The effects of expectation on the perception of soundscapes

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iii. Abstract

This thesis discusses how expectation is a contributory factor in the perception of soundscapes. "Soundscape" is a term attributed to R.Murray Schafer to define the acoustic environment, a recent ISO workgroup has proposed a formal definition as the "*perception and understanding of an acoustic environment, in context, by the individual, or by a society*" As such there is a move away from traditional acoustic methods of understanding environmental sound towards a more holistic, and interdisciplinary, approach to the sound environment. Previous soundscape research has identified the importance of semantic meaning attributed to soundscapes focusing on investigating linguistic and textual approaches of how people describe the soundscape. This thesis aims to extend the concept of meaning to give an insight into what particular soundscapes mean to people, and if this related to a predefined expectation based on context. This work expands Truax's notion of soundscape competence, and investigates how people perceive the soundscape. In particular how expectation of a particular space impacts on the perception of that space. This in turn addresses the issue of defining a context for a space and understanding how the soundscape is of importance to perception of spaces.

The research which forms this work uses a number of interdisciplinary methods, from the fields of acoustics, social science and psychology, with the aim of developing a new qualitative and quantitative methodology for soundscape research. The work consists of qualitative fieldwork, and the development of a soundscape simulator in the laboratory. Through the use of an enhanced version of soundwalking, participants were asked questions aimed to analyse their pre-determined environmental expectation and their actual experience of a number of different spaces, and how this impacts on their perception and evaluation of the soundscape. The soundscape simulator was a tool by which participants could control and design their own soundscapes, whilst providing useful quantitative and qualitative data about choices made in the design process. Soundscape expectation is shown to relate not only to competence in perceiving the components of the soundscape but also to attitudes towards safety, social norms, accepted behaviour, visual aesthetics and control attributed to the space. Expectation based on competence forms the basis of place expectation or context, and relates to the overall perception of the soundscape for each space. When one or more of these factors conflict with a perceived place expectation, then perception of the soundscape becomes more important and impacts on the perception of the space. This work concludes that the meaning of a soundscape and its perception is related to an individual's expectation of the context of a space.

1 Introduction

This chapter is the primary introduction to the thesis, specifying where the main area of research will be presented, with attention given to the specifics of the chosen topic. The research problem is identified, together with explanation of the originality of this work, and how it contributes to existing research in the subject.

1.1 Soundscape

The concept of 'soundscape' research is gaining increasing recognition within the academic acoustic community (Schulte-Fortkamp, 2007; Davies *et al.*, 2007). This has resulted in the funding of a number of major projects, including the Positive Soundscape Project, which this thesis contributes to. There is now a strong focus on the use of interdisciplinary collaboration as part of soundscape research (Kang & Zhang 2010; Davies *et al.* 2007; Kull 2006; Schulte-Fortkamp & Fiebig 2006; Lercher & Schulte-Fortkamp 2003; Epstein 2003; Schulte-Fortkamp & Nitsch 1999). An ISO working group has been created to work towards defining the term soundscape, and addressing the shortfall in current research. One of the primary factors in soundscapes research is the necessity for new methodologies to integrate qualitative and quantitative research methods (Kull, 2006; Schafer, 1984).

Within the last ten years, there has been a move away in research from traditional acoustic methods and measurements with regard to environmental sound issues, such as the use of L_{Aeq}, to a focus on a more holistic approach to the sound environment (Kull, 2006), as popularised by Schafer (Schafer, 1984). Previous soundscape research tended to investigate subjective responses to soundscapes using a number of techniques, including interview, rating scales, and questionnaires in the field (Raimbault & Dubois, 2005), or by the playback of field recordings in the laboratory (Guastavino & Dubois, 2005). To date, little work has been carried out to integrate the two epistemologies. With the current focus on interdisciplinary methodologies in soundscape research, it is necessary to investigate and develop research methods in this field and importantly to develop a synergy between qualitative and quantitative methods to test for the link between subjective and objective measures.

The concept of 'soundscapes' was first used by Southwark in his paper '*The Sonic Environment of Cities*' (Southworth, 1969) however it is now generally attributed to R. Murray Schafer, a Canadian composer and instigator of the 'Soundscape' movement.

Schafer's much cited and acclaimed work '*The Tuning of the World*' (Schafer, 1977) is generally credited as being first to describe the acoustic environment, as 'the soundscape'. Schafer defines the term 'soundscape' as '*the total acoustic environment*' (Schafer, 1984). Schafer was also a key facilitator on the World Soundscape Project (WSP) in the 1970s, and as such came to be seen as the founder of the discipline. It is important to note that Schafer's work was based on ecological concerns, and in particular noise pollution, which came about through his engagement with ecological movements in the 1970s (Truax, 1974; Schafer, 1994; 1984; 1988). It is difficult to understate the importance of Schafer's work on soundscapes and the work of the WSP, but at the same time it is important that the rigours of his proposed methodologies are investigated.

As mentioned above, a soundscapes approach was coined by Southwark but popularised by Schafer. Currently the approach to soundscapes research is to try to find methods by which interdisciplinary synergies can be formed. This synergy of epistemologies is an attempt to understand both the objective and subjective factors of soundscapes. In particular, The principal issues include: defining the acoustic context; understanding how individuals perceive the soundscape; and whether the soundscape affects the individual's perception of different spaces. Research in the field of soundscapes has traditionally focused on trying to define soundscape, and identifying methods of objectively measuring associated parameters, but work from Dubious, Botteldooren and Kang has focused on the investigation of semantics, meaning and experiential factors attributed to soundscapes (Dubois & Guastavino, 2006; Botteldooren & Coensel, 2006; Yang & Kang, 2004).

Whilst their approaches are based on investigating factors such as the linguistic, cognitive and social aspects of how people describe the soundscape, it becomes evident that a new approach is needed to look at 'meaning' from a higher level semantic psychological view point. In particular, "What do particular soundscapes mean to people, and is this related to expectation and memory?" OR: 'how does an individual read a specific soundscape, and is this related to their personal expectation and or memory?'

Traditionally community noise control has a tendency to suggest the reduction in noise levels, although it has been shown that volume is not necessarily the main factor affecting soundscape perception (Schulte-Fortkamp & Nitsch, 1999; Schulte-Fortkamp, 2002c; 2007). As mentioned previously, soundscape research is now focusing on using interdisciplinary methods to tackle the problem of the link between level and soundscape.

For example, Kang suggests acoustic comfort evaluation where types of sound sources, users of a space, and social factors play a role in perception (Kang, 2007:43). Combining these factors could form a 'context', a concept that Botteldooren states as crucial in a cognitive approach to soundscapes. If all spaces have a context (Botteldooren, *et al.*, 2008), then it is possible that the individual's expectation of a context is a key factor in their perception of that space. It can therefore be proposed that existing regulations are 'based on the assumption' that people expect different sonic environments (Kang, 2007:43).

Initial evaluation of existing work in semio-acoustics (Jekosh.& Blauert, 1996) where the meaning attached to acoustic phenomena is used to quantify sound quality judgements, has shown how meaning and social value play a key role in determining the acceptance of the soundscape, and in particular how traditional measurements of acoustic level (L_{Aeq}) are no longer wholly acceptable as a standardised measurement. This thesis presents the hypothesis that soundscapes and their categorisation are socially and culturally constructed through experience, expectation and implied meaning. It is greatly influenced by the findings of current ecological psychology research, which identifies that '*natural sound environments are always perceived within a multi-sensorial setting*' (Raimbault & Dubois, 2005:339), something which is of critical importance when designing a soundscape methodology.

The starting point for this work is the concept of 'soundscape competence' proposed by Truax (Truax, 2001:59). Competence is the "*tacit knowledge that people have about the structure of environmental sound*" (Truax 2001:57), he elaborates this point suggesting that it is this knowledge which "*manifests itself in the behaviour that interprets such sound and acts upon it*" (Truax 2001:57). Competence suggests that soundscape structures, that is the relationship between sound and its meaning (Truax, 2001:54) are learnt, and it is this learnt behaviour which facilitates soundscape expectation.

Key to this research is the understanding of what is meant by 'expectation', in particular the expectation of urban environments, and the effect that subjective expectation has on the perception on the soundscape. As previously mentioned, existing soundscape studies have investigated subjective response to soundscapes using a number of techniques, including interview, rating scales and questionnaires in the field (Dubois, *et al.* and by the playback of field recordings in the laboratory (Lavandier & Defreville, 2006; Guastavino & Dubois, 2005; Raimbault, *et al.*, 2003).

This research uses both qualitative and quantitative methods to produce a combined methodology for understanding and measuring soundscape expectation. This thesis examines what expectations participants have within a space; whether the space matches their expectation; and how expectation influences perception of the sound environment. In particular, it will identify specific sound sources, overall noise levels, and subjective factors which may influence the individual's perception.

1.2 Research Proposal

The thesis will additionally provide an introduction to ongoing work being carried out in soundscape research, and in particular how expectation plays a role in perception of the soundscape. The thesis then sets out in detail how this work contributes to the field, and its application within current academic and professional fields will be shown. A contemporaneous report produced for the governmental Department of the Environment and Rural Affairs (DEFRA, as it existed then) in 2009 identified outstanding issues missing from the soundscape epistemology, including the following areas:

- A lack of genuinely interdisciplinary projects (characterized by a shared perspective) instead of multi-disciplinary projects. These are needed to deal with the multidimensional experience of soundscape perception.
- A lack of basic knowledge on many aspects of soundscape cognition, perception and classification.
- A need for large-scale robust field trials of soundscape assessment methods, instead of the more common experiment of a new method in a single location (Payne, 2009).

This research work aims to address some of these issues, in particular, the primary research problem relates to the following questions:

• What are the primary factors of a soundscape which contribute to the meaning and expectation of a space?
• How does a person's expectation of a space impact on the soundscape that they find acceptable in that space?

This will be achieved through the use of interdisciplinary epistemologies and developing field methods which encompass multi-locations rather than one single location.

1.3 Aims and objectives

The aim of this research work is to investigate a link between a place (space) and a person's expectation of that space, and how this affects their perception of the soundscape. The work aims to capture a subject's different experiences in and expectations of a number of different spaces in an urban setting. In particular, the work aims to answer the following objectives:

- What factors contribute to expectation?
- How does expectation influence perception of soundscape?
- Does a-priori experience of a space create competence and expectation of different types of soundscapes?

These aims will be addressed through the use of both qualitative and quantitative methods. The objective is to measure how expectation impacts on the individual's evaluation and perception of the soundscape.

1.4 Methodology

To further this research and answer the questions posed, the project will involve collecting data through soundwalks and interviews about subjective perceptions of certain spaces. This will involve investigating factors which are deemed important in the space, as well as focusing in on soundscape components which are seen as most relevant. This includes not only sound sources and descriptions, but also acoustical features such as sound level, low frequency effects and perceived spaciousness.

Combining this data with findings from the soundwalks will provide a basis for laboratory-based work. The laboratory work involves the design and manipulation of soundscapes based on the interview data; this will entail controlling a selection of elements (such as sources, level etc), to test the impact on meaning and expectation of the presented location, removed from the actuality of being in the space.

1.4.1 Quantitative field work

The qualitative aspects of this work used a soundwalk method which involves taking a participant on a silent walk, the timing of which can vary (Adams *et al.*, 2008; Bruce & Davies, 2009). The participant was asked to walk in silence observing the soundscape and the environment. The developed method involves stopping the participant in a number of pre-determined locations throughout the walk and then facilitating an interview.

During the soundwalk interviews conducted in Manchester and London in 2008 and 2009, participants were asked questions relating to a set of specific spaces they visited. This method used grounded theory as a basis, an iterative process by which meaning and inference could be collected and inferred from the collected data. The data collected was analysed by coding the data into categories which related to the primary objectives of the project.

A semi-structured interview method was used during the soundwalk and this allowed for rich semantic data to be gathered, as well as reasoning behind the answers to be investigated. The questions related to the general environment of the space and focused on details such as '*is this as you would expect*', or '*is there anything missing or out of place?*' and more perceptual questions e.g. '*is this space louder, quieter or as you would expect it to be?*' and '*what influence do the materials and layout of the space have on the soundscape?*'

The soundwalk also provided data which was to be used in the laboratory-based experiments. An analysis of the interview data highlighted sound sources which need to be recorded for use with the simulator. Once highlighted, field recordings of the sources took place, which additionally involved the recording of sound level measurements, as these measurements allowed the calibration on the simulator during the second phase.

1.4.2 Qualitative laboratory work

The development of the soundscape simulator as a tool for allowing participants, both as individuals or as groups, to 'design' and manipulate elements within a sound environment is the principle method under demonstration in this paper. The aim of this research is to try and understand what constitutes the soundscape 'expectation', in particular the expectation of soundscape in urban spaces. The simulator is part of a combined qualitative and quantitative methodology which aims to determine the effects of expectation on the perception of the soundscape by a respondent. The simulator provides a tool by which the correlation between the designed parameters of a soundscape by individual or group can be studied and linked to real world experience and expectation.

The development of a soundscape simulator aims to address these issues, as well as to create a tool from which field data can be used to test and design scenarios in a laboratory. An additional purpose for the development of this tool is to allow planners, architects and urban designers to test designs before developing them.

Dubois has investigated the individual and group experience of soundscapes based on representation shared in language and knowledge (Dubois, *et al.*, 2006; Raimbault & Dubois, 2005; Dubois & Guastavino, 2006). Through their work, they suggest a need for "*accurate and reliable tools for measuring subjective experience of sounds before measuring physical parameters*" (Dubois, *et al.*, 2006: 866).

Their work has provided a detailed catalogue of semantic categories from questionnaire and interview methodologies, which are used as the basis of the simulator. This work hopes to provide a tool by which subjective experience can be measured effectively, and correlate this experience to physical acoustical parameters.

1.5 Contribution and main findings

This work is presented as original in its contribution to the soundscape body of work, as it takes as a starting point, existing ideas on competence, expectation and context and applies this to soundscape using a mixture of interdisciplinary methods. The work builds on the existing literature by investigating the effects of perception and the cognitive thoughts of a participant, both in-situ of a soundscape, and in a controlled laboratory setting.

The work shows that expectation, along with competence, play a key role in the perception of soundscape, but that expectation is also made up of additional factors which combine to form a participant's experience of a space, including the level to which they are aware of the existing soundscape.

The thesis is unique in its combination of acoustics, psychology and social science methodologies to study the effects of expectation on the perception of the soundscape.

1.6 Thesis Structure

A brief description of the contents of each chapter is provided in this section. The thesis will take the following structure:

- Chapter 1 this introductory chapter.

- Chapter 2 consists of a literary review of previous research relating to soundscape research and expectation. The chapter starts by defining the key terms used in this thesis, those of context, competence and expectation. It identifies the major

contributions to the field, and details how this work sits within the existing models and frameworks for soundscape perception and research. The chapter details the influence of legislation on the issues of soundscapes, and states the critical effects soundscapes on health and wellbeing. The chapter provides details on the nature of competence, expectation, experience, and perception, as well as giving a summary of the influence of semantics to the field.

- Chapter 3 provides further details on the framework in which this work sits. It details the usage of qualitative grounded theory, and describes the chosen methodologies, explaining the reasoning behind their choice and their relevance to the aims and objectives of this work.

- Chapter 4 provides details of the different stages in the qualitative and quantitative experimental methods employed in this research work, in particular detailing the primary soundwalking and soundscape simulator methods.

- Chapter 5 comprises of the main results of the work, providing a detailed analysis of the main findings, and the connections between the qualitative and quantitative methodologies employed in the research work. The chapter concludes with a discussion of how the results from the two methodologies link together to form a model for measuring soundscape expectation.

- Chapter 6 consists of an overall evaluation, discussion and analysis of the research project, analysing the major findings, and stating how they relate to the body of existing research. It also identifies decisions made throughout the research period, and evaluates the details of issues and problems that arose with the methodologies.

- Chapter 7 concludes of the research, and assesses and how the work has addressed the aims and objectives set out in this introductory chapter. It states exactly how expectation plays a role in the perception of the soundscape, in addition to further findings which were discovered following analysis of the results. After discussing the current project, there will be a discussion of the potential direction of further work.

1.7 Motivation

The motivation for this work came from the author's experience of working in the film industry as a sound designer. Throughout the production of a film's soundtrack, the design process creates a soundscape from scratch. The soundscape is designed to sound 'right', to match an expectation of the listener, although key to the role of the soundtracks is the need to ensure that it does not detract from the visual image on the screen. If it is possible to design expectation for film, this proposes the question of, where does this expectation come from? Why do certain visuals sound 'right', if this is a case of competence, then this could potentially be applicable to the urban soundscape?

This work is funded from the EPSRC's Positive Soundscape Project, which investigated attitudes towards the soundscape, primarily in urban spaces.

2 Literature Review

2.1 Introduction

This thesis aims to show how the effects expectation of a space influences a person's perception of that space. In this chapter, there will be an exploration of the existing literature used to form the direction of research for this thesis. This chapter details the arguments for the consideration of soundscapes as a research topic, and how the development of soundscape research is important in the development of environmental and community noise research. Also presented will be an analysis on the origins and development of expectation, meaning and competence in the perception of the soundscape. The aim of this research is to investigate a participant's perception of a soundscape in a variety of urban spaces, and examine the effects of expectation on their evaluation and perception of the soundscape.

2.2 Overview

This chapter begins by looking at the background to soundscapes research and how recent developments have led to an increase in soundscapes research, providing insight into the activities surrounding current research and how this works has drawn on the current limitations to develop the topic central to this thesis. From a background to soundscapes, the chapter investigates current noise and environmental acoustics legislation to demonstrate limitations in this work and the requirement for soundscapes research as a topic to be developed, The formation of the thesis topic from existing work on semantics and perception which integrate into the overall explanation of the core concepts of this work, expectation, competence and context, are then provided, before an in-depth investigation at the background and current state of these concepts. The chapter then goes onto explore the connection of the key concept with work being carried out on musical expectation and listening states. The chapter finishes detailing how soundscape understanding fits into acoustic design, and area was which has been developed as part of the initial work on soundscape which brings the work full circle back to the origins of soundscape research.

This chapter will start with the basis of this theory in soundscape competence, through the use of language and semantics to the linking of a psychological expectation of space to the perception of the soundscape. The next section provides definitions of the three key terms used, which are crucial to the development of this thesis. These terms: are competence, expectation and context.

2.3 Terminology

There are three main terms which are used throughout this work, and are key to the formation of this thesis. It is therefore imperative to explain these terms at this point, with further detail and explanation provided in sections 2.7 and 2.8 of this chapter. These concepts form the basis of the work of this thesis, which concludes that they are intrinsically interconnected, where one concept informs the others, and it is the interlinking of these factors which form the main body for this work.

The starting point for this work is the concept of soundscape 'competence' proposed by Truax (Truax, 2001). As described previously, Truax describes soundscape competence as tacit knowledge that a person has about the structure of a soundscape as they experience it (Truax, 2001). Tacit knowledge is subjective knowledge which is related to an individual's experiences, and is comprised of factors such as their personal beliefs, perspective, ideals, values, emotions and mental models (Nonaka & Takeuchi, 1995). These factors are generally taken for granted and as such cannot be easily identified, but they shape the way we perceive the world around us (Nonaka & Takeuchi, 1995).

Soundscape competence suggests that soundscape structures, which comprise of all the acoustics elements which form a soundscape are learnt through experience, and that this forms a relationship between sound and its associated meaning (Truax, 2001). In this work, competence is to be tested by looking at structural relationships, between an acoustic environment and activity within the space, to discover knowledge about the soundscape, and elements within the soundscape. These structures related to a space's context which a person is present in; context is defined as follows.

Context is defined as the '*circumstances that form the setting for an event, statement, or idea, and in terms of which it can be fully understood and assessed*' (Burke, 2005). It is these circumstances which link context to soundscape perception, as this work shows that expectation is based on judging the context of the environment, in particular, judging it based on the setting of the events and physical nature of the space. The work aims to shows that the setting is formed from a person's competence of the setting they are entering. The act of noticing a soundscape depends on a variety of factors including the individual's activity, personal factors, focusing (Muer, *et al.*, 2007). It is the combination of these factors which Muer labels 'context'; this work will expands on this, and proposes that these factors in combination form expectation, and thus the subjective perception of the soundscape.

Expectation is defined as '*A strong belief that something will happen or be the case in the future, or the series of events which are anticipated prior to an experience*' (Oxford English Dictionary, 2010). Expectation is used in this work in regard to the likelihood of events happening, and the anticipation of the occurrence of events, in relation to the soundscape context. Huron in his work on the psychology of expectation likens expectation to a cliché; a stereotype for a context or situation (Huron 2007). Expectation is used in this work to compare or draw a distinction between the likelihood of events happening, and the participant's anticipation of the occurrence of events, within the soundscape context. Key to this research is the investigation and understanding of the meaning of 'expectation'; in particular, the expectation of soundscape in urban environments, and the effect that a subjective expectation has on a person's perception of that soundscape.

Existing soundscape studies have investigated subjective response to soundscapes using a number of techniques, including qualitative interviews, rating scales and questionnaires in the field (Irvine *et al.* 2010; Berglund 2007; Brambilla & Maffei 2006; Adams *et al.* 2006; Schulte-Fortkamp & Fiebig 2006; Raimbault & Dubois 2005) and by the playback of field recordings in the laboratory (Lavandier & Defreville 2006; Guastavino & Dubois 2005). This thesis amalgamates both qualitative and quantitative methodologies to produce a combined methodology for understanding soundscape expectation.

A question arises in terms of expectation, and this is: is expectation dynamic? Is a person's individual expectation constantly in flux, as they walk through changing environments, whilst simultaneously developing thoughts and conclusions? Events and contexts change continuously and unpredictably, causing the individual to react either consciously or unconsciously, which inevitably affects their expectation and experience of an environment. It is this dynamic aspect of expectation which links expectation to context and competence.

From competence or learnt behaviour, a person then facilitates soundscape expectation. There is little existing research on the effects of expectation on the perception a soundscape, though Botteldooren and De Coensel (Botteldooren & De Coensel 2006) proposed expectation as part of a framework of cognition and emotion when perceiving soundscape contexts (Botteldooren & De Coensel 2006). The concept of auditory expectation is not new in the study of music, where the links between music and expectation are grounded (Huron 2007; Schmuckler 1989; Bissell 1921). Expectation in music has recently been reinforced and extended by Huron with his work on the psychology of expectation (Huron, 2007), as well as

work carried out on soundscape expectation and soundscape design in virtual environments (Valle, *et al.*, 2009; Chueng & Marsden, 2002), as well as the psychology of place and associated expectations (Bechtel & Ts'erts'man, 2002; Kaplan, 1987). The study of expectation is also common in the field of information systems (Bhattacherjee, 2001).

The research investigated what participants expect within a space, whether the space matches their expectation and if expectation influences the perception of the sound environment, and in particular, looking at sound sources and overall noise levels. Further to this, an investigation into whether there is auditory 'expectation' which is acceptable to the majority of users of a certain type of environment. The definition of *acceptable* has not been explicitly defined and is a factor which needs to be explored. Does acceptance of a soundscape relate to creating a positive or improved mood or more simply is an acceptance factor which does not affect a person's operation or communication within a given space. This thesis aims to address these questions, as part of the investigation of expectation. Barry Truax describes the understanding of the mind as "*the last frontier*" (Truax 2001:59), when understanding soundscapes.

2.4 Soundscapes

'*Soundscapes*' is a term attributed to R.Murray Schafer, in his well-cited work "*The Tuning of the World*" (Schafer, 1984), to depict the acoustic environment. Pre-dating Schafer, Southworth used the term soundscape, in his paper *The Sonic Environment of Cities*. Southworth does not explicitly define soundscape, but instead refers to the study area as '*the Boston soundscape*' (Southworth 1969:49). Southworth's ideas are closely tied to Schaferian ideas which came later and to current work in soundscape research, that the soundscape is more than environmental noise measurements, and is a much more holistic study (Adams *et al.* 2006). Southworth states that assessment of a sound environment depends on the information content of the sound and the context in which it is perceived (Southworth, 1969), a thesis which is closely tied to those later developed by Schafer (Schafer, 1984).

Southworth also proposed the idea of design of soundscapes (Southworth, 1969), and design is a key feature of the work of both Schafer and Truax (Schafer, 1984; Truax, 2001). Acoustic design is explored in more detail later on in this chapter. In his work on urban design, Southworth suggests that '*design of the soundscape alone may be a way of making the city less stressful, but more delightful and informative to its user*' (Southworth 1969:50). Southworth's work also poses a number of questions, which are closely tied to the work

conducted in this thesis. Southworth suggests that there is a '*correlation between sound and the visible spatial and activity form*' of the space and asks the questions '*What is the perceived variety and character of city sounds?*' and '*how do sounds influence perception of the visible city?*' (Southworth, 1969) Whilst Southworth's paper may have been eclipsed by the later works of Schafer, it provides the basis for questions still being addressed by the soundscapes community (Dubois, *et al.* 2006; De Coensel & Botteldooren 2007).

The development of soundscapes research as a scientific discipline, breaking away from roots in the artistic practice led by Schafer, Truax, Westerkamp and the World Soundscapes Project (Truax, 1974) which has not yet sufficiently provided robust methodologies or indeed a consensus of a definition of the term soundscape (Genuit & Fiebig, 2006). Soundscape definition is a current area of debate and research with bodies such as the COST network (COST Network, 2009), and an ISO working group formulating research to develop an ISO standard definition for the term 'soundscape'. As such, there has been a wide spectrum of differing approaches to soundscape research, with methodologies from many differing and contrasting disciplines being developed.

These methodologies are being suggested as possible solutions to soundscapes research, and range from acoustic measurements (Davies *et al.* 2009; Szeremetta & Zannin 2009) and auralisation (Kang, 2007), to social science ethnographic (Arkette, 2004) and phenomenological approaches (Adams *et al.* 2006), to psychological (Blesser & Salter, 2009; Schulte-Fortkamp, 2002a; Schine, 2010; Berglund, 2007) and physiological (Irwin *et al.* 2010; Hume & Ahtamad 2009; Hume *et al.* 2008). To date there is still no overall consensus, but the concept of soundscape is currently emerging as a serious topic for research.

The Positive Soundscapes Project, from which this thesis was funded, aims to address the lack of interdisciplinary collaboration in soundscapes research, and bring together academics and methodologies from sound art, acoustic ecology and social science as well as techniques from acoustics, psychoacoustics, physiology, neuro-imaging and sound quality (Davies *et al.* 2007). The aim of which to offer "*a potential escape from the one-dimensional valuing of environmental sound as a noise level*" (Davies *et al.* 2007:5). Interdisciplinary collaboration was highlighted by Schafer and others (Schafer, 1984; Kull, 2006; Lercher & Schulte-Fortkamp, 2003), who recognised that it is crucial for many branches of the sciences and the arts to come together and try and answer the question of soundscape design and appreciation.

> *"The true acoustic designer must thoroughly understand the environment he is tackling; he must have training in acoustics, psychology, sociology, music and a great deal more besides, as the occasion demands."* (Schafer, 1984:34)

The interdisciplinary approach where disciplines are integrated together to form a single research approach, has been highlighted as the principle way forward, opposed to a multidisciplinary approach where skills from different disciplines are used but the task is approached from each discipline's own perspective, to allow for synergetic thought and research design (Kang & Zhang 2010; Davies *et al.* 2007; Kull 2006; Schulte-Fortkamp & Fiebig 2006; Lercher 2003; Epstein 2003; Schulte-Fortkamp & Nitsch 1999)

One of the key advantages of undertaking soundscape research is that investigative focus can be on all aspects of the sonic environment, with consideration being given to both negative and positive aspects of the environment (Cain *et al.* 2008; Davies *et al.* 2007; Guastavino 2006; Adams *et al.* 2006; Stockfelt 1991). With these considerations, it is possible to utilise methods from other such as sound quality research (Vastfjall, 2004). It is hoped that, while many disciplines currently produce disparate work on soundscapes and consider its importance, there is a need to focus specifically on environmental sounds (Lercher, 2003).

Whilst there is a movement towards accepting soundscape research there are also those who argue against it. These arguments tend to summarise the difficulties faced by the research in terms of inter-disciplinary methodologies and misunderstanding of the epistemologies of these differing disciplines. Ingold argues that sound is in a constant state of movement, and thus understanding soundscape is irrelevant unless in the context of complete experience, *'sound is like the wind....it will not stay put.....It requires an effort to stay in place. And this effort pulls against sound rather than harmonising with it. Place confinement, in short, is a form of deafness'* (Ingold, 2006:1). However it is possible to stay in place. Whilst the problem of the temporal nature of soundscape exists, it is possible that acoustically the signal is the same. This acoustic signal may have inferred meaning, to the listener independent of its acoustic properties, but this factor is not discussed in Ingold's work.

To explore expectation, and competence, it is necessary to place this research in acoustics, social science and psychology. Whilst a scientific empirical epistemology can suggest how and why things may or may not occur, a positivist approach does not currently provide robust understanding when faced with the issue of emotion or experience.

The study of experience is now part of soundscapes research (Raimbault & Dubois, 2005; Dubois, *et al.*, 2006; Adams *et al.*, 2006), and has led to the need for interdisciplinary collaboration and understanding. The ideas and concepts put forward by Schafer are now being addressed by the acoustics and environmental noise community as a way to overcome problems surrounding current noise legislation (Davies *et al.*, 2007; Kull, 2006).

2.5 Legislation

The relevance of soundscape in environmental noise legislation is summed up by Raimbault and Dubois, who state that '*most city regulations are insufficient*' (Raimbault & Dubois 2005:340) focusing on noise levels and neglecting human experiences of noise. They argue that '*sound quality cannot be determined by a simple measurement (such as L_{Aeq})*' (Raimbault & Dubois 2005:340). Nilsson and Berglund also state that average sound levels are poor indicators when trying to understand the influence of soundscape on a person's state of mind (Berglund, 2007), Southworth stated that assessment of a sound environment depends on '*the information content of the sound and the context in which it is perceived*'(Southworth, 1969:52), as being an important factor in the perception of soundscapes.

Schafer and others working on the World Soundscape Project utilised a phenomenological approach to the study of soundscapes. They investigated if there was a constructed meaning of the soundscape to the participant (Schafer, 1977; 1994). Truax, also part of the WSP, stated that the emphasis of the studies was to examine noise beyond its physical acoustic properties, looking at the social meanings attached to the sound (Truax, 1974).

This examination allowed for the study of what the noise/sound is communicating and '*the relationship between the listener (perceiver) and the (sonic) environment*' (Truax, 2001:13). Perception and emotion have also been studied by other researchers, in relation to the soundscape (Botteldooren & De Coensel, 2006; De Coensel *et al.*, 2007; Defreville, *et al.*, 2007; Payne *et al.*, 2007; Watts *et al.*, 2007). The importance of the study of noise and how perception and emotion are important in the study of environment noise is highlighted by reports from the World Health Organisation (WHO) and the European Union. It has been reported that '*WHO's findings suggest that long-term exposure to traffic noise may account for three per cent of deaths from ischemic heart disease in Europe - typically strokes and heart attacks.*'(Highfield 2007)

According to the WHO, the health of the population should be regarded as "*a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity*" (World Health Organization 2001). Whilst this definition is broad, it is possible to see how noise-induced annoyance can have an adverse effect on a person's health, this problems is also highlighted by the European environmental noise directive (Journal of the European Communities, 2002). The report scales the problem to a European level, '*Given that 7 million people around Europe die each year from heart disease that would put the toll from exposure to noise at around 210,000 deaths. In England, heart disease kills 110,000 people annually, so the deaths linked to noise could be around 3,300*' (Highfield, 2007).

The WHO report and another undertaken by the Department of Health have also shown that some soundscapes can be detrimental to the physical and mental health of those living and working in them. Health issues which include, sleep disorders, stress, and reduced cognitive capabilities, which affect both children and adults (Department of Health, 2009; World Health Organisation, 2000). These reports highlight that environmental sound can cause issues which have far reaching consequences, but Michaud states that '*with any psychological reaction, annoyance has a wide range of individual variability*' (Michaud *et al.* 2005:39) this variability is what prevents exact figures from being collated. The variability is influenced by multiple personal and situational factors (Fields 1993, Broadbent 1972), factors which have been highlighted by Botteldooren and Guastavino as factors which relate to soundscape perception (Guastavino & Dubois, 2006; Botteldooren, *et al.*, 2001).

Current UK legislation does not consider the concept of soundscape, but only concentrates on acoustic measurements as an assessment of an acoustic environment. A review of all UK Government's *Planning Policy Guidelines (PPG)* and *Statements (PPS)*, showed little mention of sound, noise, music or soundscape. There was no explicit mention of soundscape, but the terms sound and noise were the only two aural terms used in the documents. The policy guidelines provide a considerable amount of detail and focus on landscape issues, in particular the preservation and importance of '*areas of natural beauty*' (ODPM, 2005). The guidelines use the term 'positiviness' in design when relating to landscapes and planning; although there is little discussion of what contributes 'positiviness' in terms of metrics or tangible concepts. The notion that sound or soundscape contributes to 'positiviness' or even is part of the environment is absent from the discussion and policy guidelines, although as the UK has adopted mandates from the European noise directive, including noise mapping and the protection of quiet area, and as such can be seen to be embracing the issue.

The absence of environmental sound in UK planning policy can be shown, for example, in Planning Policy Guidance 2 which relates to Green Belts. The policy has considerable detail on the importance of landscape and the importance "*to retain attractive landscapes, and enhance landscapes, near to where people live*" (ODPM 2001), this should perhaps include soundscape or the at least "thought of soundscapes" and the sound environment as a contributor to the character of the macro-space of the green belt. In Planning Policy Guidance 8, which relates to telecommunications, there is no mention of noise generated from masts and transformers or any effect on health from any acoustic noise generated from them. The only health concern mentioned is that of EMF generation. There is particular detail given to the overall design of masts, which consider how they should blend with the background, "*authorities and operators should use sympathetic design and camouflage to minimise the impact of development on the environment. Particularly in designated areas, the aim should be for apparatus to blend into the landscape*" (ODPM 2001). Similar to other planning policies, there is no discussion of how noise may affect residents living nearby, or if there should be any "*sympathetic design or camouflage*" from a sound perspective.

In Planning Policy Guidance 18, which relates to enforcing planning control, a key area where guidelines on how enforcement in areas of noise pollution or subsequent noise issues relating to developments which have been poorly planned would have been of crucial importance. The most relevant document in relation to noise is Planning Policy Guidance 24 (PPG 24), which has some detail of the impact of sound/noise on health at the beginning of the document and there is no mention of positive design, or the fact that sound or environmental sound could or should be designed. PPG 24's only reference to the issues of noise and the effects on space and communities is given by, *"Noise can have a significant effect on the environment and on the quality of life enjoyed by individuals and communities*" (ODPM 2001). The policy guidance document bases its focus on measures which can be introduced to "*control the source of, or limit exposure to noise*" (ODPM 2001).

The issues of noise are fully embraced by Schafer in all of his works, as something which should be removed at all costs (Schafer, 1988; 1984). But critically, Schafer only makes reference to 'noises' which he personally dislikes, for example the sound of a rock concert at a University destroying the natural habitat of the surrounding wildlife (Schafer, 1988). But what this example shows is how context is an important factor when developing legislation. Rock concerts will continue to happen, but as long as this is confined to a given time or place i.e. context, then this should not be a problem. The overall noise levels of the event will only

affect those who are not engaging with the context, i.e. neighbours. This reasoning shows how noise level cannot be the only metric used to define soundscape.

Soundscape research, has the potential to influence the decision making of government policy, as environmental noise is a subject of major concern, and has a large impact on the quality of people's lives. Alongside the UK's legislation, there is the European Noise Directive (END) (Journal of the European Communities, 2002) , which has a similar focus in reducing noise level. An issue with the reduction of overall noise levels is that the goal may not often be obtainable. This may be down to simple factors such as the impractically of acoustic solutions or financial decisions based on implementation costs. Soundscape research potentially provides a methodological shift away from general noise abatement, to a more holistic approach to the environment, with the focus being on the auditory environment as a whole, and those who operate within it.

Soundscape concepts started to be introduced into community and environmental noise research in the 1990's (Schulte-Fortkamp & Fiebig, 2006), and recently with a number of high profile projects, there has been an increase in recognition of soundscape research by research councils and government bodies.

In the UK in 2009, DEFRA commissioned a report to investigate the current of soundscapes research, its relevance and recommendations on how research could proceed (Payne, 2009). Prior to the DEFRA report, an EPSRC funded Noise-futures network was set up, to bring together researchers, planners, acoustics consultants, artists, and others with significant interest in environmental acoustics. The Positive Soundscapes Project, and the research presented here, is as a result of a project incubated from this network. Outputs from these projects and reports and other soundscape research suggests (Kang, 2010) that the current state of soundscape research lies in addressing the following issues:-

- The combination of methodologies, metrics and indicators from different scientific epistemologies, including a lack of standardisation and explicitation (*sic*) in the categorisation and measurement procedures.
- Relationships between quiet areas and "good" or "restorative" sound environments.
- Understanding of the soundscape different settings (context) and between cultures.
- Relationships between subjectively assessed "acoustic quality of the environment" and perceived health-related quality of life and functional health. (COST Network, 2009)

These issues have been broken down by the COST soundscape research group (COST Network, 2009) as objectives which need to be tackled in soundscape research. This has resulted in a number of work groups being set up to address them, both COST workgroups WG1 and WG2 have elements which have been utilised as part of this work. In understanding the issue, it is suggested that:-

> *"Linguistic analyses could be made of the semantics of the vocabularies and of discourses encountered in the diversity of studies concerned with soundscapes using verbal responses. This could also reflect the cultural variations in conceptualisations and subjective responses to noise and their relations to acoustic parameters. (WG1.1)"*

And in tackling the issue the COST network, highlights the importance in '*exploring the synergies and differences*'

- between field studies and experimental settings (WG2.5)
- between verbal data collection and analysis and physical measures (WG2.6)
- It is in getting a better understanding of information content and context, as well as acoustical data which is the problem to be addressed.

These are all issues, which impact on this research, and are related to the topic under investigation. Their importance has an impact on the development of the research methods and framework described in the next chapter. There is also an underlying difficult in producing legislation which is based on subjective evaluations of sound. It is easier for a local authority to implement legislation based on criteria they can quantify, such as sound level metrics. To implement anti-noise or soundscape policing would be difficult and in a sense it falls under anti-social categorisation as well as being down to subjective attitudes to the pollutant.

This work hopes to show that whilst understanding that noise levels are easier for a local authority to implement, that they do not relate to how a person may experience a space. It is this experience which constitutes acceptance and annoyance. Annoyance which arises out of perceived anti-social elements, or the inability to control the soundscape or elements within the soundscape surrounding the person (Bruce & Davies 2009). In understanding if there is competence and expectation, from its basis in linguistic theory as suggested by Chomsky (Chomsky, 1969) it is relevant to look at work on soundscape semantics.

2.6 Semantics

Methodologies and frameworks in soundscape research which address the issues of '*verbal data collection and analysis and physical measures*' and gaining a '*better understanding of information content and context*'; have been developed prior to the COST work. These findings relate closely to the theory of expectation and competence. Dubois, Raimbault and Guastavino have worked on understanding participant experience of soundscapes, through the use of semantics and language. Language and the understanding of how participants talk about the soundscape and sounds within it, prove the only access to a psychological understanding of what a participant is experiencing or perceiving. The work of Dubois *et al* is vital to this research work, which also utilised field work using semi-structured interviewing as its main method.

Research into meaning within the soundscape, in particular, is something which has been addressed by Dubois, Guastavino and Raimbault (Dubois, *et al.* 2006; Guastavino & Dubois 2005; Raimbault 2005), as part of their work on semantics. An investigation into individual and group experience of soundscapes based on representation shared in language and knowledge (Raimbault 2005), showed that the soundscape accounts for the relationship between '*individual experience and subjectivity with a physical and social-cultural context*' (Guastavino & Dubois 2005:333).

Semantics, Dubois states "*lies in the emphasis on the exploration of the concept and categories we use*" (Dubois *et al.*, 2006:867ff), this forms part of a wider field of structuralism which in turn relates to competence of a soundscape, as suggested by Truax (Truax, 2001). This relationship is what forms the theory of competence. Semantics aims to look at the relationships between meanings, while the psychological cognitive approach looks to focus on the meanings themselves. Dubois *et al*, have already carried out work into semantic categorisation, which Lobner describes as "*the mental act of classifying things and forming categories*" (Lobner 2002:171).

Category formation and the assignment of an object to a category if it fulfils a certain set of conditions have been challenged by the '*prototype theory*' (Lobner 2002:167), which leads to a different idea of categorisation and assumes that there are fuzzy boundaries which need to be considered when forming categories. The fuzziness of these boundaries is an issue which has been addressed when looking at using artificial neural networks to process soundscapes. (De Coensel *et al.* 2007)

Kang further showed that "*cultural background and long-term environmental experience*" (Kang & Yang, 2003:2352) are important aspects when determining respondent's judgement of sound preference. Kang defined this judgment as, "*macro-preference*" (Kang & Yang, 2003:2352). By considering the existing work of Dubois, Botteldooren and Kang on social factors and context, the diagram shown in Figure 2-1 proposes the beginnings of a framework of how expectation may relate to a person's experience of a space, and how experience of similar spaces, or context, may influence the perception of a space. Schulte-Fortkamp also argues that, context, focus of attention, and the knowledge of past experiences of a participant must be taken into account, when studying soundscape perception (Schulte-Fortkamp, 2002c).

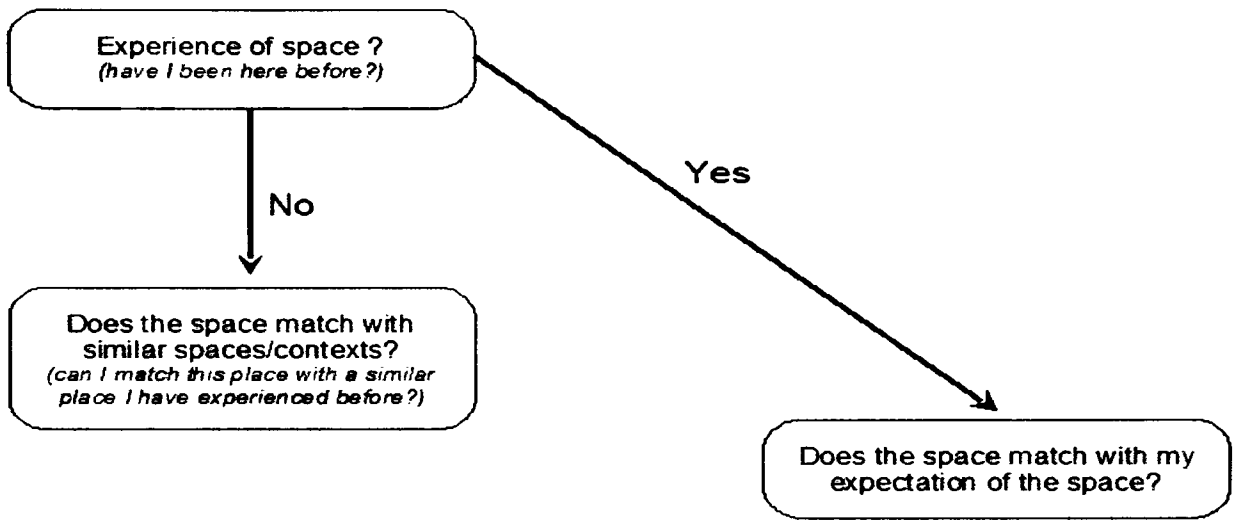


Figure 2-1 : Expectation Process Flow

The expectation process flow model extends the ideas of experience and context research carried out by Botteldooren, Kang and Schafer (Botteldooren, De Coensel, Renterghem, Dekoninck & Gillis, 2008; Yang & Kang, 2004; Schafer, 1984). Additional research by Dubois *et al*, into semantic categorisation (Dubois & Guastavino, 2006), shows further understanding the knowledge of the soundscape is based on "*converging evidence that people categorise urban soundscape into semantic categories related to social activities*" (Dubois & Guastavino 2006:1).

Dubois work provides a basis for the thesis under test in this work, namely that soundscapes and their categorisation are socially and culturally constructed through experience and associated meaning. Based on this premise, Dubois' work shows that soundscapes and their categorisation are learnt through experience, and then the possibility of testing this in relation to an a-priori expectation of a space is possible. This learnt construct can be tested by researching the experiences and expectations of respondents in a space, either with prior or no prior experience of the space.

The multi-sensory experience cannot be neglected, as a soundscape will simultaneously contain sounds from multiple sources, *"some of which attract the attention more than others, depending not only on the physical characteristics of the signal (such as intensity) but on its meaning and relevance to the listener*, (Raimbault & Dubois, 2005) and shows the importance of studying semantic meaning attributed to sound and how expectation of a location or context relates to associated meaning of the participant, but with the caveat that auditory signals are not the only sensory input occurring at the time of perception.

Results from Dubois and Botteldooren (Dubois & Guastavino, 2006; Botteldooren & De Coensel, 2006) shows that the soundscape is '*organised'* and it is through this structure of organisation that meaning and expectation can be inferred, forming context based expectations of spaces. Through organisation of meaning, the formations of structures are developed, which relate acoustic sound to inferred meaning, where structure performs the mediating role between sound and meaning. It is this semantic meaning which Truax used for the model (Truax, 2001), shown in Figure2-2, which Truax calls '*micro level preference*' to describe how structure fits into perception of the soundscape. Therefore investigating the component parts of micro preference should provide an insight into if there is a relationship between acoustical stimulus and subjective response of the listener, to a defined structure.

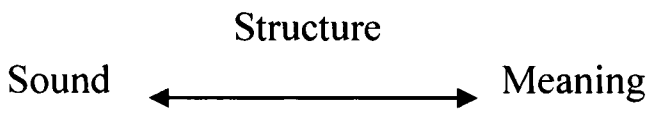


Figure 2-2 : Micro Preference (Truax 2001)

An example, of structure and inferred meaning is presented by Dubois, "*the sound of footsteps that maybe incidental can be perceived as an annoyance or just the cue to a pleasant pedestrian area*" (Raimbault & Dubois, 2005), with structure and meaning removed, the sound alone "*may not be appropriate for defining the soundscape*" (Raimbault & Dubois 2005). Dubois and Raimbault propose an alternative approach to the effects of environmental sounds, stating that qualitative evaluation comes before quantitative evaluation and must be considered as such. Their research suggests that the first goal is the need to find the level of basic knowledge and expectation of the sound environment. It may then be possible to theorise that it is social and cultural influence which provides us with this knowledge. With this theory it could be shown that social/cultural backgrounds lead to different 'expectations' of semantic soundscape categories and contexts.

Kang describes a detailed framework for soundscape description, which incorporates psychological factors such as meaning and relation to the activities, as well as the user's social/demographic factors, activities and behaviours (Kang, 2007). Using a mixed methodological approach combining social science and acoustics, Kang has produced a large body of research investigating preference in sound environments and also, the modelling of urban spaces (Yu & Kang, 2009; Kang, 2008; Kang & Yang, 2003). The methodological approach used in these studies comprised of a mixture of questionnaires and semantic differential scales, to allow for quantification of the results.

Whilst these methodological approaches can reduce the soundscape to a series of components and dimensions, they do not allow for the exploration of the subjective experience or insight into experience of the soundscape. Further work by Kang has tried to include the study of people's perception of sound, in different urban open public spaces throughout Europe. The questionnaire included was based on the identification of recognized sounds, the classification of a person's sound preference, and tried to give some indication of wanted and unwanted sounds (Kang, 2005). This does not provide any real insight into the person's experience or perception of the space. This work aims to expand on the methodologies utilised by Kang but expands them with rich semantic data retrieved from other methodologies.

Other soundscapes research has looked at a variety of factors relevant to a participant within a space in an attempt to further soundscape methodologies and understand experience and context of the space. These factors vary from the participants' preference of various sound sources (Tamura, 1998), the impact of the participants attitudes towards social and demographic factors, their own social and demographic standing (Schulte-Fortkamp & Nitsch, 1999; Botteldooren, Verkeyn & Lercher, 2001) and the multisensory interactions between acoustic and other physical conditions present in the space (Viollon, Lavandier & Drake, 2002).

Figure 2-3 shows Kang's developed framework for soundscape description, in particular focusing on urban public spaces. Crucially there is mention of meaning attributed to the soundscape, but this 'meaning' parameter is only associated with sound sources as a psychosocial characteristic. Whilst this is obviously important, it does not show how this would fit into a structure, where meaning is attributed at a higher level to all top level parameters. By doing this the attributed meaning, i.e., the users of the space, or the effects of the space, may have an impact on the participant's perception at a higher cognitive level.

This work hopes to show that this is the case, and that meaning and structure attributed to a space by a participant has an effect on their perception of the soundscape of that space, and encompasses all of the top level parameters show in Figure 2-3

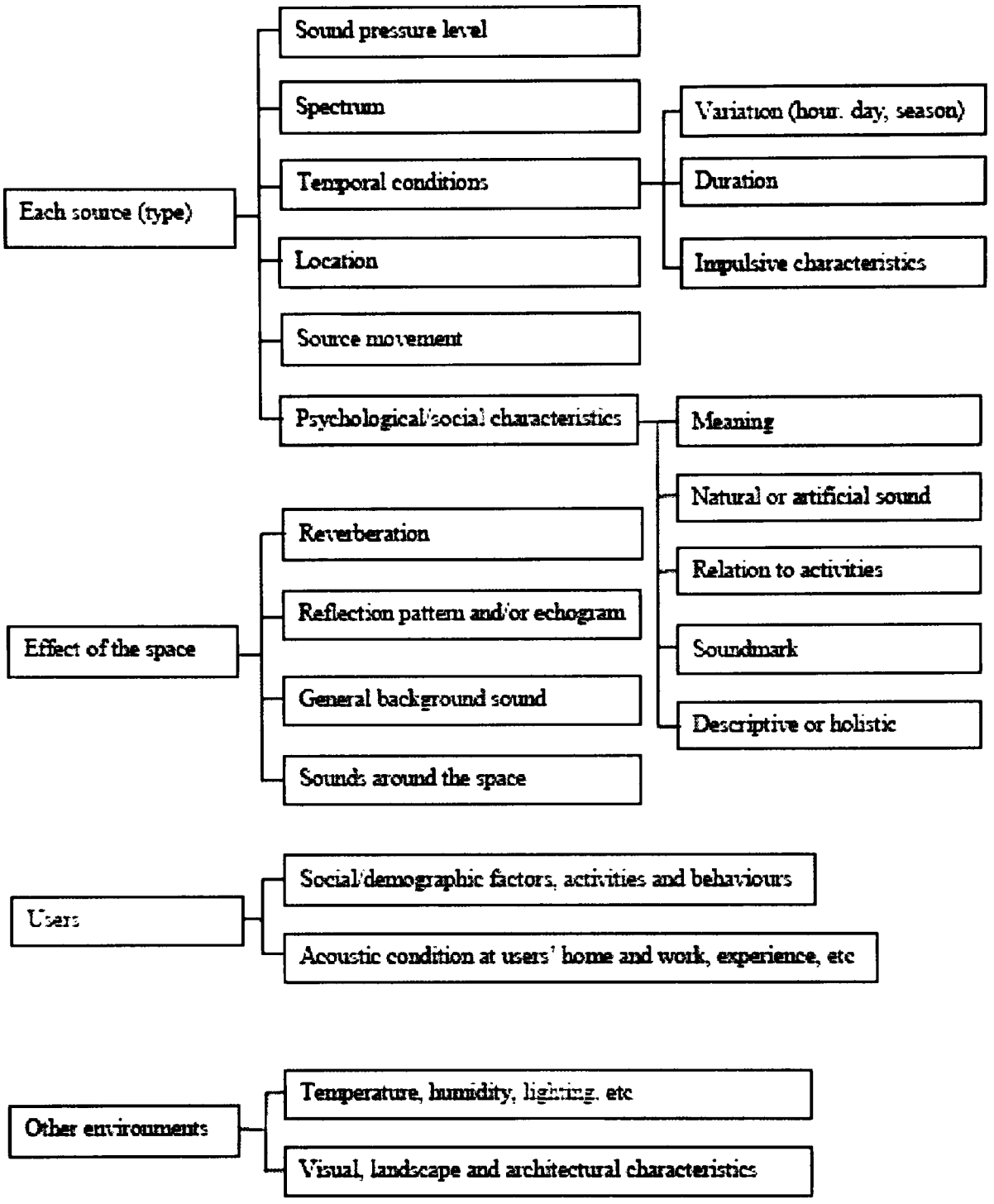


Figure 2-3 : A framework for soundscape description in urban open public spaces.(Kang, 2007)

Kang's work does not provide insight into what a person thinks of other users of the space but primarily focuses on the soundscape present in the space (Kang & Yang, 2003). The results provide an interesting insight into people's sound preferences and in particular a level of predictability. That is to say, they showed that people tend to prefer 'natural' sounds, being the sounds of nature and people and sounds which were 'culture-related'. These sounds were preferred above those of modern artificial sounds. From a social perspective, Kang showed that "*cultural background and long-term environmental experience*" are important aspects when determining respondent's judgement of sound preference. Kang defined this as, "*macro-preference*".

In another dimension to the results, Kang has found that '*differences*' such as age and gender have an impact on sound preference and labels this as '*micro-preference*'. Kang's results showed, that as the participants age increased, a larger percentage were either favourable to, or could tolerate more, sounds which related to "*nature, culture or human activities*" (Kang & Yang 2003:2352).

