there is no agreed definition of smellscape. However, previous studies suggest this concept involves human perceptions, the physical environment, smells and smell sources, the context of place and temporary environmental features. In this study, smellscape is defined as the human perceived smell environment of a place, influenced by its context and temporary features. People's perceptions of the smell environment involve both sensation and thinking process (Henshaw 2013) that lead to a response or evaluation of the surrounding environment. However, few studies have explored the perceptual process in order to explain how people perceive the smell environment and how the components of the smellscape concept work to produce a response.

The perceptual process explored in this study explains the interrelationships between people's perceptions, responses and the smell environment, and helps an understanding of smellscape. The process involves essential elements of the context, smell environment (smell and smell sources, the physical environment, temporary conditions), perceivers, sensation, cognition and responses. Each element is explained and discussed in Chapter 5 to provide a full understanding of people's perceptual processes relating to smellscapes. In particular, the perceptual patterns emerging from this research, i.e. recognising, situationalising and comparing, illustrate people's ways of thinking in response to their individual differences and components in the smell environment. In the studied cases, it was also found that people's immediate reactions to the smell environment and their responses following from perceptions varied, as a consequence of their evaluations of the perceived smell environment in different perceptual patterns.

The indicators of people's perception of the pleasantness of the smell environment identified in Chapter 6, illustrate criteria to evaluate smellscape quality. People are influenced by cleanliness, freshness, naturalness, appropriateness, familiarity, liking, calmness, purity and intensity experienced in the smell environment. Such indicators are closely related to individual differences and components in the smell environment, reflecting people's hedonic levels, arousal and dominance feelings. They work differently and through different perceptual patterns produce behavioural and psychological responses to the smell environment. This framework, demonstrating interrelations between each element in the smellscape concept, can be applied and tested to interpret people's perceptual processes in relation to the smell environment in other contexts.

8.3.3 A smellscape protocol to investigate smellscape on-site

In soundscape studies, a number of indicators of pleasantness are identified as assessment criteria (Axelsson et al. 2009) and then developed into a soundscape protocol for on-site soundscape quality evaluations in urban spaces. The protocol has three parts: the listener's information, time and location; sound categories; and a scale-rating for soundscape quality. This soundscape protocol with its identified criteria have provided a useful method for assessing soundscape quality in urban spaces. A similar smellscape protocol would be useful

for practitioners and researchers to investigate existing smellscape and its quality. With the findings of this study, a smellscape protocol can be developed, which would include: perceivers' basic information; the smell environment; and a scale-rating of smellscape quality, (see Appendix).

Perceivers' basic information would include age, gender, allergic sensitivities (e.g. hay fever) and ability to smell (able to smell or not). Components of the perceptual process of the smell environment include smells and smell sources, the physical environment and temporary conditions. According to the discussion of key components that emerged in the studied cases, the physical environment needs to include information on architectural style, indoor or outdoor, openness of space, function of space, surrounding barriers, ventilation, vegetation, waterscape and sanitary facilities. Temporary conditions need to include time, weather, traffic, flows of people and on-site activities. The smells and smell sources would be grouped in the ten categories discussed in Chapter 4: traffic related, food and beverages, tobacco, waste, cleaning products, building materials, nature related, air quality, people and animal, fabrics and other materials. Levels of agreement on detecting each category of smells need to be indicated in the protocol, which can use the same scale – from 1 to 7 - as the evaluation section, where in this case, 1 means not detected at all; 4 means detected quite often; and 7 means very dominant. The scale rating can be drawn from the seven-point scale rating evaluation system derived in Chapter 6, with ten pairs of bi-polar descriptors: stuffy-fresh, relaxing-stressful, pleasing-annoying, familiar-unfamiliar, pure-mixed, intrusive-background, clean-unclean, natural-artificial and appropriate-inappropriate. However, it would also be necessary to have an extra rating for the overall pleasantness of the perceived smell environment to provide a full understanding on the smellscape quality.

This protocol can be easily understood and conducted in the field and can also be applied in large-group fieldwork to collect data for quantitative studies, which can be used to support findings from observations and qualitative interviews as well as provide a more generalised conclusion on the investigated smellscape quality.

8.3.4 A guide for designing smellscape in urban intermodal transit spaces

Henshaw (2013: 172) suggests designing urban smellscape at macro (city), midi (district) and micro (street) level in four main steps: site assessment and stakeholder engagement; determining odour objectives and settings within the design brief; design and implementation; monitoring and evaluation. However, no detailed explanations or examples are given for each step to guide practice. Without existing examples of smellscape design practices, it is difficult to construct a stakeholder engagement framework throughout a design process. Instead, this study chose to interview people from different backgrounds to get insight into the stakeholder engagement, including users (local transport users and visitors) and staff (managers and cleaners) of the studied cases, architects, planners, and landscape designers. Their perspectives in describing, evaluating, designing and managing smellscapes in urban intermodal transit spaces helped identify the role of smellscape in a general design process from different aspects.