2.7 Perception

There is an overriding difficultly when addressing soundscape research and this is related to the epistemology surrounding the nature of perception. The soundscape perception problem is highlighted by Churchland,

> *"...people do not sit on the beach and listen to the steady roar of the pounding surf. They sit on the beach and listen to the aperiodic atmospheric compression waves produced as the coherent energy of the ocean waves is audibly redistributed in the chaotic turbulence of the shadows...." (Churchland 1979) (Chappell, 2005:29ff).*

Churchland addresses the difficulty faced by the soundscape research from a philosophical point as well as from an epistemological perspective, what Churchland is suggesting is that we can understand how another person 'hears' or experiences the sound of the waves, but all we can be sure of is there is a stimulus which is that of aperiodic waves Meaning and perception are developed through the cognitive processing of the individual. Questions surrounding the nature of perception are something which has been at the heart of philosophical study for centuries, from the work of philosophers such as Locke (Locke, 2008), and Kant (Kant, 1855) there have been various theories which try to explain the nature of perception. The difficulty lies in the study of experience.

Botteldooren states that '*the perceived quality of the sound environment strongly depends on the context in which it is experienced*' (Botteldooren & De Coensel, 2006:1) and acknowledges that a soundscape is *'not solely defined by its acoustic field, but also by the context*' (Botteldooren & De Coensel, 2006:2). Context can be both potentially small and large scale, for example a park or a room, as each acoustic environment has a multitude of differing contexts. Soundscapes can be broken down into a number of study levels; these are referred to as micro, meso and macro (Payne, 2009). These range from an individual space, to a small area such as a shopping centre or urban park, to a large area such as a city. This research work confines its study to meso soundscapes.

Key to Botteldooren's theory of context and experience, Jobs *et al* suggested the notion of '*enviroscape and psychscape*'. These terms refer to the effect of the non-acoustic environment and personal factors which affect the perceived soundscape quality (Job, 2001).

These factors play a key role in this research, in particular the design of the qualitative methods employed in the project. *Psychscape* has a close relationship to expectation, as it is the state of mind that a person is in when potentially entering a space, for example someone entering a park may choose the park for relaxation or time away from the *'hustle and bustle'*, conversely a person may wish to enter a busy street to obtain the opposite feeling (Job *et al.*, 1999).

This state of mind or Psychscape will be linked to some form of emotional response. Botteldooren considers emotion as part of his perception framework (Botteldooren & De Coensel, 2006), and emotion is discussed by Sakamoto, when investigating comfort and discomfort within the soundscape (Sakamoto & Hayashib, 1997). Their work looks at the sound source, and how sound sources produce either an emotional response of comfort or discomfort, '*the automobile engine and alarm clock tended toward discomfort. The emotional response to the warbling of a small bird, the wind chime, the murmuring of a brook, and the sacred song were distributed over a wide range from comfort to discomfort*' (Sakamotoa & Hayashib, 1997:500).

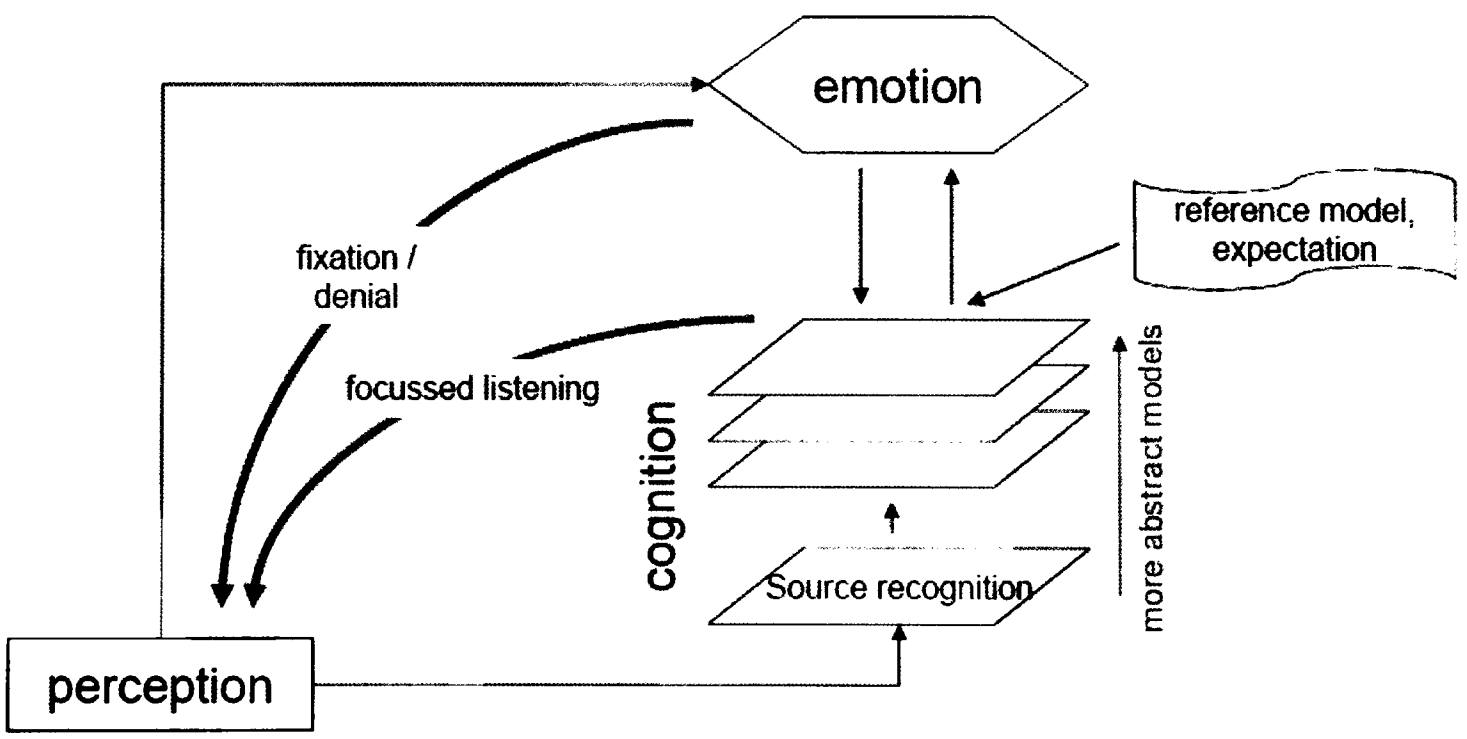


Figure 2-4 : Botteldooren perception framework (Botteldooren & De Coensel, 2006)

Botteldooren concludes that quality of life of the population benefits from the availability of high quality areas for recreation and psychological restoration. But states that any indicators of soundscape should be based on *'real experience of people visiting the area'* by investigating the 'emotions it provokes'. The provocation of emotion is an area where sound design for film is utilised, the use of music, effects and ambience is key in developing context and emotion.

2.8 Competence and Expectation

Currently there is little existing work explicitly investigating expectation or the concept of competence as factors in soundscape perception. Existing research looking at expectation as a factor in perception is focused in the areas of sound design for film and also in particular design for virtual environments (Keating, 1996; Serafin & Serafin, 2004). A motivation from this work came from work with film, where the design of expectation of the listener is key (Weis & Belton, 1985; Branigan, 1989; Sider, Freeman & Sider, 2003). Expectation in film sound is explored later in this chapter.

The term *'competence'* was defined by Chomsky in relation to linguistic competence (Chomsky, 1969). Chomsky's Universal Grammar theory states that basic language structure is innate within us, and the brain contains a series of limited rules for organising languages, which provide a common structural basis independent of a specific language (Chomsky, 1969). It is these structures which lead to a theory of linguistic competence. Whilst people may be exposed to sounds within the womb, it is hard to say (or test) that sonic structures and meaning are innate. It would seem that through the constructionist view of learning that sonic meaning and competence are developed and it is this which relates to the theory of expectation. Truax explains linguistic competence as being "*tacit knowledge that a native speaker has about a language*" (Truax 2001:54).

Chomsky states that structural relationships which represent knowledge about a language are stored in memory, rather than as set sentences (Chomsky, 1969), suggesting that it is possible to understand language without having to know all constructs. Truax proposed "*musical competence*", similar in principle to linguistic competence, but relating to musical structures and thus musical sounds (Truax, 2001). This concept was then expanded to soundscape competence, being "*tacit knowledge that people have about the structure of environmental sound*" (Truax 2001:57) and further to this, that it is this knowledge which "*manifests itself in the behaviour that interprets such sound and acts upon it*" (Truax 2001:57).

For example, when you hear a noise late at night, depending on the current context and situation it will cause you to act in a number of ways. If you are expecting someone to visit, you will have a different reaction to this sound event than if you are not. This example highlights how situational context, and thus competence affects the cognitive interpretation of the same acoustic stimulus.

With music generally it is known when something '*sounds*' wrong, for example, the pitch of a note or tempo fluctuations. People also know the '*sonic*' correctness of a virtuoso playing the violin, verses someone learning the violin. Why is this so? It would seem that there is a value associated with the correct performance of a piece, or a note. So where does this value and meaning come from? Is it due to an imposed or learnt structure and expectation? If structuralism applies to the soundscape, then learnt structures for given contexts would exhibit expectation within people experiencing those contexts. Similarly, whilst a person may learn structures for say urban parks, it should then be possible to extrapolate these and construct expectation for parks never experienced just as Chomsky states that it is possible to understand language without knowing all constructs.

This has been also been suggested by Aucouturier, who found that perception of the soundscape not only related to cognitive reasoning about the nature of the acoustic signal, but also the '*cultural expectations, a-priori knowledge or context*' (Aucouturier, 2007:2) of the soundscape. Aucouturier goes on to suggest that the subjective evaluation of an urban soundscape can depend just as much on semantic features of the soundscape, as perceptual factors. By developing a computer model to investigate categorisation of the soundscape, it was shown that it is possible to model acoustic contexts (e.g. a park) but without the need to model sound sources, because '*if globally sounds like a "park", then this "car horn" must be a "bird"*' (Aucouturier 2007:7). Aucouturier also suggests that there is more context in music than in soundscapes, thus soundscapes are not processed at such a higher level.

Returning to musical competence, Huron writes extensively about expectation within music, trying to address some of the issues such as '*why do clichés work?*' (Huron 2007:2). Huron refers to a cliché is a stereotype for a context or situation. It is this question that Huron uses to develop the theories around expectation, in particular when referring to music '*that the principle content of music arises through the composer's choreographing of expectation*' (Huron 2007:3).

Having knowledge of musical structure and expectation would dictate a response when provided with a new melody. This knowledge then allows the listener to judge if the music is well formed on not. If the structure does not make sense in their knowledge or experience of existing structures, then this would change the listener's perception of the piece (Truax 2001:57). In effect, states Huron, "*episodic memory allows us to revisit "the original data" in order to revaluate alternative hypothesis*" (Huron 2007:232)

Competence can be used to investigate acceptance of new music. For example, if played Hendrix's opening chord to Purple Haze, the structure may not make sense in a listener's knowledge or experience of existing structures. But as the listener becomes habituated to it after a number of listens, it is no longer foreign. Semantic meaning and experience is then attributed to the music, and this is then either conveyed as a positive or negative experience, of course aesthetic value also is a factor in this. What if the concert virtuoso is playing an experimental or avant-garde piece of music, mimicking the sound of a badly played note, this may initially 'sound' wrong to the untrained ear. But this perception, it could be argued can be changed in some people. Once the structure or purpose of the piece is explained and given meaning, the sonic qualities of the note are given new meaning. This process then leads to the '*musicscape*' being accepted, experience and meaning attributed to it.

If a person's knowledge is based in experience as proposed, then when is competence of acoustic factors learnt? As a whole, the public are never trained to listen (Schafer, 1988; Bruce, 2007). It is generally only music students and audio professionals who are generally taught to listen. In the case of music, this listening is usually associated with a visual medium (the score). Melodies and harmonies are not only heard but can be visualised on a page.

The same is true for sound editors on film, where sounds are used to add meaning and emotion to the pictures on the screen (Weis & Belton, 1985; L. Sider, Freeman & J. Sider, 2003; Branigan, 1989). This is not true for recording engineers or radio engineers (apart from looking at the performers), their task is to create a virtual visual in the 'mind's eye', through the use of sound only.

Therefore with no real training or education, people seem to have a *tacit knowledge* of the sound environment, so how is this developed? Truax adds that '*competence refers to knowledge at rest*' (Truax 2001:56) and '*Performance refers to knowledge in motion*' and therefore '*faults in performance are not always flaws in competence.*'

This is referred to a '*meta-knowledge*' (Truax 2001:57), knowledge about what constitutes structurally correct communication even when the communication has never been experienced.

By considering competence as a factor in the perception of the soundscape, this research will investigate the tacit knowledge participants have of their sound environment. This involves examining their expectation and understanding of the environment. For example, competence in action, could be the understanding of how the refuge collection takes place at a certain time every week, whilst a noisy event, it is expected. Thus the reaction to this event is not the same if the event occurred at a different time, at night for example. This is related to the ideas of context described by Botteldooren.

2.9 Soundscape Context

Context and meaning in soundscape have been explored by a number of researchers recently (Stanley & Schomer, 2009; Botteldooren & De Coensel, 2006; Raimbault & Dubois, 2005; Bruce & Davies, 2009). The concept of context is highlighted by Dubois, where results showed, '*the same dB value can be considered as normal, unpleasant or even unbearable, depending on the type of noise, type of source and the meaning attributed to it*' (Dubois, *et al.*, 2006:870). This is further quantified by stating that '*public transportation noise (train, tram) appears to be better accepted than private vehicles*' (Dubois, *et al.*, 2006:870), because of social value, both of the individual and collective given to public transport in France. Their work looks in great detail into the language being used to describe sounds and social context in open interviews.

Perceptual acoustics and quality judgements are not new in the field of product sound quality, where studies have shown that these judgements are based on *'perception of both acoustical characteristics and various non-acoustical factors*' (Vastfjall, 2004). Vastfjall's work has focused on how non-acoustical and contextual factors play a role in sound quality evaluations. The findings of this work show that a participant's attitude towards a product, positive or negative, influences how the sound of the product was perceived. Vastfjall has stated mood of a participant is also a factor, although much more subtly. The experimental method used was able to manipulate a participant's attitude to a product beforehand using mood manipulation and consumer reports, something which is not possible in a soundscape evaluation due to the uncontrollable nature of the environment, but similarly factors and feelings towards a space can be measured through interviewing (Vastfjall, 2004).

Importantly Vastfjall's work shows that for expectation-congruence, that people made more favourable evaluations when they had low expectation. Vastfjall findings show that it is possible to '*systematically influence quality evaluation*' by means of *'subtle manipulations*' and that expectations are based on deliberative, analytic comparisons between two states of expectation.

Whilst perceptual judgements are manipulated by changing the participant's mood and attitude to a product, based on pre-learnt factors, attitudes towards the soundscape are harder to influence. To allow participants to discuss context in relation to the soundscape, is similar to the work on sound quality, and that of Dubois, where investigation into the language system used (Perlovsky, 2006) in parallel with an understanding of the cognitive system is a fundamental requirement to gain understand the relationship. Again, similar to the basis of Chomsky's linguistic theory. Thus language is the tool to sample a participant's cognitive process. This is tied to the work on language and semantics research of Dubois.

Botteldooren suggests moving from a framework which relates soundscape descriptors to a framework which includes perception of the 'sonic' environment (Botteldooren & De Coensel, 2006). Other work in the field has looked at soundscape descriptors (Guidati & Rossberg, 2007; De Coensel & Botteldooren, 2007; Burgess, 2004), or breaking the soundscape down into constituent parts (Schulte-Fortkamp, 2002b). The difficulty with this approach is, for example, when does traffic noise become a single car event? Muer proposes a model for noise annoyance based on noise events, in particular that the act of noticing a sound is a 'trigger' for an emotive and cognitive events (Muer, *et al.,* 2007). The act of noticing a sound depends on a variety of factors including activity, personal factors, coping, focusing (Muer, *et al.*, 2007). It is a combination of these factors which Botteldooren labels as 'context' which in a sense this is true, but this work hopes to expand on this and suggest that these factors combine to form expectation, and it is these factors which also contribute to perception

These levels highlighted in the model shown in figure 2-5, (Muer, *et al.*, 2007) which state the threshold of noticing a sound varied depending on context, and conversely, as this work will suggest, expectation defines a context and thus the threshold of noticing is related to events occurring which do not match with expectation for the context.

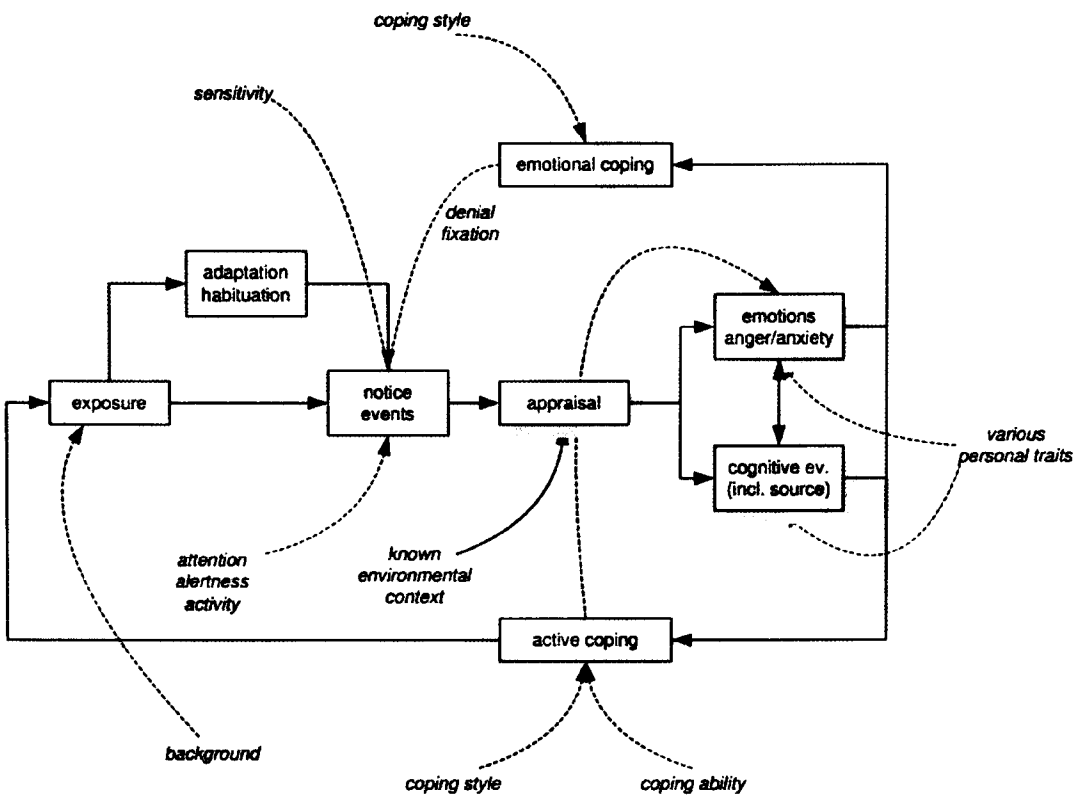


Figure 2-5 : Muer & Botteldooren's general noise impact model (Muer, *et al*, 2007)

Learnt structures or competence are developed as children mature, abstract models are formed by personal experience and 'coupling to the language system' (De Coensel & Botteldooren, 2007). The structure (or context) of a space, (e.g. urban street) will become embedded or learnt, this learning of a context will wholly depend on the persons exposure to the environment, either through direct physical immersion or cultural learning. Botteldooren explicitly states this relationship *'the model of a rural environment - and in particular the soundscape associated to it - can be related to expectation'* (Botteldooren & De Coensel, 2006) and this is further explored in his general noise impact model Figure 2-5. The model shows how appraisal is linked to exposure, habituation and context.

Expectation as a factor in perception is additionally related to emotion and aesthetic value placed on an environment, similar to that placed on a product (Jekosch, 2004; Vastfjall, 2004). According to (Perlovsky, 2006) aesthetic emotions are related to knowledge instinct as other emotions are related to more basic instincts. The knowledge instinct is seen as the driving force that makes us want to match our model of the work to sensory inputs. Expanding on this, Perlovsky states that '*aesthetic emotions, if we do not understand the surroundings, if objects around do not correspond to our expectations, negative emotions immediately reach consciousness*' (Perlovsky, 2006). This statement is not backed by rigorous testing and as such this work hopes to investigate if a person in unfamiliar space, will match the space to their expectation, and then investigate the impact it has on their perception of the space, as shown in Figure 2-1.

When considering emotion and its relationship to the soundscape, generally focus on the soundscape is related to complaints about noise, rather than people commenting on the pleasantness of the soundscape (Genuit & Fiebig, 2006). Therefore, annoyance to noise is the general emotion associated with sound. Schulte-Fortkamp has investigated the links between annoyance and soundscape, taking into account parameters such as '*architecture, natural environment like parks and gardens and also odour and dust*' (Schulte-Fortkamp, 2002a), and at the same time whilst taking into account physical factors of the environment, does not investigate the social factors, such as users, and attitude to users, as well as any contextual ideas of what surrounds the soundscape.

Although Schulte-Fortkamp later goes on to suggest that '*interaction of people and sound, the ways people are consciously perceiving their environment, habits towards natural and self produced sounds, the context, the focus of attention, and personal knowledge/experience, background factors which influence reaction to noise, topography, meteorology, land use pattern, visual contributions, landscape evaluation - show the close relationship of perceived environmental sounds and the context of experienced soundscapes.*' (Schulte-Fortkamp, 2002a), which raises the question of which parameters of an environment that constitutes the soundscape? Whilst this question is still being addressed, key to this work is the fact that personal knowledge and experience function at a higher cognitive level and these personal values could be mapped onto the environment as a whole and influence a person's perception of that space.

Similarly, Ipsen has highlighted the importance of the person in the perception of soundscapes by defining three components (Ipsen, 2000). These components back up the framework suggested by Botteldooren (Botteldooren & De Coensel, 2006), and the work proposed here. Ipsen's components are the context, the focus of attention, and personal knowledge/experience. Nonetheless, further research is required to establish whether other features of the enviroscape and psychscape are relevant to noise reaction (Job *et al.*, 1999). Lercher found that '*noise sources interact with the specific acoustic and environmental makeup (topography, meteorology, land use pattern, and lifestyle). The higher dissatisfaction expressed with their environment, in spite of overall satisfaction with personal life quality, points to difficulties to control the noise adequately*' (Lercher, Brauchle & Widmann, 1999).

These findings reinforce the ideas that emotion, in particular the emotion and expectation of a person entering a space will have an impact on their perception, which places soundscape fully in a subjective epistemology. It is possible though that whilst perception is subjective, that by parameterising expectation, it may be possible that there is group correlation in expectation, that is to say a general structure and meaning is learnt for a given environment. This could be understood as a set of sound rules which related to what one might expect in an urban square, coffee shop or library. With this understanding, if something occurs which is outside of the expectation, and then annoyance may occur. Fyhri considered that a subjective soundscape and evaluation is dependent on the relationship of the person in the environment and how they relate to the parts of that space (Fyhri & Klaboe, 1999).

The difficulty arises, when considering expectation and perception, about the links between auditory processing and emotion. Irwin and Hall, as part of the positive soundscape project investigated links between soundscape and physiological triggers in the brain (Irwin, *et al*, 2010). The study played back soundscapes which has been pre-rated for pleasantness and vibrancy (Davies, *et al.*, 2009) to participants using a functional magnetic resonance imaging and vector cardiogram scanner, and then investigating the areas of the brain which were activated. The work showed that an emotional response occurred when played varying soundscapes, but the amygdala activation was independent of the positive or negative nature of the soundscape. This would reinforce the argument that interpretation of the meaning associated to the soundscape is the deciding factor on how it is perceived. Huron has also explored the question of activation, to see if a direct path between auditory sensory perception and emotion exists (Huron, 2007; 2000).

Berglund has addressed this issue in relation to the soundscape, by developing a 12 attribute tool framework (Berglund, *et al.*, 2001). The '12 attribute tool', focuses on emotional evaluation of the soundscape, but utilising semantic differential scales as a basis for the framework. The use of semantic differentials is typical of soundscape research studies (Payne, *et al.*, 2007; Kang & Yang, 2003; Cain & Jennings, 2007). The choice of this methodological approach is trying to bring the soundscape into a number of measurable dimensions. Whilst semantic differential studies can produce interesting results, which allows for the potential use of these methods to be incorporated into planning legislation easily, as it provides planners and legislators with an easy measurement tool kit, it does not take into account the factors under discussion in this thesis.

The factors of emotion, experience and expectation, as well as attributed meaning to the acoustic stimuli, may force the participant into a different listening state when considering their environment, a case of forced listening. Listening state is discussed later in this chapter. Additionally, it does not take into consideration other sensory or personal emotive experience which is occurring in that environment at the time of the study.

Botteldooren also agrees that this is problematic, and that consideration of context is a key parameter in any soundscapes research (Botteldooren & De Coensel, 2006; Botteldooren, *et al.*, 2008). This argument is also backed up by Stanley who states that whilst context is primarily related to the visual environment, context has been shown to be important in sound quality research, but this importance has not yet been linked to environmental sounds and the soundscape (Stanley & Schomer, 2009). The difference between contexts, for example, at a higher semantic level of urban and rural, is due to a difference in presence of people, sound level and aesthetic quality (Staats, 2003). Crucially, that acceptance relates to higher level cognitive activation and correspondence to expectations.

Expectation as a method is used in consumer behavioural literature as a method by which to track and study satisfaction and behaviour in Information Systems and Marketing (Bhattacherjee, 2001) . A model of expectation-confirmation theory used in marketing is shown in Figure 2-6. This figure shows how expectation of a product is linked to a choice to purchase the product, this is similar in context to the argument of this thesis, where expectation is linked to a decision to enter a space and how this expectation affects the perception of soundscape in that space.

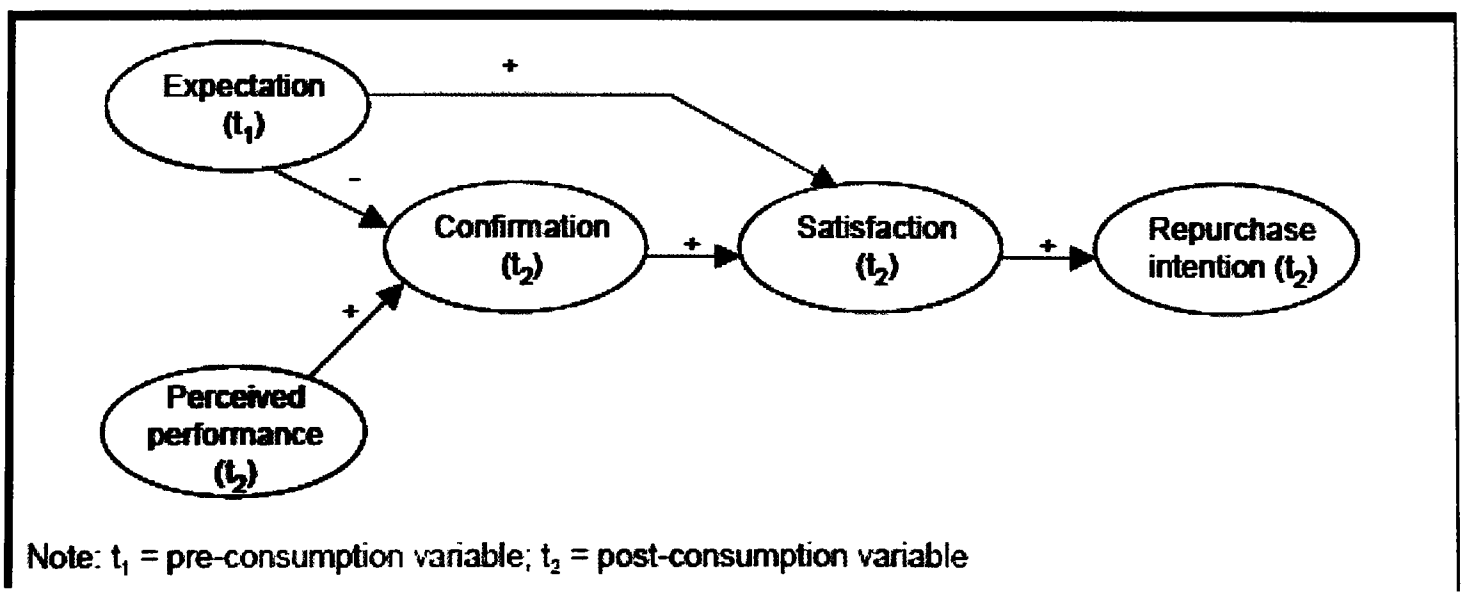


Figure 2-6 : Expectation-Confirmation Theory (Bhattacherjee, 2001)

Expectation-confirmation theory (ECT) is related to a consumer's requirement to repurchase a product or service, but could be motivated to a participant's satisfaction with the soundscape and choice to re-enter a space based on their experience. Again, this would also reinforce the notion that a respondent would choose a space based on their expectation for it e.g. a coffee shop to do some work and then be annoyed as a crying child is present. ECT also theorises that expectation is an additional determinant of satisfaction, because expectation provides the baseline or reference level for consumers to form evaluative judgements about the focal product or service.

Helson developed an adaptation level theory, which suggests that humans '*perceive stimuli relative to or as a deviation from an 'adapted' level' or baseline stimulus level*' (Bhattacherjee, 2001:3). The adapted level is determined by the nature of the stimulus and psychological factors characteristics of the person experiencing the stimulus and the situational context. This theory is similar to the notion proposed by this work, that stimulus and context link together and are assessed at a cognitive level based on expectation and experience. Expectation is coupled with the consumer's prior feelings about the consumption experience; similarly it is proposed that expectation links with a person's prior feelings about the environment experience. Experience is a factor which potentially cannot be measured explicitly by rating scales.

Botteldooren suggests that measurements should go beyond rating scales of a cognitive evaluation of the soundscape but include the emotions it provokes. This has been used to inform the methodology utilised in the work, moving from semantic differential questionnaires to an open interview approach, where rich semantic data can be recorded about the participant's experience in the space. This approach will allow for psychological or affective state related to and resulting from a cognitive appraisal of the expectation to be explored. When examining expectation, it is important to now look at how expectation of acoustic stimuli has been tacked within music.

2.10 Musical Expectation

The theory of musical expectation is an area where there is already existing work; this work can be seen as closely tied to that being undertaken here (Levitin, 2007; Huron, 2007; Bissell, 1921; Schmuckler, 1989). The use and understanding of musical structures is based on auditory stimulus by acoustic stimuli. This factor links musical expectation to the understanding and use of soundscape structures.

The nature versus nurture argument is an area where this work tends to flounder, but in accepting that in either case there is a learnt behaviour which provides humans with structures which relate to auditory events, then this provides a basis to work from. Huron writes extensively about expectation within music, trying to address how stereotyping or clichés are formed, and how the psychology of expectation leads to an understanding of cognitive processing of auditory stimulus (Huron, 2007).

To explore expectation in music, Huron developed the ITPRA theory, in which he proposes that '*emotions evoked by expectation involve five functionally distinct physiological systems*' (Huron 2007:7). Importantly, Huron states that expectations are not only related to music but '*a constant part of mental life*' (Huron 2007:15). Expectation is both part of biology and culture at the same time. These ideas form the basis on which to develop the theory of expectation within the soundscape and how expectation may relate to a participant's appraisal and acceptance of the soundscape.

ITPRA theory relates to five responses pre and post the outcome of a given stimulus. These responses are Imagination, Tension, Prediction, Reaction and Appraisal (Huron, 2007). Using these responses, it is possible to examine how conscious thought can incorporate appraisal responses and how this leads to a positive or negative emotion, although the basis '*often draws from complex social and contextual factors*' (Huron 2007:15). This link to social and contextual factors and emotion when presented with music, provides the link to the social and contextual factors explored earlier in this chapter (Dubois, *et al.*, 2006; Kang & Yang, 2003), in regards to perception of the soundscape. Analysing expectation within the soundscape as well as these factors should provide a greater insight into how expectation of a space in addition to social and contextual affects the perception of the soundscape.

Examining expectation, it is possible to look at musical consonance, "*the pleasing result of two or more sounds heard in combination*" (Huckvale *et al* 1999:70). Some definitions of the term try to equate this to musical intervals and acoustic relationships. For a period of time it was also thought that a judgement made on consonance could only be based on the numerical relationships. The consonant relationships usually correspond to certain ratios between frequencies (e.g. 2:1, 3:2, 4:3), discovered by Pythagoras. This is a difficult approach to apply to judging a sound as pleasant or unpleasant.

When considering music, people listen to the sounds in terms of its musical context and its relationship to what has gone before and what comes after it. There is also the issue of judgement which can occur between subjective measurement and these theoretical ratios, which would mean perception, would be subtly different for different people and different conditions.

Pythagoras suggested that musical writings should follow the mathematical models and ratios he devised. This theory suggested that it was religious intervention that caused the perfect consonant harmonies in their simple ratios, and that music "*reflected some carefully designed world order dictated to by the creator*" (Huckvale *et al*, 2002:72). As music progressed, these rules were broken, and as we moved in to the 20th Century period of the Western Classical style, composers were breaking the link between the acoustic and perceptual thoughts about consonance and dissonance.

In western music the harmonic relationship of the major chord is often described as happy and the minor (*1 b3 5*) as sad. The dominant (*1 3 b5 7*) is discordant. In Western harmony there are sets of harmonic patterns (e.g. the chordal pattern *I IV V*) which are liked and are the basis of Blues and most popular music. There have been sounds (harmonic and melodic arrangements of notes) in the past, which were banned, for example during the Renaissance and to some extent the Baroque period. Igor Stravinksy's 'The Rite of Spring', a ground breaking piece for its time caused riots after its performance in Paris in 1913. This was due to it being composed '*with an emphasis on dissonance used for its own sake*' (Various, 2002:70). But listeners can quite happily listen to the piece today without any desire to riot.

The question arises as to why does this occur? Is this an important implication of society or changes? This change in what is perceived as being consonant or dissonant, therefore goes to show that it is difficult to accept that there is some numerical or psycho-acoustical description for them, at least in terms of music, but does this apply to expectation within the soundscape? We are told that "*the cultural and contextual aspects of musical consonance are so important that explanations of a purely mathematical or physical sort can only provide part of the story*" Huckvale *et al*, 1997:116).

With both music and soundscape, the experience is ultimately a result of the listening process. A number of researchers have investigated the idea that there are different listening states, which also influence the way in which sounds are heard.

2.11 Listening States

Before the process of perception can occur, the person in question must actively be engaged in the act of listening. It is therefore important to investigate listening states. A person's perceived quality of a soundscape is currently unknown depending on their listening state, in particular, for example, is 'quality' only important if people are engaged in actively listening? Listening states has been addressed by a number of researchers (Cain *et al.*, 2008; Truax, 2001; Handel, 1989) as a requirement to understanding perception of acoustic stimuli in the soundscape.

The question remains, do we wish people to actively listen in an urban space, or in fact do they actively listen? Or is a soundscape where people are unaware of the sound environment the norm i.e. that the soundscape does not interfere with a person's speech and is similar to a film underscore? The term '*underscoring*' is music and sound '*motivated by dramatic considerations'* (Handzo, 1985:408), it also refers to the music or sound track that that was considered only good when unnoticed (Handzo, 1985).

What is the difference between hearing and listening? Psychoacoustics generally refers to this in a number of texts as Gestalt principles (Sonnenschein, 2001; Bregman, 1994). Gestalt psychology theory suggests that a pattern or sound has specific properties which cannot be derived from an investigation into the summation of its parts. This is important when considering the process of listening.

Sonnenschein, lists four differing types of listening modes (Sonnenschein, 2001:77), which may help create design methodologies based on a respondents operational mode. These modes are *reduced, causal, semantic* and *referential. Reduced* listening is listening in real time and being aware of a sound but not interpreting meaning in that sound, Sonnenschein provides the example of searching for a sound effect in a library. The participant knows that they want something low or rumbling, but at this point they are not interested in the source or other features of the sound.

Causal listening refers to gathering information about the cause of a sound; the interest here is in qualifying who is creating the sound and in what kind of space. *Semantic* listening, as the title suggests is analogous to the spoken language (and musical language) where sounds tend to symbolise ideas and actions. Combining semantic and causal listening seems to be what Truax is suggesting is the basis for competence.

Sonnenschein suggests a further type of listening called *referential.* This is a type of listening which consists of being "*aware of or affected by the context of the sound*" (Sonnenschein, 2001:78). This concept involves linking not only the source of a sound, but understanding its emotional and dramatic connotations. This means its understanding could be based on instinct, cultural background or symbolism within a specific context.

How do these listening modes fit into a method for understanding context? Along with theories on listening mode, Sonnenschein details a number of ideas from Gestalt psychology. He believes that understanding a number of basic concepts, based on how the brain analyses information can provide the sound designer with a number of tools for creating effective design. For example, the use of figure and ground is the process by which a traffic light bleep stands out over the background traffic ambience. The bleep is the *figure* against the *ground* of the background ambience. He states "*sound quality influences what might be noticed in a soundscape in the reverse sense of masking*" (Sonnenschein, 2001:80).

Truax similarly proposed a number of listening states, the first being 'listening in search', or 'analytical listening' (Truax, 2001:62). This form of listening is active and a conscious activity where the person is actively aware of whatever they are listening to e.g. concentrating on listening to the sounds of traffic is similar to causal listening. The second type of listening proposed by Truax is listening in readiness a state by which attention is given allowing the reception of significant information. This is similar to semantic listening, e.g. hearing and recognising your name, when other chatter exists in the environment. The final state is that of 'background listening', where the listener is engaged in another cognitive activity and not consciously listening, but is still processing acoustic stimuli, this is similar to reduced listening (Truax, 2001:64), each of these states related to processing and interpretation of environmental cues.

People are subconsciously aware of subtle changes in the environment, once again something that seems to be acquired without any formal education. For example, the mechanic working in a garage knowing when something sounds wrong with a car (something that comes with years of experience no doubt). However it is much greater and more subtle than this, as learning to hear sirens though immersion in the environment is crucial when 'designing' a soundscape for a film for example. The placement of an American police siren in a British based film would sound completely wrong to most people in the UK (obviously playing the film to an American audience may not cause the same issue).

If one accepts the film (sound design) concept that a soundscape should not interfere with the communicational process, which fits in with Truax's acoustic communication model (Truax, 2001), where noise in the system masks or corrupts the message, The greatest problem perhaps for annoyance is when the person is not wishing to listen, but obviously cannot 'turn off' their hearing. This would suggest a state of '*non-listening*' listening, or non engagement listening. The difficulty arises because the communication model becomes multi-modal. The use of a mobile phone on a train for example, whilst trying to read, interference in the auditory is moved to the visual, in the sense that the user focus is on the visual act of reading, but auditory interference is causing a problem. Therefore along with the listening models discussed before, we are presented with active and passive listening. Placing the listening in the soundscape is proposed in a model of acoustic design by Truax.

2.12 Acoustic design

A central idea of Schafer and Truax's work is the concept of *acoustic design*. In particular, Truax has presented some ideas for models and strategies for acoustic design. Once again, he refers to this subject as one which is both "*practically and theoretically*" interdisciplinary and "*in the throes of being defined*". Truax details two models, which are seen as key components of acoustic design, but stand in opposition to one another. These are the traditional 'energy and signal transfer model' (from the acoustic and audio world) to that of the 'listener-centred soundscape model' (from the soundscape studies world). These models are shown in Figure 2-7 and Figure 2-8.

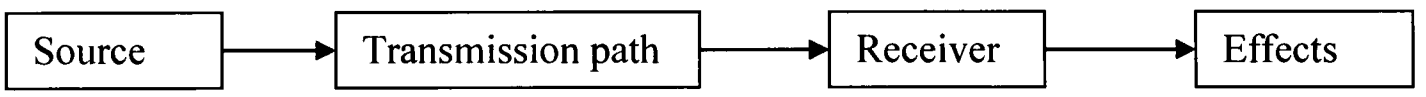


Figure 2-7 : Truax's Acoustic Environment Model (Truax, 1998)

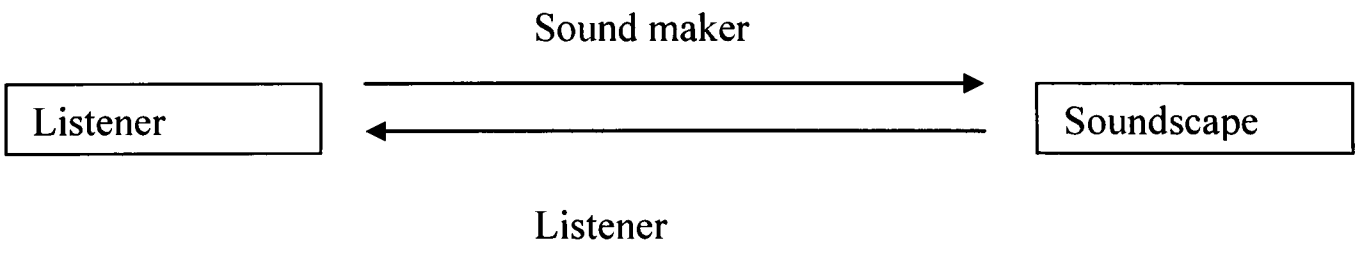


Figure 2-8 : Truax's Sound Model (Truax, 1998)

Comparing these two models, there is a shift from the quantifiable model of the energy transfer model firmly into a wholly qualitative model. This, Truax states, is loathed by acoustic engineers, who also favour '*even less the quagmire of listener attitudes*'.

However, interestingly Truax provides the notable exception being the subjective evaluation of the auditorium acoustics. Truax discusses listeners' preferences for clarity balanced against spaciousness, which can be statistically determined and correlated with objective measures. However, this cannot relate to the soundscape, unless a context is defined for the design. An auditorium is a controllable environment, where the source material is predefined and as a whole consistent. In defining soundscapes others have also noted that acoustics sits somewhere on the side lines, for example Hiramatsu states that "*One may say soundscape adds no theory or method to acoustics*" and that "*Soundscape rather uses acoustics when necessary and requires modification*" (Hiramatsu, 2004:206).

Truax suggests that with the energy transfer model, based in acoustics and engineering that, we tend to deal with each constituent part of the system when developing a solution. Noise is either reduced at source, or via attenuation added to the transmission path or finally trying to isolate the receiver. He states "*it is imperative to change the sound and the environment*", changes to these stages are removed from the listener and that it takes an expert to deal with the issue of a noisy system.

Using the soundscape model would suggest a more holistic approach to this removal of noise, and the encouragement of a more 'positive' soundscape. The soundscape model suggested is more '*listener centred*' and does not require '*the intervention of experts*'. Truax backs this up with statements suggesting that much of the success which has taken place in the field of soundscapes, in the last 30 years, is due to the "*empowerment of the individual*" (Truax, 1996). Indeed, Schafer suggests that the environment be listened to as a composition, he calls this "*the music of the environment*" (Schafer, 1994). Truax furthers this with a theory of there being three major systems in acoustic communication, which have a natural order.
These are:

Speech – Music – Soundscape

The reason for this order is due to the increase in "*repertoire*" within each part of the model, speech is generally made up of a small number of phonemes. This level of sound parts increases when considering traditional music, to the virtually unlimited number of sound present in the environment. It is also suggested that there is a decrease in the temporal density of the information as one passes across the continuum. That is information is more easily confirmed by two seconds of speech than two seconds of music. Therefore, there is a requirement for more long term relationships with the material when progressing from left to right to gain understanding.

At each point within these systems it is suggested that sound is in some way '*organised*' and through this structure of organisation that interference of meaning and expectation can be defined, as discussed earlier and shown by Truax's micro level model, Figure 2-9. This suggests that design can be related to meaning, in that if meaning and expectation are important in perception, than this can be designed into a space. Truax expanded this to a larger level with a macro level model, shown in Figure 2-10 below. This model shows the higher level integration of the listener and the environment, Truax also refers to these models as forming context, which links to Botteldooren's concept that spaces have context, which then must relate to their structure.

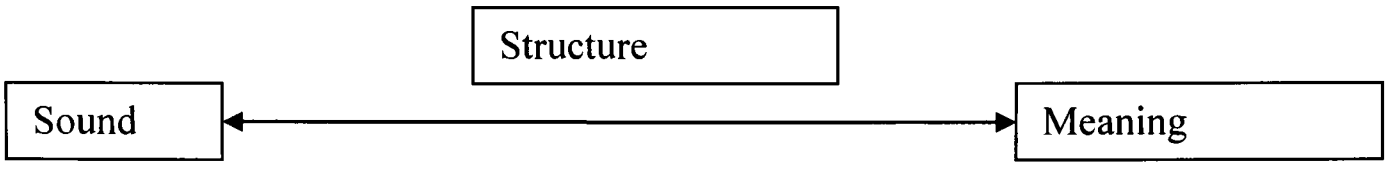


Figure 2-9 : Micro-level model (Truax 1998)

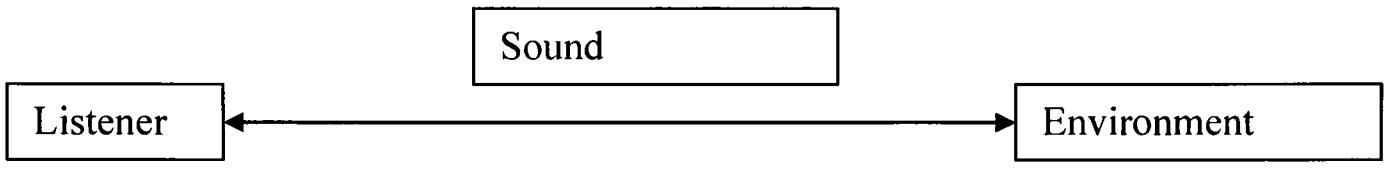


Figure 2-10 : Macro-level model (Truax 1998)

What the model shows a theoretical model of the makeup of 'soundscape', but without an expansion of the factors which contribute to the current understanding and knowledge of soundscapes. The model aims to show the interconnectivity between the physical 'sound' and the 'scape'. This has also been realised by Cain *et al*, whom make this distinction (Cain *et al.*, 2008). As such there is a need to investigate the factors from each which have an impact on perception of the soundscape.

2.13 Conclusion

This chapter has provided the background to how and where the topic of the presented thesis originated. The work has shown that there is a requirement for the further study of soundscape as a research topic, and that due to the large number of parameters involved in understanding how a person may perceive a soundscape, there is a need to look beyond simple measurements and semantic differential models resulting in limited parameterisation of the topic, as the importance of meaning and expectation in perception is not represented well on differential scales.

The research has also shown that collaboration between a wide range of differing disciplines has been, and remains key in bringing together synergetic understanding and development of soundscape epistemology. It has been shown that research from outside the field of soundscapes, that expectation as factor in perception links at a higher level to structure and meaning attributed to acoustic stimuli. Whilst the ontology surrounding the nature of perception will be part of fundamental philosophical argument, understanding of the components which comprise to form perception can be studied.

The next chapter details the approach taken in developing a methodological approach to the study of expectation. The chapter highlights qualitative and quantitative methodological epistemologies and the areas which in each are appropriate for consideration in this work.

3 Framework and approach

3.1 Introduction

To investigate the effects of expectation on the perception of soundscapes, through interdisciplinary measures requires the consideration of a number of differing methodological approaches. In considering suitable methods to form the basis of this work, an investigation into existing and emerging soundscape research methods is required. This chapter of the thesis will highlight the approaches chosen and discuss their merits when used in conjunction with other methodologies. The chapter will also look at existing frameworks and how these can be extended as part of this research.

The primary approach taken for the quantitative work undertaken by this research is based on grounded theory, a social science research methodology where theory is generated from data collection, where the process of theory development occurs through the process of undertaking research. The approach taken for the quantitative laboratory work of this research utilises a combination of questionnaires, semantic differential scales, real-time data collection and sampling.

The work carried out in this thesis is based in both qualitative and quantitative methodologies, to develop a mixed methodology for soundscape research. The motivation to develop a mixed methodology is based on suggestion from Schafer (Schafer, 1984) and others (Davies *et al.*, 2007; Kull, 2006; Kang & Zhang, 2010; Epstein, 2003; Schulte-Fortkamp & Nitsch, 1999; Lercher & Schulte-Fortkamp, 2003; Schulte-Fortkamp & Fiebig, 2006), who state that the combination of disciplines is important as there is a need to understand not only the cognitive processes, attitudes and responses to the soundscape, but how these are linked to actuality of the physical environment. This collaboration between multiple disciplines can provide an understanding of the all processes involved when addressing soundscape research. Understanding can only occur when multiple disciplines are brought together in an attempt combine their epistemologies to develop a new soundscape epistemology.

This research aims to combine elements from social science, psychology and acoustics, disciplines which cover a wide spectrum of methodologies, to develop a methodology and framework which enhances existing studies. In combining the elements from different epistemologies, it is crucial to gain an understanding into why the methodologies used in this research were chosen.

3.2 Qualitative Process

The use of a qualitative methodology in research is to allow for an inductive analysis to take place on real world observation to form and develop a theory around the phenomena of observation. This inductive form of analysis contrasts that of quantitative research methodologies, which allow for deductive thinking to take place on a general theory and build confidence in the theory through specific observations of the phenomena (Norwood, 2000).

The nature of qualitative research invokes intense academic debate (Bryman, 1984), over the robustness and validity of qualitative methodologies. Qualitative research operates with differing epistemological assumptions than those of quantitative research. Depending on a research group's epistemological perspective, there is often rejection of frameworks and methodologies between disciplines. To counter this, a 'framework of validity' which requires the researcher to evaluate and provide evidence which supports the assumptions and inferences being made with the argument is usually accepted in more quantitative research in social science.

The main divergence in epistemological view points between qualitative and quantitative methods is that a realist approach makes the assumption that reality which is measured through empiricism is external to a person's perception (Trochim, 2006). This implies that concern about the "truth" or "falseness" of an observation with respect to an external reality should not be the overriding issue when obtaining or analysing the data, as the observation is valid to that point in time. It is argued that qualitative research can have different standards for judging the quality of research. This implies that the bases of the quantitative-qualitative epistemological arguments are based on philosophical differences, not methodology (Bryman 1984).

In particular, most qualitative research believes that it is best to understand the phenomenon under study by viewing it in a real world context, in this case experiencing the soundscape in-situ and not in isolation, for example in a laboratory where the soundscape is the only factor under investigation. This enables the participant to have a full sensory experience, and the research the ability to consider other interactions which maybe occurring at the same time that the answers are given. Whilst this makes the analysis process harder, with multi-variate data to consider, it allows for richer data to be collected, which with the application of a framework such as Grounded Theory can be iteratively processed to develop new hypothesis and theories for testing, some which may be suitable for quantitative study.

Qualitative research breaks away from what is seen as a limited approach in quantitative studies. The limits are seen as being the fact that a quantitative study will investigate only a small part of a reality, a sampling of the phenomena. Quantitative methods from the natural sciences generally employ a reductionist approach, which aims to remove or eliminate confounding factors or variables and investigate a single aspect of the theory at one time. Qualitative research differs significantly from quantitative research, as it is felt that the best way to investigate a phenomenon is to become immersed in it, from an environment under study to a culture, as described by the ethnography research methodology (section 3.3.2 below). It is also felt that immersion in the phenomena of study allows the researcher to experience it first hand, and allows a familiarity and understanding with the study.

This epistemological view point breaks from the idea of fixed measurement or set questions, allowing for an organic and holistic approach to the study as understanding emerges. It is important to note that from an ontological perspective, qualitative research assumptions are also different. There is no assumption *'that there is a single unitary reality apart from our perceptions' (Trochim, 2006)*, this is because it is seen that each person will experience the world from their own view point and thus, we each experience a different perception of reality. Trochim also states that '*there is no point in trying to establish "validity" in any external or objective sense*', as all a researcher can hope to achieve is an interpretation of the view point of the world of the participant.

The difficulty for the qualitative researcher is trying to separate their own assumptions from the research and analysis. For example, does the researcher influence the data analysis by only looking, or interpreting the data from already formed opinions? It is argued that both qualitative and quantitative analysis imposes 'artificial structure' on the phenomena under study (Bryman, 1984) and as result of this the researcher will introduce distortion and bias into the analysis. With this in mind, it is important to investigate how the robustness of qualitative data can be judged.

3.2.1 Criteria for Judging Quantitative Research

To judge the robustness of qualitative data, Guba and Lincoln proposed four criteria, they labelled these criteria, credibility, transferability, dependability and conformability. (Guba & Lincoln 2005) The criteria were developed as an alternative to what was seen as existing quantitatively-oriented criteria for the judgement of qualitative data.

It was felt that these criteria offered a better reflection of the assumptions underlying qualitative research (Lincoln & Guba, 1985). These criteria will be shown to be important in this study into soundscapes, as they are key in getting around some of the current issues surrounding research, namely moving away from sound level based assessments to a more holistic approach to understanding soundscape, as mentioned previously.

The first criterion is that of '*credibility*' this involves establishing that results of qualitative research are credible or believable from the perspective of the participant in the research. As the participant is key in the research, and can be considered as the expert, this has also been embraced by soundscape researchers (Schulte-Fortkamp, 2010). The researcher's role is to understand and describe the phenomena of interest from the participant's perspective. Since the participant is the only person who can '*legitimately judge the credibility of the results*' (Lincoln & Guba, 1985). Guba and Lincoln, detail techniques for establishing credibility, which include the following:-

Prolonged Engagement involves spending a sufficient amount of time conducting field research and time in the field to '*learn or understand the culture, social setting, or phenomenon of interest*'. They state that the researcher should be immersed long enough to become totally oriented to the phenomena of interest, so that '*the context is appreciated and understood*', this allows for the researcher to have the ability to '*detect and account for distortions*' that might be present in the data or in that instance of time, when undertaking a certain participant account.

To achieve this, the method of soundwalking and field-work have been chosen and developed as part of this work. Soundwalking was chosen as it allows both the participant and researcher to have exposure to the soundscape, and spend time immersed in the soundscapes in question Due to the nature of soundwalking and the period of study, which was over the period of a year and a half, the researcher immersed in the soundscapes in question, can become orientated with the soundscape.

Persistent observation of the phenomena of interest is to '*identify those characteristics and elements in the situation that are most relevant to the problem or issue being pursued and focusing on them in detail*', in addition to this, that '*if prolonged engagement provides scope, persistent observation provides depth*' (Lincoln & Guba 1985:304).