The design strategies discussed in Chapter 7, developed from understandings and evaluations of smellscape in the studied cases, can provide smellscape design guidance in urban intermodal transit spaces, including design objectives, identification of stakeholders, design strategies and key elements at three scale levels. In particular, the guidance explains objectives regarding features of the three scale levels. Henshaw (2013) suggests that odour objectives should be established at the beginning of the design process and defined within the context of targeted places. However, she does not explain in detail what an odour objective might be. From the studied cases, it can be suggested that an odour objective can also be determined through identifying wanted and unwanted smells, relating to pleasantness types and masking effects and indicators of smellscape pleasantness derived from the cases in this study: intensity, freshness, cleanliness, calmness, familiarity, purity, naturalness and appropriateness.

However, rather than having one overall odour objective, it would be necessary to have several odour objectives at macro, midi and micro levels. For example, the overall odour objective for a midi level smellscape design in an urban intermodal transit space might be to spatially separate different smell sources and people flows to create a less mixed smell environment. Such objectives set out at the beginning of a design process to inform detailed designs at each level would more appropriately be called smellscape goals rather than odour objectives. An odour objective needs to be more specific, such as: ensuring that no toilet smells can be detected anywhere inside and outside the toilets, creating fresh background

smells of cleaning liquid in waiting concourses; making sure traffic smells cannot be detected in food courts and that smoking is banned in/around waiting areas.

Components of smellscape are key elements to design with at each level. Informed by odour design principles of separating, diluting, scenting/masking and removal, each component of smellscape at each level in this study has been given design suggestions for planning, architecture, landscape, interior design and station management. The design process using smellscape goals, key stakeholders and design components from macro, midi and micro levels in urban intermodal transit spaces provides a detailed example of how a smellscape design framework can guide design practice for a specific functional space.

8.4 Limitations and future work

Due to time constraints on this study, it was only possible to study one typical case in each selected country. The contrasting contexts of the two cases allowed this study to compare differences and similarities to gain a more comprehensive understanding of smellscape in the target spaces. However, there are stations at different scales in both rural and urban contexts. The selected case in each country presents a typical type of intermodal transit space in each urban context, but this limits comparisons between, for instance, different built forms or rural and urban contexts in each country. As mentioned in Chapter 7, the newly-built Wuhan Station on the outskirts of Wuchang district in a rural context and surrounded by undeveloped farmlands, was frequently commented on by participants in the Wuchang case as a having a relatively pleasant smellscape. Similarly, in the UK, there are several compact models of intermodal transit spaces in large cities, such as London, Manchester or Birmingham, with more vibrant atmospheres and complex functions. In the Sheffield case, participants sometimes mentioned differences between the Sheffield Railway Station and Bus Interchange and large compact stations, such as London King's Cross, St Pancras and Manchester Railway Station. These stations have different form from the one has been researched, which seems can provide different angles of looking at smellscape of intermodal transit spaces in this country. Based on the framework and findings of this study, future work can be developed in three aspects: compare other types of urban intermodal transit spaces in each country, explore smellscape in other types of public spaces

A study to compare other types of urban intermodal transit spaces in each country

One of the limitations discussed earlier suggests the need to examine various types of intermodal transit spaces in both countries. In the UK, stations are mostly built in the urban context, close to city centre, while most types of intermodal transit spaces are built in a dispersed model. In order to include more varieties and differences in the study, it would be necessary to compare the Sheffield Railway Station and Bus Interchange with a compact model such as London St Pancras Station, which would be a good case to compare, being a compact model with large passenger flows and featuring a commercial environment.

In China, most intermodal transit spaces are compact models like the Wuchang Railway Transit Centre. However, there is a large number of newly-built stations in rural contexts, which may have different smellscape conditions: regenerated stations in an urban context it would be necessary to compare between rural and urban contexts in order to explore the impacts of surrounding environment and design context on smellscape in intermodal transit spaces. The Wuhan Station, as mentioned earlier, would be a good case to compare with the WRTC. A cross-comparison between Wuchang and London St Pancras Station as well as the Sheffield and Wuhan cases, would also contribute to a more detailed and generalised framework of smellscape in such spaces.

A frequency analysis on weightings of indicators composing smellscape pleasantness

As a qualitative research, this PhD study focused on understanding the composition of smellscape and variables among people's evaluations of smellscape pleasantness by summarising modifiers in people's descriptions. Due to the nature of this study, frequencies of modifiers were not analysed to generate weightings of different smellscape features. Meanwhile, sample of this study were selected following emerging categories during the fieldwork rather than chosen for a quantitative generalisation. The qualitative data collected in such conditions may also not suitable for a frequency analysis to compare weightings of different smellscape features. However, a frequency analysis will be useful to help identify weightings of identified indicators in this study to quantify different elements involved in assessing smellscape pleasantness. This can be developed as a future study.