Triangulation is a method by which findings in the data can be corroborated and tested for additional validity. One danger in triangulation is that it is possible that a weakness in one method could be compensated for by another method and because of this, triangulation is generally used in qualitative research to gain data which is 'rich, robust, comprehensive and well-developed'. Triangulation can also result in use of multiple methods when examining a phenomenon, as multi-methods can help provide a deeper understanding as well as corroborating or dismissing findings within the data. Four types of triangulation have been identified, each of which is relevant to the research work presented here (Patton, 1999; Denzin, 1978) and these are:

Methods triangulation, which involves checking consistency of themes and concepts generated by using different methods of data collection, this also is important as part of the grounded theory approach as it allows an iterative approach to analysis based on combined findings from multiple methods, as well as the combination of qualitative and quantitative research methods. To achieve this in this work, different forms of data collection were used, these were soundwalking and focus groups, which then provided data to be tested with the quantitative soundscape simulator.

Triangulation of sources, involves examining the consistency of data obtained from different sources as part of the same methodology, for example, research could be carried out at different times, or using participants with different viewpoints, the research presented used both a wide range of participants and participant participation took place at varying times throughout the years of study. In this work, this was achieved by undertaking soundwalks over a variety of differing periods, for example at different times during the same day, and throughout different times of the year and in different cities.

Analyst triangulation is similar to peer review, where data is viewed by additional researchers, who may be able to highlight issues or corroborate findings within the data. In this work, data was submitted to supervisors and other researchers working on the positive soundscapes project to obtain further insight and review.

Finally, *theory or perspective triangulation,* which involves examining the presented data through a variety of different epistemological perspectives and this approach allows for different interpretations based on theoretical background to be put forward in relation to the data.

Returning to credibility criteria, the process of 'peer debriefing', which is stated as the process of '*exposing oneself to a disinterested peer in a manner paralleling an analytical session and for the purpose of exploring aspects of the inquiry that might otherwise remain only implicit within the inquirer's mind*' (Lincoln & Guba 1985:308). This process is an important part of judging the credibility of qualitative data, as it can show any issues in the analysis or data which then may infer biases, interrupted perspectives and assumptions from the researcher. It also allows the researcher the ability to defend their work and hypothesis. This was achieved in this work, by having a supervisory team from different epistemological backgrounds, as well as through the formation of inter-disciplinary workgroups which consisted of interested academic parties and those working on similar project, which met throughout the course of the project to discuss findings.

The second criterion is that of '*transferability*', which relates to the amount by which the data and results obtained can be transferred or generalised and applied to other context or phenomena. This concept was first used by Ryle and later by Geertz who applied the concept to ethnography in order to achieve external validity in the data (Geertz, 1973; Ryle, 1949). Validity is achieved by describing a phenomenon in sufficient detail so that the extent to which inferences are made from the data are applicable to other contexts (Lincoln & Guba, 1985). In addition, where the detailed account of field experiences in which the researcher makes explicit the patterns of cultural and social relationships and puts them in context (Holloway, 1997).

The third criterion is '*dependability*', and this relates to the traditional quantitative epistemology of replicability or repeatability in research studies. In qualitative studies, dependability relates to whether it is possible to obtain the same data more than twice when examining the same phenomena of interest. However, by the nature of the study of phenomena, such as soundscapes which are constantly changing through time, it is generally impossible to measure the same thing twice as, by default, two different situations are being measured due to a number of factors, such as temporality of the study and, differing participants. *'Dependability emphasizes the need for the researcher to account for the ever-changing context within which research occurs'* (Lincoln & Guba, 1985). It is therefore down to the researcher to account for differences which occur between the participant data and how these may affect the study. In addition to this, the data showed how no matter what the varying conditions were, that there were some correlations between responses which forms the basis for a stronger argument around the hypothesis.

Dependability of research can be established by audit; a process by which external researchers examine both the process and product of the research study. This process can evaluate the accuracy of the data and ensure that attempts to interpret and understand the differences between measurements are supported by the collected data. Dependability was also undertaken in collaboration with other researchers as mentioned previously.

The final criterion is '*confirmability*', which is a process by which the results of the research study can be corroborated or backed up by other studies or work. Confirmability can be undertaken using the methods discussed previously, in particular, further triangulation, auditing and additionally, through reflexivity. Reflexivity is the process of '*attending systematically to the context of knowledge construction*' (Lincoln & Guba, 1985), at every stage of the research work.

Confirmability was harder to achieve in this work, as it there is little existing data in the literature, instead by using the different methods employed was seen as a way to address this. Malterud states that the researchers own self interest and epistemological background will influence what the study comprises of and how the investigation is approached and methodologies implemented (Malterud 2001:483ff). The researcher's epistemological perspective will influence all research, not only qualitative studies.

Whilst bias in research is unwanted, '*preconceptions are not the same as bias, unless the researcher fails to mention them*' (Malterud 2001:484). In fact, the contrary is also true in that any biases a researcher may have can enable the researcher to bring unique perspectives to a study and allow for the fertilisation of ideas which may not have been considered previously.

In summary, the confirmability criterion requires a researcher to freely report on factors from the data which are either negative or positive in relation to their hypothesis, and investigate how these additional findings may influence their argument, or in turn discover a new feature set. Utilising these four criteria in a qualitative study aims to provide rigour in the epistemological arguments between qualitative and quantitative methodologies, which may arise. Trochim takes the view, as does Schafer, that quantitative and qualitative research methods have strong foundations at their core and can be combined and employed to address any research topic (Trochim, 2006; Schafer, 1984).

3.3 Grounded Theory

The qualitative approach used in this thesis is based on Grounded Theory. A methodology based on grounded theory is undertaken in a different manner than that of traditional research. A Grounded Theory approach is iterative in approach and requires some data to be first collected and then analysed to develop a hypothesis (Martin, 1986). Analysis for this work takes the form of '*coding*' where interview text is first transcribed and then analysed, to look for and collect together similar themes within the text. Through this process, tentative themes are developed between the initial theoretical concepts and the data which has been collected up until this point, this phase of the research tends to be open from an epistemological perspective.

From these themes, smaller categories can be formed, which then form the basis of the hypothesis. Coding is the process by which themes within the data are examined and extracted, for example, examining any themes or trends in words used to describe a place. A further explanation of coding is given in the methodology chapter of this thesis. As the coding process continues, more work is then engaged in verification and summary for the collected data. Through this the data trends toward one core category that is the central hypothesis.

A Grounded Theory approach to research is generally the opposite of that which may occur in a quantitative scientific methodology, where a framework of study is chosen and then a model or series of models are applied to the topic being studied (Allan, 2003). In this thesis the data collection is obtained from a variety of different sources, these were fieldwork and field interviews, focus group discussions and laboratory based questionnaires and computer controlled parameters from a soundscape simulator.

A major issue with a Grounded Theory approach is determining a stopping or end point (Allan, 2003). As an iterative process, Grounded Theory has the potential to continue indefinitely, general consensus about when to stop the process is when there is a *'well-considered explanation for the phenomenon of study'* (Trochim, 2006:1). It is at this stage that the inference about a hypothesis can be developed, presented and reinforced with contextually relevant data from the research work undertaken.

3.3.1 Why Grounded Theory?

Grounded theory as a qualitative research method was developed by Glaser and Strauss in the 1960s, and was first implemented in Awareness of Dying (Glaser & Strauss, 2005). After this,

Glaser and Strauss expanded and formalised the methodology to obtain legitimacy for their method. The purpose of grounded theory is to develop theory about phenomena of interest, but the theory should to be 'grounded' by observation of respondents of the phenomena (Glaser & Strauss, 2005).

The use of Grounded Theory was appropriate in this work, as few formalised methodologies in soundscapes research currently exist (Payne, 2009). Obtaining an epistemology of participants' engagement with their environment, and particular their soundscape, through observation initially to form a hypothesis seemed the correct course of action. The choice of Grounded Theory provided flexibility in the early stages of the study of expectation with initially, no fixed parameters in place. Through pilot studies carried out as part of this research (Bruce, 2008) and the larger Positive Soundscapes Project (Adams *et al.*, 2008; Cain *et al.*, 2008), it was possible to extract topic of interest and reoccurrence from the data, which could then be analysed and studied in further detail.

Through the usage of additional qualitative research methods (Adams *et al.*, 2008), it was possible to formulate the methodology described in this thesis. The overall process may be considered as prototyping, adjusting and re-evaluation of the data collection as part of a grounded theory approach. The qualitative research conducted in the field did not focus wholly on grounded theory, but also borrowed from other social science methodologies, including ethnographic study, field work and phenomenological methodologies. This was done to collect the widest range of data from the study and look for emerging patterns in the results. Each of the different methodologies may be viewed from an overall grounded theory approach, where theories could be developed and explored as the work continued.

3.3.2 Ethnography

The basis for ethnographic qualitative research is in the field of anthropology, where the method is based on observation, usually of culture or group (Trochim, 2006). From the origins of ethnographic research, the concept of culture was linked to the ethnicity and geographic location of a group under study. Lately, ethnography has been expanded to the study of groups, organisations or individuals, or in this case, the study of users of a space. The importance of this form of study is to be able to compare with responses provided by participants on soundwalks, to see if there is any correlation between what a participant had said about their subjective experience, and the events that may have also been occurring in the space at that the same time which may not have been noticed or experienced.

The main epistemology of ethnographic research is immersing the researcher in the culture or group or, in this case, environment and soundscape with the participant. The study of ethnography is extremely broad with a large variety in the methods implemented by practitioners (Trochim, 2006) although the most common ethnographic approach is participant observation as a part of field research. Ethnographic study was considered as part of this work, where the spaces under consideration were observed, initially to check for suitability, but ultimately to observe the relationship between answers provided by participants on soundwalks, and the actual activity happening in the space. Field recordings and note taking of the observations were the methods by which the data was recorded. As field recordings were made throughout the years of study of this project, these contribute to a longitudinal study of the spaces in question, where analysis of the effects of temporality can be observed. Similar to a Grounded Theory methodology, there is little or no prior knowledge of what will be observed by the researcher, and potentially end point to the study.

3.3.3 Phenomenology

Phenomenology is more generally known as a field of philosophy, but is also used as an approach to qualitative methodologies, being used primarily in psychology, sociology and social work disciplines (Arkette, 2004; Bull & Back, 2003). The study of phenomenology investigates subjective experience and subjective interpretation of the world. The core goal of a phenomenological study is the interest in perception, in particular the perception of the respondent of the world around them (Trochim, 2006). This is important to the study being undertaken in this work, as it is perception of the space and how this connects to a preconceived expectation of the space and soundscape which is of interest.

Phenomenological methods are generally effective at allowing experience and perception of participants to be gathered from the perspective of the participant. This allows for the researcher to challenge or explore cognitive structures and assumptions. This was achieved in the field by the user of semi-structured interviewing during the immersive soundwalks, as it allowed for responses to be explored in more detail and to obtain a more in-depth understanding of what the participant actually meant when answering the question. This is explored in more detail in the section 3.4.

Using a phenomenological approach in multiple participant research, the ability to investigate inference and the strength of developed theories about the phenomena under investigation, by indicating the presence and corroboration of factors between participants is possible this being

a key goal in this project, where commonality and correlation between participants responses about their perceptions based on expectation was hoped for The phenomenological approach is appropriate in this work as it links to the soundwalking methodology and it allows for the subject examination of respondents experience of place.

3.3.4 Field Research

Field research is an approach to qualitative research which considers the act of research itself independent of prime method, i.e. conducting an ethnographical study or interview would be considered field research, it is also a method of gathering qualitative data. The essence of field research is the notion that a research is 'in the field' with the task of observing the phenomena of interest in situ. As such, it is probably most related to the method of participant observation. As part of the methodology, the researcher will take extensive field notes, which can be through a variety of different methods, for example detailed note taking, audio recording, and photography, the data collected is then coded and analyzed in a variety of methods described below.

Field research is a key factor in the study of soundscapes, where the researcher and participant can be actively engaged and immersed in the soundscape which relates to particular real world spaces. Undertaking qualitative field research also requires the researcher to be aware of the environments and dangers or ethical issues which could affect the participant. Not only is the participants' safety crucial in field research, that of the researchers is too, as such for this project the author undertook a course of researcher safety training. As part of this training a number of methods were put in place, such as clocking in and out, the act of informing a third party that an interview had begun and ended.

3.4 The use of interviewing as a qualitative methodology

The choice of interviewing as part of a qualitative methodology is based in grounded theory, where the collection of data from the participant is open-ended in nature. Data collected from the participant is generally not based on provided information a priori to the interview. For example, in this case, participants are informed that they will be going on a walk; there is no mention of the focus of the study, i.e. soundscapes, so as to limit as much as possible, participant bias. There are potentially ethical issues around not fully explaining the nature of the experiment beforehand to a participant (American Psychological Association, 2002). Consideration of ethics is described in section 3.4.1, and how ethical consent was obtained in explained in section 4.2.3 of the methodology chapter.

The use of interviewing as a qualitative methodology extends the data analysis process, and allows for the focus of the study to be on the meaning of the data provided by the participant. Meaning is extrapolated as discussed in section 3.5 by the use of content or thematic analysis (Braun & Clarke, 2006). Interview data by its nature is more descriptive, e.g. (Bardin, 1977, Ericsson & Simon, 1984), through the *'interpretation of the responses in terms of levels of complexity'* (Selman, 1979). Interpretation through qualitative analysis and coding the data into categories or themes, allows for similarities and differences to be found within the data and further explored..

The semi-structured interview methodology is open in its nature, it allows for other research procedures to take place concurrently, for example sound recording, sound level measurements and for exploration of themes relevant to the participant and the situation. Particularly relevant to the work being carried out in this thesis, as it allows for temporality in the soundscape to be explored between different interviews and times of study.

Whilst the semi-structured interview is open-ended and allows for divergence in discussion, an interview script was used to give some structure to the procedure and provide a starting point for the interview. The starting point is also useful as a method to develop a relationship with the participant, and help ease them into the research. The interview script consists of a set of questions relating to the research topic, although the aim is to capture the participant's thinking on the research topic, the researcher is able to ask new questions based on answers given by the participant. As a result of this process, it is probably true that every interview can be somewhat different from the others undertaken as part of the research.

This process results in the requirement for a more extensive coding process to take place in the data analysis stage, some may see this as a disadvantage to the methodology, as it results in a potentially endless cycle of revisiting the material. Semi-structured interviews have a number of advantages and disadvantages. Honey states that *'the semi-structured interview is the most adequate tool to capture how a person thinks of a particular domain'* (Honey 1987). With a semi-structured interview, the researcher has to combine a *'faith in what the subject says'*, but at the same time maintain a scepticism about the underlying meaning of what the participant is saying, *'While the original script of the interview guarantees the uniformity of topics across the whole sample, each particular interview is different due to the new questions elicited by the particular answers given by the interviewee'* (Honey 1987).

The other issue that must be taken into consideration is the semantic meaning of terminology used in an interview may have a different meaning for different participants, particularly in consideration of new terms, for example soundscape and acoustic related terminology. One of the most important techniques to develop as a researcher, using a semi-structured interview methodology, is in explaining the concept to the participant without providing the participant with insight to the research topic which might bias their answers in favour of the research questions. There is a difficulty as with some work there may be ethical issues surrounding the psychological aspect of the work and thus, not informing a participant of the study area would be unethical. This difficulty arises throughout this project, where participant opinion on the soundscape is a key factor in the study, but focusing the participant to think overwhelmingly about soundscape would potentially bias their answers, as it would potentially force them to change listening state and listen more intently to the soundscape for example.

Additionally, informing the participant that they are taking part of research relating to sounds will encourage them to adjust their answers to consider the soundscape more intently as it would be felt that they are giving the correct answers expected by the researcher. To overcome this problem, when recruiting participants for the study, they were informed that they were taking part in a study investigating opinions on urban environments, not explicitly focusing on any particular sensory experience. Ethical approval for the work was undertaken as part of the wider Positive Soundscape Project, but it is important to highlight the necessity for ethical approval.

3.4.1 Ethical Approval

The use of human participants in research requires the researcher conducting the work to consider the likely impact that the study could have on the participant. The requirement for this consideration is different from research in most of the science epistemologies, e.g. physics, chemistry, or earth sciences, i.e. research which primarily involves inanimate objects or materials. Consideration of any ethical issues which may affect the participants be they human or animal, which may result in harm, a change in behaviour or distress to the participant must be fully taken into account. Generally, most Universities and research organisations have rules in place which govern human and animal experimentation and as such, any research carried out within these institutions is bound by their code of conduct. This requires a research proposal to be passed by the ethics committee of the institution. For this research work, ethical approval was sought and approved.

To summarise the requirements of ethical approval, The American Psychological Society provides guidelines (American Psychological Association, 2002) which govern the conduct of research, whilst this primarily relates to psychology, which forms a part of this work, the guidelines are relevant to other research epistemologies. Generally, the researcher should justify the research with a cost-benefit analysis of the likely outcomes, as a researcher's interest alone is not a sufficient justification with which to carry out the work. However, as such, a researcher has to assume and accept responsibility for how the research is conducted and any consequences that the research may have on the participant. These consequences care both during and after the research participation.

The research conducted as part of this work, does not subject the participant to questions which are liable to damage them in anyway, the main area of potential harm is of a physical nature through an accident occurring whilst escorting participants around city streets. The author was therefore sent on a personal safety training course, to ensure not only his protection, but that of participants in his care during the research period. All questions were screened before hand, but were seen to be non-damaging to any participant. During laboratory based experimentation, noise levels were explained to the participant, and it was ensured that the participants would not be subject to noise levels which would in any way damage their hearing. All participants were assured that the answers they provided were anonymous, and would be attributed to a pseudonym in any results published; they were also informed that any data kept on them would be destroyed at the end of the project. This also enabled the participants to be candid in their answers, without any repercussions that their answers could have on them.

The above conditions were explained to all participants, before beginning any of the experiments they were also informed that they could leave the experiment at any time and their answers would be destroyed. If the participants were happy with these conditions, they were made to sign a consent form. The ASA state that in any human based research, all participants must participate in the research voluntarily. The participant must provide informed consent, with their free decision to participate. The ASA also stated that it is the responsibility of the researcher to explain the research to the participant, and that the participant is not exploited in any manner.

With ethical approval gain, it is then possible to conduct the interviews and experimental work, which forms the research. As stated previously, this work utilises semi-structured interviews to form a large basis of data collection of the research hypothesis. With the data collected from the interviews, the data must then be analysed. Analysis of qualitative soundwalks data is performed using coding.

3.5 Coding

Analysing data taken from soundwalks is performed using qualitative methods to provide '*theories and concepts for further testing*' (Silverman, 2006b). Interviewing participants using an open-ended questionnaire format allows the exploration of meaning (Kidder & Fine 1987) within their answers. An issue with using a social constructionist (Burr, 1995) epistemology, is that there may never be a true indication of environmental conditions, i.e. conditions which could be measured at the same time as the study, it provides a '*specific reading*' (Willing, 2001) of these conditions.

This is an important issue to consider in the data collected for this work; as such additional data will be recorded at the same time as the interview, using field recordings to allow for comparison between what was being said and the sound environment at the time. The process of coding involves the use of several analytic approaches. The first stage of coding is a process by where categorising themes from the research data takes place and then disseminating the results to describe details of themes and categories. Initially, the process is one of '*open coding*', which involves analysing the data in minute detail formulating initial high level categories. After this process, a process of more 'selective coding' can take place and where a more systematic approach is taken, and codes formed which relate to the core concepts (Corbin & Strauss, 1990) are established.

Throughout the process of coding, 'memoing' will also take place. Memoing is the process of recording further thoughts and ideas, which become apparent during the coding process. These notes may or may not relate explicitly to the area of study, but can provide additional insight into the data and respondents responses. Additionally, memoing may result in concepts which may relate to the core concept under investigation, but not be explicit. They can provide additional data to backup or undermine an argument (Corbin & Strauss, 2008).

It is also common during the coding process to use other notational forms such as '*integrative diagrams*' which can be used to summarise and give a visual overview to bring aspects of the

data together. The use of diagrams and mind maps (Buzan & Buzan, 2003), can help to formulate the theories and trends emerging from the data and linkages between themes in the data. Through coding data iteratively throughout the research process, new findings in the data can lead to new linkages and thus revisions in the theory. This can lead to a more informed approach to further data collection, and revisions on the methodology to focus in on the research questions.

The transcribed interview and questionnaire data is analysed line by line, and these lines are separated into meaningful segments, when a meaningful segment is located, a code is applied to it. Generally, coding of these segments requires defining it with a symbol, word or category. The development of codes in qualitative data analysis, results in many different types of codes. The use of code which already exists is called '*a priori*' coding, codes which are decided upon, before the data is analysed.

Alternatively, and most commonly in a Grounded Theory approach, codes are developed as the data is analysed, these codes are known as inductive codes. An important feature of the Grounded Theory method involves systematic methods of data collection and analysis. These methods are described by Strauss and Corbin (Corbin & Strauss, 2008) and are summarised below.

3.5.1 Stages in Grounded Theory and coding

The systematic nature of the method is useful in judging, generalising and comparing the results of Grounded Theory research. This is not always possible with alternative ethnographical methods where no clear system is involved. In the following sections, the stages of the Grounded Theory methodology are outlined. Three stages of data analysis are involved in Grounded Theory (Borgatti, 2008). These are open coding, axial coding and selective coding (Corbin & Strauss, 2008). The features and uses of these methods are explained below.

3.5.2 Open coding

Open coding is the process of selecting and naming categories from the analysis of the data. It is the initial stage in data acquisition and relates to describing overall features of the phenomenon under study. Variables involved in the phenomenon are identified, labelled, categorised and related together in an outline form. The properties of a category are described or dimensionalised at this stage. This involves placing or locating the property along a continuum within a range of possible values (Corbin & Strauss, 2008).

Coding the data, involved reading through the transcripts to find how the soundscape was being described by the participants in relationship to their expectation, Codes were assigned to the text which represented the major categories of expectation, context and competence, On the initial passes through the data new codes and categories were formed when participant answers expanded or developed new ideas, for example in this work, the importance of control as a factor in perception of the space. Open coding was also the first chance to enumerate data, for example collecting instances of word usage or descriptors as new codes.

3.5.3 Axial coding

Axial coding is the next stage after open coding. In axial coding, data is put together in new ways. This is achieved by utilising a coding paradigm, i.e. a system of coding that seeks to identify causal relationships between categories. The aim of the coding paradigm is to make explicit connections between categories and sub-categories, for example the relationship between context, usage and users of the space. This process is often referred to as the 'paradigm model' and involves explaining and understanding relationships between categories in order to understand the phenomenon to which they relate (Barker, Jones & Britton, 2005).

3.5.4 Selective coding

Selective coding is the process of selecting and identifying the core categories and systematically relating them to other categories. It involves validating those relationships, filling in, refining and developing those categories. Categories are integrated together and a Grounded Theory is developed.

The Grounded Theory is based around a core category obtained from the data; this core category in this case would be expectation and attitudes towards expectation, from which other categories with the data are formed. To validate the grounded theory, relationships between the developed categories are formed and hypothesis developed, further field work and data collection as part of the Grounded Theory allows for the hypothesis to be tested. As discussed above, as part of this process, categorisation and analysis is continually refined and developed. This process concludes with a developed theory.

3.6 Enumeration

Qualitative research, like quantitative research can also use enumeration of data, as part of the data analysis process. As an example, in this research work, when the question '*Does this place sound as you would expect?*', a simple binary answer of Yes or No, is given.

It is then possible to count the number of times this occurs and plot the result. The benefits of this approach are that the rich data of the interview can provide an additional insight into the reasoning behind the choice and allows for further exploration. It is also possible to count the number of times a word appears in relation to a question, e.g. noise, traffic etc, and additionally count the number of times a specific code is applied to the data, e.g. transitory space. Enumeration of the data can also help when reporting the analysis of the data, as specific quantities can be used to explain frequency of occurrence, rather than words such as 'some', 'a few' etc. Enumeration is also used with the mixed qualitative and quantitative methodology developed as part of this work.

3.7 Development of Questions

The development of the questions used in the research work, were trialled and formed as part of the Grounded Theory approach undertaken through this work. In the early stages, a number of different methodologies were trialled; these included static questionnaires, soundwalks, and interviews. This process enabled a number of different styles of questionnaires to be tried. In these trials, approaches to the questions were changed, along with the types of questions. The types of approach ranged from Lickert scale based questions based on rating of the soundscape and the spaces, to open ended questions.

Whilst the questions based on Licket scale ratings and semantic differentials provided some insight into expectation, it was difficult to gain an insight into how expectation and competence of the individual participant were affecting perception of the space based on their answers. It also showed that this type of question did not lead to significantly rich data which would provide insight into the research topic.

The initial questionnaires also had a very high rejection rates. There were a number of reasons for this; primarily the approach of stopping a participant in the street and then asking them to spend a significant amount of time answering questions was not practical. As a result it was decided to recruit participants prior to the interview/soundwalks.

3.8 Mixing Qualitative and Quantitative Methodologies

This work hopes to bring together both qualitative and quantitative methodologies, as suggested in the literature review chapter, to allow for interdisciplinary collaboration as highlighted by Schafer (Schafer, 1984) and discussed in the Literature Review chapter. The soundwalking methodology forms the qualitative part of this work, using enumeration of some of the answers to give it an element of quantitative study.

The soundscape simulator laboratory experiments form the quantitative part of this work, but have elements of qualitative methodology encapsulated in them. The soundscape simulator also uses data from the qualitative soundwalks to inform its design.

The soundscape simulator allows a participant to manipulate a soundscape for a given location or create new soundscapes, based on a number of criteria. The ability to examine the effects of perception and preference of a soundscape, by allowing a participant to manipulate the soundscape, is the basis for the simulator. The soundscape can be manipulated by adding or removing sound sources or changing characteristics of the audio spectrum. Soundscape simulator data is analysed by looking at changed parameters and sound source content, and then by looking for correlation between participants in terms of these soundscape components.

Details of a participant's subjective opinion to their choices and changes are captured via questionnaire. Subjective data obtained from interviews taken during the semi-structure interview process described above. Analysis of this data through coding provides a basis for the sound sources and locations used in the simulator, this data also informs the field recording process for the simulator. The simulator uses as a basis two semantic categories these are 'background' sounds and 'event' sounds (Guastavino & Dubois, 2006). These categories are very similar to those used in a film soundtrack, ambient or background tracks and FX and Foley sounds (Purcell, 2007; Yewdall, 2003).

These categories also relate to the notion of figure and ground from Gestalt psychology (Sonnenschein, 2001), which has also been used in many experiments on auditory attention, such as auditory scene analysis (Bregman, 1994). The categories also relate to sound marks, sound events, sound objects and soundscape, suggested by Schafer (Schafer, 1984). The ambient track is a general track which is a baseline soundscape for a space, as such for an urban square would contain as few external/individual sounds as possible, the benefit of this method is to create an acoustic signature for a space. With a base line, additional event sounds can be added and removed to the base.

There are some limitations with this method and these are discussed later. By utilising these two categories, the soundscape simulator provides a method by which the breaking down soundscape components for a given location and manipulating ambient verses event elements and investigating the effect this has on preference and expectation.

There are two phases which make up the process flow in this methodology. The first phase involves collecting primarily qualitative data from soundwalking and interviews, in the field. Although there is also collection of quantitative acoustic data including $L_{Aeq,}$ peak levels L_{max} and position of sound sources occurring at the same time. Analysis of the interview data highlights sound sources which need to be recorded for use in the simulator. At this point field recordings take place. Field recording also involves the recording of sound level measurements; these measurements allow the calibration on the simulator during the second phase of this work.

The soundscape simulator presents the user with the ability to manipulate the soundscape via a panel of controls. They are able to change level and other acoustic parameters, as well as add and remove, different sound sources. By utilising the soundscape simulator for a 'location', it is possible to see if there is correlation between the parameters of a group and their expectation. The simulator allows research into the question of manipulating a 'location's' preference by removing/adding characteristics of the audio spectrum, and different types of sounds.

3.9 Conclusion

In conclusion, qualitative research methods have been shown to provide valuable methodologies for providing rich and detailed participant descriptions of both simple and complex phenomena. These methodologies combine to provide the researcher with insight into the experience and participant interpretation of the research phenomena under study by participants who have differing background and roles. Quantitative research also allows for the ability to conduct initial explorations of the phenomena of study and thus the development theories and hypotheses. That is to say that qualitative and quantitative methodology can be complementary to one another as this proposes hopes to show. The use of Grounded Theory as a qualitative research methodology, allows researchers the ability to develop and test theories on a topic which may yet to be researched, although it is similar to other inductive methodologies, it is different as approaches to analysis of the data can differ from researcher to researcher. It has been shown that qualitative research can be '*systematic and rigorous*', and it through its process can '*reduce bias and error and to identify evidence that disconfirms initial or emergent hypotheses*' (Pope, Ziebland & Mays, 2000) .

4 Methodology

4.1 Introduction

In researching the influence of expectation on perception of the soundscape, a number of different methods were used in conjunction with one another to provide data, which was then used to inform the next iterative stage of the research. The combination of multiple inter-disciplinary methodologies aims to provide an overall method which creates a more complete characterisation of a participant's soundscape experience, thus gaining a greater insight into the factors which influence their perception. The methodologies under discussion were separated into two areas; these areas were fieldwork and laboratory based experimentation. For this thesis, fieldwork consisted of soundwalking with interviews, questionnaires, field recordings, space observations and focus groups; the laboratory work consisted of the development of a soundscape simulator, which was used in conjunction with soundscape playback and questionnaires.

4.2 Methodological Approach

The following section details the component parts of the methodological process undertaken in this project, highlighting the developmental stages and final methodologies used in this study, these are shown in Figure 4.1. There were two phases of data collection which formed the overall process flow in the presented work. The first phase involved collecting primarily qualitative data from soundwalking and interviews in the field, with centre-based focus groups. Collection of quantitative acoustic data including L_{Aeq} measurements, also took place during soundwalks. Through the analysis of interview and focus group data, sound sources were identified and these were then marked for recording for use in the soundscape simulator. Field recordings took place, both during the interview period and after all interviews had been completed.

The second phase of data collection involved collecting primarily quantitative data from the soundscape simulator; this included further field recording with additional recording of sound level measurements; these measurements allowed the soundscape simulator to be calibrated to real world levels, and participant data collected from the soundscape simulation experiments. Figure 4-1, shows the two data collection phases and how they work in conjunction to inform each one another. The constituent parts of the method involve the following approaches; these approaches will be expanded upon in the rest of the chapter.

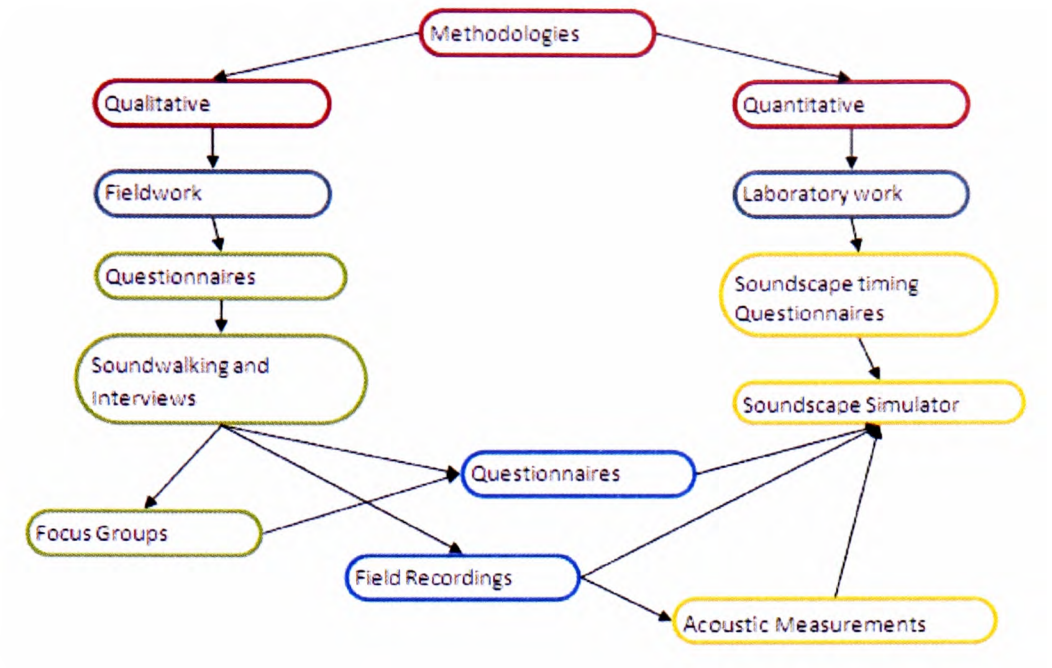


Figure 4-1 : Methodological Approach

Using data collected from soundwalk interviews conducted in Manchester and London in 2008 and 2009, it was possible to extract the primary soundscape components for locations under test, as well as attitudes towards the perception of the space and the expectation of the space. The soundwalk interviews were recorded and then later transcribed, the transcription process allowed for content analysis (Silverman, 2006a; Neuendorf, 2002) via coding taking place on the text.

Participants' answers were used to identify which sound sources would be included in the soundscape simulator, where they could be manipulated to measure the effect this has on preference and expectation. The soundscape simulator was also developed for use with focus groups to provoke group discussion. The formal focus groups undertaken as part of this thesis, did not use the soundscape simulator due to the limited time that was available during the focus group sessions, but were based around a semi-structured interview method. The use of the soundscape simulator with groups was achieved through demonstrations with professional groups and other interested parties.

The soundscape simulator was used with professional groups to gain feedback into potential usage as a design tool; members of these groups consisted of acoustic consultants, planners, architects and design professionals. The soundscape simulator provided participants with the ability to manipulate elements of a soundscape via a bank of controls. The manipulated data was recorded in real time and enabled the examination of numeric features such as level and frequency content to be compared to see if these have any impact on the perception of the space, as well as if there is any group correlation between subjects in the test.

4.3 Soundwalking

4.3.1 Introduction

Soundwalking as a methodology was used to gain a detailed knowledge of a subject's expectation of a series of spaces. The Schaferian soundwalk methodology involves going on a silent walk, the timing of which can vary. Typically, a Schaferian soundwalk is one hour (Schafer, 1984; 1988) or longer in length.

Critical evaluation of this method and that of ear cleaning (Bruce, 2007) showed a number of potential flaws and assumptions in Schafer's soundwalking and listening in silence methodologies. Whilst Schaferian soundwalking as a primitive methodology has useful components, which could be used as a basis to teach and instruct people on how to actively listen and engage with their sound environment, it proved to be limited as a methodology for studying perceptions of soundscapes (Adams *et al.*, 2008). The soundwalking method was explored and trailed on a number of pilot and test studies. The results from these studies showed that the traditional Schaferian model, with an hour's walk and discussion at the end was found to be less effective than a method involving regular stops. (Adams *et al.* 2008; Bruce & Davies, 2009).

An enhanced soundwalking methodology was developed and used in this thesis. The method required the participant to walk in silence over the course of a predefined route, observing the soundscape and the environment. Throughout the walk, the participants were subjected to semi-structured interviews, which took place at specific locations. This method had been used and was examined on pilot and test studies (Adams *et al.*, 2008). The method differs from the traditional Schaferian model (Schafer, 1984; 1988) and that used by others (Westerkamp, 2002; Semidor, 2006), in that it involves stopping the participant in a number of pre-determined locations throughout the walk and conducting an interview about the space. During the soundwalk interviews, conducted in Manchester and London in 2008 and 2009, participants were asked questions relating to a set of specific locations they visited.

Upon embarking on the walk, the group or individual walks for 5 to 10 minutes, and was then asked to stop and listen to the new environment for one minute. This procedure was to enable participants to acclimatise themselves to the space. After the minute's acclimatisation period, the researcher then facilitated a semi-structured interview.

This procedure enabled the individual to become more immersed in the process and refocus on the listening task presented, rather than walking for an hour unsure of what exactly they were supposed to be doing, which occurred when testing the Schaferian method (Bruce, 2008). Participants on initial trials of this method commented that they were able to get more out of the walk, and the interspersed discussions helped them to regain concentration. During group walks, participant's feedback expressed that the breaks also helped some members of the group understand the process better and as a result change their listening focus.

Features of the soundwalk used in this thesis were that it had to include differing spaces which matched set contexts, and these spaces were within walking distance for a given time frame of an hour to an hour and a half. There was a requirement to also find similar spaces in terms of usage, scale and size to make meaningful comparisons between different cities. During the interview, participants were allowed to talk freely about the space and diverge on certain tangents whilst within the topic. If participants began to deviate too far off the topic, they were brought back to the question in hand.

4.3.2 Soundwalk design

Prior to the soundwalk, a walking route was designed. This process required the researcher to walk around a chosen city looking for a number of contrasting listening locations, to provide what could be seen to be different contexts (Botteldooren, 2006), to test if there was any similarity between perceptions of certain types of space, and if there was any correlation between how participants described the spaces. Further to this the spaces were chosen to identify if any similarities were perceived between spaces of similar context but in different cities. Once selected, the chosen locations were then used as designated areas for interviewing the soundwalk participants.

The chosen locations also served as points for sound recordings to be used in the laboratory-based quantitative work, described later. Once a soundwalking route had been decided upon, the route was then trailed to check for timings and for any issues at the locations, or in travelling between the locations. This process also involves contacting any local authorities or land owners to clear permission for conducting recordings or interviews on their property.
With the soundwalk route finalised, participants were recruited from a variety of sources. Recruitment sources included contacting interested parties such as local residents, professional bodies, and by direct contact. 42 soundwalk participants aged between 22 to 65 years old took part in soundwalks in London and Manchester.

Participants included one hearing-impaired participant and six local residents, with the remainder being planners, architects, acoustic consultants, and members of the general public. The mix of participants also provides the ability to test competence between inexperienced and experienced listeners, to see if this has any impact on competence.

The number of participants is representative of qualitative studies, where the key objective is to produce a rich and authentic dataset, representative of the environment or phenomena under study, rather than statistically significant sample sizes (Williams, 2000; Small, 2009). Variety in the collected data is ensured due to a wide range of participants from varying backgrounds taking part.

A selection criterion was implemented to recruit, as far as possible, those who had experienced and those who had not experienced the chosen locations. The purpose for this criterion of having non-experienced and experienced users of the locations, was to allow for the investigation into the differences in expectation of the locations. The self-reported hearing impaired participant, did not require a hearing aid, and was unable to produce a recent audiogram; therefore it was difficult to judge the level of impairment. This is addressed in the results section of this thesis.

The recruitment process was conducted through direct contact with professionals within the fields of design, architecture and the local council, who were all stakeholders in urban development and urban design strategy. Other participants were recruited via messages on the University of Salford's intranet, personal contacts, and members from the local resident community. The participants selected had no previous knowledge of the research, and also did not have a stake in the project. Participants were not compensated financially for their participation in the soundwalks.

4.3.3 Identification of participants in transcriptions

As part of the ethical guidelines bounding this project and data security, as mentioned in chapter three participants were asked to complete a consent form before undertaking the soundwalk. As part of the consent process, anonymity of the participant was guaranteed in all captured data. To keep the anonymity of the participants, a method was devised to identify the participants when coding the interview data. In accordance with data protection guidelines, participants were also informed that all recorded data would be destroyed at the end of the project.

In the transcription of the interviews and the results section of this thesis, participants are referred to by location and walk number, e.g. LON-SW1

Soundwalk participants	**Number**	**Gender**	
		M	**F**
London	25	15	10
Manchester	17	9	8

Figure 4-2 : Soundwalking demographics and number

4.3.4 Soundwalking procedure

Upon arrival at the start location for the soundwalk, participants were informed about the details of the walk, including some background information on the project, the soundwalking procedure, as well as the route and expected duration of the walk. Participants were first asked to complete the consent form. They were informed that they could withdraw from the soundwalk at any point, and were free to ask any questions. The soundwalking procedure required the participant to walk in silence between each of the interview locations, following the researcher at a short distance. For the duration of this section, participants were asked to actively engage with the environment from a multi-sensory perspective, i.e. to observe the environment not only from an auditory perspective, but also with total visual, tactile and olfactory awareness. This was to ensure that the soundscape was not their primary focus, to allow for an investigation in the analysis of their answers into the effects that the contextual environment had on their perceptions of the spaces.

Once the formalities had taken place, the first location interview began. At the start and finish locations a series of preliminary and rounding-up questions were additionally asked. To begin with, the participants were asked about their professional background (e.g. if they are involved in planning, architecture, acoustics) or relationship to the areas (e.g. for local residents and members of the general public) and any thoughts they had on soundscapes before starting the soundwalk.

Maps of the Positive Soundscape soundwalks routes from London and Manchester are given in Figure 4-3 and Figure 4-5, and the shorted soundwalks for this PhD are given in Figure 4-4 and Figure 4-6 below.

As mentioned above, at each of the individual locations, the participants walked for 5–10 minutes before stopping to listen for a minute. They would then answer a set of questions relating to the walk and space they were in, also at the final location, an additional series of concluding questions were asked, and the participant had the opportunity to ask any questions or make any observations that may have arisen during the walk.

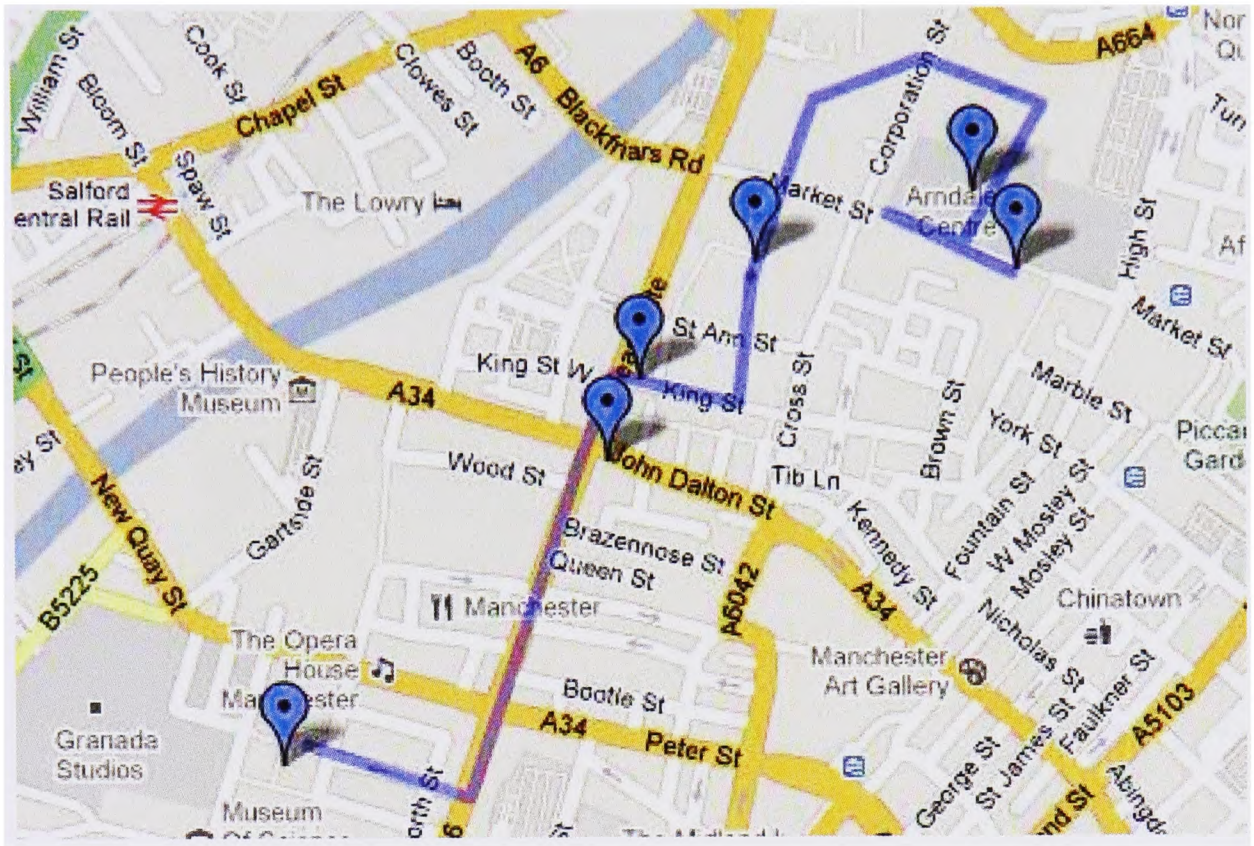


Figure 4-3: Manchester Positive Soundscapes Project Soundwalk route

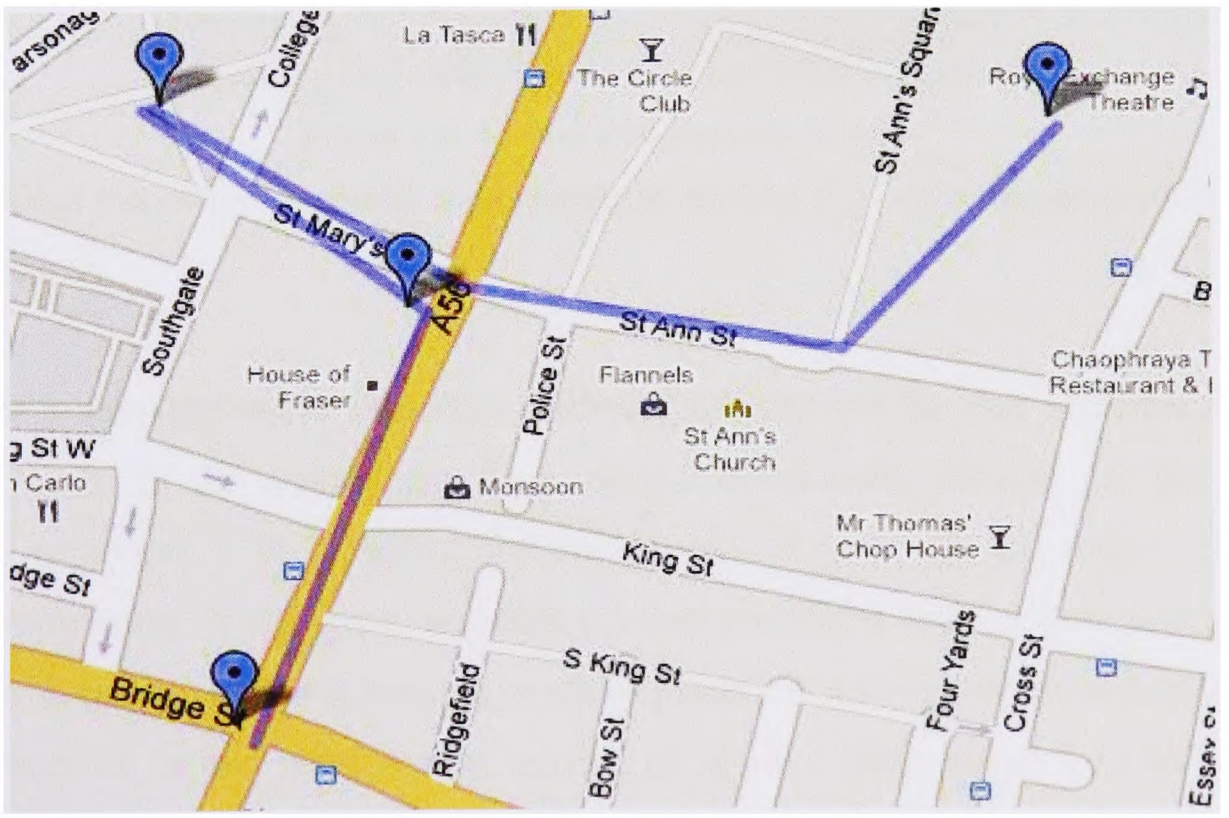


Figure 4-4 : Manchester PhD Soundwalk route

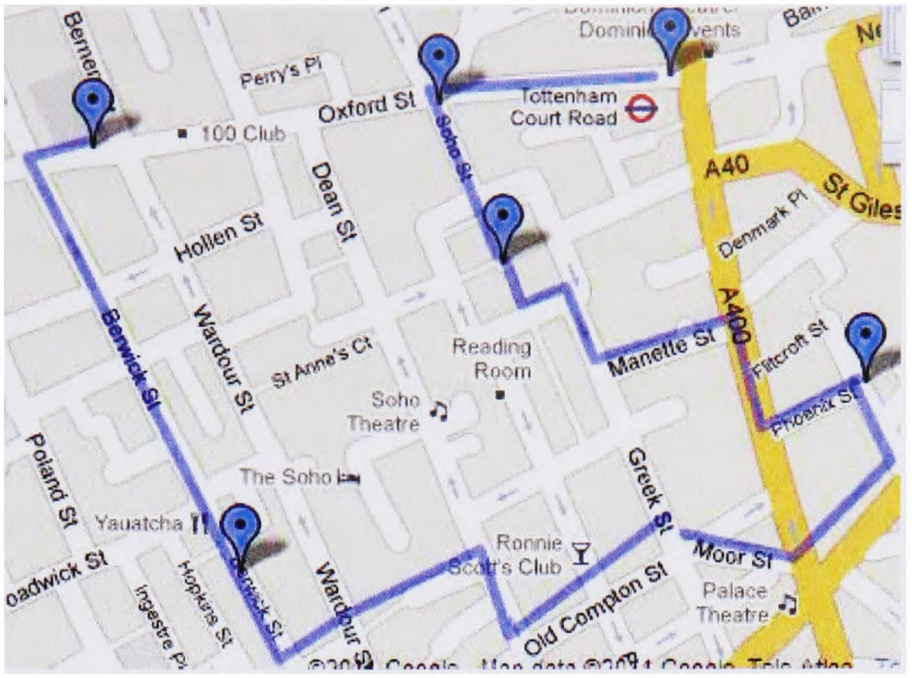


Figure 4-5 : London Positive Soundscapes Project Soundwalk route

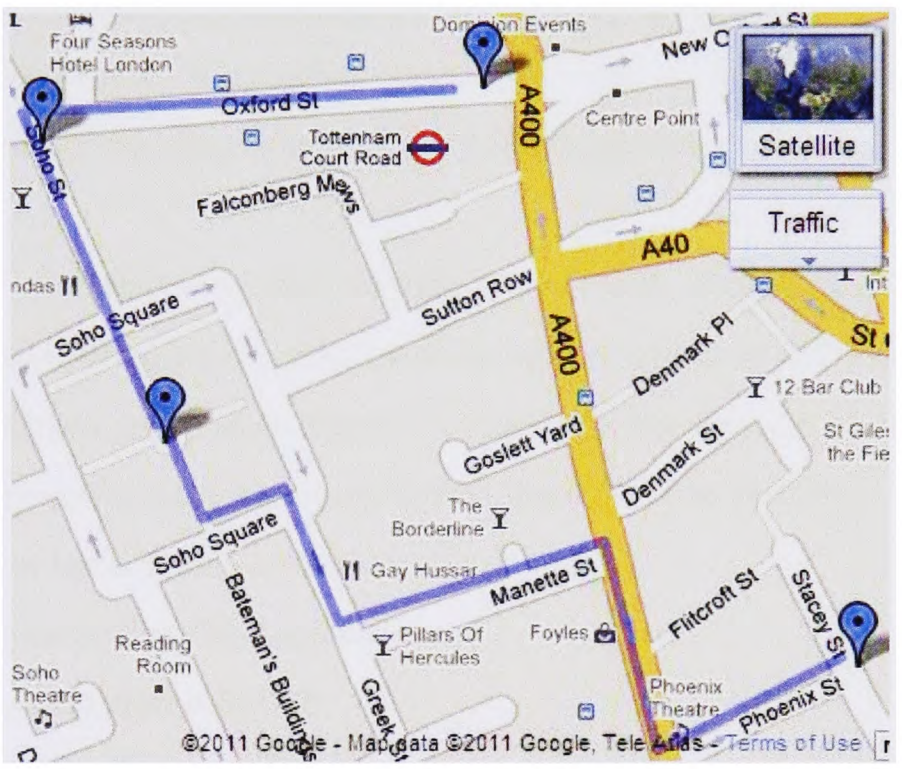


Figure 4-6 : London PhD Soundwalk route

A full detailed list of the locations is available in section 1.2.7 Identification of locations in case study areas.

The use of a semi-structured interview methodology allowed for rich semantic data to be collected in-situ of the soundscape. This method additionally allowed for the reasoning behind the responses to be identified and developed. The interview questions related to the general environment of the space, and then focused on details such as 'is this as you would expect', or 'is is there anything missing or out of place?'. It then moved on to more perceptual questions such as 'is this space louder, quieter, or as you would expect it to be?' and 'what influence do the materials and layout of the space have on the soundscape?' The soundwalk also provided data which was to be used in the laboratory-based experiments, relating to sound sources heard in the locations. The questions asked on the soundwalk are given below.

The initial pre-soundwalk questions were:

1. What is your professional background?
2. How would you describe this area of London / Manchester?
3. In general what do you expect to hear in an urban environment?
4. As an individual do you like or dislike hearing these urban noises?

The primary idea of these questions was to relax the participant and get them used to being questioned and recorded. It introduced the format that the questions would take, and also gained an understanding of their expectation of what the soundscape is and contained, before being immersed in it. The third question also served as the basis to test expectation and competence of the participant, by gaining an insight into the sounds that they thought would be present in the soundscape of an urban space. This was to be compared with the answers they gave later of sounds that they actually heard in the spaces.

There was then an introduction to the practice of the walk, including information that they should walk in silence, listening to urban sounds, whilst trying to draw connections between the physical environment and infrastructure. Upon entering the spaces on the soundwalk, a number of location-specific questions were asked, these were as follows:

1. Have you ever been to this location before?
2. How would you define this location?
3. Is it how you expected it to be?
4. What can you hear at the moment?
5. Is what you can hear as you would expect, or as there elements which are out of place?
6. What words would you use to define the overall sound you can hear?
7. What would you say is the purpose of this place?
8. How does this location make you feel?
9. Are your expectations of this location met? Why/why not?
10. Does anything you hear make you feel more, or less, comfortable?
11. Who would you say uses this location? And how do they use it?
12. Is this place quieter or louder than you expected?
13. What do you think of how this location looks?
14. What impact, if any, do you think the design of the location (e.g. the buildings, the layout, the physical environment etc.), have on what you can hear?
15. How do you value this space?

The purpose of these questions was to gain an understanding of a participant's experiences in the specific locations, related to their various perceptions of, and relative responses to, the distinct soundscapes in the different locations. The concluding questions at the end of the soundwalks encouraged the participants to think back to the locations of the interviews

1. How would you describe the places?
2. Would you say we have experienced a number of different soundscapes today or just one 'urban' soundscape?
3. If more than one, how would you classify the different types of soundscape we have experienced? How would you describe them?
4. Did the places sound as you would have expected?
5. Has being on this soundwalk changed your perception or understanding of urban soundscapes in any way?
6. What London / Manchester urban space do you prefer? Why?

For each of the locations, Manchester and London, two different routes were used. Initially, as part of the Positive Soundscapes Project, a longer route was used in both locations (see Figure 4.1 and Figure 4.3 The longer routes took up to one and a half hours to complete and passed through an additional number of spaces. For this thesis, a short version of the route (see Figures 4.2 and Figure 4.4) was used to allow for more data collection to take place, due to the reduced time commitment of respondents, and a focus on areas of which due to the Grounded Theory approach being used on the project, showed had points of interest and anomalies relating to the main question of this thesis. This change of focus was to allow for a further investigation into the factors of experience, expectation and context, as the spaces on the shorter walks all seemed to have strong contextual elements or elements which resulted in other factors being extracted from the data which seem to relate to participant perception.

It was essential that the participants fully experienced the specific locations. It was this that was the primary motivation for the use of soundwalks, allowing respondents to experience a fully immersive sensory experience. It was also a necessity to move the respondents through varying type of space, each with differing contexts. As part of the soundwalk design process, careful consideration was given to selecting different locations with greatly contrasting conditions, within close proximity, within the urban environment. In particular, this allowed the possibility of having both experienced and non-experienced respondents taking part in the research, thus identifying actual expectation, or perceived expectation.

Perceived expectation is a state where the participant had not experienced a certain space before, and thus, could take their 'competence' or expectation of similar spaces to make judgements of that particular space OR makes their expectations of the new space based on their previous experience of similar spaces. This state of competence is key to this work, in that it provides the opportunity to test expectation, and how it influences perception of the soundscape. As shown in the results section, experience of a space is informed not only from an auditory perspective, but by all of the senses, especially sight. Capturing participant's holistic sensory experiences, as well as more intangible influences such as a sense of security or anxiety about an unknown environment, was shown to have a profound effect on soundscape perception.

In designing of the soundwalk, the use of multi-purpose spaces, for example Soho street as shown in Figure 4-7, was also a key factor in choice of spaces for the walking process, although a discrete context could be assigned to each of the spaces, for example busy street, urban square, shopping centre. Whilst these spaces were different in the two test cities, the context of 'busy street' and thus expectation of 'busy street' is potentially similar. By analysing the interview data and answers to key questions, it was possible to theorise that the context of a busy street and its expectation are similar, but the learnt understanding of the acoustic architecture, and acoustic environment, as well as visual input, was the key factor in determining expectation.

Figure 4-7 : Soho Square

In placing the respondent in the space, they were subject to complex interaction with the space, including multi-modal stimulation. This is something which would not have been possible in the laboratory. Whilst this work was not explicitly interested in quantifying the influence of the other senses, their presence was key to understanding the perception and expectation of the space. The design of the soundwalk and associated questionnaire allowed for the exploration of multi-modal sensory perception, but was not explicit about it being important to the project, as to not bias the participant's answers in favour of the soundscape.

The data collected from the soundwalks captured participants' subjective experience of the spaces. It created the possibility of investigating the correlation between what is expected in a space, and how this influences an individual's perception of the soundscape. The data was transcribed from the recorded interviews and coded initially using AtlasTi qualitative data analysis software, but latterly using pen and paper this is explored in the results chapter (Chapter five) of this thesis.

The analysis of the coded interview data was first used to highlight soundscape attributes which were to be recorded for modelling in the soundscape simulator. At this point, some field recordings of these sound sources took place, as well as the recording of sound level measurements, to allow the calibration of the simulator during the second phase of the methodology.

4.3.5 Questionnaires

A series of questionnaires were trialled in the early stages of this thesis, to test for relevance and suitability to the research questions. Initial questionnaire methodologies included answers based on Likert scales; open-ended questions and semi-structured interviews (Likert, 1932). Firstly, a structured questionnaire with a combination of open questions and rating scales was tested (Semidor, 2006).

In the trials it was shown that the method has some problematic issues (Bruce, 2008; Adams *et al.*, 2008), for example, there was an issue in stopping participants and getting them to take part, particularly as the questionnaire took between 5-10 minutes to complete. Given that a criterion for this thesis was for participants to respond to their environment, it proved difficult for participants to properly focus on their surroundings in such a short period of time. This meant that answers given were focused on single events rather than on describing the soundscape as a whole.

The developments of soundwalking as a methodology arose from these initial questionnaire tests, as a methodology by which the participant could be engaged with the environment, and able to speak freely about the environment and their expectation as required. The semi-structured interview methodology as part of the soundwalk was trialled tested, and then chosen.

4.3.6 Recording of soundwalks and interviews

Trials of the soundwalking methodology included testing of methodologies for recording the soundscape. Binaural and stereo recordings were made and tested during the early stages of the project as this approach worked well in the past, and were unobtrusive to the participant and researcher. AA mono/stereo interview recording was made during each of the soundwalk interviews.

The soundwalk interview recordings provided the interview data which was then transcribed and coded. The voice recordings needed to be clear enough for the transcriber to be able to decipher what is being said – against possible background noises of traffic, other people etc. A short data sheet was also completed as part of the soundwalk – detailing personal and professional details of the participant, any variation in the soundwalk route, and time of day of soundwalk, weather etc.

A number of methods were employed to record the interviews, including initially a handheld digital recorder. It was found that a shotgun microphone was most appropriate, because it has a narrow hyper-cardioid polar pick-up pattern which rejects most of the off-axis sound, and thus provides a higher level of sound isolation in the recording, of especial importance in the noisy urban environment, but handling noise and the difficulty of trying to hold questions and recording devices meant that hand-held recorders were used.. Interviews were recorded using either the Zoom H2 hand-held recorder or Edirol R-09 hand-held recorder, using the internal microphones. The recordings were made at a sample rate of 44.1 kHz.

4.3.7 Identification of locations in case study areas

The locations for this thesis were chosen in conjunction with those used on the Positive Soundscapes Project, to enable the sharing of data. Two cities were chosen for the project, London and Manchester. Physical differences between these cities meant that there were difficulties in finding precisely identical locations in each city. Therefore the focus became fixed on the use of the city spaces (i.e. context) as the determinant for selection.

It was proposed that all locations to be used for study in each of the cities should have a uniformity – they should have distinctive character and flavour – and that the usage of the space and its vicinity was important. For example, Deansgate in Manchester is a busy through road, with single lane traffic. The road is flanked on either side by retail properties and pubs/restaurants. Deansgate is one of the main shopping streets in Manchester, and draws parallels with Oxford Street in London, which very similar characteristics, in terms of usage, dimension, and building height. This comparative selection criterion was applied to the remaining locations, which are listed in the section below.

	Soundwalk Locations	
	Manchester	**London**
Public Square Description: pedestrianised square; away from traffic; shops and mixed use buildings around it	St Ann's Square	Soho Square
Green space Description: Green area, with public seating, surrounded by mixed use buildings.	St James Gardens Partronage Gardens	Phoenix Gardens
Indoor Shopping Space Description: Indoor shopping centre, with large amounts of reflective surfaces.	Arndale Centre	The Plaza
Outdoor Shopping Space Description: busy road, lots of through traffic, temporary retail premises / market stalls either side.	Market Street	Berwick Street Market
Busy road with shops Description: busy road, lots of through traffic, retail premises either side.	Deansgate	Oxford Road

Table 4-1 : London and Manchester soundwalk locations

See maps above in section 1.2.4 Soundwalking procedure and Appendix E for photographs of the locations.

4.3.8 Focus Groups

In addition to soundwalking, focus group studies were undertaken as part of this research. The focus group study was held as part of the larger Positive Soundscapes Project, but input into the design of the questions, transcription and analysis was undertaken as part of this work. The focus group interviews took place with four different groups. These groups were: adults between the ages of 18–25, adults aged 60 or over, adults with a hearing impairment, ranging from moderate to severe hearing loss; and a panel of design professionals of all ages / or working age (between 18 – 60).

The interview questions for each of the focus groups were similar in content, while the hearing impaired and professional group has some additional questions addressed specifically to them. There were a differing number of participants in each group. Table 4-2 lists the number of participants and demographic information of each focus group.

Focus Group	Number	Average Age	Gender	
			M	F
18–25 year olds	6	23	1	5
Aged 60 and over	7	67	2	5
Hearing Impaired	5	-	0	5
Experts	6	-	5	1

Table 4-2 : Demographic information about the four focus groups

In the first focus group with adults aged 18–25 years, five participants were university students and one participant was in full-time employment. The second focus group with adults aged 60 and older was comprised of three participants in full-time employment, and four retired individuals. The hearing impaired group was comprised of a university student and four participants in full-time employment.

Each of the hearing impaired participants had hearing aids from their audiologist, but were unable to produce a recent audiogram. Again, these issues are addressed in the results section of this thesis. The expert panel was comprised of an acoustic designer; architect; architectural liaison officer from Greater Manchester Police; design and planning officer; and a professor of regeneration and sustainable development from the University of Manchester.

Focus group participants were recruited by the author and Positive Soundscape project researchers. Recruitment was conducted in a similar manner to that of the soundwalk participants, including advertising on the University of Salford's intranet, community internet bulletin boards, personal contacts, and a community group. Participants were compensated with a £10 voucher for their participation. As with the soundwalks, written consent was required from all participants and confidentiality and anonymity was explained to all participants before the start of the focus group. Focus group sessions took place at the University of Salford; the duration of each session was approximately ninety minutes. All focus group interviews were audio-recorded and transcribed.

4.4 Interview Coding

This section details the methodology involved in analysing the data from the soundwalk interviews. Interviews were recorded during the soundwalk and focus groups and then edited and transcribed. The transcriptions were then entered into AtlasTi qualitative analysis software and coded. Coding is the process by which themes within the data are identified and extracted, for example examining any themes or trends in words used to describe a place.

Analysis of interview transcripts used grounded theory method (Willing, 2001; Silverman, 2006a), examined in the previous chapter 3 of this thesis. Grounded theory analysis is a suggested method by Willing for subjective and focus group data collection method (Willing, 2001) Interview transcripts are read through and analysed by coding each relevant sentence into a category or theme. This analysis is carried out on each transcript in turn and then for categories defined in one transcript there is a return to all previous transcripts for further evidence of the newly identified category.

Unfortunately certain soundwalk locations had issues with high levels of background noise being present on the interview recordings. In some instances, the presence of this background noise required the audio files to be 'cleaned' as much as possible to allow for easier transcription. The cleaning process aimed to lower the background noise levels and bring the speech of the interviewer and the participant to the fore, and also edit out extraneous noises from the recordings.

A number of techniques were employed to achieve this reduction. The first process removed the higher and lower parts of the frequency spectrum, below 300 Hz and above 4000Hz, the usual ranges of speech (Titze, 1994). The first stage in this process involved listening to the audio files in turn and judging those which were problematic. To remove unwanted high and low pass filters were applied respectively to the audio file. If the noise was still problematic, and relatively constant (e.g. traffic), a noise filtering technique was employed from Adobe Audition. This process involves first creating an audio snapshot of the noise source. Once this has been captured, the snapshot is analysed and filters are created which match the spectrum of this noise print. These filters are then applied to the whole file.

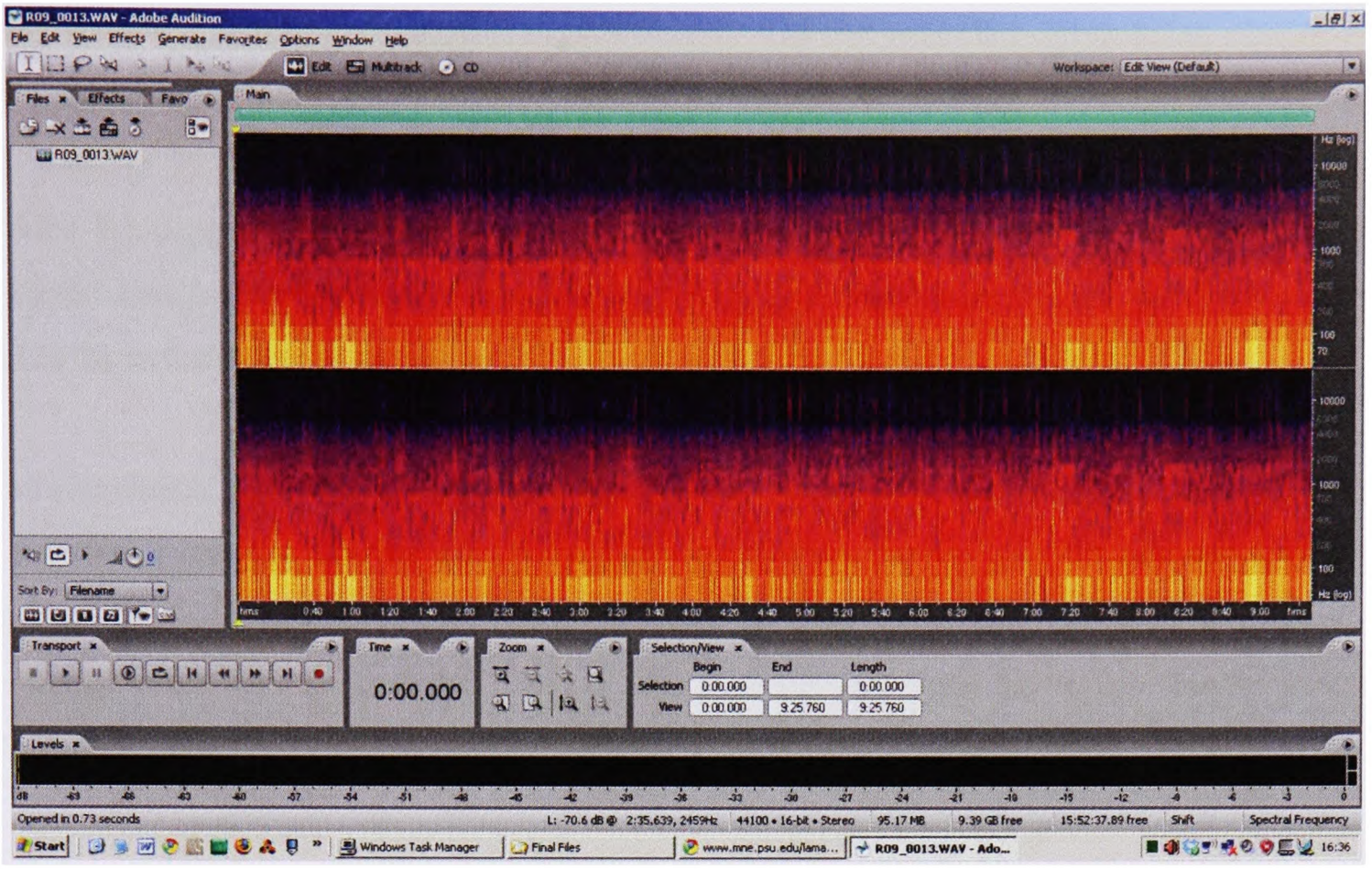


Figure 4-8 : Audio file pre cleaning

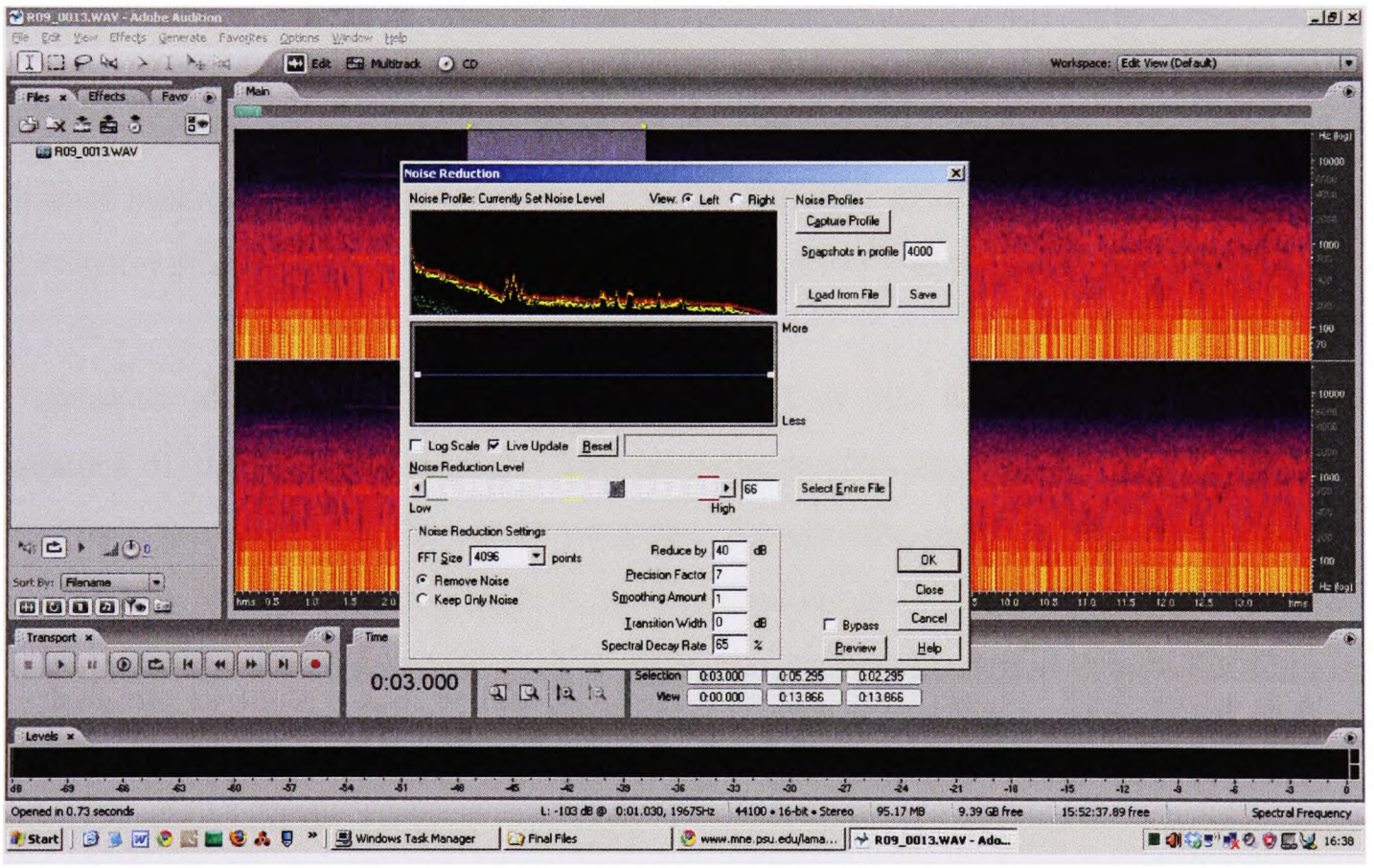


Figure 4-9 : Audio file noise print filter

A threshold can be set to adjust how much filtering occurs. Generally this method can be effective at low levels of application, but the higher the level the greater the impact it has on the speech. In some instances, selective filtering of certain frequencies was required. This process involves applying selective notch filters either throughout the whole file or at certain instances to remove certain consistent and tonal sounds, e.g. background traffic.

With some of the sound files, there were problems with the recorded signal being clipped due to sudden loud noise events occurring during the interview, for example, emergency vehicles etc passing by. This resulted in the file being heavily clipped to remedy this problem the Adobe De-clipping process was used. This process attempts to reduce the amplitude of the affected area, and interpolate samples using previous and next samples in the sequence as a guide, as to the correct waveform.

The soundwalk files were recorded in wave (.wav) format at 44 kHz. To transfer the files to a transcription service, smaller files were required for internet transfer. To achieve this .mp3 format files were generated at 1/10th or 0.1% of the size. Mp3 encoding make it possible to generate small file sizes using a lossy compression technique based on psychoacoustic modelling.

4.5 Soundscape Simulator Experimental Method

The soundscape simulator enables the participant to have the ability to manipulate the soundscape via a panel of controls. Participants are able to change level, position, reverberation and frequency content of a sound source, as well as add and remove different sound sources from the soundscape. The soundscape simulation concept is different from the traditional method of auralisation (Kang, 2007a; Lundén, *et al.* 2010), and is based on the manipulation of real world sounds recorded in-situ, against a background ambient track.

The simulator differs from an auralisation method in that it does not try to model the parameters of the space or perform any acoustic modification to the sound sources, but instead uses the sounds as they were recorded. By utilising the soundscape simulator for a 'location', it is possible to see if there is any correlation between the parameters of a group of participants, and their expectation of that space. The following section details the soundscape simulator methodology. The methodology is broken down into two distinct parts, these comprise of field recordings and simulation testing.

The use of the term location in this section refers to St Ann's Square, Manchester and Soho Square in London as well as an 'idealised' soundscape simulation. The 'idealised' soundscape simulation uses the same methodology as the 'real' simulations, but with a greater number of sound sources, i.e. 16 sound sources instead of 8 in the first instance. These sound sources are based on data extracted from soundwalk interviews.

4.6 Phase 1 - Field Recording

Field recordings for the simulator involved recording specific sounds highlighted from soundwalk data, as well recording ambient background recordings with a minimal amount of sound sources occurring as possible, to provide a base line. The mono recordings were made as close as possible to the sound source so as to isolate the sound from the background noise. Recordings were made in the locations visited on the soundwalks the recordings were made throughout the day to get an ambience with the least amount of activity, and also throughout the year to get a wide variety of sources.

The field recordings in London and Manchester took place over between 2008 and 2009, and over the course of a complete day, to ensure each of the locations was thoroughly recorded. These recordings would be used as the basis for the sound sequencer, and provide material for subjective/focus group listening in the laboratory.

It was originally thought that the sound recordings would be taken at the same time as the soundwalk field work. This process occurred during the initial phase of soundwalks, but did cause some problems, as it is necessary for someone to be recording the soundwalk (the interview) at the same time. Therefore, stationary recordings were made between soundwalks. Field recording varied in length from a few minutes to up to an hour for ambient recordings. Ambient recordings were made at times where there was minimal activity occurring in the location, to provide a baseline on which to base the simulation. With minimal activity occurring in the soundscape, it is the possible to add and remove sound sources to this base. Generally, these recordings were made very early in the morning or late at night.

The recording methods used included, Sound-field (ambisonic), binaural, stereo and spot recordings (mono). Studies have shown that Ambisonics and binaural (dummy head recordings) (Guastavino & Dubois, 2005) provided the best results for ecological validity, and so Sound-field was to provide the recording method for the ambient background recordings, and mono recordings were made for individual sound sources. Additional stereo recordings were made of ambiences.

4.7 Field Recording

After highlighting required sound sources from the soundwalking analysis, field recordings of these sources were made. The following equipment was used in making the field recordings and reproducing the recorded material.

For field recording:

- Edirol R-4 Portable location recorder for Ambisonics recording
- Zoom H2 and Edirol R-09 Portable Recorders for interview and mono recordings
- Sound Devices Mixpre 2-channel preamplifier
- Soundfield ST250 B-format microphone
- Rode NTG-2 Shotgun microphone
- Tripod
- Sony MDR-7506 headphones
- CEL Sound Level Meter.

For playback:

- 8 x M-Audio BX-8A monitor speakers,
- Mark of the Unicorn (Motu) 896 HD 8 channel soundcard
- 8 Channel M-Audio Firewire soundcard,
- Sonar 6.0 0 Digital Audio Workstation (DAW) software for audio playback,
- Behringer FCB-2000 controller for participant manipulation
- Matlab for decoding the b-format ambisonic files.

Playback took place in the semi-anechoic chamber and listening room facilities at the University of Salford.

4.7.1 Phase 2 – Simulator experimentation

The following section details the soundscape simulator experimentation methodology.

4.7.1.1 Participant recruitment

Participants were recruited by the Positive Soundscape Project researchers. Recruitment was conducted in a similar manner to that of the soundwalk participants, including advertising on the University of Salford's intranet, personal contacts, and a student groups. Participants were not compensated for their participation.

For the main test 16 participants were recruited. All were in the 20-37 age group, and were all Salford University students. The simulator was also tested on a smaller group prior to the main test, this consisted of a group of 9 school children aged 13 to 14 and 11 adults in the age range 23-34.

As with the soundwalks, written consent was required from all participants and the same confidentiality and anonymity was explained to all participants before the start of the experiment. The experimentation took place at the University of Salford. The duration of each session was approximately 45 minutes.

The soundscape simulator was also used with design professionals at a special session in London, to gain feedback for its use as a potential design tool.

4.7.1.2 Simulator configuration

An ambisonic reproduction system was used for the reproduction of soundscape field recordings made with the Soundfield ST-250 microphone, using a 'pantophonic' or horizontal ambisonic plane. This reproduction system allowed the participant to experience the spaciousness, clarity and localization features of the recorded material (Marentakis & Brewster, 2010). Two off-the-shelf computer based digital audio workstation (DAW) packages were used as the basis for the soundscape simulator; these were Sonar 6.0 from Cakewalk for PC (Cakewalk, 2009) and Logic Studio for the Apple Mac. The reason for cross platform support was to enable the simulator to be used by other researchers on different hardware platforms.

The simulator required a number of specific features which are standard in both of the selected packages. These features are: playback of multiple channels of audio; the configuration of multiple speakers; and the acceptance, recording and playback of midi automation parameters. All of these features were available in both packages, and therefore switching between them did not cause any problems, as the configuration is performed in a similar manner in each. Another reason for the choice of DAW package is the implementation of a plug-in architecture.

A plug-in system allows for software to be written for additional DSP, measurement or display purposes, and loaded into the signal path in the DAW, without having to add any additional code to the DAW. This feature provides the ability for more control and processing of the soundscape to take place. The flexibility also allows future possibilities and expansion of the simulator to take place. Sonar supports Steinberg's Virtual Studio Technology (VST) (Steinberg, 2009) and Microsoft's Direct X (Microsoft, 2006) plug-in architecture, whilst Logic supports Apple's Audio Units (AU) (Apple, 2009).

A Behringer BCR-2000 Midi controller was used to manipulate the chosen parameters in the DAW. Midi (Musical Instrument Digital Interface) is a music technology industry-standard protocol defined in 1982 (MIDI Manufacturers Association, 1982). The MIDI protocol enables a wide variety of musical instruments and computers to communicate and synchronise with one another. In particular for the soundscape simulator, it allows the DAW and controller to exchange midi event messages. These messages allow the control of almost any parameter in the DAW. In this thesis, the simulator parameters under investigation were level, surround panning, sound selection, filter cut off and reverberation time and level to control spaciousness. The choice of these parameters was to link the work to that of Kang and acoustic comfort (Schulte-Fortkamp & Nitsch, 1999; Kang, 2007b), and the main premise that level and sound sources reflect that nature of the space, and that as stated sound level may not have a direct influence of the perception of the soundscape.

Parameters in the simulator are set by using the 'midi learn' or 'remote control' feature in the DAW, this process involves selecting the parameter on screen which needs to be controlled and right clicking to select the 'remote control' window. Clicking the 'Learn' button and then turning one of the controls on the controller surface, a midi message is sent to the DAW and a controller (CC number) ID is assigned to the parameter. Once the controller is assigned to a parameter, parameter data can be recorded as automation tracks within the DAW.

4.8 Playback

The Soundfield microphone system uses first-order Ambisonics or B-format, where the output from the microphone is encoded into four discrete channels. These channels are referred to as W, X, Y and Z, similar to the X, Y and Z axes on a Cartesian graph. The aim of this reproduction method is to reproduce a sound field with 360° localisation in the horizontal plane with the ability to add height information. For the soundscape simulator a 360° horizontal ('pantophonic') system was set up; further work on the simulator could enable this to be expanded to a full sphere ('periphonic') setup up at a later point.

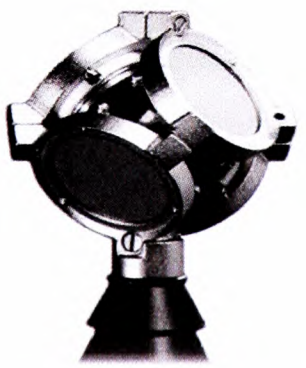


Figure 2- Soundfield Microphone Capsule

The W channel provides the general mono level of the signal, which relates to the equivalent output of an omni-directional microphone. The other channels (X, Y, Z) contain the directional components. This is known as a B-format signal, which is based on a spherical harmonic decomposition of the soundscape being recorded.

The W component is composed from using an implied omni-directional microphone and the X, Y and Z components are composed from implied figure of eight microphones. In this instance, the X component can be considered as a 'front and back' polar pattern of figure of eight microphone. Likewise, the Y component as the 'left and right' pattern and the Z component as the 'up and down' pattern.

The ST-250 Soundfield microphone achieves these microphone configurations (and many other possible combinations) by utilising four matched and near-coincident sub-cardioid capsules. Each of the four capsules is mounted on the face of a metal tetrahedron; this can be seen in Figure 2- Soundfield Microphone Capsule.

The outputs from the microphone, which are collectively known as Ambisonic A-format, can then be combined to create any microphone directional response. Due to the issue of coincidence errors, caused by the microphones being positioned on the faces of a tetrahedron, the output from each of the microphone are corrected electronically using a control box. The combination of omni-directional pressure and 3 x figure of eight directional velocity responses selected on the control box produces B-format. The B-format signals can then be derived using the microphone outputs form the A-format signals which can be labelled as follows:

- LFU = Left Front Up
- LBD = Left Back Down
- RFD = Right Front Down
- RBU = Right Back Up.

To obtain the B-format signals the following signal addition and subtraction is used (Gerzon, 1973).

- W = LFU + RFD + LBD + RBU
- X = LFU + RFD - LBD – RBU
- Y = LFU - RFD + LBD – RBU
- Z = LFU - RFD - LBD + RBU

4.8.1.1 Setup and cabling

The eight loudspeakers for the pantophonic setup were arranged in a circle formation as shown in Figure 4-10. The speakers were places at a distance of 1.5m from a fixed central position; this position was also used to measure the angular position.

The most effective method to achieve this was to insert a nail into the floor and use a piece of measured string to firstly locate the speaker angular position and then to move the speaker to the correct distance. Measurements were taken from the central position to the edge of the speaker enclosure. The same method was used to ensure that the speakers were also at the same height.

Once the loudspeakers were correctly positioned, the system was calibrated using the pink noise to ensure that each speaker was playing back at the same level. A pink noise .wav file was placed on each track of the 8 channel reproduction system and a sound level of 76dBA measured at each speaker using a sound level meter.

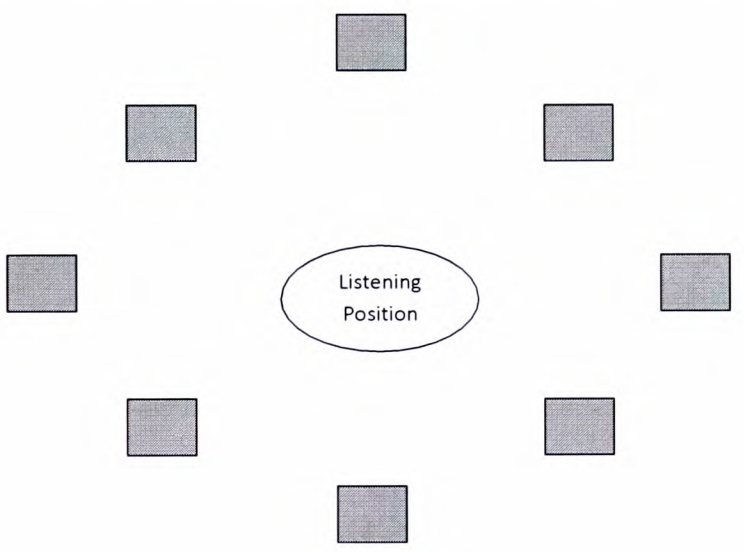


Figure 4-10 : Ambisonic Loudspeaker Arrangement

A major advantage of ambisonic reproduction is that the speaker configuration is not required at the encoding stage. It is during the decoding process that the number of speakers and their angular position is required. This is so that the B-Format signals can be combined together with the set formation to accurately reproduce the correct spatial cues of the original sound field. The field recordings .wav files were transferred via USB from the Edirol recorder on to the Sony Laptop. The W, X, Y and Z components were then loaded into a Matlab™ script, and each of loudspeaker signals were derived by decoding a combination of these four channels, using equations developed by Gerzon (Gerzon, 1973).

$$V_{LS} = W + \sqrt{2}\,(X\cos(\alpha) + Y\sin(\alpha) + Z\sin(\beta))$$

Where V_{LS} is the loudspeaker signal and α and β are the respective horizontal and elevation angles of each loudspeaker. In the first test involving pantophonic reproduction the Z component was ignored.

The output from Matlab produced eight .wav files relating to each of the speakers, which were loaded into their relevant position within Cakewalk's Sonar DAW application. A template was designed to route each track to an individual output on the MOTU 896 soundcard, which in turn was routed to an individual loudspeaker.

Figure 4-11 : Picture of ambisonics setup in semi-anechoic chamber

Additional pictures of the simulator are provided in appendix F.

Setting up the simulator required each of the sound sources to be loaded into individual tracks within the DAW. Once each sound source is loaded into the DAW, it is 'dragged' and 'dropped' on the relevant track. At this point, the sound source is played back and the level is calibrated, using the track level control in the daw to ensure that it is set to the same level as the level recorded in the field, using the measured SPL values. This process is then repeated for each of the subsequent sound sources. With all the sources in the DAW, each of the tracks are initially muted to enable sources to be added to the soundscape being designed, rather than taken away from. The sound sources are then positioned using the surround sound panner built into the DAW. The sources are positioned roughly in the same locations as there were in relation to the centre of the location.

4.9 Soundscape simulator timing

In the development of the sequencer simulator it was necessary to get an indication of a suitable time for soundscape playback. To achieve this, an experiment was devised to test participants for a preferred playback time, by playing a number of different soundscape recordings to the participants. The participants were told to stay 'stop' when they had felt that they had heard enough of the soundscape. Results of this experiment showed that two minutes was the average time for soundscape engagement. This result provided the basis for the simulator loop time.

4.9.1 Experiment 1 - Sound Source Selection

The first simulator experiment used sound sources highlighted and recorded in the specific soundwalk locations; each sound source can be listened to in context with the background ambient soundscape or isolation of the ambient soundscape. The participant is able to select or deselect the sound source using the buttons on the controller highlighted.

For example, the following sound sources were used for St. Ann's Square:

- Big Issue Seller call,
- Cleaning Machine,
- Bell from nearby Clock tower
- Footsteps
- Loading rubbish
- Passing car
- Traffic light warning signal
- Bird song (Pigeon – Sparrow –Wagtail mixed together)
- Acoustic Music (Pachelbel's Canon)

The choice of these sounds arrived from data extracted from participants' comments made during the soundwalking process, as sounds that were heard in the real location. Whilst some sources were not explicitly referred to by name but by a higher semantic descriptor, e.g. music or bird song, these sources were recorded in the location relevant to what was described. After listening to each of the individual sound sources, the participant was asked if they wished to include or exclude the sound source from their soundscape simulation. The following questions are also presented at this point.

- Why did you choose to include/exclude this sound?
- Would you expect this sound to be present in this location?

There is a possibility the participant will not know the actual location of the simulation, but will be given an outline of the location, e.g. a green square in London, with buildings on each side.

4.9.2 Experiment 2 – Source Level Adjustment

Once the source sounds have been selected the participant was asked to adjust the level of each sound source in relation to the 'ambient' track and to a level which they think is acceptable. In this experiment, the use of all sound sources is an attempt to investigate levels which participants set for sources which may not be 'accepted' in a space, but are actually present. The experimental methodology described below will be the same for both parts described above.

Firstly, the participant was asked to adjust the overall global level of the ambient track using the controller. The initial global level presented to the participant was calibrated to the dB(A) level recorded at the time the ambient recording was made. The calibration method will be applied to all sound sources. The calibration not only enables an investigation into the levels that participants find acceptable for the ambience and each of the individual sound sources, but also the relation between levels acceptable for each of the sources.

The participant was able to adjust the overall global levels at any point during the experiment, should they wish to. This data was recorded as automation data within the DAW and was analysed at the end of the experiment. This method allowed for an accurate simulation of background to foreground (Sonnenschein, 2001 ;Dubois & Guastavino, 2006) sound level relationships, where the participant may initially set a background level in isolation but wish to adjust these once additional sounds sources are added to the soundscape.

Figure 4-12 : Sound source level adjustment

The participant listened to all the sound sources and adjusted the levels for the individual sources. The section of the controller used to adjust levels is in Figure 4-12, participants were informed at the beginning of the experiment how to adjust the sound levels, and were given instructions on which controls related to which experiment.. The material was looped as many times as it is necessary for the participant to be satisfied with their levels.

4.9.3 Experiment 3 – Source Positioning

This experiment investigated source positioning within the horizontal plane1. The participant was asked to position each sound source in a 360° horizontal plane. As the sources are mono sources, the control parameters which are being manipulated are 'angle' (angular position from 0 to 360°) and 'focus' (distance position from central point). Each control is independent and has the same level of control as the other.

Each of the sound sources was controlled using a spatial 'panner' built into the DAW, the 'panner' is assigned to each source channel, and the source then manually positioned to a place representative of it's location within the actual environment. The 'panner' controller uses a inverse square panning law to reduce the level of the source as it's focus is changed.

4.9.4 Experiment 4 – Spaciousness

This experiment aimed to examine the importance of perceived spaciousness of the soundscape. This method uses a convolution reverberation plug-in with a suitable impulse response for the simulated locations. The effect was used in a simplified way to control, wet/dry mix of the signal and the amount of early reflections in the soundscape.

A convolution reverb plug-in is assigned to each channel and the relevant impulse response loaded. The controller is assigned to the wet level of the signal and the amount of early reflections

4.9.5 Experiment 5 – Low frequency cut-off

The aim of this experiment was to investigate if there is a correlation between a participant's acceptance of a soundscape, and the removal of low frequencies from the soundscape. A high pass filter plug-in was inserted across the main output channel in the DAW which feeds each of the eight loudspeakers in the ambisonics configuration. The filter is set to have a steep drop off set at -24dB per octave. The filter frequency was initially set to the lowest point in the software which was 10 Hz. The controller is then set to control the filter frequency and the participant has the facility to sweep up and down the frequency range to the point they feel satisfied.

4.9.6 Experiment 6 – Global level adjustment

The aim of this experiment was to determine if participant set similar overall levels when asked to set the level that they felt was acceptable for the overall soundscape. Similar to previous experiments, a control on the controller is assigned in the DAW via midi learn to control the global level of the soundscape. The participant was asked to set the level to the level that they preferred.

On completion of the listening tasks, the participant provided demographic data and was free to ask any questions about the task and give their opinion on the method.

4.10 Conclusion

In conclusion, the methods developed for this thesis provide new ways to combine inter-disciplinary research methods in attempting to understand a participant's expectation for a given soundscape, by building on and enhancing existing methods, such as soundwalking. Each methodology has strong merits in soundscapes research, as well as the means to be developed further. The next chapter in this thesis details the results obtained from the three separate investigations: soundwalking; focus group interviews; and the soundscape simulator.

5 Results

5.1 Introduction

In this chapter, there will be a discussion of the results obtained from the presented research work and how these results relate to central question of expectation and the perception of soundscapes. This chapter will detail the results from the soundwalks, focus groups and the laboratory soundscape simulation experiments, and show how the results from the different methods employed inform one another as part of grounded theory methodology. The analysis of the results will then be combined to provide a model of expectation and its influence on soundscape perception.

5.2 Overview

The results are presented in three sections; results which relate to the qualitative soundwalking aspect of the project, results which relate to the quantitative simulation aspect of the project and a section which combines both of the two data sets to provide a final conclusion on the presented research question, and overview of this is provided in Figure 5.1. Details are provided on how the data was analysed and how inference was constructed from the data, and in addition to this, how the data corresponds with findings from the existing literature. The results are presented in an order which relates to the structure detailed in figure 4-1.

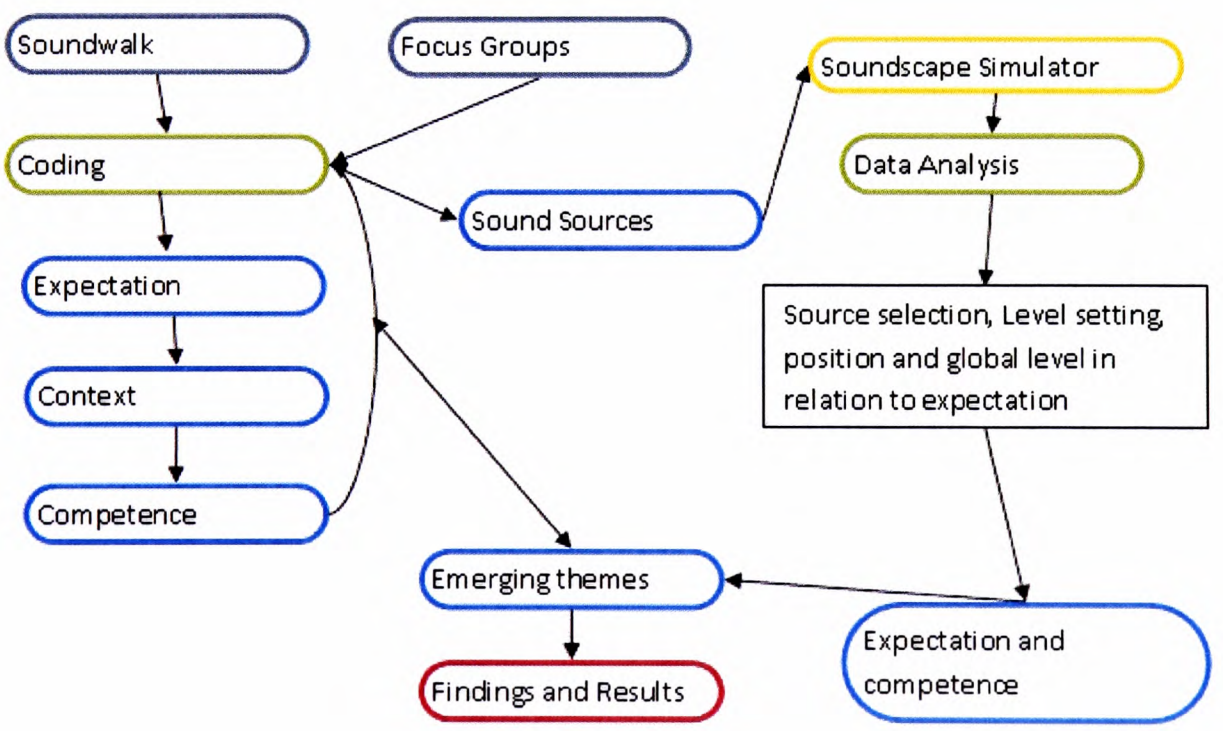


Figure 5-1 : Results general overview

The first section details the data analysis process applied to the qualitative field work, and shows how data from the soundwalks was used to inform focus group question development and the soundscape simulator.

5.3 Soundwalk Data Analysis

In this section, there will be a discussion of how the data collected for this thesis was analysed. The reasoning behind the chosen methods of analysis will be identified and it will be shown how this analysis links to the main objective of the work. In particular, how data from soundwalks carried out as part of the Positive Soundscape Project, were initially analysed as part of a grounded theory methodological approach to inform and develop themes and codes for the analysis of the subsequent soundwalks and focus group interviews. There will also be an explanation of how the soundwalk interviews were coded to develop themes relating to a participants expectation of a space and how this expectation impacts on their perception of soundscape that they find acceptable in that space. The results will also show what the expected elements within that space are, and how qualitative data was enumerated from the soundwalks, looking both at binary response questions and from the codes themselves.

Qualitative data analysis (QDA), as described in Chapter 4, was used to examine the meaning and symbolic content of the soundwalk data. The analysis of the transcribed soundwalk data attempts to identify themes relating to competence, expectation and context within the soundscape. Themes are extracted by examining a participant's interpretation of the soundscape, and the justifications for the responses given. The process of qualitative data analysis primarily involves the identification of themes relating to expectation, and then analysing the underlying reasoning applied to the themes extracted. Codes were then applied to all the data and the resulting analysis was derived.

Interviewing participants using an open-ended questionnaire format allowed the exploration of meaning (Kidder & Fine, 1987) within their answers. It is accepted that by using this constructionist epistemological approach (Burr, 1995), that the results may never be a true indication of environmental conditions, which could have been measured at the same time, but instead the analysis provides a complete picture of a participant's perception of a space at that specific time. Interviews were recorded using an audio recorder during each soundwalk and then transcribed at a later stage.

5.3.1.1 Coding

The following section describes how qualitative data analysis was undertaken and applied to the data collected from the field work and focus group interviews and how results were interpreted from the analysis. Coding is the process by which themes within the data are examined and extracted, for example examining any themes or trends in the words used to describe a space on the soundwalk. Participants' interview transcripts were read and analysed by coding each relevant sentence looking for connections relating to a theme, or for the development of a new theme. The analysis of the data was conducted on each interview transcript in sequence, but when new themes or categories were formed from a transcript, the previous interview transcripts were revisited for evidence or further insight of the newly identified theme.

The first phase of data coding applied a-priori codes to the data and also extracted additional rough themes which would be applied at the next stage of coding. The first phase of coding was also a time to read through the data and gain an understanding of the reasoning behind the responses provided by the participants in response to the interview questions. The reading process also allowed for an insight into the nuances in the data to be achieved. Coding was initially carried out using the AtlasTi software, as detailed in Chapter 4. During this initial coding phrase, it was decided that the traditional method of coding, using printed transcripts of the data and highlighter pens was a more effective method of analysing the data. Whilst the AtlasTi software provided a comprehensive feature set, and the quick production of multiple versions of analysis, it was felt that being able to physically manipulate the data, as well as write appropriate notes on the transcripts was much more effective in the longer term. The data collected using the pen and paper method was then entered into a Microsoft Excel spreadsheet, for further analysis and the production of graphs. An example of a complete coded transcript is provided in appendix C.

The first series of themes developed and coded were from the soundwalks carried out as part of the Positive Soundscape Project. The Positive Soundscape Project soundwalks were longer in duration, with questions which were relevant to other areas of research being conducted as part of the larger project. A number of questions relevant to this research work were included, these included questions around expectation, and competence of the soundscape and environment. The analysis of the data from these soundwalks was then used to inform the soundwalks carried out as part of the presented work. The time taken to undertake a PSP soundwalk was between one and a half to two hours.

The soundwalks relating to this work were shorter in length, lasting forty five minutes and focussed on themes which were more relevant to expectation and competence. The reason for shortening the soundwalk was to allow the research to concentrate on spaces which the PSP soundwalks had shown to either have a strong context or provide interesting anomalies between participants. Additionally, the walks were also shorted to take a more feasible amount of a participant's time.

Themes arising from the first PSP soundwalks are given in Table 5-1, and they relate to both the London and Manchester soundwalks. These findings were based on thematic analysis for the interview transcripts, which was primarily focused on positivity and experience of the soundscape, relating to the overall project. There was also inclusion of factors which related to this work. The PSP data was still of use to this work, as it included attitudes and experience of the same spaces, which could be thematically analysed in line with this work, exploring themes present in both.

Ideas around the themes of control and choice began to emerge from this work, and were something which was then applied to later soundwalks. These themes arose from the analysis of expectation, and the factors which contribute became apparent were extremely important in the perception of the soundscape of the space. The following themes were applied a-priori to the transcripts, and relate to the research question, and the themes extracted from the initial soundwalks. Throughout this process further themes were extracted, and these are presented in the next section.

Theme	**Participant Input**	**Inductive Category**
Users of the space	Who is using this space?	Context
Expectation of the space	What do I expect in this space?	Expectation
Purpose	What is the space for? What is it being used for?	Context
Feelings towards the space	How does this place make me feel?	Mood
Description of the type of space	How would you describe this space?	Context
Feelings towards users of the space	What impact do users of the space have on me?	Mood
Control in the space	Can I leave? Would I leave?	Control
Choice	Did I choose to be here?	Control/Behaviour
Auditory	Description of the sources	Semantics
Auditory	Description of the soundscape	Semantics
Visual	description of the buildings	Competence
Visual	descriptions of the surfaces	Competence
Aural Competence	Effect that built environment had on soundscape	Competence

Table 5-1 : Themes extracted from PSP soundwalks

5.3.1.2 A-priori themes

The themes which were applied and searched for first related broadly to the key research questions and concepts extracted from the literature. These themes were related to what constitutes expectation of a space, does the space match the expectation and competence of the environment.

The other a-priori themes related to the concept of context as suggested by Botteldooren (Botteldooren & De Coensel, 2006), and a participant's subjective perception of the sound level. These a-priori themes were as follows:-

- Expectation – Does this sound as I expected?
- Users – Who uses this space?
- Expectation Matching – Does this sound match my expectation?
- Competence – What would I expect this place to sound like?
- Psychological perception – Is this space quieter or louder or as I would expect?
- Purpose of space (context) – How would I define this space?
- Purpose of space (usage) - What is space used for?
- How do I feel in this space?

During the coding of these themes, notes were made of potential new codes and areas which further extended the analysis of the data. These new or extended codes were applied during the second phase of coding.

5.3.1.3 Extracted themes

For the second phase of coding, additional themes were extracted from the data, these additional themes were developed and formed from strong indicators in the data that additional factors were influencing the perception of the soundscape. These extracted themes were as follows:-

- Perceived Control – Am I free to move in this space? Did I or would I choose to be in this space? Can I move away or control the sound sources?
- Attitude to space (users) – How do I feel about the other people using this space?
- Nostalgia (remembrance, meaning) – Does this space have any personal meaning to me?
- Mood – How does this space make me feel?
- Mood and expectation – Does my feeling change what I expect from this space?

Along with the a-priori themes, which were expectation, context, competence, i.e. does the space sound like it should? What is different or missing? the additional themes that were extracted further expanded on perceptions of the soundscape which were influenced by additional factors. These factors showed that experience of the space, and thus expectation that a participant may have of a space, moves away from the physical acoustic components of the soundscape, and incorporates physical and emotive associations with the space, which in turn affect how the participant judges the soundscape. Whilst control and mood were not explicitly related to the results on expectation, analysis of the text showed that they were influencing the perception of the soundscape, and as we shall see were linked closely to expected norms for the spaces visited.

After the second phase of coding, thematic analysis stopped and the data was re-processed to assign the results into specific semantic categories. For example, terms which participants used, such as '*from a to b*', '*moving through the space*', were first coded under the 'usage' theme. In this phase all the terms for usage were examined and then coded as '*transitory*' category, for example. This coding stage was important as it enabled an overall definition of a number of the themes; these were then explored to give a general context to the space. Table 5-2 shows the codes used in relation to the themes.

Theme	**Coding Category**
Expected sound sources	Traffic, Construction, People, Nature, Utility, Designed Feature
Description of space	Historical, Open, Oasis, Social, Urban, Garden, Square, Park, Commercial, Junction, Thoroughfare
Purpose of space (usage)	Transitory, Relaxation, Shopping, Socialising
Users of space	General, Workers, Shoppers, Socialisers, Students, Tourists, Diners, People in Transit, Residents
Mood	Comfortable, Uncomfortable, Moving, No feeling, Positive, Negative

Table 5-2 : Themes and associated categories

With the themes and categories in place it was then possible to examine the whole data set, extracting subjective examples and also performing frequency analysis on the text. These results showed a narrow range of terms used to describe the expected sounds as well as how the spaces generally sounded as the participant expected. In terms of the context of the space, a limited range of terms was used often to define the space context, and thus as the questioning was open and with no direction from the interviewer, the fact that there were a limited number of terms meant that it was possible to show that spaces were seen to have context.

This is a key finding, as it shows that there is a well defined set of contexts, which are few in number, and it may therefore be possible to design a space which meets a context, relating to expectation, although it may not be possible to design a space from scratch to fit a specific context. Conversely, it is possible to design spaces of interest which do not fit a context, if creating spaces of interest is a design criterion.

5.3.1.4 Focus Group Analysis

The focus group transcripts were processed in the same method as for the soundwalk interviews. The a-priori and extracted themes from the soundwalks were used to the code the focus group transcripts. Focus groups were undertaken as part of the larger Positive Soundscapes Project, and this determined the questioning route for the sessions, but it was possible to introduce themes relevant to this work in to the questioning of the participants. The main focus of interest being explored with the focus groups was how participants understood what was meant by a positive or negative soundscape. The focus groups featuring older participants and younger adults had the same questioning route, but the route of questioning was changed for the hard of hearing group and expert group. In these groups, participant specific questions were asked, to gain an insight into soundscape related issues which were relevant to these groups.

5.3.1.5 Focus Group Results

The focus group sessions were different from the immersive soundwalks, and as such there was no real world soundscape perspective, thus the results were given in isolation from the actual soundscapes under discussion. This situation meant the participants were relying on memory, and memory of experience of the real world. As such, a degree of disconnect had to be considered when evaluating the results. Conversely, removal of immersion in the soundscape meant that concentrated discussion about the actual experienced soundscape was replaced with more considered answers not just about the acoustic elements of the environment which affected the perception of the soundscape. The other difference with a focus group approach is that the nature of the process involves group interaction, this is a major difference from the soundwalk, where it was only an individual on the walk, and there was no chance for interaction to change their thought process.