A study to explore smellscape in other types of public spaces

This study explored smellscape in the specific context of two urban intermodal transit spaces, which respond to particular visitor purposes and environmental settings. The perceptual process, evaluation criteria and types of pleasantness derived from the studied cases may be slightly different in other types of public spaces. For example, this study found that healthiness-led pleasantness was most commonly appreciated in the urban intermodal transit spaces studied. However, as discussed in Chapter 6, not all indicators and perceptual patterns may work at the same time in the same way in evaluating smellscape pleasantness. Studies could be carried out to explore smellscapes in other kinds of public spaces with similar activity types as urban intermodal transit spaces like libraries, museums and galleries, using the smellscape protocol discussed in the last section. Comparing different types of public spaces would be helpful to identify key indicators influencing people's smellscape pleasantness from which to generate specific guidelines for designing pleasant smellscapes, responding to the features and functions of different public spaces

An exploration into design methods for using plants and water features to increase smellscape quality in public spaces

In the studied cases, people were found to give mostly positive evaluations of natural elements, particularly plants and running water features. These two elements make significant contributions to the level of liking, calmness, cleanness and freshness of smellscape, which are found to be highly appreciated by participants in the study. Apart from smells, both visual and auditory perceptions of running water features and the appearance of plants have significant influences on people's evaluations of smellscape. As discussed in Chapter 7, in Sheffield the water feature was found to significantly reduce perceptions of traffic fumes and noise in Sheaf Square. Plants which blossom and produce aroma may also function as barriers to mask traffic fumes and provide visual attraction. It would be useful to explore design methods for plants and running water features of different types, layout, scale and surrounding environment to provide a practical tool for achieving pleasant smellscapes in public spaces.

8.5 Final remarks

Across design and social science disciplines, smellscape is underappreciated as a way of improving environmental quality and enhancing people's social, psychological and behavioural experiences. As revealed in the cases researched for this thesis, there is a demand by users for a pleasant smellscape in urban intermodal spaces as well as a demand for guidance in understanding and designing smellscape from architects and planners. A pleasant smellscape may also be essential in and critical for other types of public spaces, such as hospitals, libraries and museums.

As a concluding remark, I would suggest smellscape as an essential aspect of the design framework of public spaces alongside other sensory components, such as sound and lighting, to create a satisfying and healthy environment. Although smellscape, with a focus on human perception, is influenced by individual differences, designing smellscape in public spaces does not aim to satisfy any single individual preference, but hopes to achieve a type of pleasantness that fulfils most people's preferences when using the target spaces. The understanding and evaluation of existing smellscape is a priority and is essential to produce design objectives and guidance that fit the context and meet people's expectations. This study provides a framework for future research and practice to systematically explore smellscape, from understanding and interpretation to evaluation and design. Meanwhile, research methods and design solutions can be informed from studies relevant sensory aspects involving physiological psychological influence to the physical environment, i.e. thermal comfort studies by Nikolopolou (2003) and Nikolopolou & Lykoudis (2007), soundscape studies by Kang (2006), Yu & Kang (2009) and Brown (2011). With more studies of smellscape being undertaken, current limitations on quantifying and simulating design elements will be overcome in the near future and more detailed and practical design solutions will be produced.

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Appendix 1: Smellscape survey used in the Sheffield case

Part 1: Participant profile

Code	
Age	
Gender	
Environmental Specialist? (if yes, please specify)	
Smoking habit?	
Able to smell? (if hayfever, please specify)	
Local resident?	

Date	
Weather	
Start time	
End time	

Part 2: Smellscape Pleasantness Rating

Please rate your pleasantness of smellscape at each stop along the walk. Please tick in the box below from 1 to 7: 1= very unpleasant, 2= unpleasant, 3= slightly unpleasant, 4= neither pleasant nor unpleasant, 5= slightly pleasant, 6= pleasant, 7= very pleasant.

Stop	1	2	3	4	5	6	7
1 Bus Interchange							
2 Station Path Greenery							
3 Railway Station concourse							
4 Railway Platform							
5 Railway Station Tram Stop							
6 Railway Station Taxi Rank							
7 Sheaf Square							

Appendix 2: Climate and air quality in Sheffield and Wuhan

Climate

- **Sheffield, UK**

Sheffield is located in South Yorkshire, UK, at latitude 53°23' N and longitude 1°28' W. The city has diverse geographical features formed by several hills at the eastern part of the Pennines. The urban area of the city is at the confluence of two rivers: River Don and River Sheaf. The climate in Sheffield is generally temperate. The Pennines at the west of the city has much influence to its weather, creating a cool, gloomy and wet environment whilst preventing prevailing westerly winds. Sheffield is claimed to be the greenest city in England.