The focus group analysis, alongside the soundwalk analysis, allowed for corroboration of influencing factors surrounding perception, and how they were linked to expectation and competence. The focus groups produced several categories which were identified by all groups as factors which are used to evaluate a soundscape.

These factors also suggested that they play a part in how a participant evaluates the soundscape as either positive or negative, or as wanted or unwanted. Evaluation of the soundscape as positive or negative was deduced from the soundwalk data, but the question of wanted or unwanted was not addressed, but rather a question of whether the soundscape is noticed or un-noticed.

There was no indication from the focus groups, as with the soundwalks, that the age of the participant played a role in the evaluation of the soundscape, components of the environment which were discussed and were revealed to annoy older people were generally identical in nature to those elements which annoyed the younger group. Exploration of these factors showed, as with the soundwalks, that other psychological factors and contextual judgements, such as users of the space and attitudes towards the users were what affected a participant's evaluation of a soundscape. Due to the grounded theory approach taken, it was possible to further examine emerging themes from the soundwalk analysis, factors which were also explored were social norms, perceived control and behaviour and context. The first theme coded from the data related to expectation, this showed the relationship between expectation and competence of the participant.

The data analysis of the soundwalks aimed to show the link between expectations prior to emersion in the space and during the real experience of the space to see if it matched. A match would show competence in the participant by illustrating their prior knowledge of the space, whilst the focus group analysis tried to gain an understanding of what non-immersive expectation is and if there is any relation to the analysis from the soundwalks. Competence is further explored by the examination of the explanations given and understanding implied by participant's answers to the questions. Competence can be shown to exist when a participant reinforces their answers by further exploring elements and understanding which relates to the space at that particular time. Competence is also shown to relate to an understanding of the acoustic of a space, based on the physical layout of the space, whilst participants are generally unable to fully express their competence in actual acoustic terminology, there is a basic understanding of simple concepts, such as echo or sound insulation.

Competence has a close relationship with expectation, and is shown to comprise additionally of a participant's expectation of the place norms, which incorporate the users and the purpose of the space. The results show that the spaces selected and visited match with the participants predetermined expectation for the space, based on its context, where context is made up of a

combination of purpose, usage, and users. The data analysis is broken down in to sub-sections relating to expectation, competence, context, mood, control and behaviour. Analysis of the linkage between them explored at the end of the section.

5.3.2 Expectation

Determining the effect of expectation is the prime aim of this work. The questions around expectation, relating to if a soundscape sounded as the participant expected, if their perception of the level was quieter, louder or as they expected, and discussion of what was in the space that was as expected, or not were key in producing the data for this work. The results show that expectation is an inter-relationship between standard patterns of behaviour, structure and the physical space. This interrelation is based on the competence and expectation of the knowledge that once a participant knows the 'purpose' of a specific space, or what Botteldooren calls context, e.g. church, library, urban square, busy street, then there is also an expectation of the standard behaviour or social norms of the people in that space.

5.3.2.1 Sounds Expected

The following section details the sounds that participants expected to hear in an urban environment. The question "*what do you expect to hear in an urban environment?*" was asked at the start of the soundwalk interview, before any consideration by the participant to the soundscape or the spaces to be visited on the soundwalk was given. The reason for asking this question was to form the basis for a participant's competence of the urban environment at a basic level based on sound sources. As the question was asked in the field at the beginning of the soundwalk, it is possible that environmental soundscape features of the start space may have influenced a participant's answers.

To overcome this issue, participant's were moved away from the actual start place to a space which was as sheltered as possible from possible soundscape intrusion, but obviously it was impossible to remove all soundscape features from potentially influencing the participant's answers. Future work will suggest that the participant is asked the question prior to entering the space or beginning the soundwalk, preferably during the initial participant recruitment stages.

Competence is further realised by analysing participant's detailed responses to expectation and the factors which reinforced or countered their expectation. The expected sound sources are also shown to match the sound sources actually heard in the spaces, as described by the participants, this is detailed in the next section.

Table 5-3 lists the sound sources participants expected to hear in an urban environment, from the sound sources listed, it was possible to code the sound sources into discrete categories. The results given in Table 5-3 combine the responses from the soundwalks undertaken in both Manchester and London.

Sound Expected	**Categories**
Traffic, lorries, traffic, rumble of cars, cars, horns blowing, cars, traffic, traffic noise, traffic, traffic noise, cars, cars, traffic, traffic noise, traffic, traffic noise, traffic	Traffic
Work vehicles, road works, industrial sounds, banging, workers drills,	Construction
Shoppers, people, footsteps, chatter depending on time of day, chatter, kids shouting, snippets of conversation, odd word, street musician, people talking (not very loud), Oasis fans, at night drunken people being loutish, loud rude, footsteps, footfalls, human chatter, people, people talking, voices, music, pedestrians making noise, pedestrians, hecklers, people talking, conversations, pedestrians, conversations in various languages, music,	People
Air conditioning, ventilation units, fire engine	Utility
wind, trees blowing, bird song	Nature
Fountains, beeping of road crossings, sirens, sirens,	Designed feature
Echoes, noise, just general noise, (traffic) noise, (pedestrians making) noise	(noise)

Table 5-3 : Sound sources expected in an urban space

The results were combined to show that the sound sources discussed by participants were general and that the description of the urban space is independent of geographical location. This independence suggests competence built on experience of a context, for example, a busy street can be translated to a variety of geographical locations. The data shows that there are six distinct categories which can be formed. The categories were as follows: Traffic, Construction, People, Nature, Utility, Noise and Designed Features.

These categories could be further resolved into human, mechanical and natural sound categories. These categories would match the findings of other researchers, (Guastavino & Dubois, 2006; Dubois, *et al.*, 2006). Recent research has tried to generalise the categorisation of soundscapes into a number of set categories (Niessen *et al.*, 2010). Ultimately, the soundscape categories are based on semantics, and reductionism to allow for the easier application of statistical analysis. The data from the transcript analysis for this work has shown that the categories formed, whilst open to interpretation, relate to the distinct sound sources described by the participants in the field.

Even with a variation in the categorisation, examining the work of Dubois and others, which shows that generally 'natural' sounds are rated higher in preference than mechanical sounds, results from the soundwalks and soundscape simulator in section show this trend in rating. Explicitly this section has shown that seven categories of sound source categorisation are expected in an urban environment, and expanding on these categories shows that there are a limited number of sound sources which are expected in an urban environment. Figure 5-2 shows the results from enumerating the textual answers into the categories described above, the graph shows the sound sources the participants expected to hear in an urban space, and those that they actually heard in-situ.

Figure 5-2 also shows the additional category of noise. The category of noise has been included in the graph, as it does not fall into one of the constructed categories. Noise was used as a semantic descriptor at the end of participant's descriptions of sound sources, such as traffic noise, people noise, but noise was also used as a descriptor in its own right. A semantic difficult arises at it is unclear what is explicitly meant by the usage of the term noise when used on its own. Inference can be drawn on what is meant by the usage of the term, but without explicit detail given at the time, this is not possible.

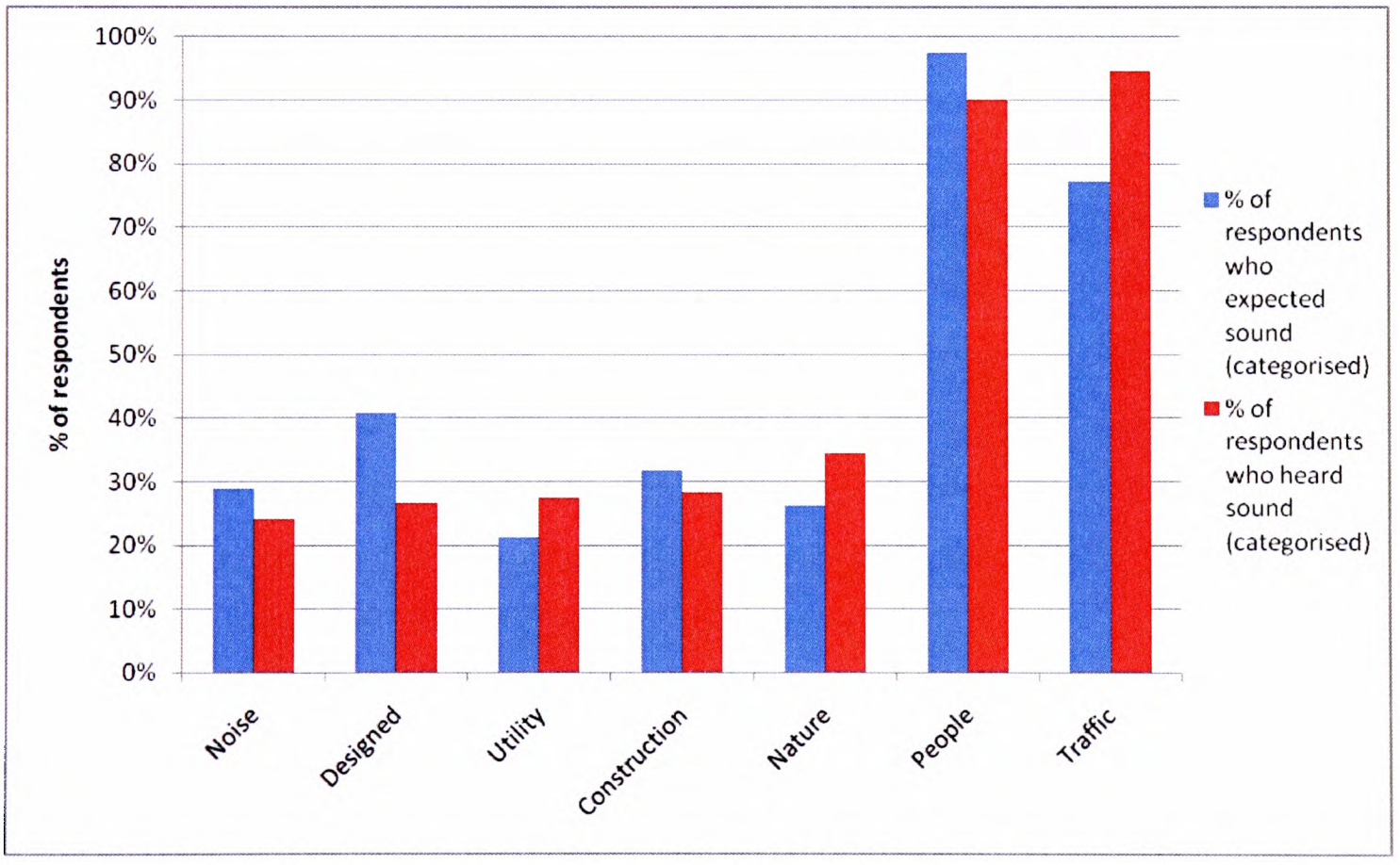


Figure 5-2 : Graph showing sound categories expected in an urban environment and sound categories heard in-situ

Generally, categorisation of sound sources was relatively straightforward, with sources resolving into the broad categories. For example, the use of the term 'people talking', resolves in the category people, and likewise, the use of the term 'air conditioning', resolves to the category of utility, as the sound is emitted by a utilitarian source. Difficulty arose with sound sources such as siren or alarm. The sound of sirens and alarms is difficult to categorise. Sirens became designed features, because they have the ability to be designed at source, they could also fall into the people category as they are used as information, and relate to people based activity, but alternatively could be categorised utility. One could argue that sirens, whilst mechanical, fall into a category of information sound as their existence is to inform people of the presence of an emergency vehicle.

There is also a social implication of sound sources and their effect on the perception of the space, this is important in the case of alarms, which generally relate to an incidence of a criminal activity. Although, competence plays a role, as competence that a participant has of the situation is used to determine the cause of the alarm and it's implication to the person. The same is true of sirens; sirens could mean that a crime is being committed, or that another emergency is occurring. The sound of the siren can have different meanings depending on context; this makes it difficult to align to a set category, although competence will give the actual siren meaning. This means that potential sub categorisation is required when looking at the sources.

Further resolution is probably most obvious in the people category. The people category can be broken down into two sub-categories, these are communication and activity. Analysing the split between the two shows that they break down relatively proportionally, with activity at 44.1% and communication at 55.9%. Further enumeration of the data shows that the general term traffic accounts for the sound expected most closely followed by the sounds of people, with construction, nature and design features not featuring as highly. The enumeration of the data results in a frequency of word usage as follows:-

Figure 5-3 shows the weighting of word usage of the expected sound sources, the weighting is similar of that shown in Figure 5-2, where traffic and people noises are expected most within an urban space. The term noise is also weighted more, but this weighting takes into account only the usage of the each word and not the singular usage of the word, i.e. traffic noise.

Figure 5-3 : Frequency of word usage in describing sound sources

Figure 5-2 shows participants expected to hear a combination of primarily traffic sounds and people sounds, which simplifies into two categories of expected sound for an urban space, where cars, beeping, engineers for example fall into the traffic categories, and people, pedestrians, footsteps, conversations fall into the people categories. Another difficulty lies in explicitly defining when a single car or a few passing cars becomes traffic and when a person speaking becomes chatter. Each is a distinct sound, and would have a distinct frequency spectrum, competence allows for the explanation of defining this difference, where understanding of context and the environment would differentiate the sound source types.

5.3.2.2 Sounds Heard in-situ

The following section details the sounds that participants heard in-situ in each of the soundwalk locations. These results were used to show how sound sources actually heard matched what the participants had expressed in the previous question, to test for a match. The results also show how similar sounds were heard in similar context locations in different cities, again showing that Botteldooren's notion of context is prevalent in the cognition of spaces. The sounds heard were also used as the basis for the sounds recorded for the soundscape simulator.

The categories from the previous section were then applied in the analysis of the sound sources actually heard in the spaces visited, to see if there was any correlation between what were actually heard verses what was expected, a-proiri to the sound walk. The question was asked in the starting space, which may have had some impact in the answers given, but was generalist, asking '*What would you expect to hear in an urban environment?*', rather than a specifically about a context. In-situ, participants were asked, "*What can you hear in this location?*", and specific answers were provided. Comparing the sounds heard during the soundwalk, and the sounds expected prior to the soundwalk, a link can be shown to a participant's expectation of a space, as shown in Figure 5-2. There is also a strong link

between the sounds heard in similar spaces in different cities, this is explored in the next section.

Figure 5-4 Frequency of word usage in describing sound sources on Manchester Soundwalks

Space	Sounds Heard	Categorisation
John Dalton Street	Traffic Jams, Engines, walking, people walking, pulling bags, sound of car/bus, generators/air con, traffic, engines, brakes, background chatter, traffic, conversation, music, drunk people, rustling bags, people, buses and cars, chatter, hum of cars and buses, engines, unloading traffic, cars passing, honking bus, people walking, cars noise, people talking, people walking, cars, traffic, buses, fans, people talking	Traffic, construction, people, utility
Deansgate	Traffic Jam, traffic, people, traffic, people, footsteps, brakes, horns, traffic, conversation, distant united fans, buses, machinery, people walking, people talking, doors opening and closing, coolers, some cars, road being dug up, conversation, people walking, car engines, traffic and buses in background, people chatting, jeep, big car, footsteps, screech of brakes, traffic, people walking, talking, noise, traffic sounds, some people	Traffic, construction, people
Parsonage Gardens	Very quiet, bin truck, people walking, talking, pigeons, background air conditioning, bit of traffic, footsteps, bad muffler on car, cars, air conditioners, people on mobile phones, some traffic noise, some birdsong, wind through trees, buzzing from Deansgate, cars, people steps, rain, Air conditioning units, fans, footsteps, quieter cars, cars, building work, traffic, drone of far away traffic	Traffic, people, nature, utility
St Ann's Square	People walking, possibly an engine, wind, people walking, telephones, rustle of leaves, alarm, children, footsteps, echoes of voices, water, car engine running, conversation, footsteps, people talking, laughing, car sounds, van unloading, fountain, wind rustling, low level chatter, footsteps, water from fountain, car, people walking, footsteps, quiet conversation, fountain, low background sound from the road, water, people talking, odd car, mobile phones, music from shop, peoples footsteps, street cleaner, water, big issue seller	Traffic, people, nature, designed feature, utility

Table 5-4 : Sounds heard in soundwalk locations (Manchester)

Figure 5-5 : Frequency of word usage in describing sound sources on London Soundwalks

Space	Sounds Heard	Categorisation
Tottenham Court Road	Traffic, people, burglar alarms, traffic noise, traffic, people, conversations, traffic noise, buses, traffic noise, sirens, fire engines, busy, building site, engines, people walking, traffic, sirens, people talking	Traffic, construction, people
Soho Street	Traffic, music, people, traffic people, burglar alarms, traffic noise, a radio, people, buses, five different languages, cards, people walking, music in background, man who has been run over, traffic noise, taxi, conversations, cyclist ringing bell, loud music, low level traffic, street cleaner, conversations, building work, fire-truck, people chatting, traffic, idling cars, people talking	Traffic, construction, people,
Soho Square	Hum of traffic, footsteps, construction noise, far away traffic, traffic noise, people, motorbikes, taxis, cars in background, conversations, distant traffic noise, alcoholics shouting, drum, didgeridoo, generator, light traffic, people, drunk man, pump, work men, crows, conversation, faint traffic, church bell, traffic, people talking, leaves rustling	Traffic, construction, people, nature, utility
Phoenix Gardens	Wind chimes, building works, delivery vans, construction noise, cranes, little bit of traffic, traffic noise, construction sounds, people, wind chimes, cars in the distance, construction work, construction site, distant traffic noise, someone pushing a trolley, wind chimes, noise from road, crane, squeal of brakes from a large lorry, youngsters playing, little traffic noise (blocked by buildings), street cleaner, birds, trees and wind in the trees, little bit of traffic	Traffic, construction, people, designed feature

Table 5-5 : Sounds heard in soundwalk locations (London)

Performing a chi-squared test on the frequency of categories usage for the two locations, using a p-value 0.05 produced a result of 0.99. This suggests that the frequency of terms used between spaces is significantly similar. This finding is important as it highlights the similarities between the chosen spaces, and as will be shown later in this chapter, how spaces have perceived contexts. The idea of a space having a context backs up the ideas put forward by Botteldooren (Botteldooren, 2006), and formulates that a context of a space defines the expectation that participants have for that space.

The data analysis shows, as in the previous section, that there are distinct categories which can be formed; these are traffic, construction, people, nature, utility and designed features. These categories gain could be further resolved into mechanical, human and natural sounds, in line with other research, but the categories formed in this work were distinct in their nature, with sound sources described easily by the categorisation. The results show seven types of sound source category that are heard in an urban environment, and expanding on these categories shows that there are a limited number of sound sources which are heard in an urban environment. Enumerating the data shows that the general term traffic accounts for the sound expected most closely followed by the sounds of people, with construction, nature and design features not featuring as highly.

Initially the question '*does this space sound as you would expect*', was asked to form a simple binary response. It was thus possible to assign meaningful numerical values to the qualitative data. This method of enumerating the data has the added advantage of still having the qualitative rich data to enforce understanding, and allow for the new ways of interpreting the data. Ultimately, quantitative data in the form of a Likert scale questionnaire is still based on a qualitative judgement of the question being asked. The quantities being asked about in themselves have no means of interpretation, without making an assumption about what the value relates to. For example if a participant rates a soundscape as 8 on a 0-10 Likert scale, it is not possible to fully understand what this value means, for example, did the participant understand what was meant by soundscape, did a previous question bias their answer, or ultimately, were they selecting the value arbitrarily.

Further to these points, there is a number of possible reasons why the participants chose to select the value of 8, they may not, for example be sure if the scale was weighted, therefore consideration of this data required the assumption that judgements have been made on the part of the participant about what the numbers mean. The principle question of if expectation was related to experience was analysed by comparing if a participant had visited a space and if the space matched their expectation. Figure 5-6 illustrates the expectation verses experience of the spaces visited in Manchester. The graph shows that three of the spaces had been experienced by more than 70% of the participants, and that Parsonage gardens had been visited by 50% of the participants. What is important here is that for each of the spaces visited, there was a 95% agreement that the spaces sounded like they had expected.

This would suggest that experience does account for what a person would expect within a space, given its context, further to this that even without experiencing a space (i.e. Parsonage Gardens) that competence of a person can adapt to provide a interpretation of the space and how it should sound. This result raises the question of if participants always claim that a space may sound as expected, even if they felt that it didn't, analysing the soundwalk data shows that not all spaces sounded as expected, and participants did say when they felt that a space did not sound as expected, this was a particular issue with Phoenix Gardens in London, as the following results show.

Figure 5-7 illustrates the expectation versus experience of the spaces visited in London. The graph shows that three of the spaces had been experienced by more than 80% of the participants, and that only Parsonage gardens had been visited by 40% of the participants. What is important in the London case is for each of the spaces visited, there was a 80% agreement that the spaces sounded like they had expected. This expectation rating is less than that for Manchester, but still high. But unlike Manchester, the results are skew by Phoenix Gardens, where the number of participants who had visited the space, were much less, but also of all spaces visited was the space where the least number of participants thought that it sounded like they would expect, at 25%. Again, these results show that on the whole, experience does account for what a person would expect within a space, with the exception of Phoenix Gardens. The nature of this difference is explored later in this section, but the primary reason do not relate explicitly to the soundscape, but more to a visual mismatch, and also that that space made the participants feel uncomfortable, due to the nature of the space.

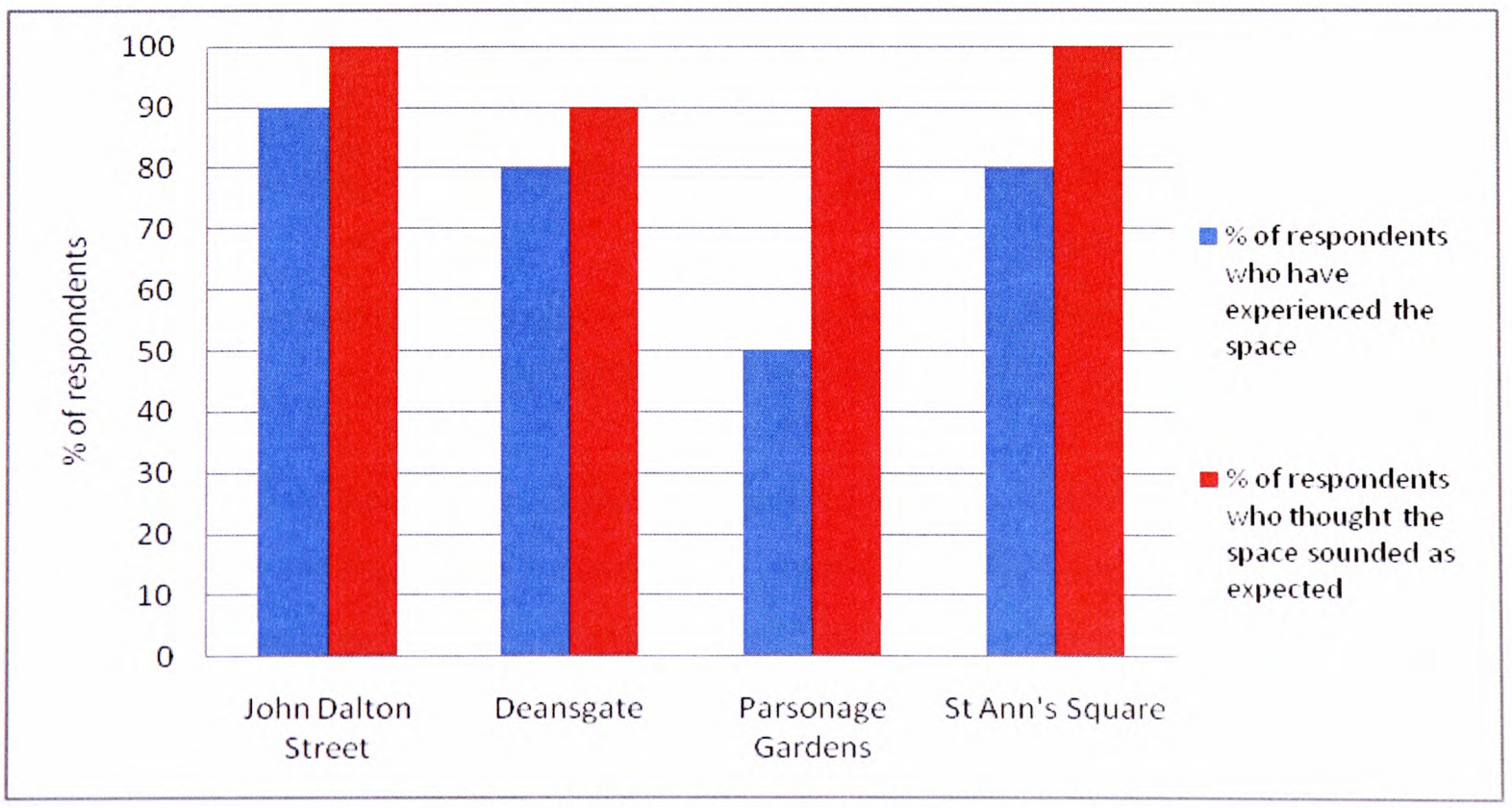


Figure 5-6 : Graph showing the relationship between a repsondent having visited a space and the space matching their expectation in Manchester (%)

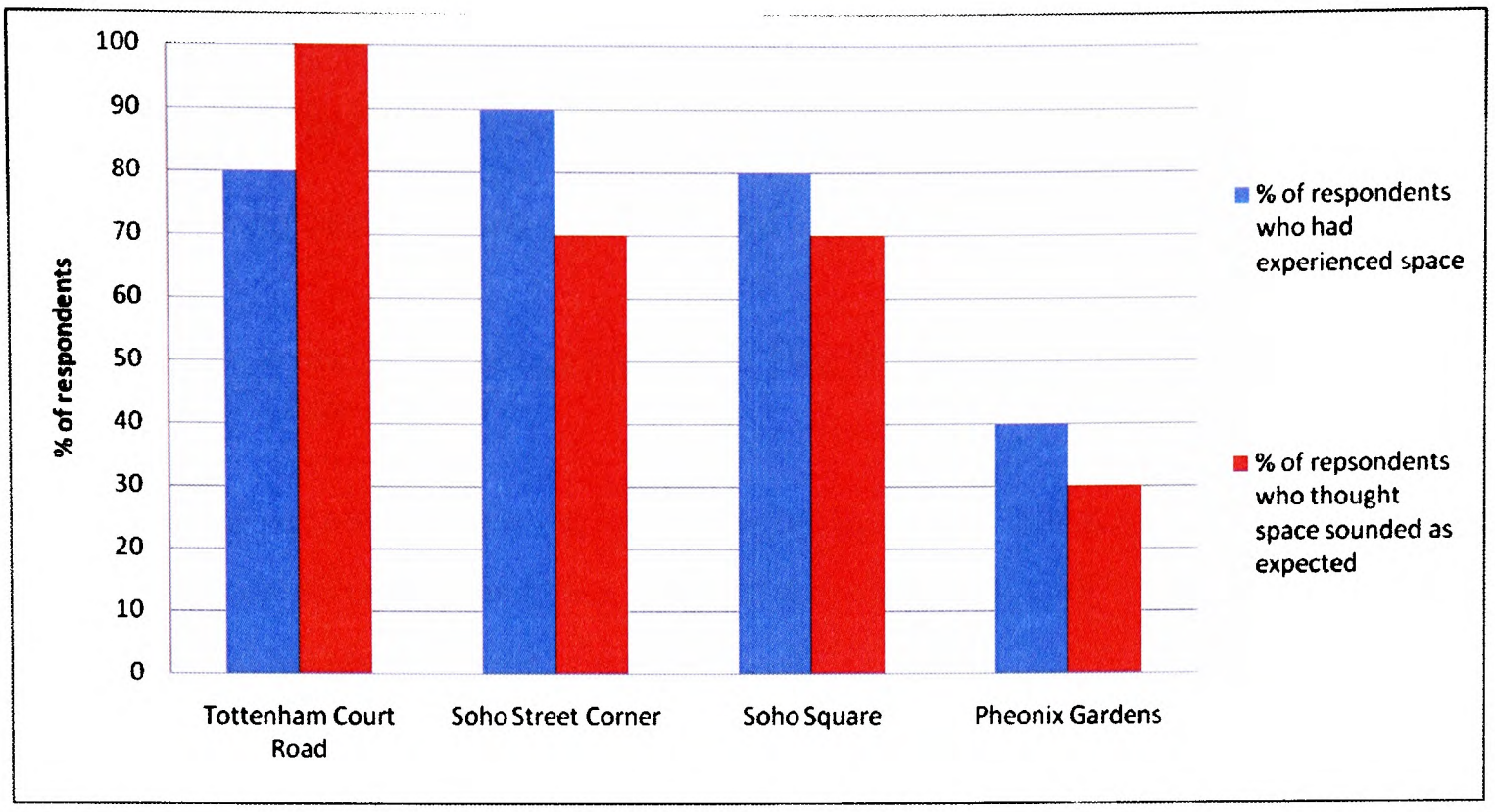


Figure 5-7 : Graph showing the relationship between a participant having visited a space and the space matching their expectation in London (%)

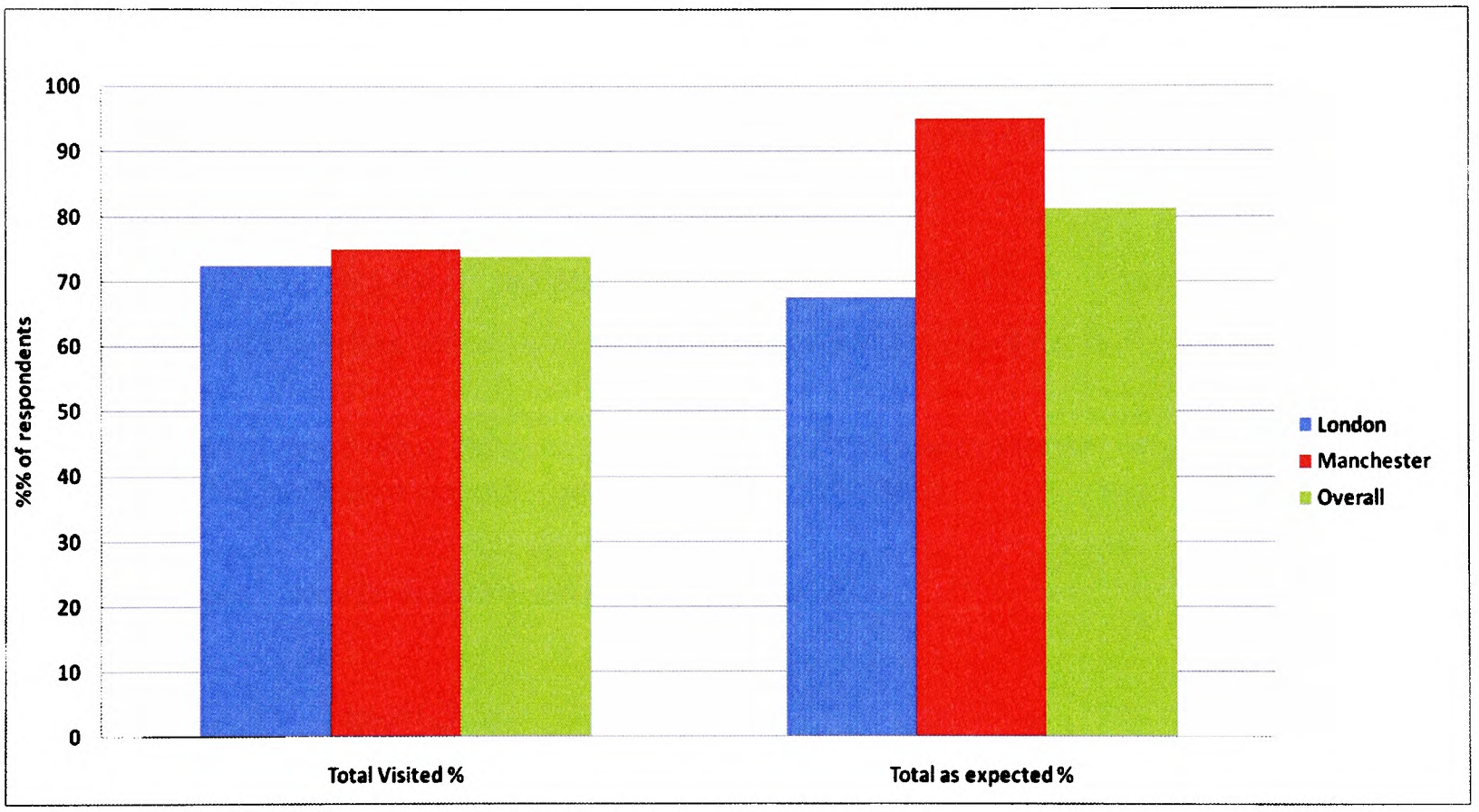


Figure 5-8 : Graph showing the relationship between a participant having visited a space and the space matching their expectation combined (%)

Combining the data from the two locations, Figure 5-8 shows that over 70% of respondents had experienced and thus had a predetermined expectation of the spaces on the soundwalk in London and Manchester, and that overall over 80% of the participants thought that the spaces sounded as they would expect. Interestingly this is higher in Manchester where 95% of spaces sounded expected, to only 80% in London. Overall, the high score of expectation is reinforced with participant responses discussing their expectations of the spaces visited:-

"My experience and expectation are met by this space" - Lon-PhD-SW2

"They sound as I would expect if I saw a picture of them." – Man-PhD-SW5

"This background is quiet, it fits, I would expect that type of noise - Man-PhD-SW10

"....we've heard all the things I expect to hear in central London, so it's all to me expected" - Lon-PhD-SW5

Participants did not always view the spaces visited positively, for example a participant who grew up in the countryside found the context of the urban setting annoying, even though they had experienced the spaces before

"I used to think I'd love the city life, got to the city, don't like it at all" - Lon-PhD-SW6

This is in comparison to a participant who has always lived in urban spaces

"'no it's a city and that's what you would expect, noisy traffic, noisy people, noisy buses, people footsteps....it's what you'd expect in the city centre" - Man-PhD-SW4

Although analysing the other responses from Lon-PhD-SW6 shows that even with this negative view of the urban space on the whole, that their expectation for the spaces was met

"It's pretty much what I'd actually expect, but I'd actually expect it to be louder at like this particular point in London." - Lon-PhD-SW6

"it's quiet....that is what I expected" - Lon-PhD-SW6

5.3.2.3 Level Perception

The influence of expectation on the perception of loudness of a space was also a primary aim for this work. The question was asked of the participant in-situ, "*Does this space sound, quieter, louder, or as you would expect?*" answers given were then collated as quieter, louder or as expected. This measure is purely a subjective rating of the participant, but importantly related to the central question of this work, what is the effect of expectation on how the soundscape is perceived. The question shows that there is an expected loudness for a space, which is perceived subjectively independent of an understanding of the actual level. That is to say, that the participant cannot judge or measure the actual sound pressure level, but has knowledge of what perceived loudness is correct for the space that they are in.

Figure 5-9 shows the results from Manchester spaces, where on average 50% of the sound level in the spaces sounded as the participant would expect, interestingly Parsonage Gardens, which had the lowest score of expectation, had the highest expected level score. What this Figure 5-8 shows is that three of the spaces were said to be 80 % as 'expected' or 'quieter' and only a few participants rated the space as louder than expected.

Returning to the interview transcripts, it is possible to see that it was primarily one participant who constantly rated the spaces as louder as expected, and this was Man_Phd_SW6, returning to the interview transcripts it was possible to see that, their actual answer was that the Parsonage Gardens was *'As I would expect I think, or possibly slightly louder'*, this was coded as louder, there was also at the time of the interview a rubbish collection truck in the square, which provides the reasoning for this answer and is reiterated by '*I think the bin truck was a little unnecessary, but everything else is as it should be*', reiterated the condition that the space has a context, but singular events can affect the observation at the time of the soundwalk.

Participant competence shows that the bin truck would eventually move from the space in a short period of time, and competence relating to the temporality of the event meant that the participant did not perceive the overall soundscape as negative, as they answered, when asked, that the location makes them feel '*calm, peaceful*'.

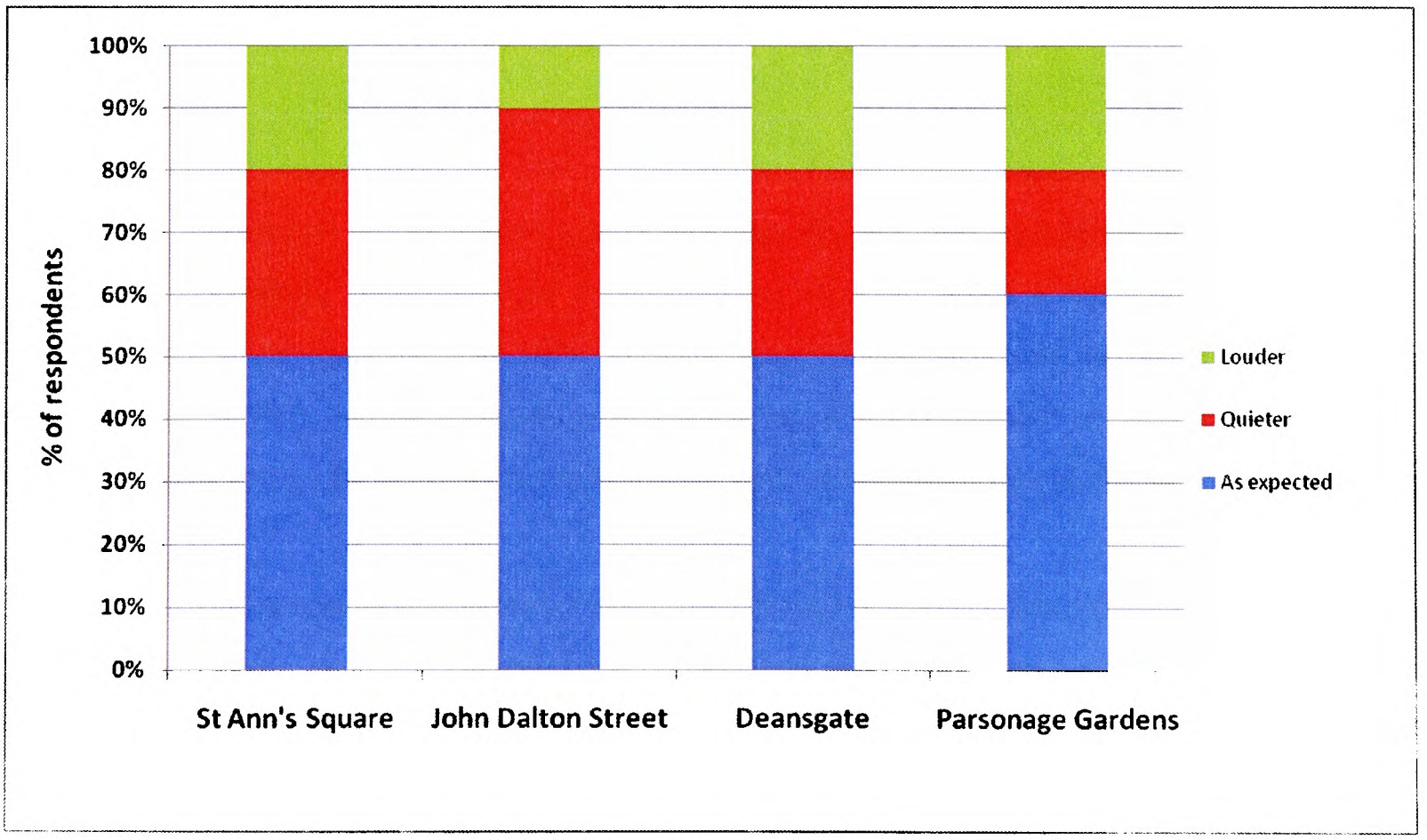


Figure 5-9 : Perceived level of spaces in Manchester

What is interesting from these results is how all of the spaces had around a 10-20% perception that they were louder than expected, with the main road junction of John Dalton Street (see figure 5-10) having the lowest. What is also interesting about this is how John Dalton Street has a 40% rating of participant's perception being quieter than they expected. This was also true of Soho Street corner, a similar context, shown in Figure 5-11. This finding is interesting as it shows that even in a loud space with average L_{Aaq} measurements of between 70-75dBA, that the space matched or was perceptually quieter than the participant has expected.

Figure 5-10 : John Dalton Street

Figure 5-11 shows the results from London spaces, where on average 40% of the sound level in the spaces was perceived as the participant would expect, Phoenix Gardens again has the lowest score of expectation. What is interesting from these results, like those from Manchester is how all of the spaces had on average around 25% perception that they were louder than expected, with the main road junctions of Soho Street Corner and Tottenham Court Road having the lowest at 10%. What is also interesting about this is how Phoenix Gardens has a 40% rating of participant's perception being quieter or louder than they expected, even with a low expectation rating the space provided an anomaly in the data set.

The reason for this anomaly was found by exploring the soundwalk data, the results tended to show that for those participants who had experienced and visited the space previously, that there was a response of the space being as expected or quieter. Those participants whom had not visited the space previously tended to state that it was louder than expected, the reasons being that they did not understand the purpose, or felt unsafe or did not like the space. This is explored in more detail below.

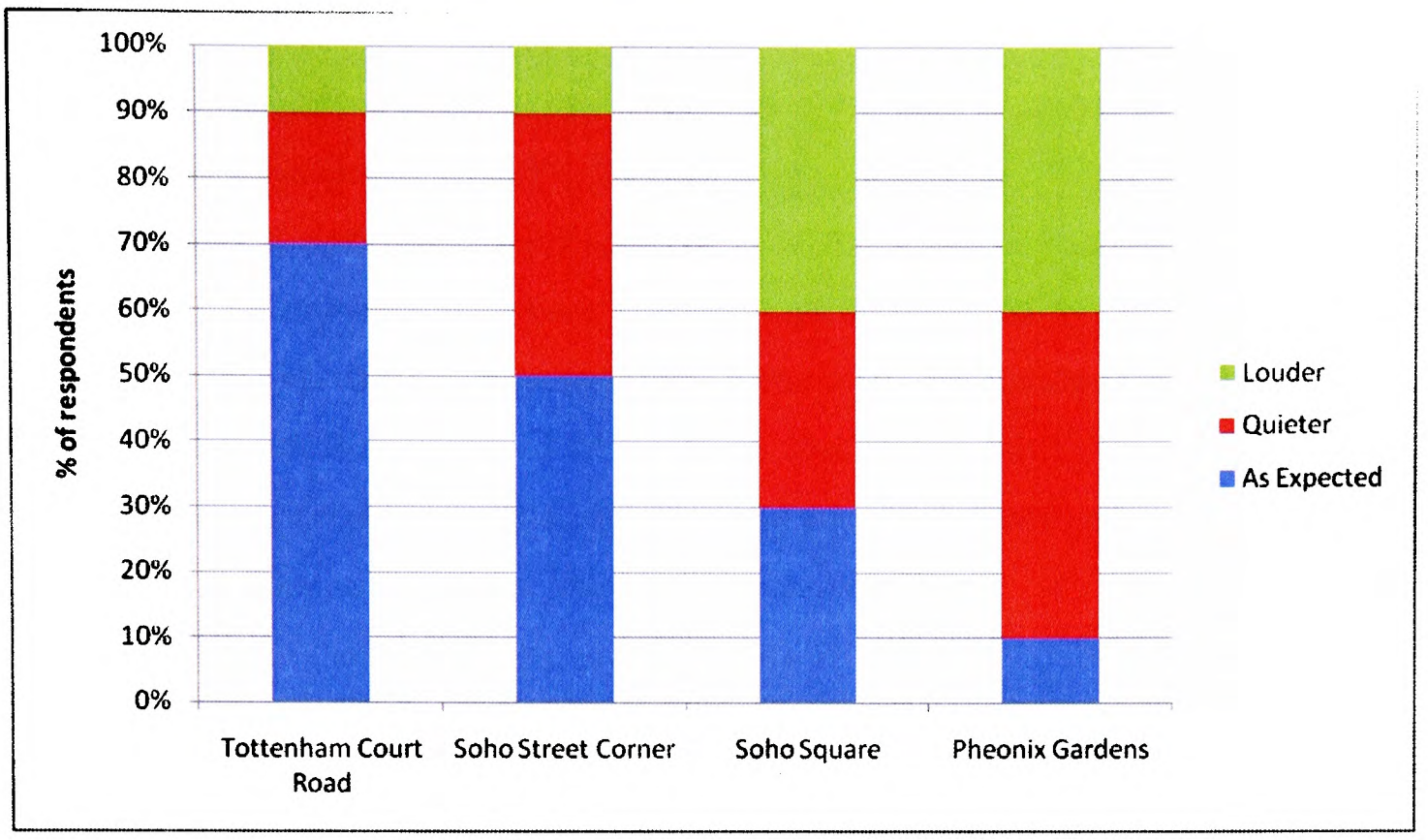


Figure 5-11 : Perceived level of spaces in London

Figure 5-12 shows the combined results from all spaces. The chart shows that for all space, there is a 46% perception that the level is as the participant would have expected, and that 33% of the participants thought that the level was quieter than they expected, with only 21% of participants feeling that the space was louder than they expected. This is an interesting finding, particularly that for what would be called a 'loud' city centre environments, that 79% of participants felt that the spaces were as expected or quieter. This finding would suggest that as has been discussed earlier, sound level may not the prime factor in determining how a person perceived the soundscape that they are immersed in.

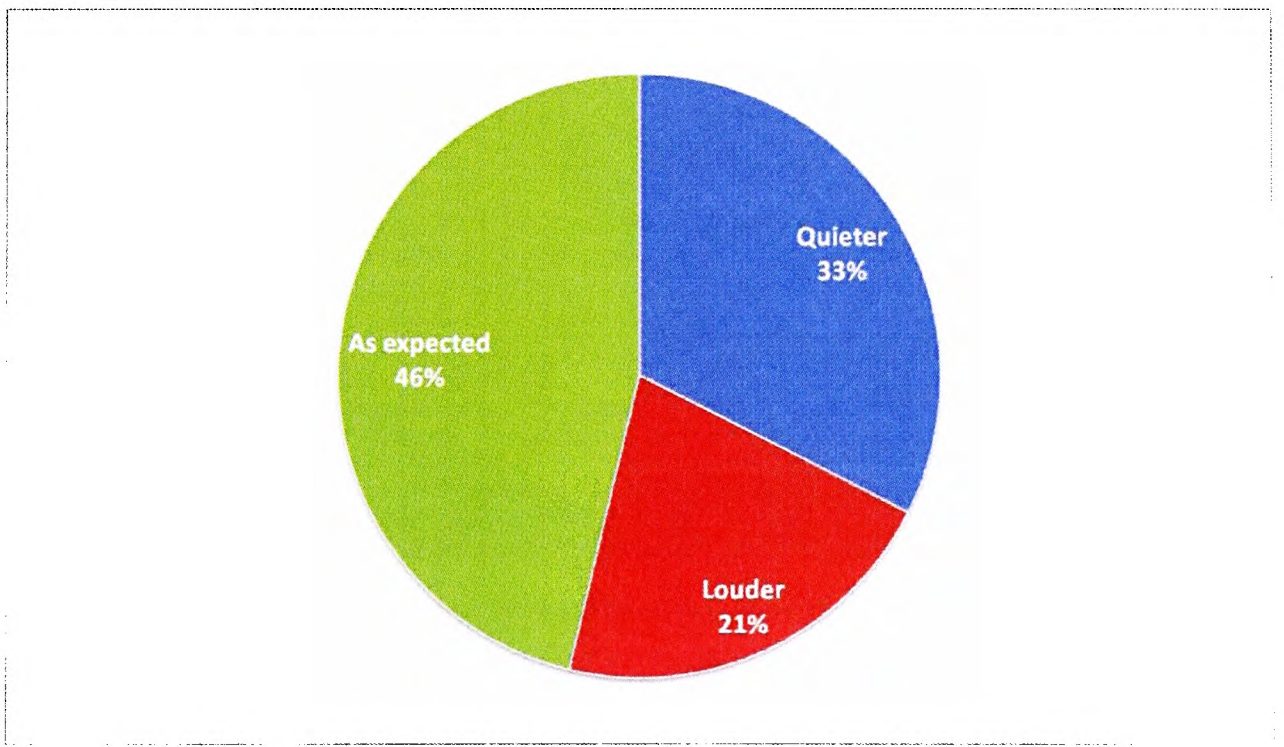


Figure 5-12 : Perceived level for all spaces in both cities (%)

The benefits of the method employed in this work are shown here, as in a space where the soundscape was judged as quieter or louder, the effect can be examined further by analysing the reasoning provided at the time that the answer was made. Given the number of spaces matching with a participant's expectation, it is the negative response that then provides reasons why the soundscape in those space was not as expected. In particular, it was Phoenix Gardens which provided the most negative responses to the question of matching expectation and expectation of the perception of the level. The garden due to its location had not been experienced by a number of participants, and the non experienced participants generally had a different perception of the space. This tended to be negative,

> *"in the garden here makes me feel uncomfortable, it's a bit weird, I don't really like it" - Lon-PhD-SW1*
>
> *"It's strange because I've visited a lot of community gardens in London and they're always in the middle of very busy places and I've never felt this before and don't know what's doing it and whether, maybe its visually because you've got very dominating buildings around here, it does feel to me like the sound is confusing". - LON-PSP-SW4F*
>
> *"I'm reading two different things at once, I'm reading sounds and visuals that are making me feel that this is a space. I don't particularly want to be in not through any sort of safety kind of thing." - LON-PSP-SW4F*

Figure 5-13 : Phoenix Gardens sign

This was compared to experienced users, such as local residents or those who has experienced the space, who had a positive experience of the space, using terms to describe the space such as oasis, safe.

"it just gives people that extra something to look forward to in their day.....it's a secret place", - Lon-PhD-SW6

"It's an oasis I think in this area it really is, it really is a local garden this one, it's not packed, I don't know what it's like during the week I don't work around here.....It's just lovely, it's an absolutely fantastic place to come" - LON-PSP-SW13F

"Yeah, I mean I love, I do love this little bit, because there's the church, it's always kind of quite sad round here but it's changed a lot since, this never used to be like this did it, it's great." - LON-PSP-SW10M

Fortunately, a similar space which had not been used on the preliminary soundwalks in Manchester as part of the Positive Soundscapes Project soundwalks was found in Manchester, to investigate the anomaly of Phoenix Gardens, this space was Parsonage gardens.

Figure 5-14 : Parsonage Gardens

Parsonage Gardens was used in all soundwalks relating to this work, see figure 5-14. Similar to Phoenix Gardens, Parsonage Gardens are surrounded on all sides, have buildings with ventilation systems attached, is just off a major road (Deansgate in Manchester, Charing Cross Road and Shaftsbury Avenue in London) accessed by a side road. Photographs from all locations are provided in appendix C. Parsonage gardens is a maintained gardens, and larger in size, but most importantly it was felt that the nature of its context away from a major street, overlooked by residential accommodation, close to a church, plus the potential type of users, made it similar in context.

The results have shown that the variations in the two spaces expectation are quite different, but in terms of discussion around context, there is a similarity to those expressed above

> *"Yes, really valuable for people to have that contrast between city are and a little bit of open space" - Man-PhD-SW10*

Expectation of the space, whilst on the whole showed that they were as expected, and that there was no real evidence of negative expectation, instances where expectation were not met provided a negative assessment of the space in question, for example

> *"There's more noise than usual, there's more of a dull hum of the workmen, work going on in the background, I wouldn't expect that normally" Lon-PhD-SW7*

LON-PHD-SW2 found Tottenham Court Road (see figure 5-15) aggressive, and '*as an individual I dislike high levels*' of traffic and pedestrian noise, and who *'would avoid Oxford Street*' if possible, but they still stated that it matched their expectation for the space '*My experience and expectation (of Tottenham Court Road) are met by this space*', and that the sound level of the space matched what they expected for the space. Through interpretation of this data, and their subsequent answers, examples of how control, and the participants ability to move from the space started to become important in how they perceived the soundscape.

Figure 5-15 : Tottenham Court Road

Expectation was also dynamic and changed for spaces throughout the course of the research work. Deansgate (see figure 5-16) in Manchester was one example of this, and explains why some of the participants may have stated that the space was quieter than they expected. During the study period the soundscape of all the spaces visited changed, but the most dramatic was that of Deansgate, which went from being a busy main road in the centre of Manchester to having a major construction project to replace the Victorian drainage system occurring during the research project.

Figure 5-16 : Deansgate

This change of context was useful, as we shall see later, in judging participants competence in action. An example of this, from an experienced participant, was by taking in the environment and matching it to what was expected for the visual elements of the space, which in this instance were absent. This was expressed by 'I'd *expected more cars and traffic, but even so it sounds as I would expect'* – Man-PhD-SW5. From the comments given, there seems to be some indication that expectation is a combination of a series of interrelated factors, which relate to the subjects 'experience' of the space they are in, the term experience in this context relates to whether or not they have visited the space before.

It would seem that un-experienced subjects try to relate the new space to one of a similar type which they have visited in the past, based on this, they then try to match if the whole environment including soundscape is as they would expect for the new space.

When asked to describe overall their experience and if all the spaces visited, even with a variation of liking and disliking the space, there is still agreement that the spaces in question meet the participant's expectation.

> *"Once I saw them (Phoenix gardens) they sounded how I would expect them to sound when I saw them" Lon-PhD-SW9 - 8-30/31*

> *"Expectation met? Yes they are, absolutely 100% " Lon-PhD-SW4*

This is also backed up by comments from the focus groups, who also detailed what they expected to hear in an urban space, for example

> *"I expect that in the city, if I'm walking somewhere quiet I'd always expect someone else to be there because you're in a city." Sophie 4.29-30*

> *"Whereas if it's like during the day you expect, like what you said before, if you're expecting a sound, I can tolerate that, if you're in the city there's lots of noise, you expect that and I tolerate it." Fiona, 11.34-36*

As well as the relationship of expectation to context of the space in question

> *"I'd been in the Library previously and it was so quiet, people were actually walking with little padded steps so they wouldn't make too much sound, and I'd got so used to doing that, and I thought that was what was required and really essential to be as quiet as you possibly could in all the other libraries I had been in." - Sophie, 11.42-50*

This shows that there is a knowledge and expectation of the environment, or competence, which results from experience of the space and an expected standard behaviour for the space, and from this there is expectation of the sounds which relate to the environment

> *"I enjoy the solitude of the countryside as well, but when I'm in the city centre and I can hear the general noise its part of life, I just have to accept that."- Simon, 4.29-30*

Showing that context places an important role in the perception of the soundscape, context is further explored in the next section and which shows how it relates to a place, social and behavioural norms.

5.3.3 Context

The context category relates to a combination of the norms expected in the location and how the soundscape is perceived within that expectation, as well as to how the individuals within the space adhere to the expected behaviour, individuals within the space who do adhere to these standards are generally considered to be 'good citizens' and have 'social etiquette'.

This point is important, as those breaking this inferred social code generally contribute to a negative perception of the soundscape, thus showing that existing measures, such as sound level, may not be as important in perceiving a soundscape as negative, rather than a breaking from a social norm.

Context, within the soundscape is shown to be the compatibility of the soundscape to the behaviour, purpose and/or psychological state of the person operating within that space. Where compatibility is defined by Kaplan as "*the match between the environment and one's purposes and inclinations, a sort of person-environment 'fit'*....a *setting that lacks congruence requires an excessive amount of directed attention*" (Kaplan & Kaplan, 1989). The context category relates to a combination of the norms expected in the location and how the soundscape is perceived within that context, additionally how well elements within the space adheres to the expected behaviour. The results show that the implication of a social behaviour for a type of place is important, and that those breaking the social norms will generally contribute to the negative perception of the soundscape. Analysis of the focus group data again showed that context was composed of three subcategories, social behaviour, place norms, and changes in normal behaviour.

The responses provided emphasise how participants have an expectation, based on a norm, for the space, i.e. "*We tolerate it because it is the norm*", where the norm is both related to the space, but also the social code associated with that space, which generally means human generated sounds that are appropriate or inappropriate to social and place norms. Human generated sounds in this instance does not always mean those generated physically by a person, but mechanical sounds that a person controls, e.g. mobile phones, music etc.

> *"...she made several phone calls and very loudly too, so I think she was quite unaware of my discomfort" Fiona, 7.54-55.*

> *"....it depends very much on the time of day and when you expect to hear something. If it's unexpected and it sort of interrupts your natural rhythm and routine it's going to be damn annoying really, that's when it's going to begin to cause problems." Oliver, 10.15-18*

> *"I was playing with a jazz trio...and it was only eight o'clock at night, I just thought, well its 8 o'clock you know, who's asleep at eight o'clock, who's going to be bothered now, it's eight. If it was six in the morning or half past twelve at night then gripe away, you've got a valid point." Oliver 10.47-50*

> *"I wonder if we tolerate it because it is the norm and when it's something out of the norm like the drill or something I think that's when we get annoyed." Cat, 12.49-50*

This is an interesting contextual argument, but does not take into account the fact that others may not operate on the same time norm as the participant. This is a difficult issue to address given the nature of the 24 hour city, but generally it is understood the hours which sound production is acceptable and when it is not.

> *"I am quite sure that I make a lot of noise, maybe playing music and stuff but I know that once it gets to a certain time–nine or ten o'clock whatever–I know that people are going to be sleeping so you turn it down." Fiona, 11.31-34*

Context not only relates to a place norm, but also a temporal norm and what is important here is how acceptance of the soundscape varies depending on the time of day and week. Thus showing again that level is not the key indicator in annoyance, but a combination of expectation, context and expected behaviour. This is obviously true within certain bounds. i.e.an increase from 20dB to 100dB would certainly be cause for annoyance based on level but again related to such an increase generally being unexpected for most place norms, but normal for example at a concert.

> *"... we always had drunk students walking past my flat because we lived on the main road between eight o'clock and four in the morning. During the weekends, Friday, Saturday and Sunday I didn't mind because I usually go to sleep quite early, but during the week it would really, really make me angry so I suppose sort of night time noises I find acceptable and almost comforting in a way on a Friday and Saturday night but the rest of the week it really, really grinds me." Cat, 12.18-24*

> *".... it was a weekend night and it was like three o'clock in the morning and you could still hear people talking outside in the street like fives floor below and heels and cars and all that. Because it 's the weekend you kind of accept that. If it was a Tuesday night you'd be livid but because it was a weekend you accept it....But again, because it's the weekend you accept it. But during the week it's not quite as nice." Fiona, 12.26-36*

> *"..... I would put it down very much to the time of day and when you expect to hear something. If it's unexpected and it sort of interrupts your natural rhythm and routine it's going to be damn annoying really, that's when it's going to begin to cause problems." - Oliver, 10.10-18*

> *"'it's standard for a big city and I'm reconciled with the fact it is a noisy place", Lon-PhD-SW5*

It is possible that there is no understanding of a space's context, this was particularly evident with Phoenix gardens as was shown in the previous section, and

> *"'I never quite understand what the purpose of it is (Phoenix Gardens)" Lon-PhD-SW7*

The importance of context was highlighted in responses detailing how it was important to know the place you were and the expectation of what it should sound like:

> *"It's important to hear London in the background.....you don't feel like you've left it" Lon-PhD-SW4*

In a environment where context is compatible and a person "*can carry out one's activities without effort or struggle*" (Marselle, 2004:6), there is an expected idea of the activity carried out in that space, but with negligible effect on the perception of the soundscape. For example in relation to Deansgate, *"it is a place you wouldn't expect to stop still", - Man-PhD-SW10,* who perceived the soundscape as '*as expected*' - *Man-PhD-SW10* but didn't '*pay attention to it*'- *Man-PhD-SW10*. This was further emphasised by Lon-PhD-SW2, who classed Tottenham Court Road as a transitional space where the soundscape was as expected, and that' *what I can hear is probably because I am thinking about hearing'* rather than passing through

> *"I guess living in the city you sort of walk round and you're aware of everything going on, but very rarely do you actually stop and try and break down all those individual sounds that make up that space. I've never really noticed until today how much noise ladies heels make on some of the hard surfaces in the squares and paths, but that's quite a dominant part of the underlying sound of people's movement – their footsteps." - MAN-PSP-SW2*

> *"I guess so because it is a fairly busy traffic junction so I would expect it where you've got people – it's a crossing point, it's a place for people to pass through and obviously cars pass through, no one really stops and pays attention to what's going on here other than passing cars or person making sure they avoid an altercation". - MAN-PSP-SW2*

5.3.3.1 Description of space

The responses provided by participants in relation to the description of the spaces, or context, on the soundwalk, where coded into a number of categories. These categories show that, a number of different contexts emerge from the different spaces, and that spaces in different cities, which initially were chosen because it was thought they would have similar contexts are show to have the similar descriptors used when describing them. This results in eleven types of space or contexts emerging from the research, but from these categories it is possible to further narrow the results down further. The context of the spaces is either broadly one of a transitory space or junction, where usage is that of passing through the space, a shopping or commercial space, or that of an urban square or park space.

The categories have been left as described in this section; it is import to understand the semantics used by participants to describe the context of the spaces they were in. As will be shown, context is not formed solely from the description of the space, but from other factors, such as the purpose and users of the space.

The results are presented in the following sections and combine together to form the sense of context that a participant's expectation and competence are built on. Table 5-6 and Table 5-7 detail the description given by the participants to the spaces visited on the soundwalk.

The eleven categories used to describe the spaces were coded as; historical, open, oasis, social, urban, garden, square, park, commercial, junction and thoroughfare. As with the results for sound source selection, semantics plays a role in the descriptors used. Terms such as oasis, open and urban may not explicitly clear as to their meaning, and would not be designed for example, like a park or junction context could. These categories could be further resolved into three main categories as mentioned before, these being transitory or thoroughfare, commercial and recreational/relaxation. The reason for initially leaving all the categories is, from a semantics point of view, a way of understanding how participants were describing the different spaces and their context

Space	Description of Space	Category
John Dalton Street	Noisy/Ugly/Old nice buildings, main route, busy street junction, busy crossroads, crossing point, crossroads, intersection, thoroughfare, major traffic junction, mixed use, busy, urban, bustling, energetic ,main road, busy main street	Junction Shopping Thoroughfare,
Deansgate	Crossing, main thoroughfare, heavy traffic, functional busy cross roads, place to get from a to b, busy road, lots of traffic, people passing by, main shopping street, restaurants and shops, Main thoroughfare, major shopping area, major retail area, passing area, thoroughfare, public junction, traffic junction, polluted noisy area, city centre crossroad	Thoroughfare Shopping Junction Noisy
Parsonage Gardens	Green Point, still, enclosed, pretty, green oasis, small park, green space, small park surrounded by medium tall buildings, park space small park, attempt at an urban park, park within a city, Garden square	Garden Park Square Oasis
St Ann's Square	Quite nice, nice square, shopping, office area, public open space, pedestrianised shopping precinct, popular shopping destination, public through place, meeting place, quite calming, nice area, wide precinct, walkway	Square Shopping Junction, Social

Table 5-6 : Description of soundwalk locations (Manchester)

Figure 5-17 shows that there are four major categorisations which are used to describe the space in terms of a context for the space. These categories are park, commercial, junction and thoroughfare. The transitory spaces of junction and thoroughfare record the highest number of term usage, with commercial a close third. If a category was formed to encompass, a space for recreation for example, this would enable social, garden, square and park to be combined and thus also dominate the rankings.

Space	Description of Space	Context
Tottenham Court Road	Aggressive, junction ,junction, busy junction, major intersection, very busy, busy, chaotic, historic, mixed commercial, heart of London, commercial, functional, chaotic, bustling, shopping	Junction, shopping, historic, commercial
Soho Street	Busy Shopping Street, urban environment, noisy, busy, intersection, hectic, busy, commercial, big junction, less busy street corner	Shopping, Urban
Soho Square	Residential square, social space, backwater, oasis in the middle of Soho, meeting point, park space, open space, Victorian square, pleasant green square, nice quiet-ish park	Square, oasis, park
Phoenix Gardens	Secret garden, left over space, between space, garden, overgrown, rough, rugged, wild, crazy, quiet, rather strange, semi overgrown park, overgrown garden, urban park, modern garden, treasure in the middle of London	Garden, park,

Table 5-7 : Description of soundwalk locations (London)

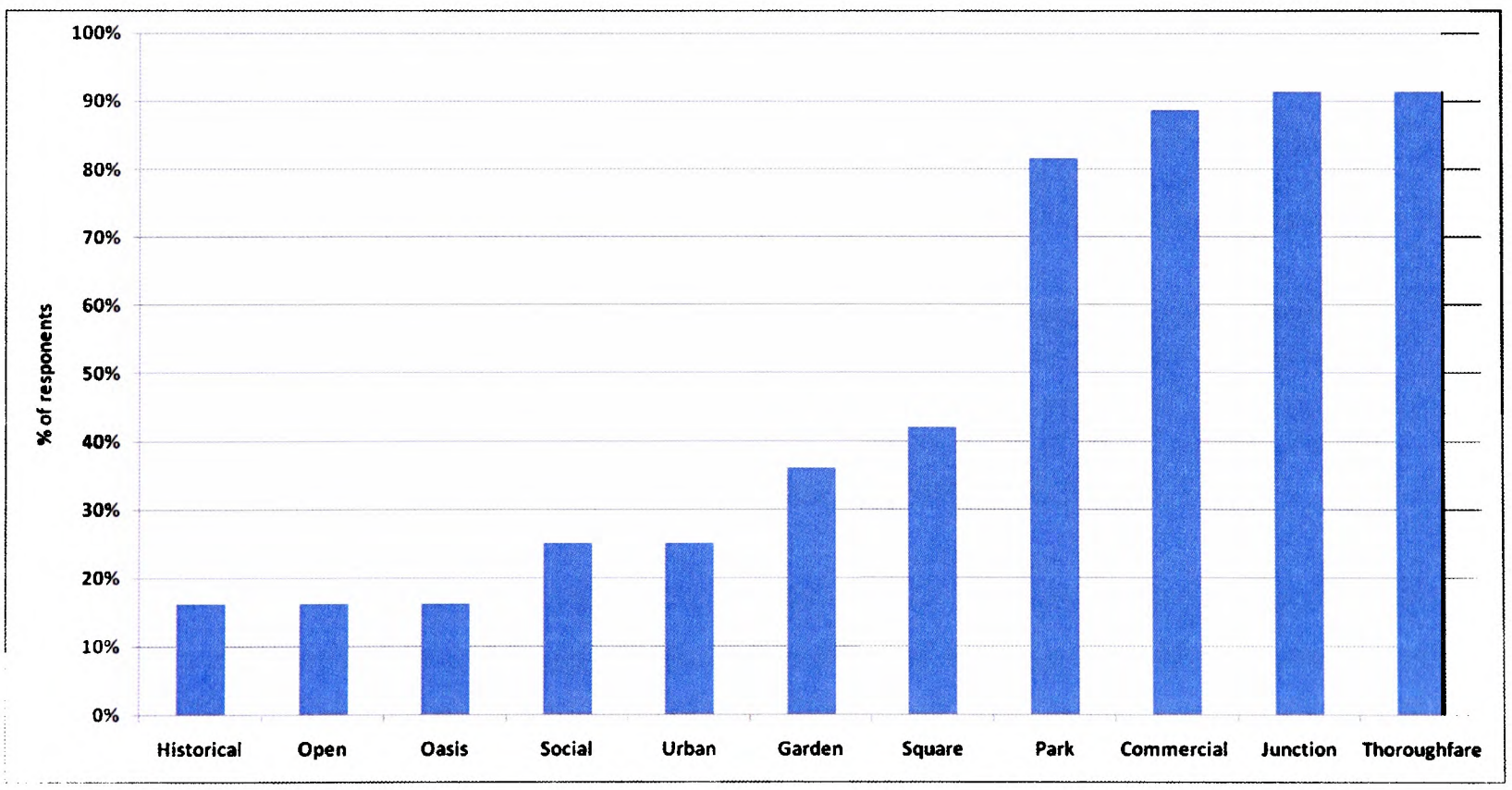


Figure 5-17 : Graph showing description of a space categorisation

This finding is important for two reasons, firstly when trying to define the context of a space and how a participant perceives that space, it would be possible to design a context based around a descriptive purpose, and secondly, that given the eight spaces visited in two cities, both of which had two major contexts assumed, the results show that the expectations were correct. The interview transcript analysis also shows that in a transitory space. The soundscape is of little importance to the participant. Answers suggest that they are merely moving through the space, and generally have the free ability to move through the space. This shows an element of control being important in the perception of the space. As such the actual level of the space is of no real importance.

> *"you've got the noises that you can't stop coming in (to the soundscape) which is always going to be happening because you have no control over them" –LON-PSP-SW3*

> *"I have no control over it, I just have to accept it and walk through it. It's not a environment you create it's an environment that's imposed on you" - LON-PHD-SW9:*

> *It's very much a pass through place I think, because it becomes a pass through, people's attention to detail in its design is quite limited. –Man-PhD-SW2*

The converse is true of the park space where the soundscape was perceived to be more important as are elements within the soundscape,

> *"It's still the same things, in terms of the loudest things that are surrounding us; it's still traffic, even here. Wow, that's the first bird I've been aware of since we started, which is nice to hear that moment he or she dominated" – Lon-PSP-SW8*

> *"On a warmer day you will have more people, there will be more conversation, but again the conversation tends to be quieter than if it was in St Anne's Square because the surrounding grass etc. softens the echo effect of people's conversations, so therefore conversation can be had at a lower level so you find that this space is always a little bit more tranquil". – Man-PSP-SW2*

The lower scoring categories could potentially be included in to the main four categories, but the semantic differences between them meant that it was felt that they should be separated. If they were included, the results would show for the urban space that the soundwalks covered, there were four main types of context experienced by the participants, three of which where the soundscape was of little importance, but one where the soundscape was noticed when expectation wasn't met. When asked for an overall description of context, one participant summed it up with

"Description of soundscape? "Urban. The city"' - Lon-PhD-SW3

To further expand on the context, the inclusion of the space's purpose was analysed, to show possible matching between the description and the purpose. Ultimately, context can be seen to consist of description and purpose combined to form a space of which a participant has an expectation and through experience of the context and similar contexts develops competence. To further extend context the next section examines a spaces purpose.

5.3.3.2 Space Purpose

In line with the major categories for description of the spaces visited, the coding of the purpose of spaces resulted in a small number of discrete contexts being categorised. These categories are in line with those which relate to the description of the place. The categories extracted for a space's purpose were shopping, socialising, transitory and relaxation. The results of term usage are given below in Table 5-8 and Table 5-9. There were a number of purpose contexts described, and these match for each of the spaces in the different cities. With this categorisation of a space being common between participants, it strongly reinforces the nature that a space has a context, backing up Botteldooren's theory of context and the relationship to the soundscape.

The linkage between purpose and description is very explicit, such that the spaces visited have a distinct context, which relates to the activities and purpose that occur in them. With such a strong categorisation, for each of the spaces it is possible to show that there is a strong expectation of the soundscape in these contexts. It also shows that potentially it is possible to design spaces to match a context, and thus match a categorisation.

Figure 5-18 shows the total breakdown of purpose categorisation from both Manchester and London combined, where there are two distinct categories featuring highly, these are transitory and relaxation. This is an important finding as it shows that participants were assigning the spaces into distinct purposes. As suggested at the outset, the spaces chosen were selected to be as close together in context as possible.

This is highlighted by from the descriptions given. Tottenham Court Road, Soho Street corner, Deansgate and John Dalton Street are primarily described as transitory, where as Soho Square, Phoenix Gardens, Parsonage gardens and St Ann's Square are described as spaces for relaxation.

Space	Purpose	Categorisation
John Dalton Street	Connection, Shopping, Transit, crossroads, link to other areas, intersection, transit, getting from a to b, urban space, for passing through, a to b, thoroughfare, junction for cars, accessibility, people coming from one side to the other, crossroads, passage of people	Shopping transitory
Deansgate	Connection, Shopping, commercial, transit, transit, mixed use (restaurant, office space), transport purposes, congregation, car transits, buses, people transits (a to b), shoppers, retail, food outlets, shopping, restaurants, thoroughfare, junction for big cars, more of a meeting connection through Manchester, getting from a to b, function to get across the city	Shopping transitory socialising
Parsonage Gardens	Relaxation, break, recreation, eating lunch, people to come in and relax, sit have lunch, read, community space, public space, recreational space, green space, meeting point, relaxation, relaxation, place to escape, sit and relax	Relaxation socialising
St Ann's Square	Quiet area where people can walk, without cars and has nice shops, shopping, social, lunch, sit outside, breather space away from city, meeting space, community space, passing through, retail, pleasant square, open space, shopping, people passing through, socialise, meet people, shop, eat, meeting place, to give peace and tranquillity, precinct	Relaxation shopping socialising transitory

Table 5-8 : Purpose of soundwalk locations (Manchester)

Space	Purpose	Categorisation
Tottenham Court Road	Getting from a to b, transitional, junction, busy junction, public amenities, main road, mixed commercial, busy city artery, cross street	Shopping, transitory
Soho Street	Retail, thoroughfare, getting from a to b, shopping, junction, spending money (shopping), mixture of facilities, pedestrian crossing, crossroads, commercial street, somewhere people walk past to get somewhere	Shopping transitory
Soho Square	Retreat from busy location, recreational space, relaxation, lunch, lunching space, take a break, relax, be able to speak, recreational space, relaxing, eat lunch, chat, meeting, lunch, take it easy, watch the world go by, a place where people want to be, to get away from the hustle and bustle, sit and relax	Relaxation socialising
Phoenix Gardens	Green space, community space, recreational space, gardening area, for residents to escape to an open space, pure relaxation, to get away from it all, eat lunch, take a few moments, garden for residents, a beautiful area for people who live around here	Relaxation socialising

Table 5-9 : Purpose of soundwalk locations (London)

With two popular categories for purpose, it is worth returning to usage presented in section 5.3.3.1; here it is shown that the breakdown into these two categories is evident. This is an important finding, as it shows that there are distinct contexts experienced by participants in the urban space. This finding means that it has possible that these categories could be used as the basis of space design. The other difference as has been shown is that in one context, transitory, there is little attention paid to the soundscape, where as in the other relaxation, the soundscape comes to the fore.

> *It's very much a pass through place I think, because it becomes a pass through, people's attention to detail in its design is quite limited. –Man-PhD-SW2*

> *"just walking around and dedicating the time to listen and look around, I tend to go from A to B as quickly as I can you know always in a hurry and I'm not really aware of what's going on, but it's nice to be able to walk around and appreciate and look around and see what's influencing the noise" - LON-PSP-SW2F*

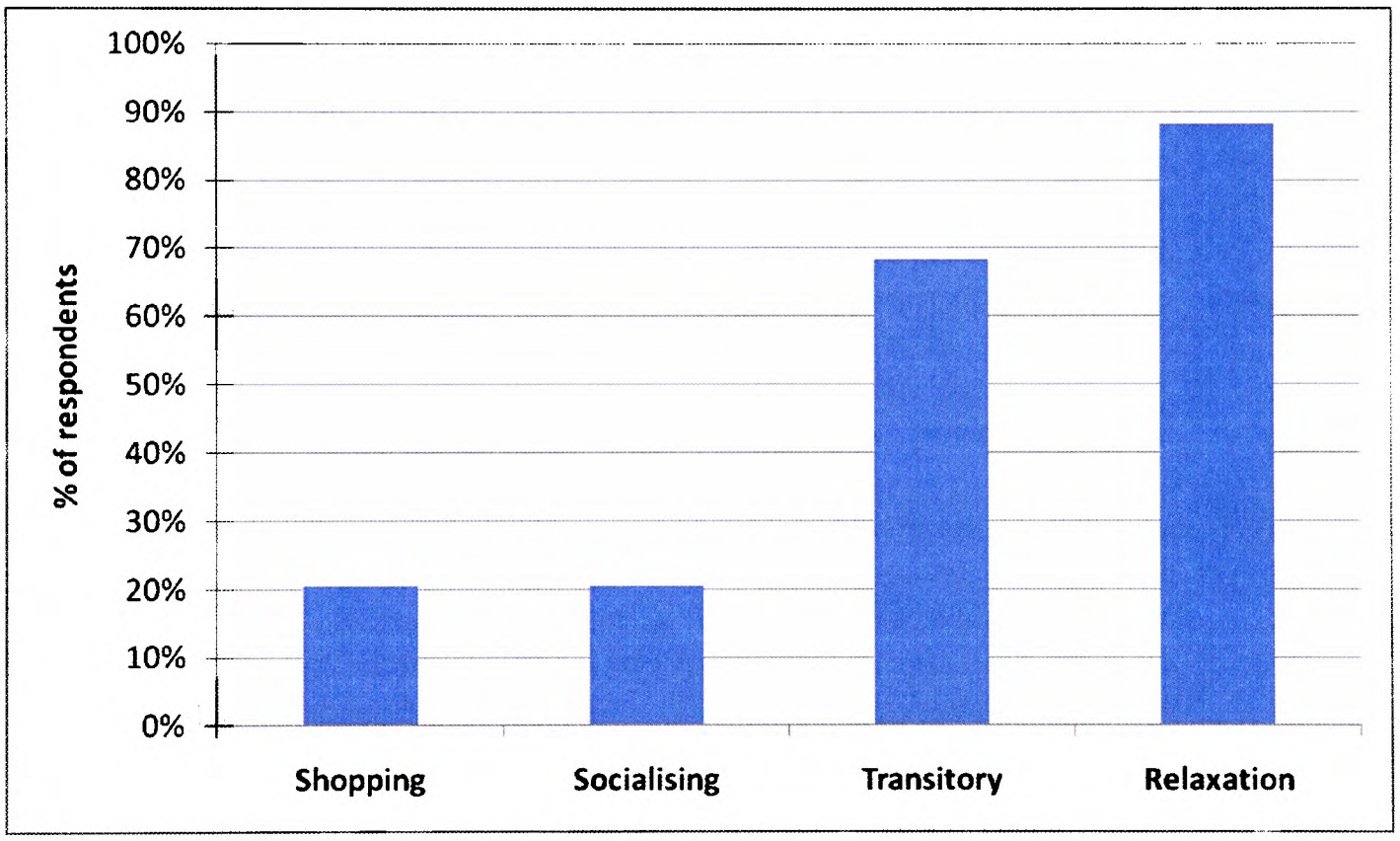


Figure 5-18 : Graph showing purpose of a space categorisation

The low number of different terms used and the similarity between them, showed that the spaces under consideration fell into predetermined contexts, and thus has similar expectations amongst the participants. Analysis of the language used was important, and showed that definite semantic categories were described, in line with Dubois' findings. (Dubois & Guastavino, 2006; Dubois, *et al.*, 2006).

5.3.3.3 Users

The following section details 'who' participants thought used the spaces visited on the soundwalks. The relationship between the users of a space, it's purpose and the context of the space, all figure in combing to form the enviroscape, and thus the expectation that a person may have when entering that space. The question "*Who uses this space?*" was asked of the participants, and their answers are given in Table 5-10 and Table 5-11. Whilst participants gave a wide range of answers, a number of distinct categories were formed about who was using a space. The categories extracted for users of a space were as follows: general, workers, shoppers, socialisers, students, tourists, diners, people in transit, residents.

Space	Who Uses Space?	Categorisation
John Dalton Street	Shoppers/People in transit, wide variety, en route, delivery, driving, people in transit, transit, people getting from one place to another, drunk people, shoppers, people going to cultural activities, gigs, mixed use, shoppers, office workers, people in cars, people coming and going to/from work, people, general public, people getting from A to b, pedestrians, cars, shoppers and dinners	Shoppers, patrons, workers, transitory
Deansgate	Shoppers/People in transit, majority of people for driving, shopping to get to restaurants and bars, mixture, people in transit, a bit richer, higher class, man u fans, people eating, shoppers, people going to restaurants, shoppers, workers, people going to nightclubs, wide range of ages, cross roads, people, broad spectrum, people going about their business, back and forth, diners, shoppers, general public, couples, meeting place, pedestrians, traffic	Shoppers, patrons, workers, transitory
Parsonage Gardens	People during lunchtime, office workers, different at different times of day and year, coffee drinker, party goers, people with kids, residents, people meeting for lunch, homeless people at night, sunbathers, people walking their dogs, people from offices, shoppers, relaxation, office workers, transit, homeless people, youngsters, older people, business people on lunch, residents, people having their lunch, everybody, office workers, shoppers	Workers, transitory,
St Ann's Square	People going to church, have a rest, shoppers, shoppers, workers, kids, street vendors, Shoppers, office workers, transit, shoppers, lunchtime, various at different times, morning people going to work, shoppers during the day, people going to concerts and theatres, people walking, everyone, young people and old people, business people on lunch, residents, everybody, shoppers and office people	Shoppers, transitory, general, residents

Table 5-10 : Users of a space (Manchester)

The use of the category of general was to group responses which were non-specific in nature. Similar to the categorisation of noise in the sound source descriptions, general was used to cover the use of terms such as people, everybody, mixed use, general public for example. Figure 5-19 show the frequency of term usage for each 'users of a space categorisation'. The graphs shows that whilst the term 'general' has the highest number of uses, i.e. participants did not explicit state a type of person using the space, there was a high number of users which match the types of answers given for the description and purpose for a space. Again, the coding of category general is a semantic issue, and it could be that in further design of the interview that the participant could have explored what they meant by the usage of the term general, or explicitly ask them to describe the type or user they were describing in that instance.

Figure 5-19 shows, if we put aside the general category which types of users fall into similar categories as described in the previous sections. That is to say, users of a space are defined as people in transit (transitory space), shoppers and workers (commercial space) and tourists, diners who are designated to recreational space.

Space	Who Uses Space?	Categorisation
Tottenham Court Road	Office workers, everybody, shoppers, people on lunch shoppers, tourists, tourists, people, commuters, shopkeepers, workers and tourists, tourists, office workers, tourists, shoppers, shoppers, tourists, general public	Shoppers, Transit, Tourists, General
Soho Street	Tourists, office workers, everybody, anybody, shoppers, shoppers, tourists, people on their way somewhere, locals, tourists, pedestrians, tourists, offices workers, shoppers, tourists, shoppers, pedestrians	Shoppers, General, Transit, Tourists
Soho Square	People eating lunch, office workers, people circulating, locals, office workers, passersby, office workers, tourists, locals, for lunch, everyone, workers, office workers, shop workers, tourists, office workers, students, tourists, families with kids, local residents	Workers, Residents, tourists, students, transit
Phoenix Gardens	Everyone, workers, residents, local community, office workers, not many people, gardeners, dog walkers, local residents, local office workers, tramps, students, local residents, local residents, older people	General, Workers, residents

Table 5-11 : Users of a space (London)

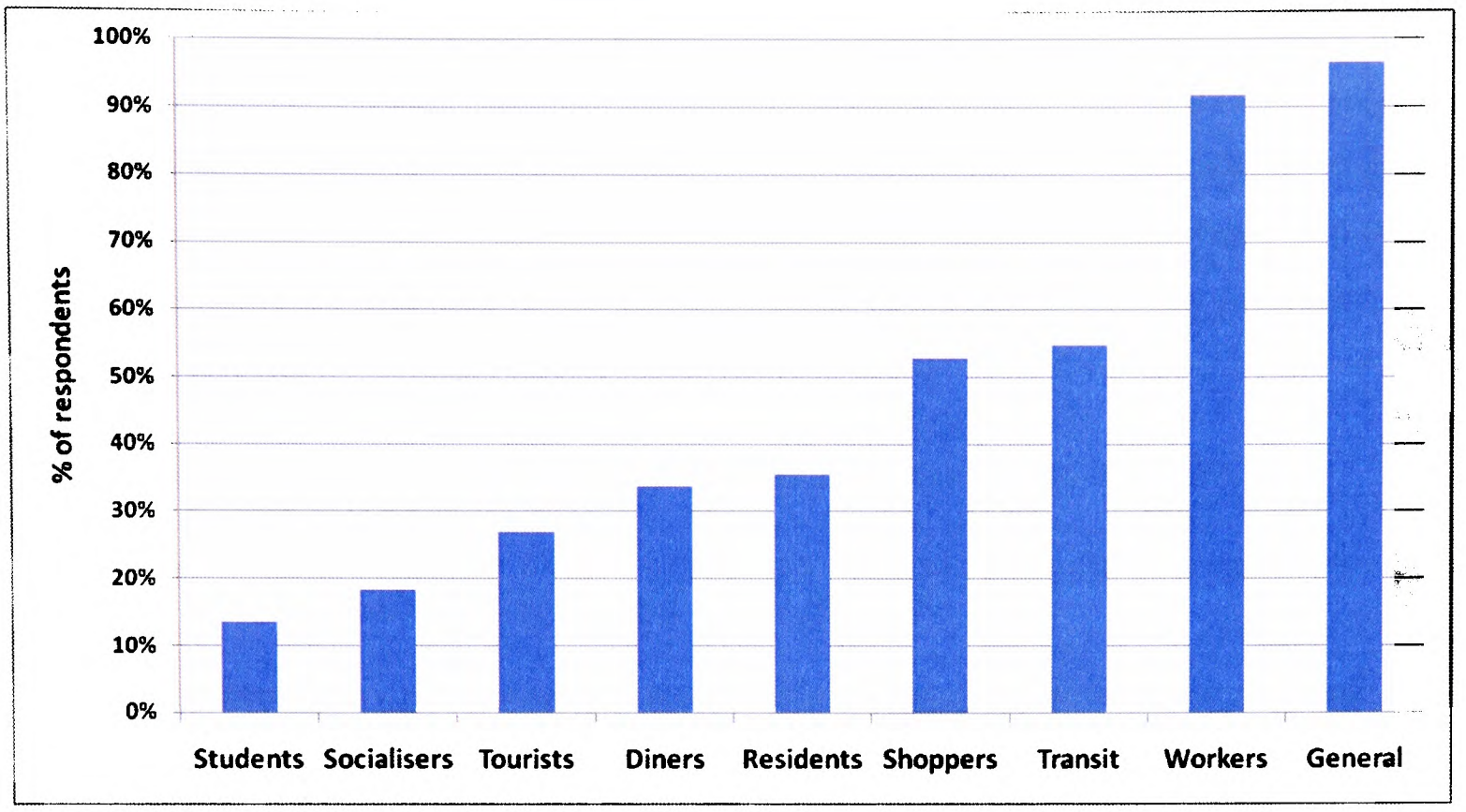


Figure 5-19 : Users of a space categorisation

The results so far have shown that participants have very strong notions of the types of activity, purpose and sound sources that they expect to encounter in a space or context. The participant data has also shown that there is an expectation of the sound level in those spaces, which is generally met or quieter than they expected. Combining the findings show that there is an expectation of the context of a space, this relates to a participants competence of that space.

5.3.4 Competence

Competence could simply equate to what a participant expects to hear in a context, verses what is heard. This is competence in a very simplistic form, as it is factors such as adaptation to the context based on experience, and activity also form part of what is understood by competence. Competences based on previous experience of a space or similar contexts, as well as including the task to be performed within the space affect the perception of the soundscape. Competence is shown to be a cognitive match between what you expect to hear against what is heard in a space, taking into account the factors of expectation, and environmental knowledge. The first interview question asked prior to the soundwalk, "*What do you expect to hear in an urban space?*" was a key aspect in exploring competence, as it attempted to show a participants knowledge of the space they were entering into prior to entering it.

Questions directly asking about competence were not included, due to the subtlety of the nature of competence; data on competence was extracted using inference about a participant's understanding of the space, their expectation and differences within. The results have shown that there is a close link between the sounds expected in a space and those heard in a space, but this link does not fully explore the tacit knowledge about the space that a participant may have.

> *"I'd expect to hear some birds, but then again it is winter' – Lon-PhD-SW2*
>
> *"I would expect a bit less traffic...so it might be louder...but then the bus to the right of us stopped at the traffic light' - Man-PhD-SW1*
>
> *"it's quieter than expected on account of being less people, maybe that's given the time of day" - Man-PhD-SW10*
>
> *"The shouting alcoholics and drug addicts that's just normal for central London" - Lon-PhD-SW5*
>
> *"It sounds as I expect it to because it's a fairly decent chunk of green space and I would expect to find wildlife, I mean predominantly birds, but I am in the middle of the city centre and I would expect to hear traffic, I would expect to hear construction because it's Manchester and in this sort of period that we're in, you're never going to get away from the sound. So yes I would expect to hear every sound that we've heard in these few minutes, there's nothing in here where I would be like what's that." - MAN-PSP-SW6*

To explore competence further, involved looking at how participants discussed changes to the context, and how these matched the soundscape which they expected in that space. By examining the attitudes to environmental changes suggests competence in motion, or dynamic competence, which is what one would expect, as the incoming auditory data is constantly being processed by the brain, and competence is determining the understanding of the data as suggested by Huron's theory of the psychology of expectation. The interview transcripts revealed that participants did adapt to the environment, and understood how changes matched what they expected from the soundscape. This relates to an understanding of how the environment should be if something changed within the environment.

Throughout the course of this research work, soundwalks were conducted throughout the year; this resulted in a variation in the activities occurring in and around the study spaces. The work was also carried out at various times throughout the year, resulting in differing metrological conditions, from snow, rain to hot sunny days.

These features were only mentioned in passing by a few participants, and were not deemed to have too much of an impact on their answers. In particular, the effect of rain on traffic noise was not mentioned, but does change the overall soundscape, and may be part of the expected soundscape. This question was not explicitly asked and may prove a question to be asked in any future work.

> *"Yes it is how I expect 'in this weather", - Man-PhD-SW2*
>
> *"If it were warmer I would expect more people, so perhaps more sound", - Man-PhD-SW9*
>
> *"It's quieter because we are getting towards closing time, and the sun is disappearing" Lon-PhD-SW8 - 3-24*

In Manchester, there was less change throughout the study period, there were some seasonal variations in St Ann's Square with seasonal markets (see figure 5-20 and 5-21) using the square, and at one point the water feature being boarded up for maintenance work. The main change occurred on Deansgate, which during the later stages of the work was closed for replacement of the sewerage systems.

Figure 5-20 : St Ann's Square 1

Figure 5-21 : St Ann's Square 2

Whilst there was little construction work occurring during the soundwalks, the closure of the road had a major impact on the traffic, as it is a major through road in Manchester. This point was highlighted by some of the participants, and shows a level of expectation and adjustment of expectation to the new situation. In particular, this point was highlighted by comments such as

> *"Deansgate is blocked off....that's cutting out traffic noise I would expect to hear....and it is quieter...because of the road works and time of day" - Man-PhD-SW10*

The closing of Deansgate was fortunate, as it allowed for a change in context to occur and therefore be explored. The change in context was from a junction, to construction site. This showed that removal of the main sound source, the traffic, resulted in the soundscape missing the main contextual component. Participants explored the nature of the missing source, by suggesting that the space was missing the source, but still sounded as they would expect, given the new context. Further explanation of this was explored and found that the space was quieter than they expected

> *"..Its quieter here....because of road works" - Man-PhD-SW9*

> *"It's little less hectic because there are no cars on Deansgate which is quite bizarre because of the work....it's much quieter' - Man-PhD-SW9*

"I think they (road works) go to actually worsen than the soundscape...they amplify the road noise which then makes that more of a negative, but the amplification with the people noise makes it more positive because it helps them bring it in to some balance against the traffic". -MAN-PSP-SW2

In London, transformation of the study area to allow for CrossRail development in the Tottenham Court Road area meant that there was an increase in the amount of building work being carried out; this was tied to the demolition of the Astoria complex located close to the starting location, and the Soho Square spaces. Soho Square was also subjected to building work related to improving the water system, and restoration work to the monument in the centre of the square. Additionally, construction work on the buildings around St Giles also started during the research period and affected Phoenix gardens (see figure 5-22) Important to this work is the effects of expectation and competence on how a person perceives the soundscapes, competence in action is shown by the following statements, where judgements on the actual acoustic level of the soundscape are judged based on a competence of the environment. This shows the dynamic nature of competence and thus expectation

"it's louder because of the building site" - Lon-PhD-SW5

"it's slightly different today because of the road works and the men workings, so I would expect it to be quieter actually" – Lon-PhD-SW7

Figure 5-22 : Phoenix Gardens 1

The participants perceive the space to be slightly louder than normal, but this does not affect their judgement of the space and experience of the space informs their comment

> *"There's more noise than usual, there's more of a dull hum of the workmen, work going on in the background, I wouldn't expect that normally" – Lon-PhD-SW7*

> *"Yeah cause its all conflict, I think there's something, something doesn't quite gel somewhere in my head about what I'm seeing and what I'm hearing, they don't go together somehow and so you've got this kind of pushing pulling tension kind of thing in the gardens. To me and I'm really surprised because I looked at it through the railings, I thought oh fantastic, this will be great and I'm standing here thinking." - LON-PSP-SW4M*

Participants also showed competence by explaining reasons of what they would additionally expect to hear in a space. Whilst the participants stated that the place sounded as expected, there were certain sound sources, which if heard, would not be against expectation. The general form of the responses took the form of the 'place sounds as I would expect' but

> *"I'd expect more constant traffic jams, car horns at this time of day....I can see birds but can't hear them, I might expect to hear a siren", - Man-PhD-SW8*
> *"I'd expect to hear a few more people chatting" - Man-PhD-SW1*

> *"'I'd expect to hear more sirens" - Lon-PhD-SW5*

> *"I'd expect to hear traffic" – Man-PhD-SW7*

When asked about the construction and materials which made up the space, and the effects that these might have on the soundscape, participants responses showed that whilst they did not have specific knowledge of acoustics and the nature of sound propagation, there was knowledge how surfaces, and buildings might affect what they were hearing.

> *"Well like it was before, I mean I think Manchester's got quite a lot of these tall buildings and I guess the sounds echo from the people walking on the street which you hear and they reverberate off the sounds of both sides of the buildings I would think." - MAN-PSP-SW3*

> *"Expect to hear...I'd expect to hear echoes, because of the buildings and how the sound kind of reverberates around. I'd also expect to hear the sounds of people, foot steps" - Man-PhD-SW7:*

> *"It's quite built up so that'll definitely have an impact with the sounds bouncing off like different walls of the buildings and things like that. Obviously there's nothing really to absorb the sounds, there's lots of like pavement and hard surfaces and things like that, so you're not really going to absorb much of the sound so it's really just going to be you know, reflected and...guess that both those things I said make it worse, because both contribute to increasing the level*

of noise and also you know decreasing the, what's the word, the fidelity of the sound" - MAN-PSP-SW4

"they're all hard surfaces we've got around here, even the road surface itself, it's not absorbent, there's plenty of other surfaces you could use which in theory, maybe different road surfaces and blocks that might absorb the noise rather more effectively than this which just reflects things back, so we've just got a very large reflective surface from the stone buildings and from the road surface which reflects up and down in the street".- Lon-PSP-SW2

"I'd say the buildings are acting as a kind of natural barrier from a lot of the traffic noise, the fact that it's a square, but then you've also got the traffic using it which is reflected off the surfaces of the offices frontages." - LON-PHD-SW7

Interestingly, whilst the spaces described matched the participant's expectation, they still expected to hear sounds which generally would be considered as noisy. As has been shown, these sounds are sounds of the city, and thus are part of the expectation of the city. To further the understanding of a participant's competence of the space, it was important to examine if their feelings or mood was affecting their judgement of the context they were in and the impact it may have on their evaluation of the soundscape.

5.3.4.1 Meaning and feelings

The following section details the meaning and feelings that the spaces induced in the participants, what was important was to gauge how a space made a participant feel and how this affected their perception of the space. It was also important to extract from the transcripts how mood and feeling impacts indirectly on the perception of the soundscape, this was judged by comments made about a participant's mood, and how they would use a space or choose to enter a space depending on their mood. It was also possible to see how mood and feelings were also changeable depending on soundscape and elements in the soundscape.

The primary question asked was '*how does this space make you feel?* Categorization of feeling induced in the space was broken down into six categories; these categories were comfortable, uncomfortable, moving (as in the desire to move through the space), no feeling, positive and negative. The term comfort discussed is not explicitly related to Kang's notion of acoustic comfort, but a general feeling that participants had within the space, related to safety, or mood, for example. Although, for example in Phoenix Gardens, where the space was felt to be 'different' from the other spaces, comfort levels dropped and as has been shown, perception of the sound level was perceived to be higher than expected. Table 5-12 and Table 5-13 show the usage of the terms used to describe feelings of the participants in the soundwalk spaces.

From the table it is possible to see why there are two categories for Comfortable and Positive. The words were used quite specifically to describe how the participant felt in the space, other terms such as 'ok', 'good' were easily categorized as positive terms, but the use of comfortable and not comfortable was explicit in their usage. This usage of the term was also highlighted by examples given by participants

> *"I don't feel uncomfortable in that sense but I just, it doesn't make me feel like a space that I'd want to linger particular cause it's not, it doesn't feel comfortable as a sort of place to relax." LON-PSP-SW4F*
> *'I feel uncomfortable due to the road works'- Man_PhD_SW10*
>
> *"footsteps make me feel comfortable, because I know humans walking around.....i feel kind of safe because I know it is a place I would normally walk'", - Man-PhD-SW2*
>
> *"I feel like part of the city, part of a bigger system, quite comfortable" – Man-PhD-SW6*
>
> *"'the recycling man makes me feel a bit less comfortable, but everyone has got a job to do" - Lon-PhD-SW6*

Figure 5-23 shows the categorisation of participant feelings within a space. Overwhelmingly, a feeling of positive was the highest category rank with more than double that of the next category which was uncomfortable. The results for context of each of the spaces showed that there were four spaces in all which matched with a transitory space, which was of little interest to the participants, it is interesting to see the high ranking of positive feelings towards the spaces. The mood and feeling felt in the space were explored by the contextual judgements given by participants.

> *"Depends on your mood, really. Sometimes you want silence. Sometimes you want noise." Oliver 15.10-13*
>
> *"If I'm going on public transport maybe I have problems or thinking about an assignment it's good to hear people talking or music. But if I had to read on the bus it is not good to hear people talking or music so it does depend on what I am experiencing at that moment and what I have in my mind." Denise, 6.56-59*
>
> *"I do like comforting sounds of like traffic in the background." Cat, 19.45-46*

These finding imply that the mood and feeling felt within a space is related to the meaning that that space has with the participants. The context as well as any associated meaning that the sounds may have with the participant has a direct impact on how the soundscape is perceived by the participant.

Space	How does the space make me feel?	Categorisation
John Dalton Street	Nothing, going somewhere else, not a place to dwell, not the greatest, because of the amount of traffic, feel good, positive association, uncomfortable, quite nice, I like it, want to go somewhere, move and go about my day, like part of the city, part of a bigger system, quite comfortable, not calm, ok, comfortable	Transitory, Positive, negative uncomfortable
Deansgate	Normal, going elsewhere, passing through, not a place to dwell, , not natural, you'd never really come here and just hang out and meet people, everyone is on the move, ok, more pleasant without cars, uncomfortable, indifferent, get away from it, not pleasant location	Transitory, negative, positive, Uncomfortable, No feeling
Parsonage Gardens	Relaxed, calm, peaceful, good, dislike as it's too quiet, Good, relaxed, Comfortable, very nice, self-conscious (feel like being watched due to all of the windows), if there was water, a lot calmer, claustrophobic (because of the buildings), calm	Comfortable, Positive, Negative
St Ann's Square	Happier than other places, calming, nice, calmer and more peaceful than other shopping areas, quite relaxed, quite comfortable, calm	Positive, Comfortable

Table 5-12 : Feelings of participants (Manchester)

Space	How does the space make me feel?	Categorisation
Tottenham Court Road	Like I should be doing something, moving to something, At home, familiar, I love London, agoraphobic, at home, I want to go and not stay here, slightly stressed	Shopping, Transitory
Soho Street	I like it here, depressed, slightly uncomfortable, normal, weary, quite calm, want to go inside a cafe or keep going, indifferent	Transitory, Positive, negative uncomfortable
Soho Square	Peaceful, quite calm, relaxed, calm, at home, comfortable, quite like it, relaxed, nice and chilled	Transitory, Positive, Comfortable
Phoenix Gardens	Not sure, a but funny, pleasant uncomfortable, calm, i like it, very good, never liked it, curious, very happy	Transitory, Positive, negative uncomfortable

Table 5-13 : Feelings of participants (London)

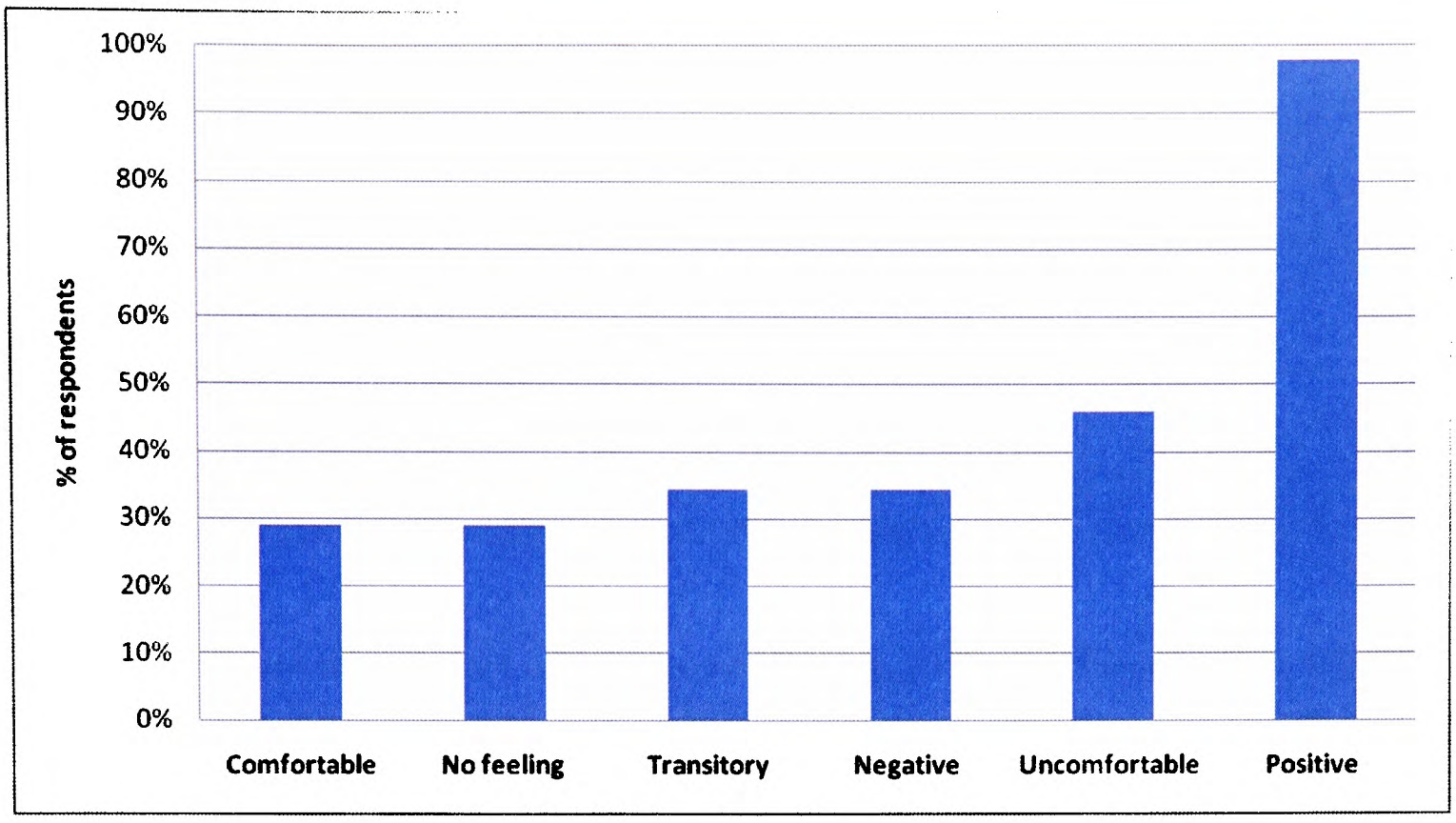


Figure 5-23 : Graph showing participant feelings towards a space

The space itself may have a meaning to the participant, which either brings them or takes them from the space, for example they may have happy memories in the space, or it may be somewhere where they carry out a function, such as a favourite spot for lunch.

In addition to this association with a space, the participant, through competence, can attribute meaning to the sound sources themselves. For example, construction noise can be thought of as either positive or negative, depending on a person's attitude towards the development of the area or fixing of a problem or conversely destroying of the norm. This was highlighted by Raimbault with regards the attitude of French participants towards public transportation, and the value it has to society as a whole, and is thus seen as positive and the sound emitted was not perceived as being as loud as traffic noise from individual cars, which have a lower societal value (Raimbault & Dubois, 2005).

Meaning attributed to a space and the soundscape, with the majority of participants, results in positive perceptions and attitudes towards the space.

> *"I like loud cities, it makes you feel like there is something going on", - Man-PhD-SW8*
>
> *"I'm quite fond of this location because I used to study around the corner" Lon-PhD-SW7*
>
> *"The wind chimes make it better they do, it's sort of a special extra touch, it's a cute little touch" Lon-PhD-SW4*

"it's lively and it's full of life and opportunity", - Lon-PhD-SW7

Conversely on the negative side

"I don't use this space enough that it would have a personal meaning to me" - Man-PhD-SW10

When talking about Soho Square (see figure 5-24

"'it's one of my favourite places in Soho....and...it's going to be noisy, you expect that really....personally I love it, that's why I brought a house here" - Lon-PhD-SW3

This point was also reiterated by other respondents, stating that they had chosen to live in the space (LON_PSP_SW5 and LON_PSP-SW8), their feeling was, "*I chose to live here, I accept the noise*", but changes in legislation have an effect on this, for example the introduction of 24 hour drinking legislation, means that there is then a change in noise patterns. Glass bottles cannot now remain on the street as they are a hazard and as such are collected throughout the night, thus changing the experience of the residents, and the soundscape they have been habituated to.

Figure 5-24 : Soho Square

Other small changes also have an effect, for example, alongside the twenty-four drinking legislation there was a smoking ban inside premises introduced in April 2007. The smoking ban therefore resulted in people who previously would have been kept inside premises which would have had sound insulation incorporated into the design, due to noise legislation and PPG-24 to obtain their license, were now being breached by people opening doors to access smoking areas outside.

This example shows how experience, competence and thus expectation changes through time and thus spaces experience changes too, this is explored later in this chapter, but this is an example of how noise legislation and social issues combine and there is no clear definition of where the cause lays. Is this both an acoustic issue and a social issue?

As part of the pilot work carried out on the thesis and the subsequent data analysis on the interview transcripts, it was quickly noticed that participants were showing indicators of nostalgia. Acoustic and soundscape nostalgia has been discussed by other researchers when conducting soundscape research, (Birchfield, *et al.* 2005; Nagahata *et al.*, 2004). It is felt that part of this issue can be overcome by using the soundwalking methodology presented in this thesis, as this asks sound related in situ of the soundscape itself, and does not rely on memory and thus nostalgia or habituation in the soundscape.

5.3.4.2 Control and behavior

The finding that control was a factor in the perception of the soundscape was perhaps one of the most important findings from this work, and this factor to have a large influence on how the soundscape was perceived. The term *'control'* is multifaceted, not only does it relate to a participants ability to move within a space either away or towards a sound source, but also the ability to be able to control the sound at source. The ability to control the source is closely linked with social behaviour in a space, if, for example, the participant felt they were in a position to ask someone to stop or quieten down, this was perceived as positive control, and the sound had a negligible effect on the perception of the soundscape. If the participant felt uncomfortable, or threatened, by the behaviour of the sound generator or had a negative association with the sound generator, but unable to do anything about the situation, such as leave the space, then this resulted in a highly negative perception of the soundscape. The result of this being that if something was seen as being outside the control of the participant, then their perception of the soundscape came to the foreground and thus became 'noticed'.