Figure: Map of geographical location of Sheffield in the UK

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average High (°C(F))	6.8 (44.2)	7.1 (44.8)	9.8 (49.6)	12.5 (54.5)	16.1 (61)	18.8 (65.8)	21.1 (70)	20.6 (69.1)	17.7 (63.9)	13.5 (56.3)	9.5 (49.1)	6.9 (44.4)
Daily Mean (°C(F))	4.4 (39.9)	4.4 (39.9)	6.6 (43.9)	8.7 (47.7)	11.8 (53.2)	14.7 (58.5)	16.9 (62.4)	16.5 (61.7)	14.0 (57.2)	10.5 (50.9)	7.0 (44.6)	4.6 (40.3)
Average Low (°C(F))	1.9 (35.4)	1.7 (35.1)	3.3 (37.9)	4.8 (40.6)	7.5 (45.5)	10.5 (50.9)	12.7 (54.9)	12.4 (54.3)	10.3 (50.5)	7.5 (45.5)	4.5 (40.1)	2.3 (36.1)
Average relevant humidity (%)	85	83	80	76	75	74	74	75	78	82	85	86

Table: Climate data of Sheffield (1981-2010), sourced from <http://www.metoffice.gov.uk/> and <https://weatherspark.com/>

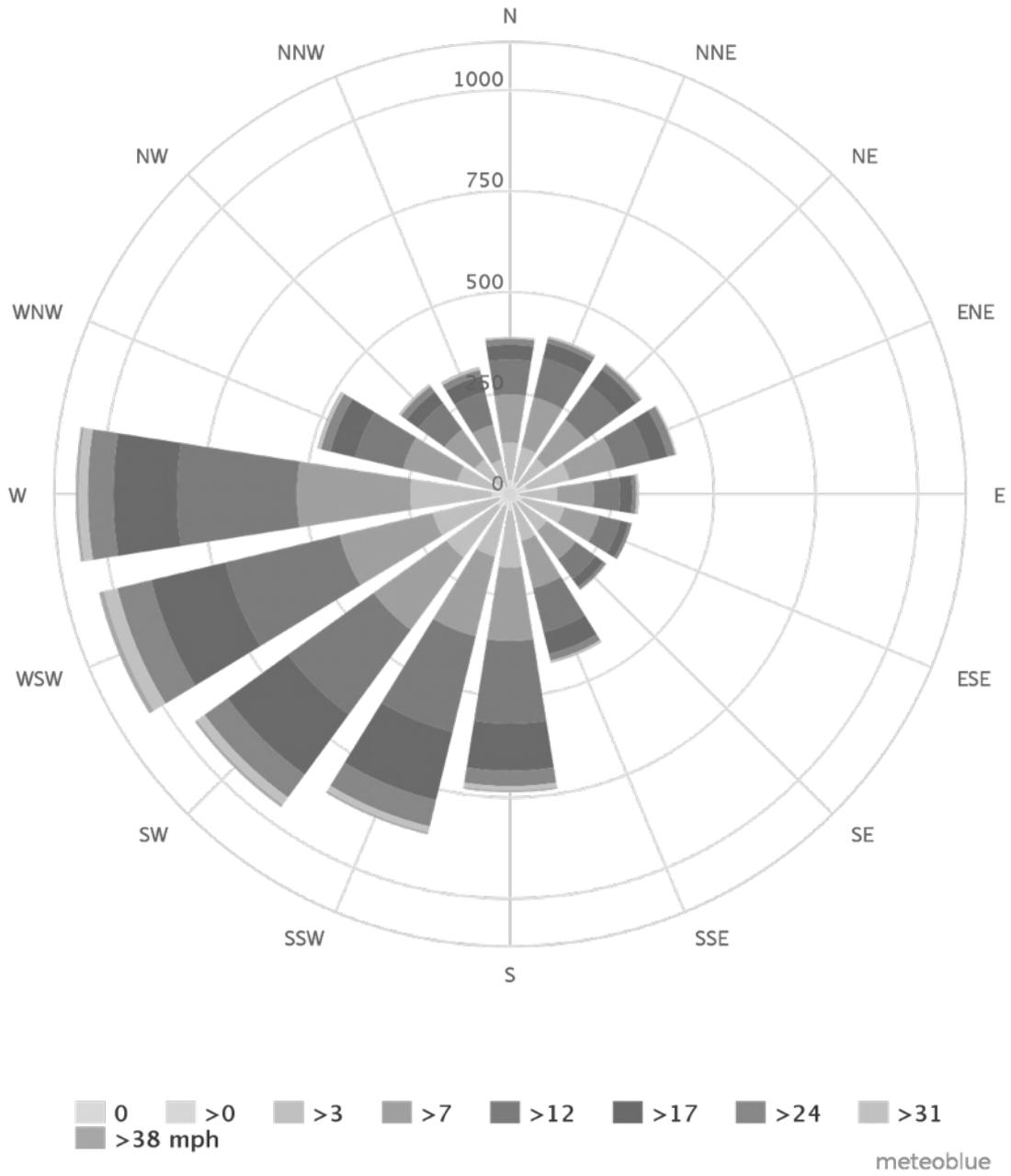


Figure: Wind Rose of Sheffield, sourced from <https://www.meteoblue.com>

- **Wuhan, China**

Wuhan is located in Hubei Province, China, at latitude 29° 58'–31° 22' N and longitude 113° 41'–115° 05' E, east of the Jiangnan Plain. The city is at the confluence of two large rivers: Hanshui and Yangze Rivers, which divide the city into three districts: Wuchang, Hankou and Hanyang. The climate in Wuhan is humid subtropical which has four distinctive seasons and plenty rainfall throughout the year. Spring and autumn are generally mild, while winter is cool with occasional snow. However, Wuhan is known for its oppressively humid summers. Wuhan is geographically low and flat in the middle and hilly in the south, with the Yangtze and Han rivers winding through the city.