When considering context, it is also important to appreciate that an optimal environment for one person, where actions and expectations may not be the same for someone else, can provide a mismatch in expectation or appreciation of the context. Analysis showed that place expectation is composed of three subcategories: social behaviour, place norms, and temporal changes in normative behaviour. The soundwalk data was further explored in the focus groups, to test the relevance further of whether the participants perceived control over the soundscape and elements in the soundscape affected their evaluation of the space.

Perceived control, suggests "*It's your ability to escape something that annoys you really*", rather than the actual sound or loudness of the sound. If elements within the soundscape, such as certain sound sources or behaviours where perceived to be outside the control of the individual, the perception of the soundscape was negative, or when from being unnoticed to noticed. There was variation between those users who chose to enter spaces, to those participants who felt that they had no choice, and had an inability to escape the space.

Place norms, where the link between behaviour and the physical space is key in the understanding of context, and the linkage between the purpose of the space and the expected behaviour in that space, which has been shown previously to be key in the perception of the soundscape. The factor which links to this is the ability to control the source or have the ability to move from the source, which overall affects the perception of the soundscape.

When social norms were not met as the participant would have expected, the participant's ability to control the sound source, for example their ability to 'turn it down' if it becomes annoying, was key in how they perceived the soundscape, which links with finding from community noise research (Dieser & Börsenkommunika, 2003; Gaver, 1993; De Coensel *et al.*, 2010). Additionally, it is also the feeling that the participant has towards their ability to interact and control the noise producer, if the participant feels intimidated by the person/s producing the noise than this lead to an additional negative perception of the space, if the person feels that they can ask the person to control the sound source, then this has a positive effect on perception, this is it the perceived lack of control which produces the negative judgement.

> *"I think it's down to your ability to escape it as well.....It's your inability to escape something that annoys you really." - Oliver, 17.13-19*

> *"Noise is fine as long as we can turn it down, but there is so much of it that you can't." - Keren, 15.12-14*

Where control was possible, the evaluation was seen as positive where the participant has the ability to manipulate their soundscape, or chose to be there

> *"Music ....is good when it is outside and you can go to it or get away from it but when you are on the bus and it is just being played at you and you have no choice then it's bad because it feels like I am having it assaulted on me and I have got no choice about it." Sophie, 6.11-14*

"Manchester's a very noisy place on an evening, but I think that's probably to do more with the sort of UK binge drinking culture. I lived right in the city centre for about two years and it's not that unusual to get woken up by people shouting and bawling after they've clearly had a skin full" – Man-PSP-SW6

"in this bar ....they play this music of the rain forest and that's all you can hear to be honest and it's the most traumatic experience I've ever had in my life. .....when you are forced to listen to it and there is no way of escaping it, it is not quite as relaxing as they hoped." - Cat, 21.47-53

"I like music, just as long as I can control it." - Charlotte, 2.35

This last statement emphasises both the inability to escape, but also the sound source being schizo-phonic (Schafer, 1984) and sounds not being '*tied to the sounds that produce them*' (Schafer, 1984) with the expected element soundscape of the context that the sound source related to, the was explored as follows

"for example say if you go to a beauty parlour, or something, it is completely silent and to help you relax they will put water fall sounds on but it is out of context because there is no waterfall there so you know it's trying to make you relax but usually for me it has the opposite effect and because that's all you can focus on." Fiona, 21.40-43

"I think with talking it's nice to hear a hubbub of talking, but when you can hear the actual content as well and you can't get away from the content and you end up finding out all their business, I find that really, that sound I really want to get away from" Sophie, 7. 3-5.

As shown previously in the soundwalk analysis and the analysis of expectation, there is a close link between control and normative behaviour, this link being the relationship of how users of a space behave and the sounds that they produce. The importance here is how the participants discuss what they feel is acceptable within the context of the space, and their attitudes to when and what is acceptable, and not, of users making sound.

"If I have very loud speakers and making intolerable sounds and somebody living next door or below, or above, that is not acceptable. People argue it is;....'it's my life, its my sound', but that's not, it intolerable. It's a social thing, a behavioural thing, which sound is not separate from other things obviously, it's behaviour." - John, 17.27-43

"....it has become more acceptable in talking and in loud noise... Sensitivities have changed. It may not necessarily be behaviour in terms of good and bad but what people consider acceptable has changed." - Charlotte,19.4-18

"It's the setting you're in and what you are doing" Rubia, 10.20-22

"I think it depends on what you're doing. If you are studying I don't think the sound of sirens would help at all, that would be negative in that case. But if there was a fight going on and you heard sirens I think it adds to the excitement that you have of a fight going on, you'd think, "Yay, more action." Rubia, 5.57-60

"Like if you worked on Saturday morning you'd probably have to get used to hearing people really loud on a Friday night even though you're trying to sleep. I think I'd still find that really annoying even though it is the norm." Sophie, 12.52

It is not only a view towards the people who use the space, but the inability to control the natural and nature based sounds which inhabit the space which can be problematic

MAN-PSP-SW6: That's the sound I don't like, the pigeons.
I: You don't like the pigeons?
MAN-PSP-SW6: I hate the pigeons.
I: Why do you hate the pigeons?
MAN-PSP-SW6: Because they're dirty, horrible things aren't they, horrible and they pinch all the food from the sparrows. I also try and feed the sparrows and then the dirty pigeons come along and try and pinch all the food, but that's another story!

The participant's action within the space, and the stimulation required by them played a role in determining their choice to enter a space

'it's sort of a relaxing zone....and then go back into London"; Lon-PhD-SW4

Interestingly, level explicitly was not a main consideration. Judgements of spaces being too loud or events being too louder were evident, but conversely spaces being too quiet were also discussed. Typically loudness was primarily an issue where it affected communications. This was evident with the hearing impaired participants. Expanding on this, the issue of control became important in determining perception of the soundscape.

"interesting, but incredibly noisy, the masking noise from traffic makes it very difficult for me to understand it very difficult for me to understand speech.....I have to move out of the space to hear someone" - Lon-PhD-SW5

Quietness also played a part in evaluation of a space; quietness was also potential seen as a negative.

"It is too quiet here, I don't like it" – Lon-PhD-SW7

"I dislike as it's too quiet"- Man-PhD-SW3

Level perception changed based on annoyance, but also the inability to control the situation.

> *"It's quieter, but there are other noises which you kind of don't even pay attention to them, so, yeah, maybe it's about the same as some of the other places like the second place we stopped at, but you actually focus on different things here"' Lon-PhD-SW9 - 7-33-36*

Closely tied to control, was the category of behaviour, which describes normative behaviour in relation to how users of the space behave and the sounds that they produce. The importance here is how the participants discuss what they feel is acceptable within the context of the space, and their attitudes to when and what is acceptable, and not, of users making sound. The impact on the perception of the soundscape in relation to behaviour is highly related, where the soundscape and perceived level is evaluated as unpleasant when non-normative human behaviours occur.

> *"don't particularly enjoy street musicians even thought I love music...they just kinda annoy me" – Man-PhD-SW6*

Overall the importance of control and expectation is summarised below

> *I wouldn't say I kind of have a...I mean I think the kind of like the screaming teenagers, that doesn't really and I don't think anyone likes that, and people on a night, kind of like the drunken behaviour is something, but I mean construction vehicles, the whole thing, I think you have to kind of expect that, you can't, you know, in some, ways, you can't, that's why I moved out of the city centre because you can't have that city centre lifestyle and expect peace and quiet really. – Man-PSP-SW6*

A choice is made to enter a context, and there is an expectation for that context, the person entering can either choose to accept the context or move from the context, the main issues arise when the person does not have the ability to move from the context or control elements within.

5.3.4.3 Semantics

The usage of language throughout all of the participant interviews provides an overall insight into the terms used throughout the interviews and their frequency. Using a frequency count for each terms it is possible to see that the most popular terms used by participants. The use of tag clouds below give a strong visual indication of the prevalence of terms used throughout the interview, and it can be seen that the categories of expectation and context feature highest in frequency, with people and traffic being the most frequently used terms in the whole collection of interviews.

The other issues surrounding semantics is the use of descriptors associated to the main categorical terms. There is extensive usage of adjectives to describe sound sources and events such as 'people', 'noise' 'sound', these tend to suggest there is a degree to which the participant perceives the source, or a relationship between the influence of the source and the degree to which it is being perceived. This is similar to the finding of Dubois *et al* (Dubois & Guastavino, 2006; Dubois, *et al*., 2006)

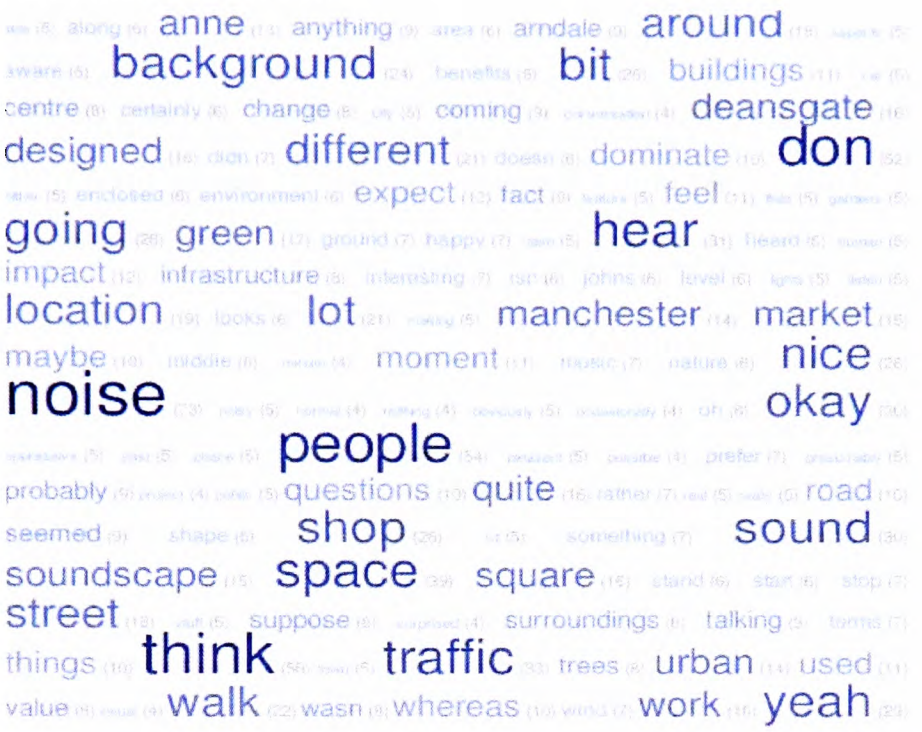


Figure 5-25 : Word Frequency Manchester Soundwalk (Man-PSP-SW2)

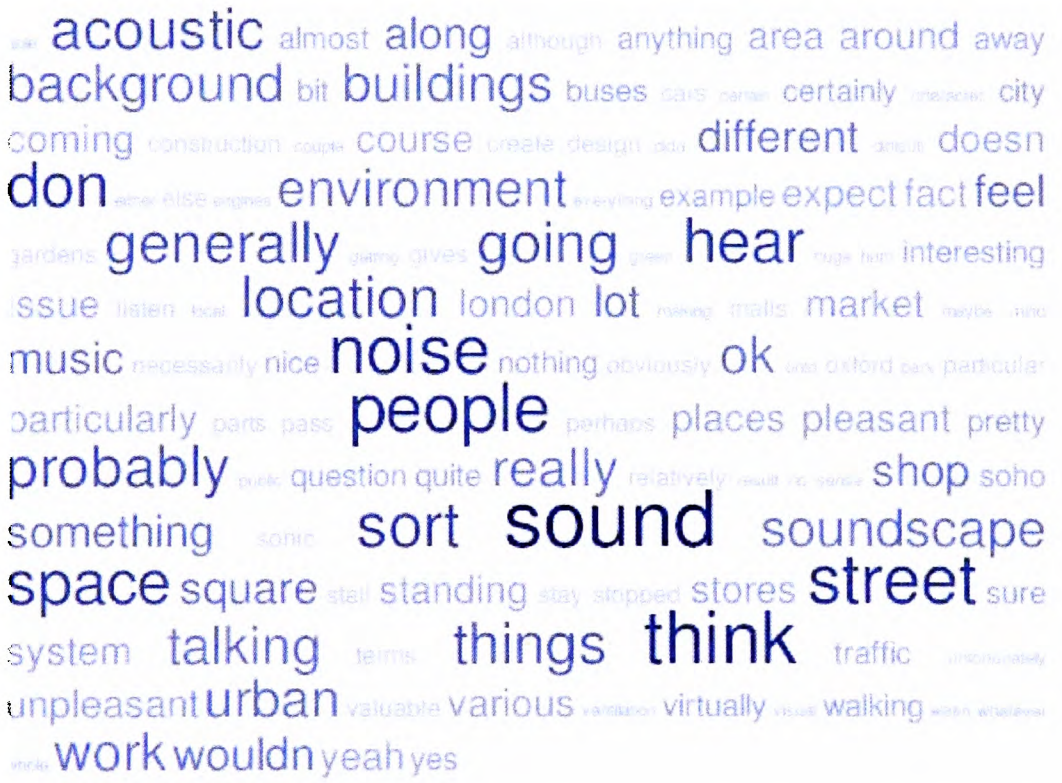


Figure 5-26 : Word frequency London Soundwalk (LON-PSP-SW3)

5.3.5 Soundwalk Analysis Discussion

Analysis of the soundwalk data provided a number of themes on how expectation of a space influences the perception and acceptance of the soundscape. The 'expectation' factor of a

soundscape relates to a combination of interrelated factors, which relate to the subjects 'experience' of the space they are in. The term experience in this context also relates to whether or not they have visited the space before. Expectation it would seem is not solely based on the context of the space, which is defined by the purpose, activity and users and can be defined as, for example, park, square, junction, but on tacit knowledge of activity, purpose and users thus structures or competences, as proposed by Truax and Huron.

Whilst it seems most participants were unable to voice competence explicitly, for example being unable to explain how the surroundings, such as the layout of the buildings or materials used were affecting what they heard in terms of correct acoustical nomenclature, it would seem that they are trying to match the soundscape they are experiencing with soundscapes they have experienced in similar settings, ergo the layout of buildings, materials reflective surfaces, users and the effect it has on what they can hear. This was particularly evident in spaces where the expected context has changed from what it was typically, and participants were able to adjust their expectation based on the current situation experienced in that space.

The next section details how expectation and competence were further expanded upon through laboratory experimentation with the soundscape simulator. The simulator's structure was based upon findings from the results presented about, in particular the use of sound sources. The soundscape simulator aimed to show that removing the participant from the in-situ situation, competence and expectation were still being cognitively processed and matched with the participants learnt structures and implied meaning of space in the real world.

5.4 Soundscape Simulator

In this section, there will be a discussion of how the data collected from the soundscape simulator was analysed and a presentation of the results obtained from the soundscape simulator experiments. The soundscape simulator method consisted of six experiments which combined both qualitative and quantitative data collection methods. The use of quantitative data collection was incorporated to reinforce and gain understanding of the quantitative values set by the participants during their use of the simulator. The soundscape simulator was also demonstrated to a number of design professionals, architects, acoustics consultants and other soundscape researchers during the course of the project. Whilst the no data was collected during these demonstrations, feedback was particularly important in the development and the potential for real world usage.

From the analysis of the soundwalk data, details of sound sources and underlying soundscape structures were integrated into the soundscape simulator to investigate how a participant's competence and expectation affected their design and expectation of a soundscape, with only auditory clues present. In particular, the soundscape simulator had the ability to investigate if participants selected and set the same parameters presented with the different tasks. The participants were also asked to provide a reason behind their choices, to provide insight into their subjective quantitative judgements.

Tests of the soundscape simulator during the pilot study showed that participants felt that the ability to control and 'play' with the soundscape was hugely beneficial and enjoyable. Participants presented with specific instructions on usage of the simulator felt that the ability to manipulate and play with the sounds, rather than follow the set instructions for processing one sound at a time, led to a more interactive and enjoyable experience. The 'playing' approach produced better results from the participants in terms of their engagement with the task and was commented to be an 'educational experience', soundscape education being an important tenet in Schafer's ideas around soundscape awareness (Schafer, 1984; 1988).

It was suggested by a number of participants, that the soundscape simulator method was useful in communicating the concept and importance of soundscapes to participants, in a fun and hands-on way. This sentiment was echoed by the design professionals who tried the simulator, and felt that while the current simulator was not perfect or a complete auralisation system, that it was able to provide an insight into how a location would sound for demonstration and design purposes. A number of enhancements and features were suggested, and these are discussed in chapter eight.

5.4.1 Soundscape Simulator Experiments

The following section details the results derived from the six experiments described in the methodology chapter 4 previously

5.4.1.1 Sound Source Selection

The first part of the soundscape simulator experiment allowed the participant to select from sixteen sound sources, noting on a separate questionnaire which sources they would expect to hear and which they would like to keep in their soundscape. Participants were informed that they were to imagine that they were in an urban space, which was either Soho Square or St Ann's Square. Participants who had not experienced either of the spaces were provided with a verbal description of the space.

This was important aspect of the experimental design, as it allowed for the effect of the competence of a participant to be investigated, as non-experienced participants data could be compared with an experienced participant. Correlation between the two would be consistent with the idea that learnt structures of contexts were being applied when imagining the soundscape and design of the space.

Throughout the experiment, an ambient track was looped over a two minute period. The ambient track as described previously in the methodology chapter, and relates to the underlying base soundscape, with the least amount of activity occurring in the space. The ambient tracks were recorded very early in the morning or very late at night to reduce influence from additional sound sources. The ambient track forms the 'ground' against which the 'figure' is later added (Bregman, 1999), or in existing soundscapes literature is the background upon which foreground sounds are added (Adams, *et al.*, 2009; Guastavino, 2006). From prior testing of the simulator, it was found that allowing the participants a period of time to 'play' with the simulator provided the most engaging experience for them, they were able to familiarise themselves with the simulator control and operation, as well as 'mess around' with soundscape design.

Once the experiment began, the participants were first asked which of the sound sources from the sixteen that they expected to hear in the space they were in. A reduced version of the soundscape simulator was carried out using eight school children aged between 13 and 14 years old and twelve adults. The reduced version contained nine sound sources the reason for the reduced version was due to the amount of time available with the participants. This also provided another chance to test the method. The results from this experiment will be presented after the main results where correlation between this and the main results will be analysed.

A breakdown of participants was as follows:

- Average Age 27⅓ years old
- Age Range 22-36
- Number 16
- Male Participants 88%
- Female Participants 12%
- Experienced St Ann's Square 100 %
- Experienced Soho Square 50 %

Participants consisted of students and staff from the University of Salford, none of the participants had an interest in soundscapes research, nor were expert listeners.

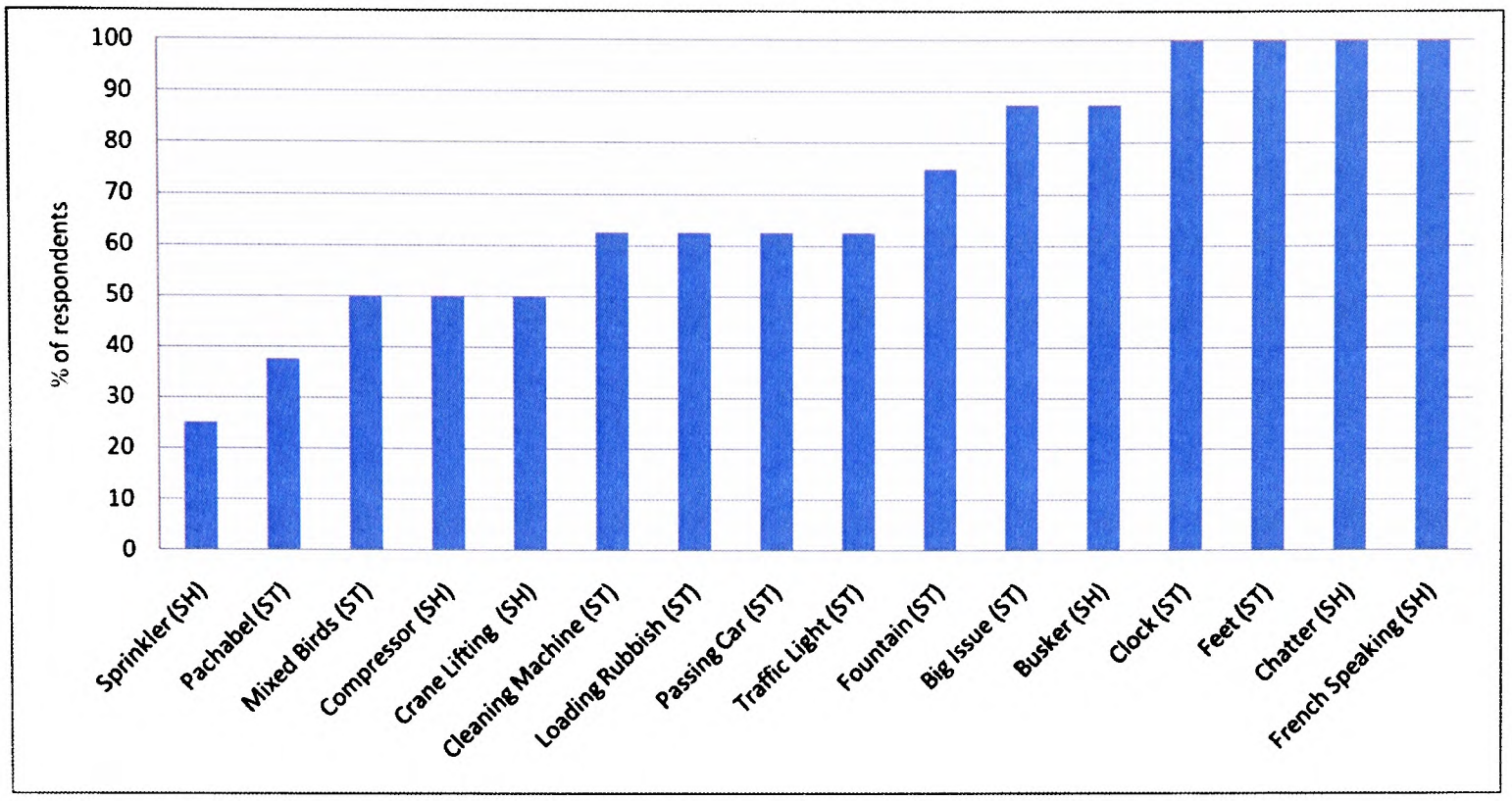


Figure 5-27 : Sound Sources ranked by expectation - Soho Square

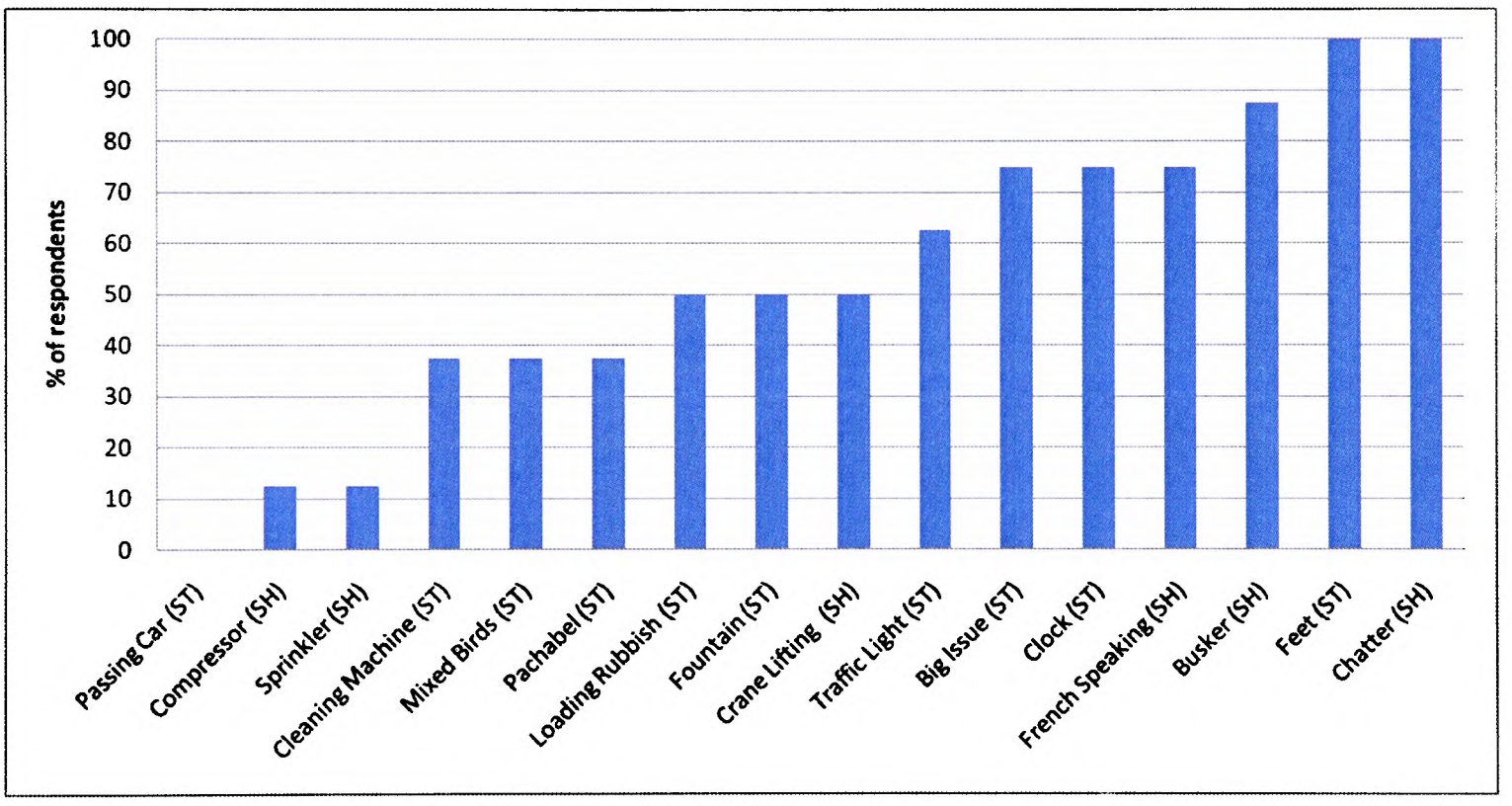


Figure 5-28 : Sound Sources ranked by expectation - St Ann's Square

Figure 5-27 and Figure 5-28 show the participant ranking of sound sources by expectation. For both spaces there is a similar expectation between the two with French Speaking, Busker, Feet and Chatter being the most expected in both locations, albeit in a slightly different order of expectation. Conversely there is a similar correlation between those of lowest expectation. A point of interest relates to the passing car which was not expected in St Ann's square at all, but was actually recorded in St Ann's square. St Ann's square was also the space which has been experienced by 100% of the participants.

Possible reasons for this anomaly related to both the recording, and the 'unusual' sound recording as the cars in question were driving over cobbles. This is a usual sound and the recording caused some of the participants to question the sound. This was even the case with experienced participants as well. The other source which caused participants to question it, was the sprinkler source. Participants were not informed what the sounds actually were, but were asked if they expected to hear them, uncertainty of the source may have resulted in the low ranking, or as stated, the recording was not convincing enough to pass for an expected sound.

Figure 5-29 shows the results of the combined expectation of the sound sources. The results show that a participants expectation of an urban square highly features people sounds, with designed features included (fountain, clock), this would match the sound sources which were described in 5.3.2.2, and matches with the contextual nature of the spaces under experiment.

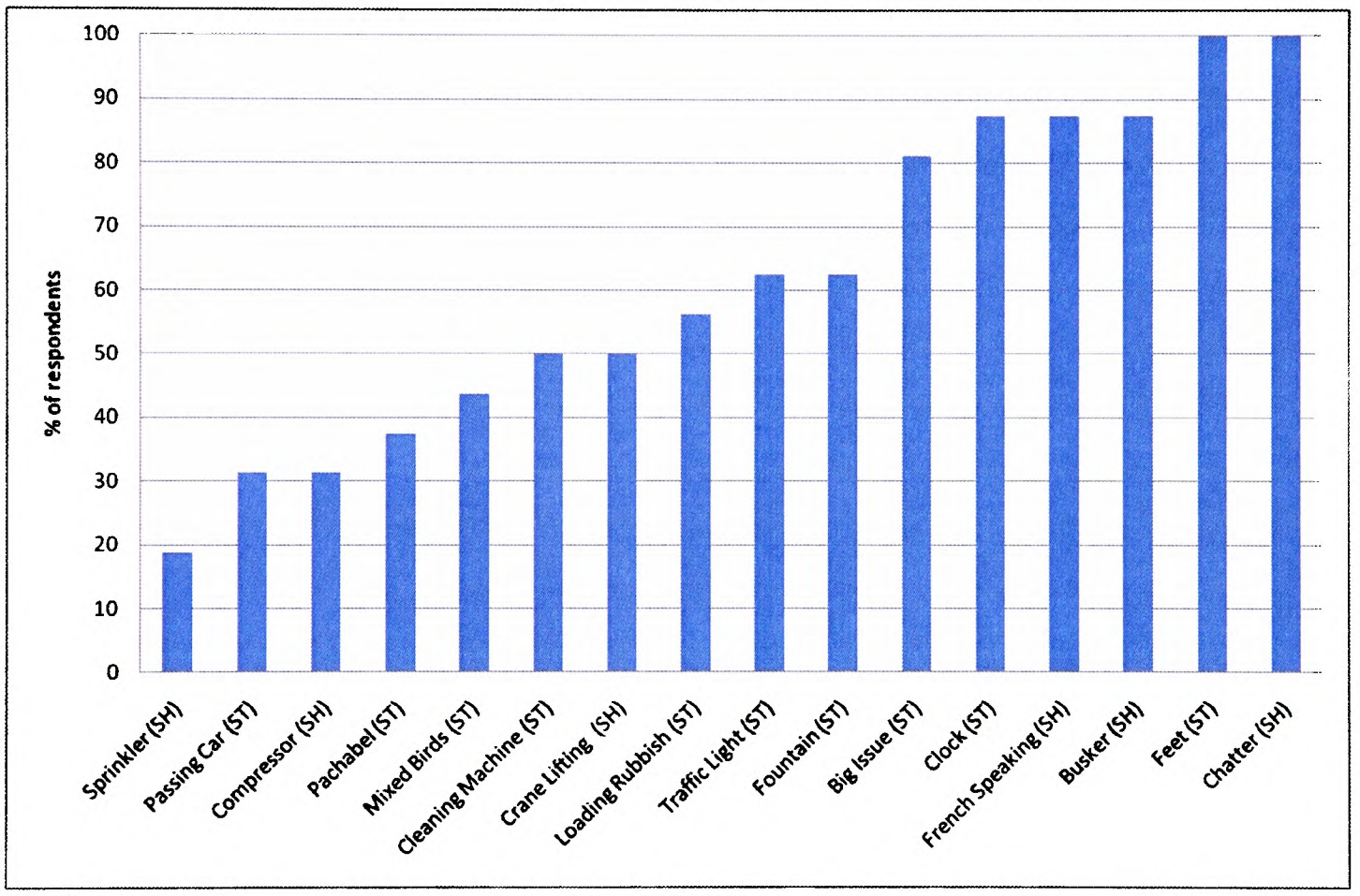


Figure 5-29 : Sound sources ranked by expectation – combined

The figure shows that with the exception being the passing car and compressor sound in Soho Square, sound sources which were present in the actual location. Pachelbel's canon which was performed by a string quartet, would be classified acoustic in nature, as there was no electronic amplification present, but was rated quite low and was not expected, whereas similarly acoustic of the strummed guitar of the busker was expected and rated highly, analysing the qualitative data showed that the reason for this was down to the nature and level of the musical content.

The string quartet was much louder than the busker, and the music and the idea of string quartets was seen to have a relationship to Christmas, given the experiment was untaken during the summer months, participants felt that the would expect it, but only at Christmas. Most interesting is the bird song, which is not highly expected, looking at data behind this shows that this could be down to the nature of the recoding. The birdsong was recorded close to the source and is a prominent recording. In general listening, it would be unusual to hear birds this close and this may have contributed to the low score for this sound source. Further to this, the bird song was a mixture of different birds, including wrens, pigeons and sparrows at dusk this again could have played a part as it may not have sounded natural or as expected.

When investigating the match between sounds and specific recording locations, whilst one might expect Soho Square sounds to be most expected when imagining Soho Square, this was not the case as the results show, primarily due to participants not fully being able to differentiate between the sounds of chatter, as due to the nature of its close recording additional acoustic factors were removed from the sound source. As such chatter is chatter where ever it may have been recorded in the absence of reverberation for instance.

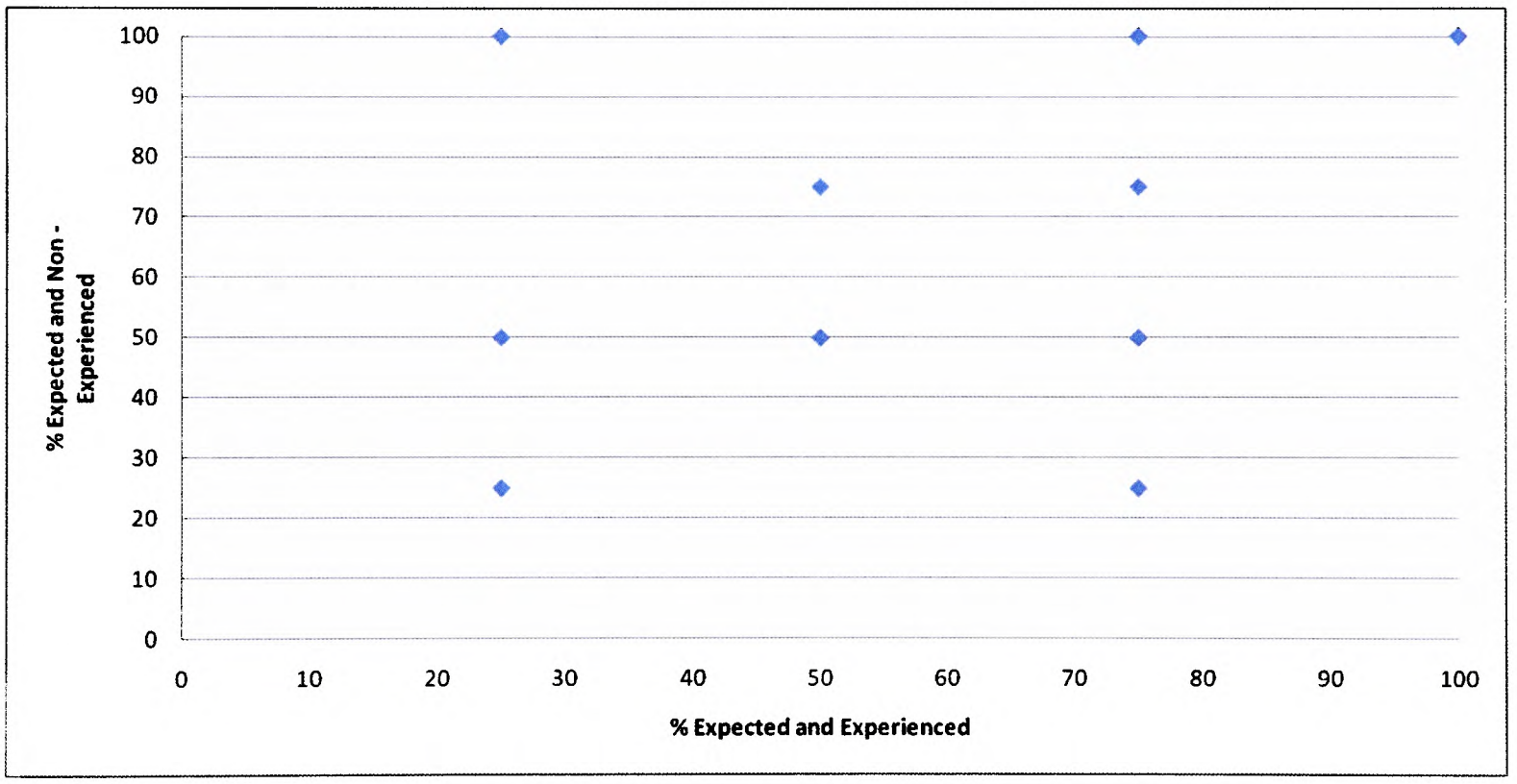


Figure 5-30 : Graph showing relationship between experienced and non-experienced participants and the effect of sound source expectation

Figure 5-30 show a scatter plot of the relationship between experienced and non-experienced participants and the effect of sound source expectation. The data is presented by performing a Spearman's correlation on the expected sound sources for experienced and non experienced participants.

This looked at the relationship between those who had experienced the space and stated it was as expected and those who had not experienced the space and rated it as expected. The results return a correlation which is significant, albeit not highly significance at 0.542 for a p-value of 0.05 level (2-tailed). This suggests that there is some correlation of the sound sources expected in a space, independent of if the person has experienced or not experienced the space, which is consistent with the notion of competence, suggesting that a learnt competence of similar spaces is employed when evaluating the soundscape of that space. This would need further research to determine develop a better correlation.

5.4.1.2 Sound source inclusion and exclusion

The following section details the sound sources which participants chose to include or excluded from their soundscape design. Figure 5-31 shows the results for the inclusion of sound sources, for each space and combined together. The response data was analysed and an average of source sources selected was collated.

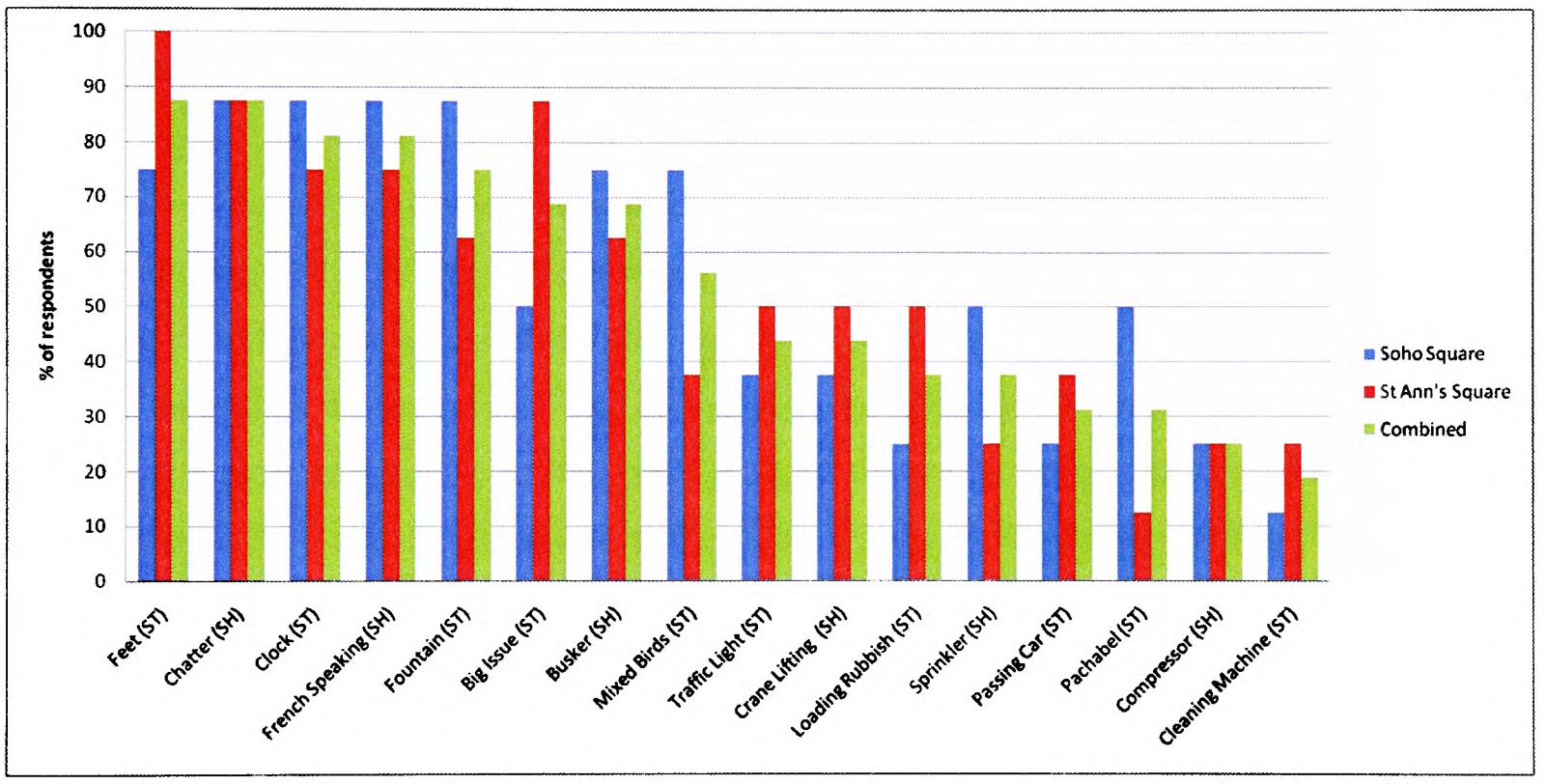


Figure 5-31 : Graph showing the sound sources included by participants in their soundscape

Interestingly the chatter sound source has an exact correlation as well as being the most expected sound source too, the same is true of the compressor sound source, which as we shall see is the lowest rated of the sound sources, and with the cleaning machine has the lowest inclusion. The graph also shows that the highest deviation occurred in sound sources which participants in their subjective answers were most talked about.

The questionnaire taken at the same time provided an insight into the subjective reasons behind the participant's choices. These answers begin to provide some understanding of why some features of the soundscape are tolerated in an urban square.

For example, the presence of the Big Issue seller divided opinion, these ranged from a positive inclusion as it 'adds human elements' or a negative inclusion as it felt like '*harassment, is unwanted*'. These subjective reasons are not related to the acoustic nature of the source, but a more social expectation, aligning with the ideas presented by Dubois (Raimbault & Dubois, 2005). This was also true for Pachelbel's canon, which divided participants, with some feeling that it reminded them of Christmas, where as others felt that it was too intrusive in the soundscape. The mixed birds sound source was problematic and this may explain the wide difference in inclusion, as some participants felt that the bird sound were again too intrusive in the soundscape.

Similarly, reasons for choice or rating provided by the participants showed similar reasoning to those given in the soundwalking phase of this work. For example, the competence of the temporality of a sound, or the purpose of a sound, such as the cleaning machine 'it is very noisy, but it is serving a purpose and I know it won't be here for more than five minutes', the same is true for other utility sound sources.

Categorising the sound sources into the six categories as described in the soundwalking analysis in section 4.2.2.2 gives the ability to show if there is a link between the soundscape simulator expectation and design and the soundwalk data. Figure 5-32 shows the relationship between the results for expectation and inclusion of the sound source in the spaces. The graph shows that there was high expectation and inclusion for people sounds and designed features which include the fountain, clock and traffic light. Construction sounds are third in terms of expectation, with nature sounds not being as highly expected but with a high inclusion rating. These finding would suggest that for an urban square that a mixed of designed features and people sounds would be expected and accepted in the space along with other urban sounds such as construction and utility sounds.

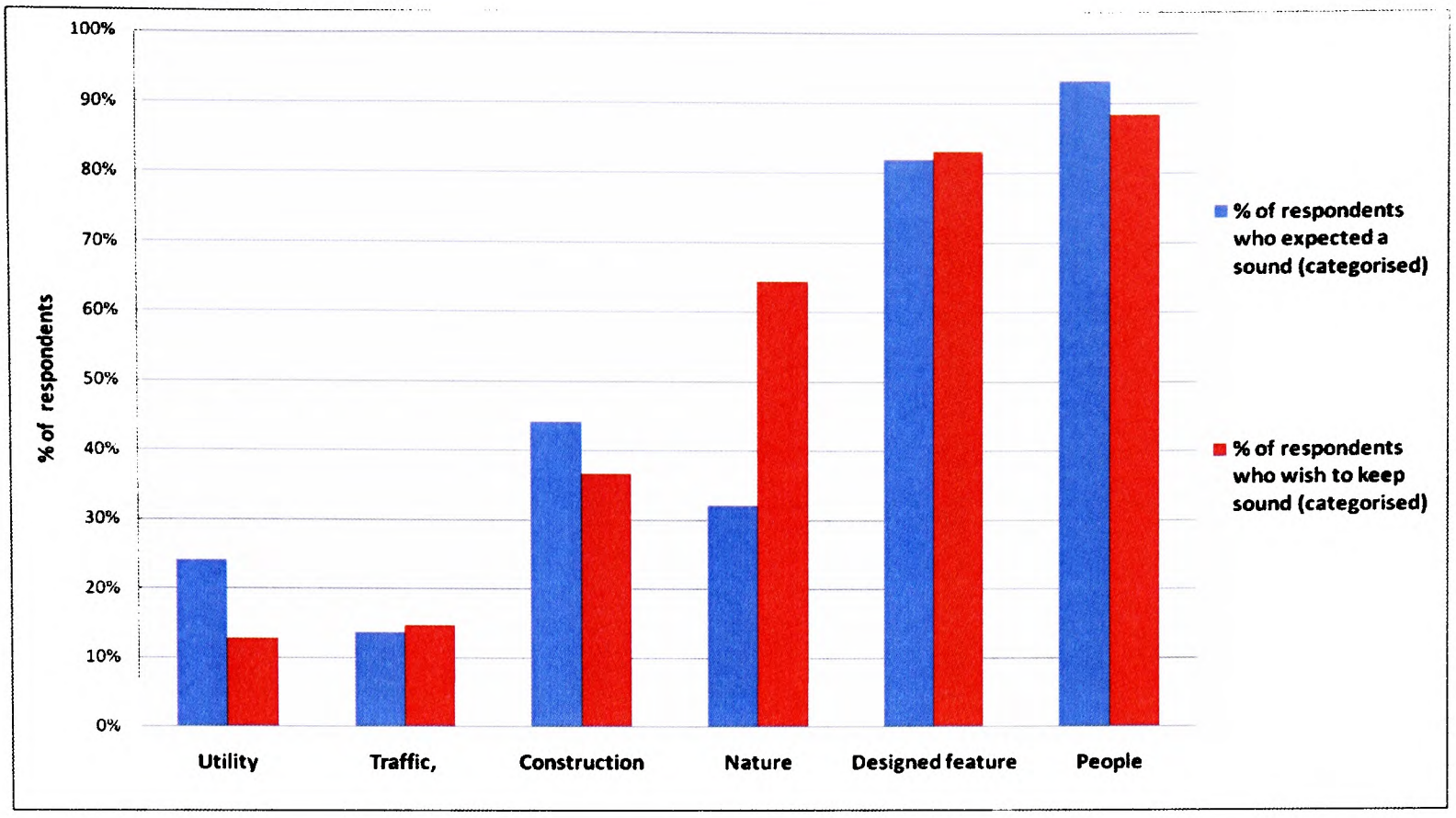


Figure 5-32 : Sound Source Expectation and participant choice for an urban square categorised

5.4.1.3 St Ann's Square limited test with school children and adults

The following section details the results from a limited test of the soundscape simulator with school children and adults. The reasons for the limited test were due to the amount of time available with the school children and their attention span. The breakdown of the school children participants was as follows:

- Average Age 13.5 years old
- Age Range 13-14
- Male Participants 88%
- Female Participants 12%
- Experienced St Ann's Square 50 %
- Total Participants 9

The breakdown of the adult participants was as follows:

- Average Age 27.1 years old
- Age Range 24-33
- Male Participants 72%
- Female Participants 18%
- Experienced St Ann's Square 100 %
- Total Participants 11

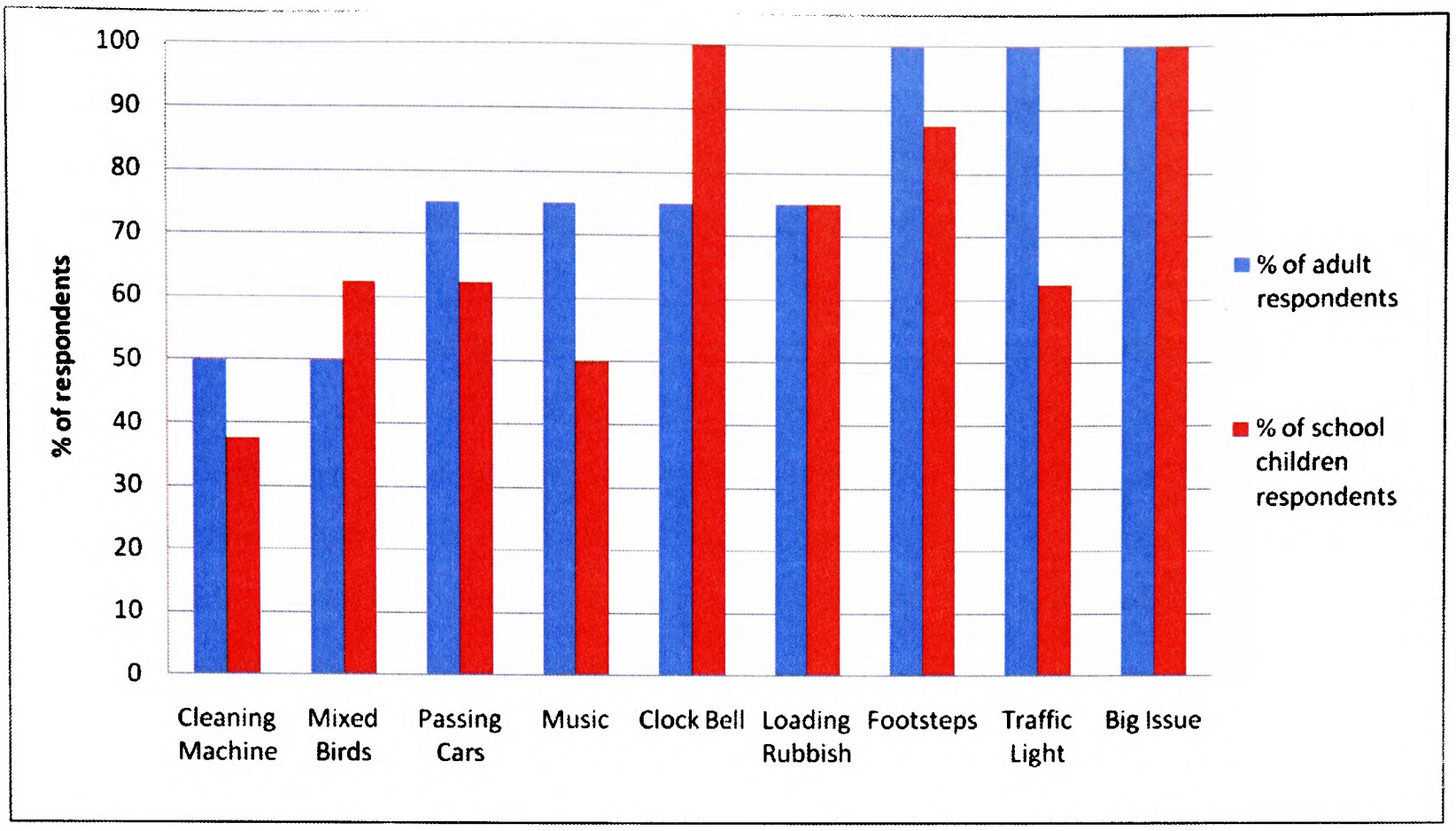


Figure 5-33 : Graph showing sound sources expected in St Ann's Square

Figure 5-33 shows the relationship between school children and adults of sound sources expected in St Ann's square. Performing a Spearman's rank correlation on the data sets shows there is a 0.6 correlation between them, which suggests a strong significance. This suggests that even at a young age, children have a competence of what to expect from an urban square soundscape, either having directly or in-directly experienced it.