Figure: Map of geographical location of Wuhan in China

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average High (°C(F))	8.1 (46.6)	10.7 (51.3)	15.2 (59.4)	22.1 (71.8)	27.1 (80.8)	30.2 (86.4)	32.9 (91.2)	32.5 (90.5)	28.5 (83.3)	23.0 (73.4)	16.8 (62.2)	10.8 (51.4)
Daily Mean (°C(F))	4.0 (39.2)	6.6 (43.9)	10.9 (51.6)	17.4 (63.3)	22.6 (72.7)	26.2 (79.2)	29.1 (84.4)	28.4 (83.1)	24.1 (75.4)	18.2 (64.8)	11.9 (53.4)	6.2 (43.2)
Average Low (°C(F))	1.0 (33.8)	3.5 (38.3)	7.4 (45.3)	13.6 (56.5)	18.9 (66)	22.9 (73.2)	26.0 (78.8)	25.3 (77.5)	20.7 (69.3)	14.7 (58.5)	8.4 (47.1)	2.9 (37.2)
Average Relevant Humidity (%)	76	75	76	75	74	77	77	77	75	76	75	73

Table: Climate data for Wuhan (1981-2010), sourced from <http://www.cma.gov.cn/>

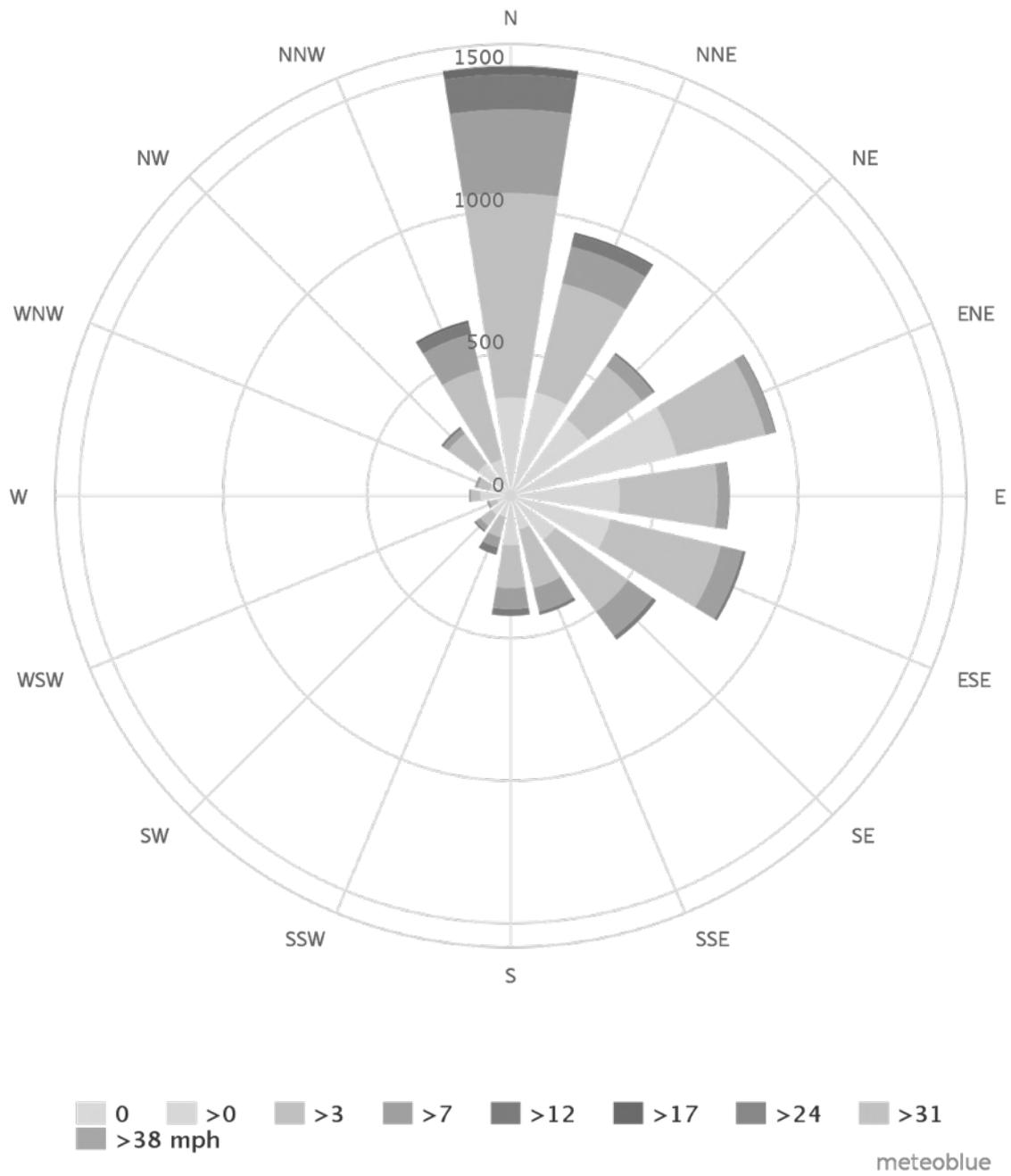


Figure: Wind Rose of Wuhan, sourced from <https://www.meteoblue.com>

Air quality

UK and China use different air quality index. The air quality index used in the UK is the Daily Air Quality Index recommended by the Committee on Medical Effects of Air Pollutants (COMEAP), which has four categories: Low, Moderate, High and Very high. However, the air quality index used in China is developed by the United States Environmental Protection Agency (EPA), which has six categories: Good, Moderate, Unhealthy for sensitive groups, Unhealthy, Very unhealthy and Hazardous. Pollutants calculated in both AQI are based on essential five elements identified in Clean Air Act: Ozone, Nitrogen Dioxide, Sulphur Dioxide, PM2.5 and PM10 particles. The AQI developed by EPA has two more indicators: the Carbon Monoxide measured per 15 mins running 1 hour and Ozone hourly running 8 hours.

Index Category	Index	Ozone, Running 8 hourly mean ($\mu\text{g}/\text{m}^3$)	Nitrogen Dioxide, Hourly mean ($\mu\text{g}/\text{m}^3$)	Sulphur Dioxide, 15 minute mean ($\mu\text{g}/\text{m}^3$)	PM2.5 Particles, 24 hour mean ($\mu\text{g}/\text{m}^3$)	PM10 Particles, 24 hour mean ($\mu\text{g}/\text{m}^3$)
Low	1	0-33	0-67	0-88	0-11	0-16
	2	34-66	68-134	89-177	12-23	17-33
	3	67-100	135-200	178-266	24-35	34-50
Moderate	4	101-120	201-267	267-354	36-41	51-58
	5	121-140	268-334	355-443	42-47	59-66
	6	141-160	335-400	444-532	48-53	67-75
High	7	161-187	401-467	533-710	54-58	76-83
	8	188-213	468-534	711-887	59-64	84-91
	9	214-240	535-600	888-1064	65-70	92-100
Very high	10	≥ 241	≥ 601	≥ 1065	≥ 71	≥ 101

Table: AQI Categories used in UK, developed by COMEAP

Index Category	Index	Ozone, Running 8 hourly mean ($\mu\text{g}/\text{m}^3$)	Ozone, 15 minute mean ($\mu\text{g}/\text{m}^3$)	PM2.5 Particles, 24 hour mean ($\mu\text{g}/\text{m}^3$)	PM10 Particles, 24 hour mean ($\mu\text{g}/\text{m}^3$)	Carbon Monoxide, 15 minute mean ($\mu\text{g}/\text{m}^3$)	Sulphur Dioxide, 15 minute mean ($\mu\text{g}/\text{m}^3$)	Nitrogen Dioxide, Hourly mean ($\mu\text{g}/\text{m}^3$)
Good	0-50	0-54	-	0.0-12.0	0-54	0.0-4.4	0-35	0-53
Moderate	51-100	55-70	-	12.1-35.4	55-154	4.5-9.4	36-75	54-100
Unhealthy for Sensitive Groups	101-150	71-85	125-164	35.5-55.4	155-254	9.5-12.4	76-185	101-360
Unhealthy	151-200	86-105	165-204	55.5-150.4	255-354	12.5-15.4	186-304	361-649
Very Unhealthy	201-300	106-200	205-404	150.5-250.4	355-424	15.5-30.4	305-604	650-1249
Hazardous	301-400	-	405-504	250.5-350.4	425-504	30.5-40.4	605-804	1250-1649
	401-500	-	505-604	350.5-500.4	505-604	40.5-50.4	805-1004	1650-2049

Table: AQI Categories used in China, developed by EPA

According to data recorded on <http://aqicn.org/>, the air quality in Ziyang District (where the Wuchang Railway Transit Centre is located) during daytime over the fieldwork period was either Unhealthy or Unhealthy for sensitive groups. According to data recorded on <https://uk-air.defra.gov.uk/air-pollution/daqi>, the air quality in Sheffield around the Railway Station and Bus Interchange during daytime over the fieldwork period was mostly moderate. Occasionally, it was in the Low or High category. Comparing the intensities of air pollutants during most time of the fieldwork, the air quality in outdoor spaces around Sheffield Railway Station and Bus Interchange was better than the air quality around Wuchang Railway Transit Centre.

Appendix 3 : Smellwalking records in Sheffield and Wuhan

Participation information of smell walking in the Sheffield case											
Code	Age	Gender	Built Environment Professional?	Resident?	Able to smell?	Smoking?	Date	Start Time	Duration (min)	Weather	Temperature (°C)
S01	22	M	No	Yes	Yes, Hay fever	No	07/07/14	15:15	55	Sunny	22
S02	57	M	No	Yes	Yes	No	07/07/14	16:35	90	Sunny	22
S03	32	M	No	Yes	Yes, Hay fever	Yes	08/07/14	13:45	50	Sunny	23
S04	51	M	No	Yes	Yes	Yes	08/07/14	15:25	45	Sunny	23
S05	33	F	No	Yes	Yes	Yes	10/07/14	13:30	50	Sunny	23
S06	54	F	No	Yes	Yes	No	10/07/14	14:50	45	Sunny	23
S07	24	F	No	Yes	Yes, Hay fever	Yes	11/07/14	12:45	65	Sunny	22
S08	23	M	No	No	Yes	No	21/07/14	17:50	55	Sunny	23
S09	27	F	No	No	Yes	No	22/07/14	12:55	45	Sunny	24
S10	28	F	Yes, Landscape	Yes	Yes	No	24/07/14	12:55	55	Sunny	26
S11	45	M	Yes, Station management	No	Yes	No	31/07/14	11:35	65	Cloudy	20
S12	27	M	Yes, Architecture	Yes	Yes	No	13/11/14	12:15	65	Cloudy	9
S13	30	M	Yes, Architecture	Yes	Yes	No	15/11/14	10:20	55	Rainy	8
S14	43	M	Yes, Environment Psychologist	Yes	Yes	No	05/12/14	11:30	80	Cloudy	7
S15	37	F	Yes, Planning	Yes	Yes	No	12/01/15	09:30	65	Rainy	6
S16	30	F	Yes, Architecture	Yes	Yes	No	16/01/15	11:30	75	Sunny	5
S17	38	F	Yes, Planning	Yes	Yes	No	04/02/15	12:15	85	Cloudy	6
S18	35	F	Yes, Architecture	Yes	Yes	Yes	07/02/15	10:00	60	Cloudy	6
S19	27	M	Yes, Architecture	Yes	Yes	No	08/02/15	12:00	65	Sunny	8

Note: one extra interview was conducted with a planner, who was in the design team of the Sheffield Railway Station redevelopment project. This interview was conducted off-site and the participant was coded as S20, which may appear in the thesis for quotations.

Participation information of smell walking in the Sheffield case											
Code	Age	Gender	Built Environment Professional?	Resident?	Able to smell?	Smoking ?	Date	Start Time	Duration (min)	Weather	Temperature (°C)
W01	21	F	No	No	Yes	No	12/08/14	13:25	80	Rainy	26
W02	25	M	No	Yes	Yes, Hay fever	Yes	13/08/14	13:00	75	Cloudy	24
W03	22	M	No	Yes	Yes	Yes	13/08/14	14:10	65	Cloudy	24
W04	23	M	No	Yes	Yes	Yes	14/08/14	13:15	55	Cloudy	26
W05	45	M	No	No	Yes	Yes	14/08/14	16:35	65	Cloudy	26
W06	26	M	No	Yes	Yes, Hay fever	Yes	15/08/14	12:45	70	Cloudy	28
W07	24	F	No	No	Yes	No	26/08/14	14:15	60	Rainy	27
W08	27	F	No	Yes	Yes, Hay fever	No	28/08/14	13:10	70	Sunny	30
W09	25	M	No	Yes	Yes	No	29/08/14	11:55	75	Sunny	31
W10	18	M	No	Yes	Yes	No	29/08/14	14:30	65	Sunny	31
W11	50	F	No	Yes	Yes	No	31/08/14	13:45	60	Sunny	33
W12	26	F	Yes, Planning	Yes	Yes	No	13/08/14	14:35	85	Cloudy	24
W13	23	F	Yes, Landscape	Yes	Yes	No	14/08/14	15:00	70	Cloudy	26
W14	28	F	Yes, Planning	Yes	Yes	No	15/08/14	16:15	55	Cloudy	26
W15	27	M	Yes, Architecture	Yes	Yes	No	15/08/14	17:30	85	Cloudy	26
W16	42	F	Yes, Environment management	Yes	Yes	No	16/08/14	12:30	65	Cloudy	29
W17	32	F	Yes, Landscape	Yes	Yes	No	24/08/14	13:15	55	Sunny	32
W18	32	M	Yes, Architecture	Yes	Yes	No	25/08/14	13:00	90	Sunny	30
W19	29	M	Yes, Architecture	Yes	Yes	No	26/08/14	18:00	75	Rainy	27
W20	40	M	Yes, Architecture	Yes	Yes	No	04/09/14	12:35	65	Rainy	24
W21	31	M	Yes, Planning	Yes	Yes	No	06/09/14	16:30	75	Cloudy	26

Note: one extra interview was conducted with an architect, who was in the design team of the Wuchang Railway Station redevelopment project. This interview was conducted off-site and the participant was coded as W22, which may appear in the thesis for quotations.

Appendix 4: Smellscape protocol

A survey to investigate smellscape quality onsite

Date:			Time:	
Observer:			Weather:	
Place	Function:	Built Form:	Able to smell?	Hay fever?

Smell	1	2	3	4	5	6	7
Traffic related, e.g. car fumes, petrol							
Food and beverage, e.g. sandwiches, restaurant							
People and animal, e.g. perfume, body odour							
Building and product material, e.g. stone, timber							
Air quality, e.g. humid air, clean air, stale air							
Fabrics and other materials e.g. luggage and leather							
Tobacco, e.g. cigarette smoke, cooking fumes							
Nature, e.g. roses, leaves, grass, soil							
Waste, e.g. trash bins, food waste, toilet							
Cleaning and synthetic odours, e.g. air fresher							

Rate the level of agreement on detected smells. 1 = strongly disagree, 7 = strongly agree

Overall pleasantness?	
Overall appropriateness?	

Level of agreement on overall smellscape pleasantness and appropriateness. 1 = strongly disagree, 7 = strongly agree

Element	Yes/No	Element	Yes/No
Indoor?		Vegetation?	
Enclosed?		Waterscape?	
Airflow?		Seats?	
Traffic?		Toilets?	
Food stalls?		Trash bins?	

Please tick the box if you observed the physical elements onsite at the observing stop.

Descriptor	1	2	3	4	5	6	7	Descriptor
Unfamiliar								Familiar
Stuffy								Fresh
Unclean								Clean
Mixed								Pure
Natural								Artificial
Dislike								Like
Inappropriate								Appropriate
Artificial								Natural
Strong								Background
Annoying								Pleasing
Stressed								Relaxing

Level of agreement on characteristics of the smell environment. 4= neither agree with each side, 1= strongly agree with descriptors on the left, 7= strongly agree with descriptors on the right,

Activity	1	2	3	4	5	6	7
Crowds of people							
Chatting with other people							
People watching							
Playing with phone, ipad and other digital device							
Eating food							
Drinking alcohol							
Smoking							
Cooking							
Littering on the ground							
Sitting waiting (doing nothing)							
Walking pass							
Inappropriate behaviour?							
If you have observed inappropriate behaviour, please specify:							

Level of agreement on activities you observed. 1= strongly disagree, 7= strongly agree

Appendix 5: List of publications and activities taken during the study

Conference papers:

Xiao, J., 2016. *A case study to explore smellscape in open spaces around railway stations from the well-being perspective*. In Proceedings of 2016 Wellbeing International Conference, 5-7 September 2016, Birmingham, United Kingdom.

Xiao, J., Kang, J., Tait, M., & Henshaw, V., 2015. *Smellscapes in urban intermodal transit spaces: understanding pleasantness as a concept for design in an English context*. In Proceedings of the International Conference on Changing Cities 2: Spatial, Design, Landscape & Social-economic Dimensions, 22-26 June 2015, Porto Heili, Greece.

Lavia, L., Xiao, J., Kang, J., & Easteal, M., 2015. *Developing an applied sound scape approach: Mapping the stakeholder engagement process in the City of Brighton and Hove, UK*. In Proceedings of INTER-NOISE 2015 - 44th International Congress and Exposition on Noise Control Engineering: Los Angeles, United States.

Xiao, J., Kang, J., Tait, M., & Henshaw, V., 2015. *Use the method of walking to explore the smell environment in Chinese urban intermodal transit spaces. A case study in Wuchang Railway Station*, The intricacy of walking and the city: experiments and methods, international conference, 21-23 January 2015, Paris-Marne la Vallée, France.

Book chapter:

Xiao, J., Tait, M., & Kang, J., 2016. The design of urban smellscapes with fragrant plants and water features. In Perkins C. et al. ed. *Designing with Smell: Practices, Techniques and Challenges*, Chapter 8, London: Routledge. (With Publisher)

Journal Paper:

Xiao, J. and Aletta, F., 2016. A soundscape approach to exploring design strategies for acoustic comfort in modern public libraries: a case study of the Library of Birmingham. *Noise Mapping*, 3(1), pp.264-273.

List of outreach activities undertaken:

- Public talk of Smellscape at ARCC Network Event, 27th January, 2016
- Internship on soundscape planning: May, 2015- July, 2015, Noise Abatement Society, Brighton and Hove, UK
- Teaching as lecturer in Environmental Design at Birmingham City University since September 2015