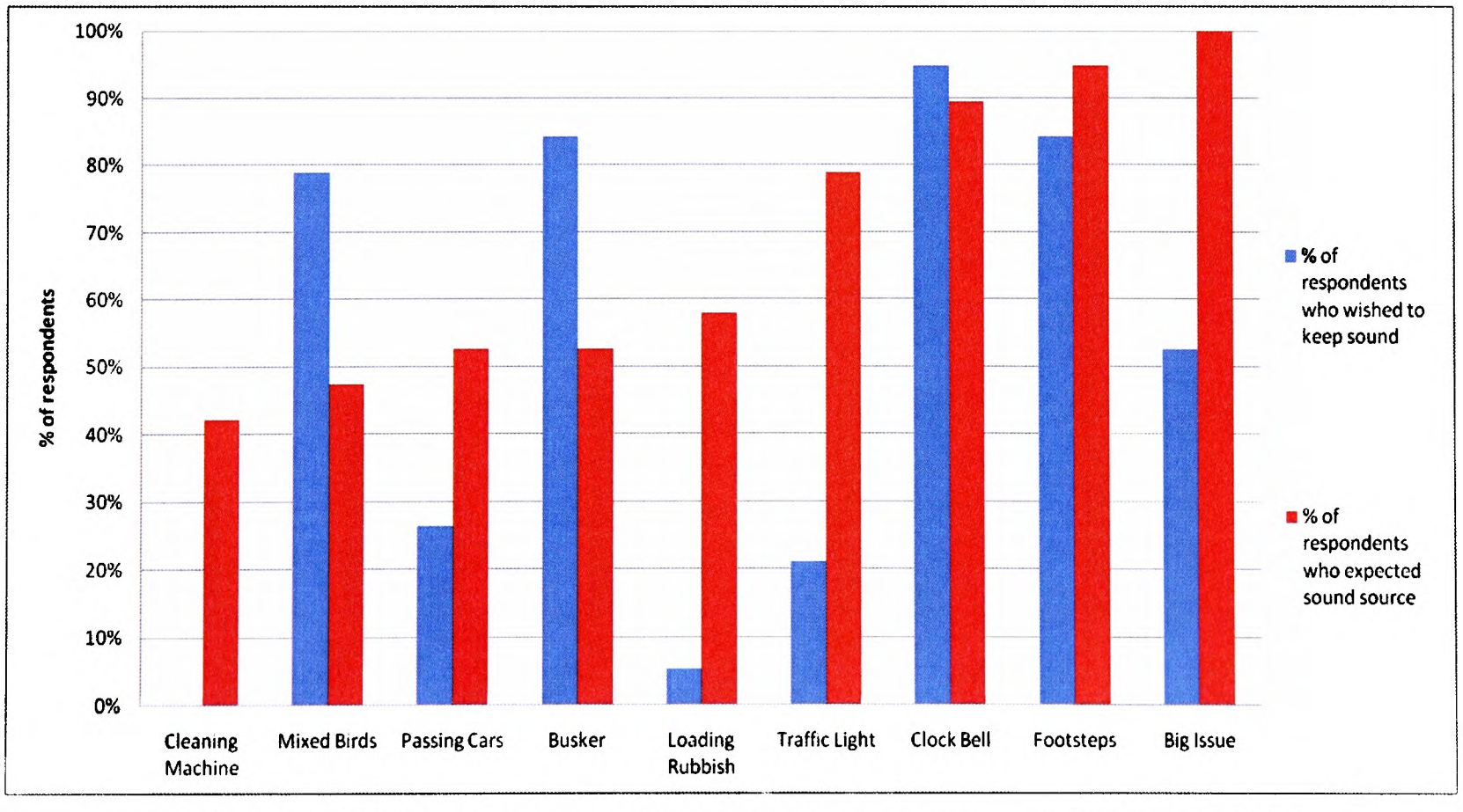


Figure 5-34 : Graph showing expectation and inclusion of a sound for school children and adults

Figure 5-34 shows expectation and inclusion of sound sources for both the school children and adults. With the exception of the street cleaner machine, which had 100% rejection rate, although 40% expectation rating, there is a mixed general consensus for the majority of sound sources, although the inclusion rankings are in keeping with the results given in Figure 5-31.

The results in Figure 5-34 are interesting as there are some quite large differences between expected sounds and sounds to be included, in particular loading rubbish, and the cleaning machine. This suggests a link between the value attributed to a sound source had not fully been developed in the school children, suggesting that competence had not been fully formed, as the qualitative answered showed that they simply did not 'like' the sound, and did not expand on the reasoning behind that answer.

5.4.1.4 Sound Source pleasantness ratings

This section of the experiment aimed to look at how participants rated the pleasantness of the sound sources, and if there was any correlation between rating values. In addition, looking at the extent to which expectation influences rating. Participants rated the sound sources on an eleven point Lickert scale, ranging from Pleasant to Unpleasant. Figure 5-35 shows the ratings for sound sources, where the fountain and busker get the highest ratings and the compressor and cleaning machine get the lowest ratings.

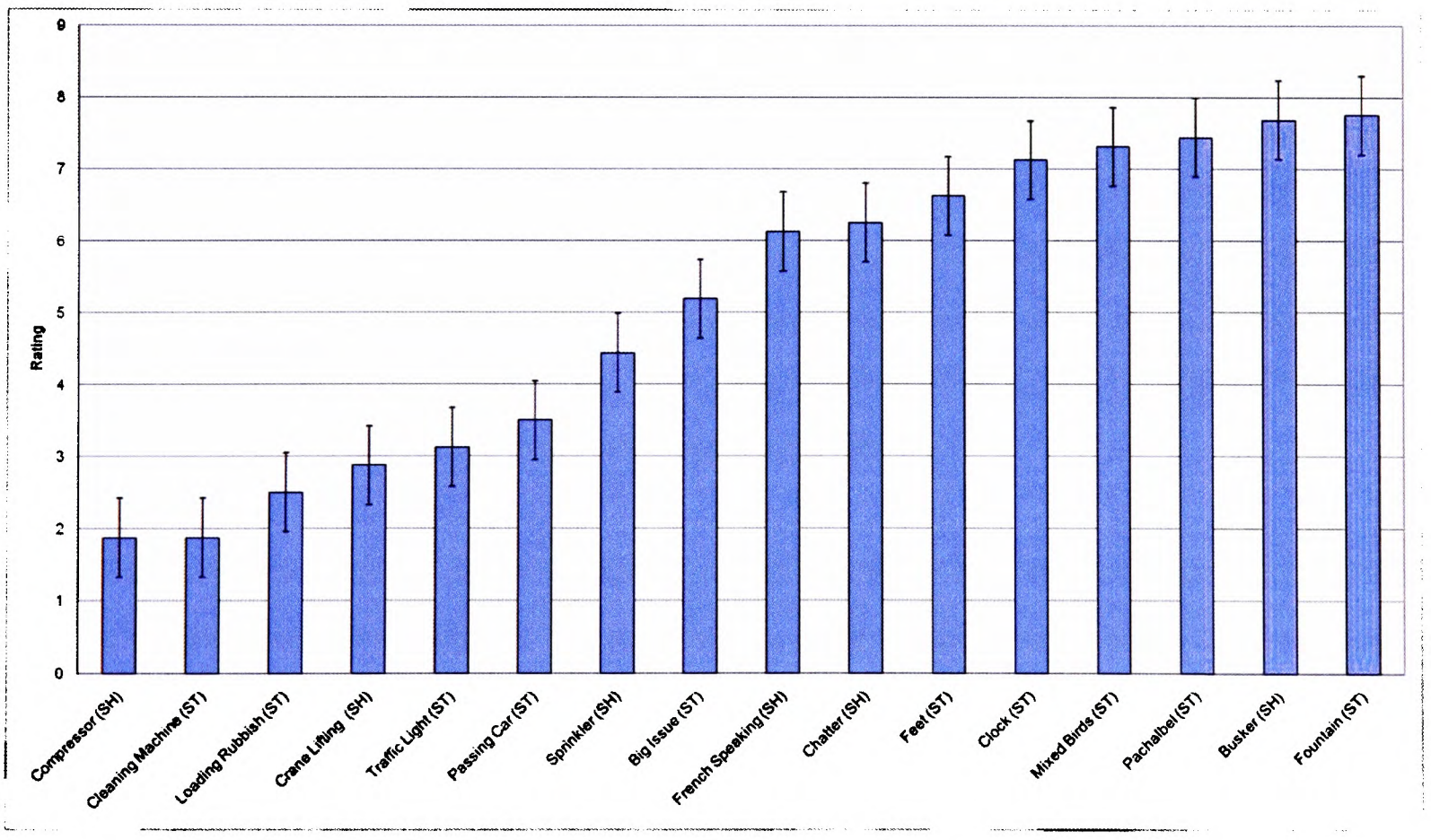


Figure 5-35 : Graph showing sound source rating for adult participants

Figure 5-36 shows the ratings of the sound sources placed into their categories, as above. Nature, people sound and designed featured sounds have the highest and similarly utility and construction have the lowest.

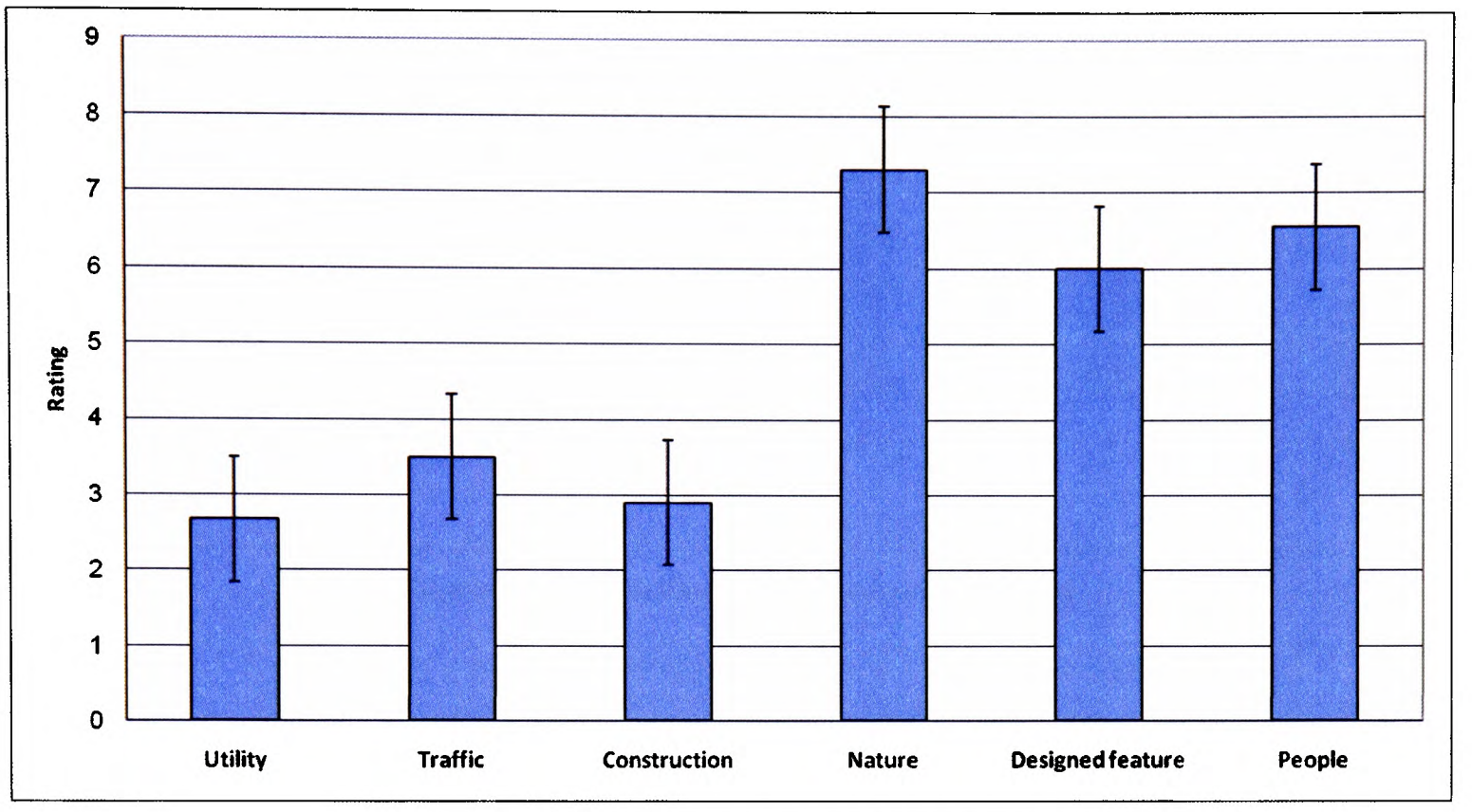


Figure 5-36 : Graph showing sound source rating

Similar to findings in the previous section, this would suggest that for an urban square, participants would expect and like to hear the sounds of people, nature and designed features (i.e. fountains etc). Analysing the ratings further and looking at the distribution of ratings, shows a bimodal distribution, as shown in Figure 5-37, where rating is from 1- Unpleasant to 10 – Pleasant. The graph shows that the majority of sounds were either rated around the 7 or 3 mark, that is to say neither very pleasant or very unpleasant. This roughly suggests that the pleasantness rating scale is being used to make a binary judgement about the sound sources, into liking and disliking, the finding show that these ratings link to the inclusion of sound source decisions of the sound sources in the soundscape design.

The participant's expectation of the soundscape is shown to be met, but they may not like or rate highly the constituent parts of the soundscape, or the environment, these facts seem to play a little part in the overall evaluation of the soundscape, but other factors as discussed such as control, are what is important, such as the ability to move to a space which is more conducive to the activity that they wish to undertake. Perception of the soundscape, as being louder may occur if the participant was forced to remain in the space, and had no control over their ability to move from the space, or control the elements within that space.

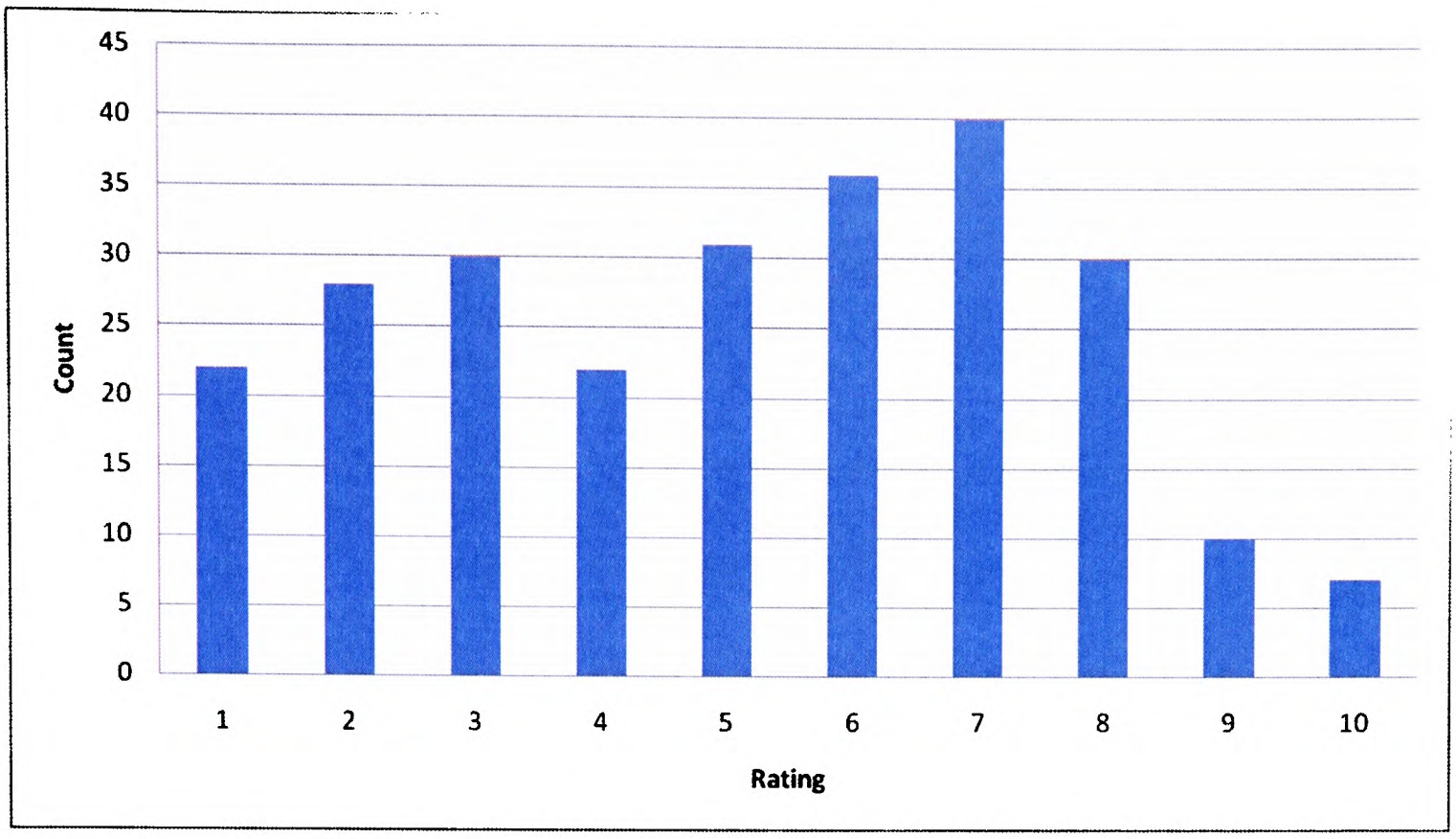


Figure 5-37 : Distribution of sound source ratings

5.4.2 Experiment 2 - Source Level Adjustment

This experiment allowed the participant to set individual levels for each of the sound sources to see is there was an overall expected level for each source, and what levels they would set the sound sources at and if there was any correlation, also comparing the difference of the set levels to the actual levels of the sound sources.

Figure 5-38 shows the distribution of the levels set for the sound sources. What the graph shows is that generally the levels were left the same as the level they had been recorded at in the field, with some sources being reduced by up to 10dB. Very few of the sources were set lower or higher, which shows a strong correlation that the source levels set matched what was expected in the real world. The reason for the -10 dB value is something which is explored in section 5.4.6, as there was a similar finding in relation to the global level set for the soundscape, and the reasons are explored there.

Further investigation looked at if there was a correlation between the sound source rating and the level set in the previous section. Figure 5-39 : Graph showing the relationship between rating and adjusted level for sound sourcesshows the relationship between rating and adjusted level set for each of the sound sources, performing a correlation calculation on the data sets show that there is a correlation coefficient of 0.4, which whilst not strong is significant as shows that there is some positive correlation, this can be seen in the graph, with the anomaly of some sources being rated highly, but being set lower.

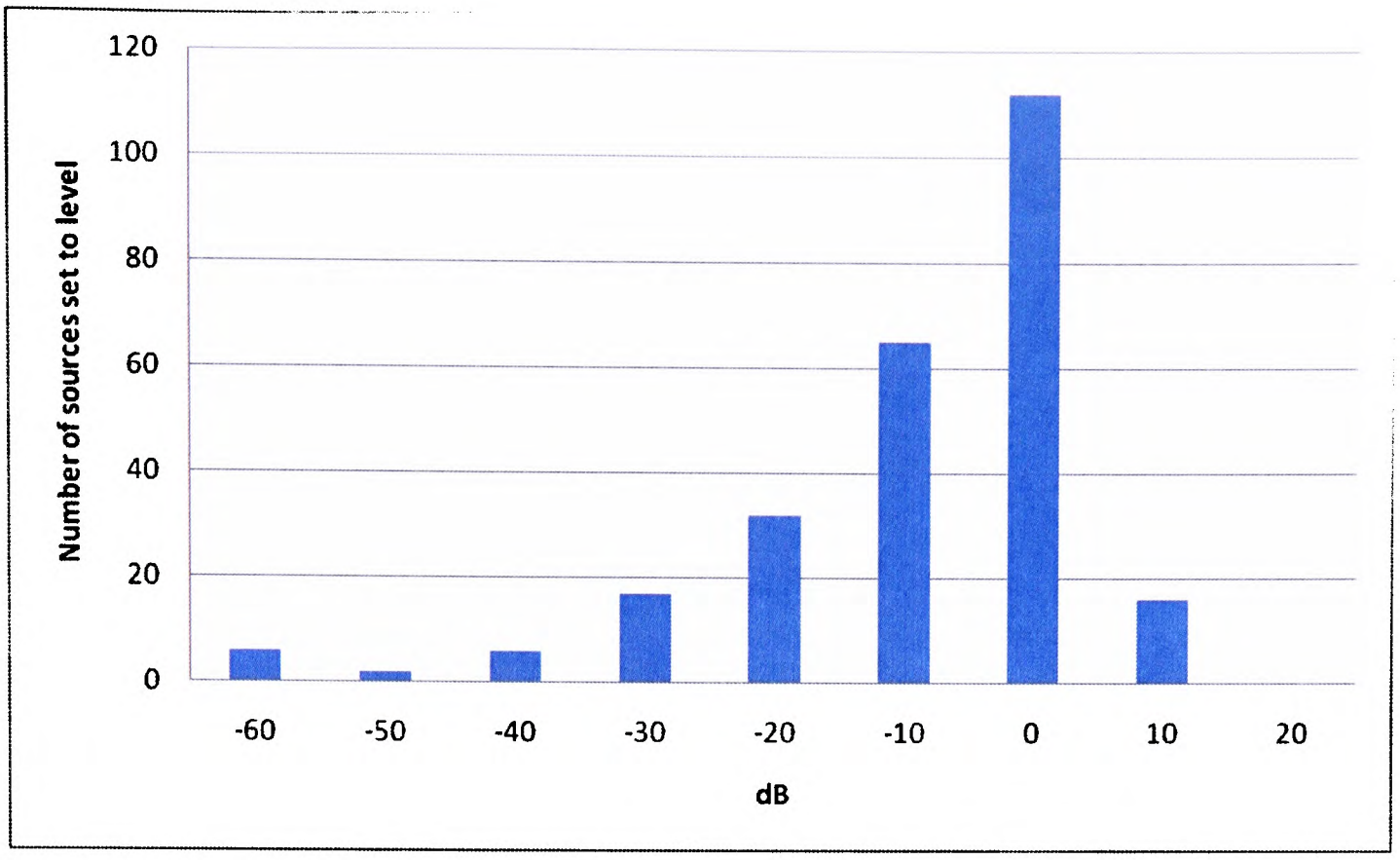


Figure 5-38 : Graph showing the distribution of sound source levels

This reiterates one of the main points from the literature, that soundscape perception is about more than just sound level (Schulte-Fortkamp, 2007; 2002b; Schulte-Fortkamp & Fiebig, 2006; Kang, 2007b). Again, these are the fountain, busker bird song and Pachelbel's canon, sources which rated highly, but due to the close nature of the recording, may have been too loud at the point of listening. Again control that the person has within the space comes into play here, as in the real world, the level reduction shown in the simulator occurs by moving further away from say the busker, until it is at a level which is acceptable to the participant.

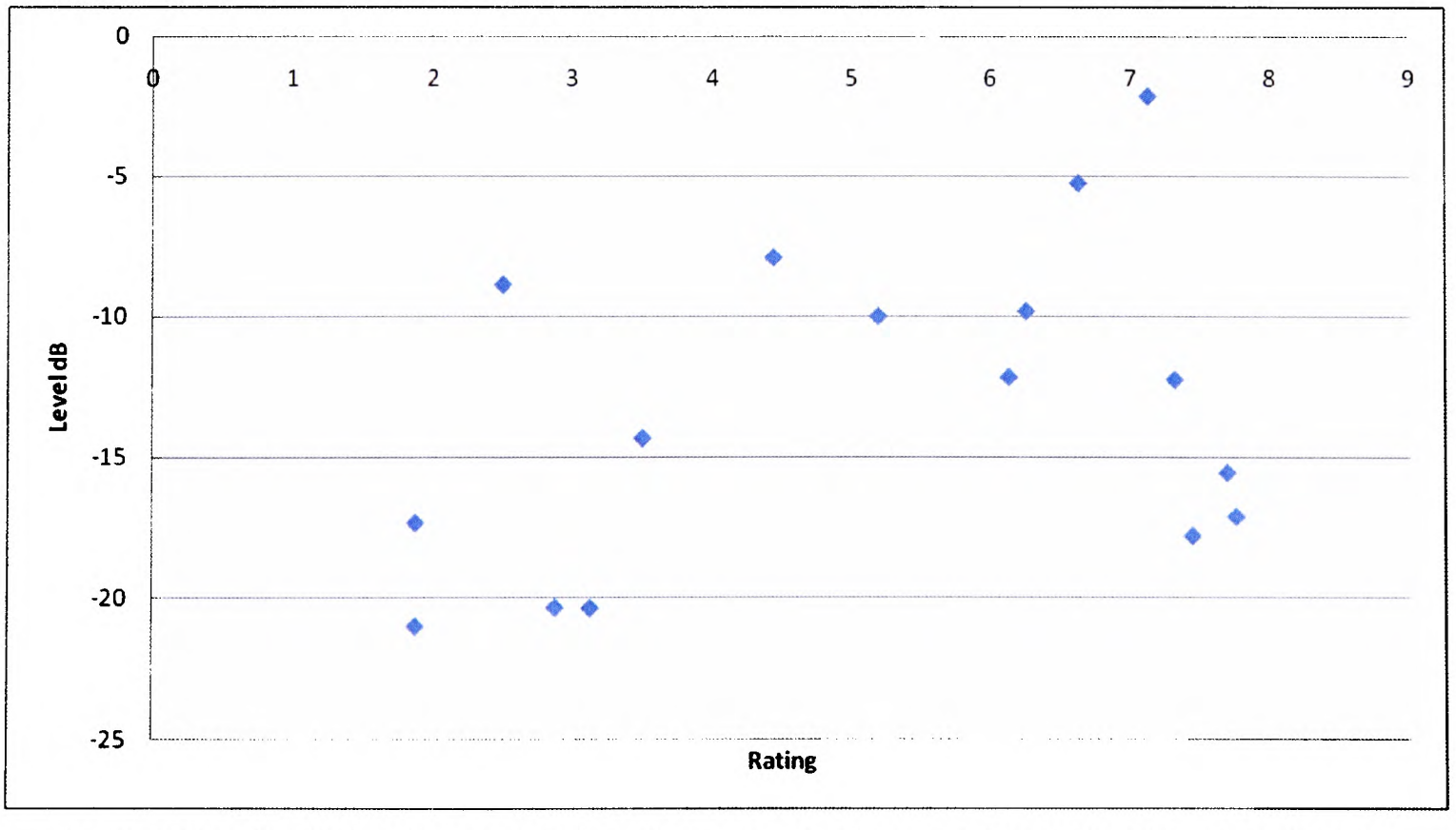


Figure 5-39 : Graph showing the relationship between rating and adjusted level for sound sources

5.4.2.1 Sound Level Measurements

Table 5-14 shows the recorded sound levels for the sound sources used in the experiment.

Sound Source	L_{Aeq} (dB)
Ambience	60.1
Big Issue (ST)	50.1
Clock (ST)	47.1
Cleaning Machine (ST)	75.3
Feet (ST)	54.3
Loading Rubbish (ST)	68.8
Passing Car (ST)	60.1
Mixed Birds (ST)	66.2
Traffic Light Bleep (ST)	62.1
Pachelbel's Canon (ST)	68.7
Fountain (ST)	60.5
Compressor (SH)	74.5
Crane Lifting (SH)	67.0
Chatter (SH)	58.7
French Speaking (SH)	69.2
Busker (SH)	62.5
Sprinkler (SH)	62.5

Table 5-14 : Sound Source Sound Levels

Key : SH – Recorded in Soho Square, London

ST – Recorded in St Ann's Square, Manchester

The table shows, as suggested in the previous section, that some of the sound sources which were rated highly did have a much higher level than the background, and this maybe one of the reasons, whilst they were rated highly, the levels were reduced.

5.4.3 Experiment 3 – Source Positioning

The purpose of this experiment was to test for correlation between participants in where they placed the sound sources in the ambisonic field. This experiment did not work as planned, primarily due to participants struggling to understand the task and the layout of the controller at the time. The ability to manipulate the position of the source during demonstrations that were given during the course of the project, to design professionals, acoustic consultants and interested parties, was easy to achieve as the recording of data was not crucial and time could be spent with assistance. As the experiment required the use of two controls on the controller, the participants found it difficult to manage the changing of position and distance (angle and focus). Since finishing the testing, an alternative method has been considered, and this is explained in the further work section.

There was also an issue with the panning law, as the software reduced level in relation to distance from the central spot, this meant in effect that there were two level differences occurring for the source, plus as these weren't being rendered as part of the ambisonic playback, but rather just point sources, there was potentially problems with the level being accurate. In the end, the sources were positioned prior to the experiment beginning, with the sources approximately placed where they were recorded and located in the actual space (for those which were recorded in the space), and the others in suitable places. The level for each was then calibrated to match their recorded level. As such there are no results from this experiment.

5.4.4 Experiment 4 – Spaciousness

The purpose of this experiment was to investigate if there was any correlation between participants in levels of reverberation set for individual sound sources. Similar to the previous experiment, this experiment did not work as planned, although findings from the tests which were carried out, showed that competence of spaciousness and artificial spaciousness were present in the participants. An impulse response matching the space was convolved with the sound sources to simulate the effect of increasing and decreasing the spaciousness of the source, and the participant could set the wet/dry mix of the signal and the amount of early reflections. After testing this on a few participants, the feedback was that the sound was 'unnatural' or 'artificial sounding'. After trying different impulse responses and different initial control set ups, the feeling with the participants was that same, that the sound was unnatural.

With regards the impulse responses used, the first is one recorded in St Ann's Square. This was generated by producing a loud clap and recording the response. Part of the issue with this impulse response is that the decay enters the background level at around -20dB, thus making impossible to obtain a RT_{60}, this also meant that early reflections were not present. The second response is a cleaner signal generated in a canyon (Cakewalk, 2009) of similar size. The participants still easily detected the nature of the 'synthetic effect' that using this technique had on the participants.

Trying to convolve a synthesized impulse response with sound sources recorded in the field, may be one of the reasons that this may not have worked. Whilst the sound sources were recorded as close as possible, there was still a small amount of reverberation on the recordings, primarily early reflections. Whilst, this didn't work, the finding that participants

were able to cognitively realise that the sound and effect was wrong and didn't match is interesting as it suggests that competence of the structures was present in the participant, and the ability to match correctness of the sound environment being one of the key objectives of this work.

5.4.5 Experiment 5 – Low frequency cut-off

The purpose of this experiment was to investigate if there was any correlation between participants in levels of which frequency they would set to remove the low frequency component of the overall soundscape. Whilst this was a rather rough experiment, the results showed that the average frequency where participants set the LF Cut off was a 110.5Hz when combining the results of the two spaces.

The quoted frequency response of the M-Audio BX-8A monitors used is 40Hz-22kHz. As there was no sub woofer present during the experiment, due to limitations with the soundcard, the full effect of the low frequency cut off cannot be fully considered. This is also true given the wide deviation between participants as shown in Table 5-15. There is a wide deviation between the levels set by participants for a specific space, but there is also a wide deviation (43.7Hz) set across the spaces and the combined level.

	Soho Square	**St Ann's Square**	**Combined**	**Standard Deviation**
Average Low Frequency Cut off (Hz)	154.3	66.7	110.5	43.7
Standard Deviation	94.3	49.3	85.6	

Table 5-15: Low frequency cut off for all spaces and combined, including standard deviation

There are multiple factors which could be causing these results, primarily that each participant has constructed their own soundscape, which may or may not have had sound sources with larger low frequency components to them, thus affecting the level at which they set the cut off. The cut off filter used in the DAW also had a steep filter characteristic, being set to -24db per octave, some participants thought that this sounded slightly strange when they swept through the frequencies, whilst others were slightly uncertain to what effect was occurring.

5.4.6 Experiment 6 - Global Level Control

The purpose of this experiment was to show if the participant set an expected overall level for the spaces soundscape, with the aim to show if there was an correlation between the values set between participants and how these values related to the ambient level recorded in the field. The ambient level measured in both St Ann's Square and Soho Square was 60.1 dB(A). Table 5-16 shows the average level set in all spaces and the combined average.

The results show that there is an average 6.6 dB reduction in set level compared to the background, this resulted in an average background level of 54.5dB being set for the global expected background level.

	Soho Square	St Ann's Square	Combined	Standard Deviation
Average Level Reduction	-5.2	-7.9	-6.6	1.4
Average Level Set	54.9	52.2	54.5	
Standard Deviation	5.3	6.6	5.9	

Table 5-16 : Global A-weighted level set for all spaces and combined, including standard deviation

The results show that there was a small deviation in the values set by participants in respect to the background level that they set (1.4 dB), but the result is also somewhat surprising. The figures suggest that all participants expected an overall reduction in the background level, which does not match with the results shown in section 5.3.2.3 from the fieldwork, where they stated that the level was as expected. The reason for this effect would seem to be, as highlighted by a number of participants who thought that the soundscape simulator was 'too loud' or 'very loud', that participants level basis went from an almost silent background level in the semi-anechoic or listening room to a much louder level when the simulator was switched on, with no time for acclimatisation. Potentially to have avoided this affect, the simulator should have been running at the time the participant entered the test.

5.4.7 Soundscape Simulator Discussion

The development of a soundscape simulator, whilst by no means a perfect solution, which has a number of issues which need to be addressed in further work, provides a tool by which participants can design, test, educate and 'play' with the soundscape. The ability to manipulate a number of parameters easily, allows the creation of soundscape ideas to be tested and group discussion to take place. It is this factor which makes this tool of use for design professionals, such as architects and town planners. The simulator's flexibility also allows for laboratory based investigation into psycho-acoustic, social and psychological factors within subjective evaluation of the soundscape.

Results from the simulator show that there is correlation between participants in regards to the parameters they are setting with regards expectation, inclusion and level, for a given context. Whilst participants did not necessarily prefer or like certain sound sources, they still expected and included them within the design context of the space they were given. This relates to the relationship shown previously linking preference, inclusion and expectation.

The simulator also showed that competence of the real world and thus the soundscape is present in participants, even if they are removed from the real world, when it comes to thinking and designing the soundscape. The results obtained from the simulator also agree with those results from the qualitative soundwalk phase of the work, where categorisation of sound sources relates to those expected in the real world.

The soundscape simulator tool also proved to be a product in its own right with real world applications. The flexibility of the software architecture and control enables the simulator to be portable and easily changed to suit different configurations. The nature of the plug-in architecture in the software means that flaws in the system used above can be overcome with bespoke coding of plug-ins, and that the platform means various configurations of sound sources and ambiences can be tested.

5.5 Conclusion

The results from this work have shown that expectation link to existing work in the field, in particular reinforcing the ideas of context, competence, experience and expectation as suggested by Truax, Botteldooren, Dubois, Fortkamp and Kang. The findings from the qualitative work show that context and the cognitive process as described by Botteldooren play a key role in the judgements participants make towards the soundscape. These judgements are based on a competence from experience, i.e. as Truax states, a tacit knowledge of the soundscape, where the acoustic signal matches with the expectation for the space, and an understanding of the purpose and activity taking place in that context. This further connects to the work of Dubois, Fortkamp and Kang in relation to the meaning, and in particular as this work has shown, the social meaning, behavioural and place norm that a space has through its context.

Attributes in memory play a role in making these cognitive judgements about the place, and in a sense relate to the ideas of Huron and cliché's in music, one might say that Botteldooren's context of place, or Truax structure which relate to structure in music. The processing of the structure and linkage with semantic memory are what enable the formation of judgements on the soundscape. This complex linkage and personal association are what form the perception of the soundscape. Expectation it would seem is similar to the idea put forward by Bhattacherjee with his model of expectation confirmation model and the ideas of 'brand'. A person may develop personal 'brand' associations with spaces, which develop over time and help in the formation of judgements of the space.

This work has shown that expectation is a factor in the perception of the soundscape and answers the aims of this thesis, but alongside answering the aims of the thesis, this work has shown that expectation is comprised of additional factors which all contribute to perception as such more research is needed to answer these areas. The details of the outcomes and how these outcomes have led to the development of a model for soundscape expectation and perception are given in the next chapter.

6 Discussion

6.1 Introduction

The following chapter provides a discussion of the results obtained from both of the methods used in this work, and how combining the results obtained leads to the development of a model of soundscape perception. Analysis of the results showed that alongside expectation and competence, there are also a number of additional factors which contribute to the expectation of soundscape. Figure 6-1 shows an extended version of the process flow given in Chapter 3 explaining how this work fits into the perception of soundscapes, where the negative or positive response to a soundscape is shown to relate to a process of thoughts about the influence of external and internal factors. These factors are summarised and worked into a full soundscape expectation model given in Figure 6-2.

6.2 Factors in soundscape expectation

It has been shown that expectation is not wholly based on context, but factors which feed into the context, such as purpose/activity/users (e.g. park, square, busy street), as well as psychological and psychoacoustic factors of the person experiencing the space, with a learnt social competence being part of this. Participants seem that they are trying to match the soundscape they are experiencing with soundscapes they have experienced in similar settings, as well as rules and behaviours of agents within that space.

The factors which seem to contribute to expectation are:

1. Does the space conform to a set of 'rules' which have learnt from similar spaces, these rules relate not only to perceptual features for all the senses, but also rules relating to activity, time of day/night, acceptable behaviour and users of the space .

2. Do I have the ability to control my activity within the soundscape, can I remove myself or sounds from the soundscape? Do I have the ability to control my interaction with the space? There seems to be an expectation of controllability for a given context, for example, I cannot control the buses on Oxford Street, but I can remove myself from Oxford Street. This also relates to the lack choice of upon entering a space, for example, if I have to enter this space, how do 1 feel about the soundscape? Can I control elements? *"I have no control over it (the soundscape), I just have to accept it and walk through it"- Lon-PhD-SW8*

3. The behaviour of other users of the space, does their behaviour conform to 'my' expectation of the space? A visual annoyance can be removed by looking away, but an auditory annoyance cannot, without having to leave the space or move further away. The sonic annoyance then creates a heightened sense of awareness, which in turn raises the level of annoyance. Some degree of annoyance also comes from the situation where a subjects feels that ' I am conforming to the rules' for this location (e.g. quiet zone on a train, not shouting in a park) so why can't others, this also goes along with the idea of rudeness and other subjective anti-social behaviours. Do I feel safe in this location or do I feel that there may be a confrontation? I cannot control the behaviour of the drunks in the park, but I can leave the park or ask them to be quiet. This though can lead to confrontation; therefore I either 'put up or move on '.

"if I couldn't get away (from the noise maker in the park) then certainly I'd feel badly about the space.....as it happens I know that all I need to do is go off into the back streets" - Lon-PhD-SW5

"I dislike it if people are drunk and I feel threatened by that...otherwise I quite like it" - Man-PhD-SW7

"if I hear people being aggressive and rude..that can make me feel uncomfortable' - Man-PhD-SW8

4. Does the soundscape prevent me from obtaining information (this is very much activity and source dependent)? These are forms of information transfer to which the soundscape has an impact on and seem to relate to signal to noise ratio in digital signal processing. *"I can't hear the train announcement" – LON-PhD-SW2*

5. Does the soundscape interfere with what I am trying to do within the space? Activities seems to range from passing through (soundscape has a low impact on annoyance) to retreating from the urban noise (soundscape has a high perception impact on annoyance).

"this is a place to pass through (i.e. transit), it has no impact or anything"- Man-Phd-SW6

"just walking past to get where they are going too' Lon-PhD-SW9 – 2:27

6. '*Traffic noise in the distance makes me feel that I am still part of the city and can re-enter at any point*', once again these types of statements suggest the importance of control.

7. The key here is finding the level at which traffic noise becomes background noise.

"....it's like taking a break from London, but you can still hear London in the background if you close your eyes, it's vibrancy" - Lon-PhD-SW4

8. This is an experience and competence of sound source events. '*I dislike the sound of a street cleaner, but I know that it will only last for a certain period of time*', plus it has the positive association with a number of subjects of being something which keeps the location clean. The same goes from construction noise, 'I don't like it, but it is progress and has to happen', but conversely there is the expectation of time.

"my comfort zone has been totally invaded by the motorised vacuum cleaner..... I appreciate that it has a job to do, maybe they could do it late at night", - Man-PhD-SW4

9. On the whole, the answer to the question 'Is the level as expected?' is yes.

10. Negative opinions of the spaces, do not always mean that the soundscape isn't as expected.

11. There was frequent use of terms such as 'Oasis, relaxation, calm, loud, loudness, quiet, peaceful, echo', for specific locations. This would tend to suggest an expectation of activity and usage within these spaces. Although there is subjects tend not to have a 'sound' language and sometimes find it hard to describe what they are hearing, there is a basic (if perhaps somewhat wrong) idea that building layout results in echo. Echo seems to be the most common term used with non-acoustic professionals. There is a basic understanding (if not explicit) of how locations should 'sound' based on their layout.

12. Other statements from subjects seem to give an indication of acceptance and expectation of soundscape which would go against measurements such as dB(A). For example, a common occurrence from subjects who live or work in the areas is 'I choose to live, to come here' there for I accept the higher level of noise. Other example statements are 'I would come here to....relax, shop, get away from the hustle and bustle, meet friends, have my lunch'. This space 'meets my expectation'.

> *"I suppose what I like most is what I can't hear, it's the quietest place we've been, I mean I would be interested to know actually in terms of sound pressure levels, how much quieter it is than Soho Square, again I would imagine it's not as much quieter as we might think it is, but the presence of other calming features, there's a lot more wildlife here and it's been a lot more tended. It makes you feel like you're somewhere that's more peaceful." - LON-PSP-SW8*

In answering the specific questions on expectation, the answer 'I have no experience of this location', if it does sound as I would expect is a key indicator it would seem in how expectation factor may influence perception of the soundscape. Likewise, when a person has no experience, but the place does not sound as they would expect (e.g. Phoenix gardens), is something to investigate further. The results enable an expansion of the proposed soundscape expectation process flow provided in chapter 2, figure 2-1.

Figure 6-1 expands on the process flow by using the results provided above to show how if a space matches a person's expectation, that there is no real negative perception of the soundscape, although there may be elements which might be classed as annoying present in the soundscape, as long as these do not interfere with information transfer then they are general ignored. Likewise if the space does not match the expectation for the context that the participant is expecting then there are a number of elements which may be causing this. These factors related to sounds which maybe out of context or un-expected in that context, activities within the space are out of context for the space, the behaviour of users of the space does not match with what is expected for the space, and that there is a perception that potentially the space is not safe or uncomfortable. Further analysis of the results show how the process flow model is expanded into a soundscape perception model, this is explored in the next section.

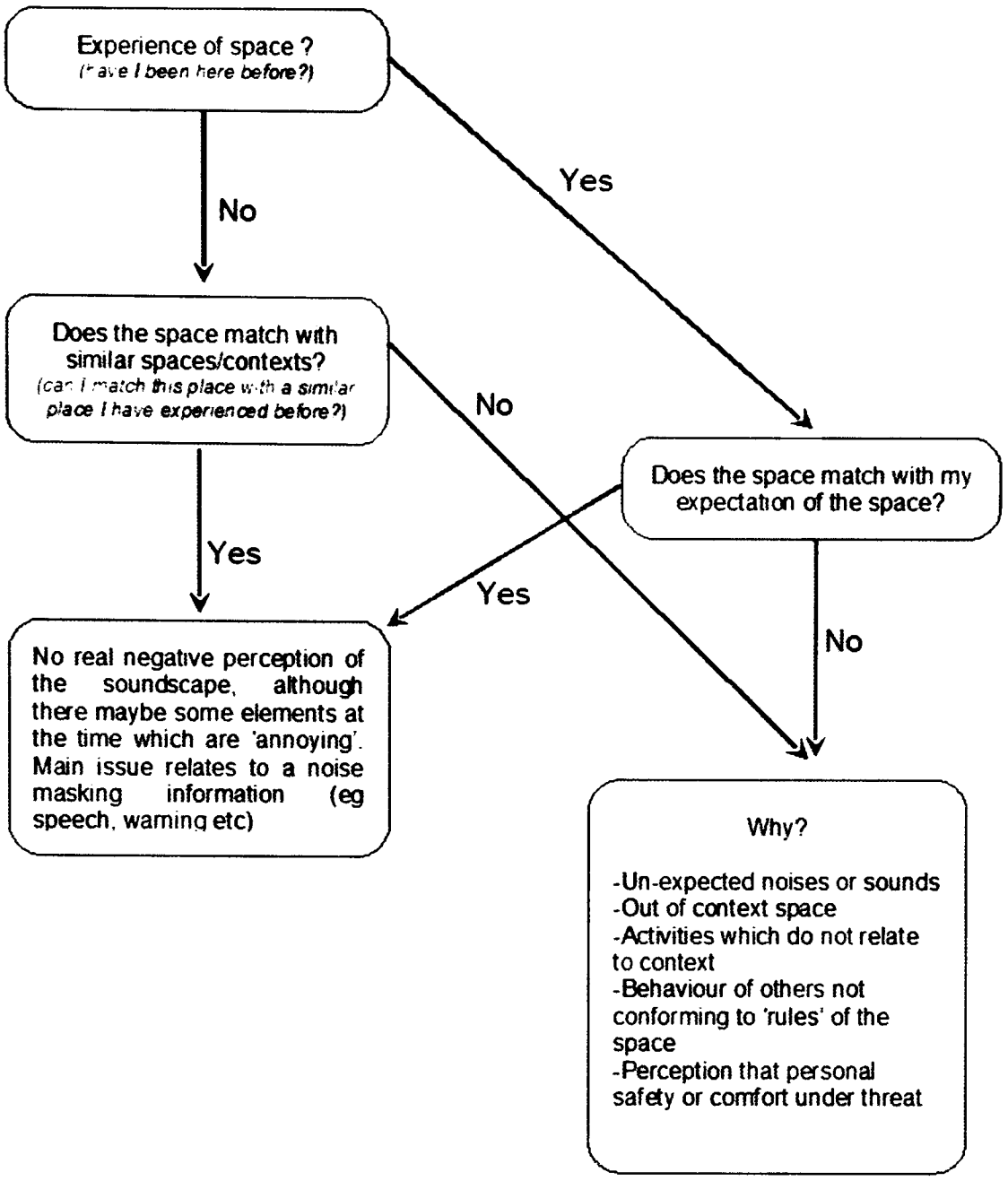


Figure 6-1 : Soundscape expectation process flow

6.3 Discussion of results

The main factor on expectation and the perception soundscape is in answering the subjective questions, does the space conform to a set of 'rules' which the listener has experienced from similar spaces? These 'rules' not only relate to perceptual features for all the senses, but also rules relating to activity, context, competence, place and social norms and users of the space. Crucial to these factors is the participant's ability to control their activity within the soundscape; can they remove themselves or particular sounds from the current soundscape space or have the ability to control their interaction with the space? For example, there seems to be an expectation of 'controllability', for example subjects could not control the 'noisy, dirty' traffic on London's Oxford Street, but they could remove themselves from Oxford Street and use 'quieter' back streets. Though such a change in space to another still led to an expectation of how it should sound, for example in an urban square (Soho Square, less that 100m from Oxford Street) , the expectation is still to be hearing the traffic noise, albeit at a reduced level.

This traffic noise in this instance was sometimes seen as a positive, '*traffic noise in the distance makes me feel that I am still part of the city and can re-enter at any point*', once again these types of statements suggest the importance of control. Likewise, in Soho Square space, the expectation of users and control had an effect on perception, the participants could not control the behaviour of the 'drunks' in the park, but they could leave the park or ask them to be quiet. Annoyance seems to stem from spaces where the subject cannot easily leave (e.g. train carriage, bus, and home) and has no influence over the sound-maker (either a person or machine).

> *"I don't like traffic noise; in fact as I get older because it interferes with my ability to talk to people and hear them, they become increasingly unpleasant"- Lon-PhD-SW5*

This suggests there is an expectation of behaviour of other users of the space. In particular, do other users of the space behaviour conform to the subject's expectation of the space? A visual annoyance can be removed by looking away, but an auditory annoyance cannot, without having to leave the space or move further away. Some degree of annoyance also arises from the situation where a subjects feels that *'I am conforming to the rules'* for this location (e.g. quiet zone on a train, not shouting in a park) so why can't others, this also goes along with the idea of rudeness and other subjective anti-social behaviours. This not only applies people but to mechanical/construction sources, but with these sources the expectation leads to a greater degree of acceptance, for example. '*I dislike the sound of a street cleaner, but I know that it will only last for a certain period of time'.*

> *"that constant hum of air con that's sort of a little bit stressful..I think you'd notice it when it wasn't there as being absent" - Man-PhD-SW9*

This example has the positive association with a number of subjects of a process which keeps the location clean and expectation leads to the fact that the source will be temporal, and thus is accepted. The same goes from construction noise, 'I don't like it, but it is progress and has to happen', but conversely there is the expectation of time constraints applying to the soundscape. A subject may accept the source in the day, but would not expect and therefore accept it at night.

> *"the sound of the van unloading wouldn't be much of a surprise...given the time of day" - Man-PhD-SW10*

> *"I guess it is what I would expect because it is a city garden square, so apart from the heavy truck which will move and leave the square" - Man-PhD-SW4*

As well as expectation relating to the structure of the soundscape of the space, expectation extends to a subjects activity within the space. Activities in the spaces researched range from spaces where a person would pass through to those where a person can retreat from the urban noise. In the *'transitory'* spaces, such as the corner of Oxford Street and Soho Street, the soundscape has a low impact on annoyance, although these spaces were noted as sounding as expected. In the *'oasis'* spaces, such as Soho Square, the soundscape has a high impact on annoyance, where expectation is higher, although again these spaces were noted as sounding as expected. Other statements from subjects seem to give an indication of acceptance and expectation of soundscape which is independent of sound level measurements (L_{Aeq}), which were also taken at the time. For example, a common response from subjects who live or work in the soundwalk areas which were subject to levels of 75dBA or greater, were '*I choose to live, to come here*' therefore '*I accept*' the higher level of noise. Other example statements are '*I would come here to....relax, shop, get away from the hustle and bustle, meet friends, have my lunch*'. This space '*meets my expectation*'.

A combination of activity and source expectation relates to an expectation of obtaining information. An example of this is how traffic noise prevents the hearing impaired in hearing conversation, 'I have to go somewhere quieter to hear conversation'. Other examples of prevention of information are 'I can't hear my phone ring', 'I can't hear the station announcement', 'I can't hear myself think', these are forms of information transfer to which the soundscape has an impact on.

"Ii don't like traffic as it masks conversation hard to understand"- Lon-PhD-SW5

Analysis of sound source expectation shows that sound sources that were expected from the simulator generally coincide with those expected and then heard on the soundwalk. On the whole, the data from the soundwalks has shown that most spaces sounded as the subject expected and the level was as expected for the given space/context and there was an understanding of how the space impacted on what was being heard. This suggests a learnt competence for spaces, as well as behavioural expectation for those spaces. Crucially, as highlighted above, expectation extends beyond the soundscape competence to how subjects can interact with the environment as well as expected 'rules' which govern the space. This links in and extends the work on social and contextual factors and provides another dimension to be addressed when undertaking subjective evaluations of the soundscape.

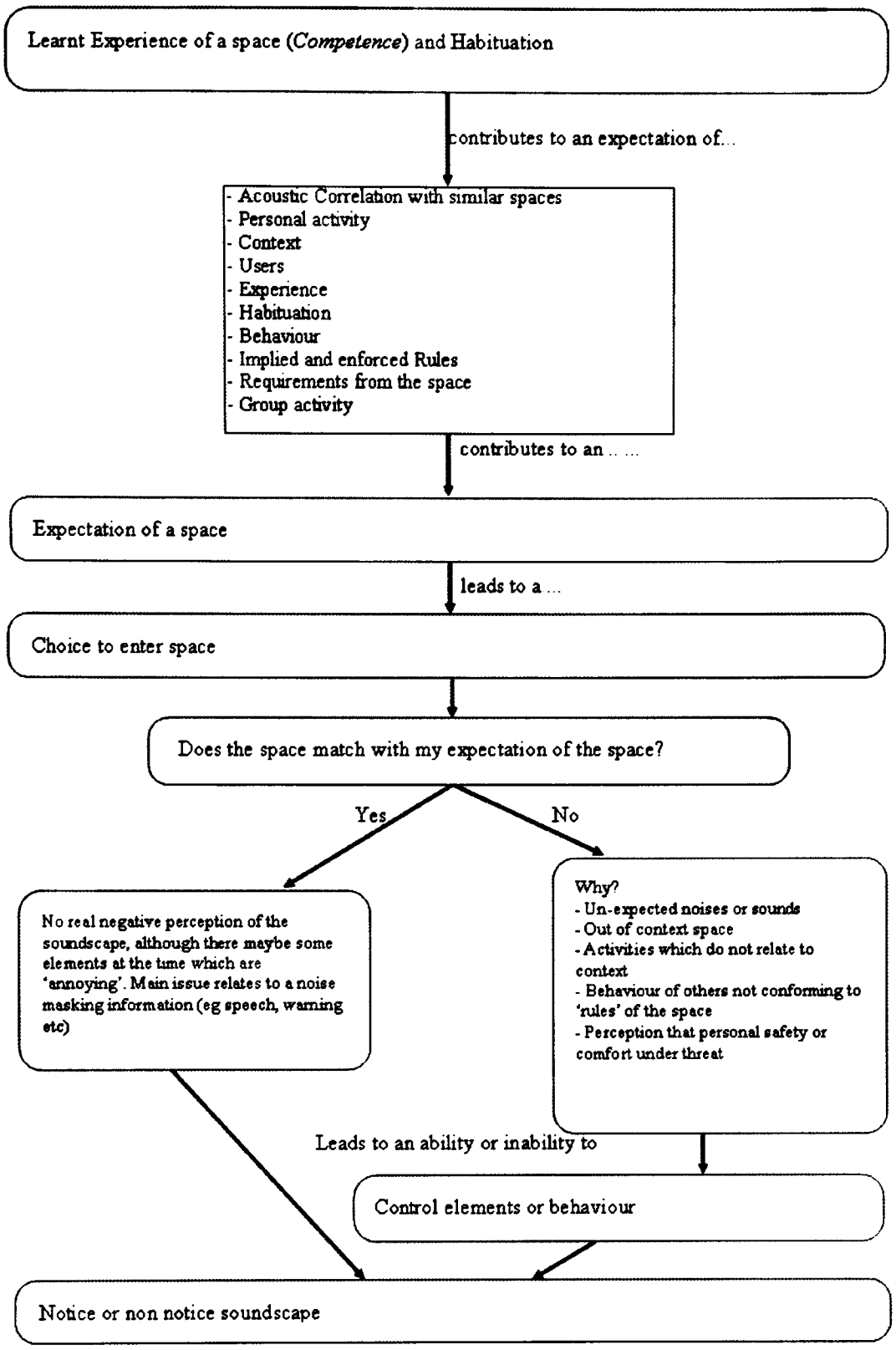


Figure 6-2 : Soundscape expectation model

"I like the buzz of being in London and hearing all this stuff going on around me, it's quite reassuring" - Lon-PhD-SW1

"....you get a sense of community atmosphere", - Man-PhD-SW8

"i like the hustle and bustle" - Man-PhD-SW8

"This is a focal point of London, and I feel comfortable, I just don't like being on the road" - Lon-Phd-SW4

"you can still hear London in the background" - Lon-PhD-SW4

"I like the sound of voices because it makes it feel like it's more alive' - – Man-PhD-SW6

"I like oxford street, the hustle and bustle and the noise of it, it's the essence of what London is about, it's people and noise and activity" - Lon-PhD-SW1

"I wonder if we tolerate it because it is the norm and when it's something out of the norm like the drill or something I think that's when we get annoyed." Cat, 12.49-50

'it's almost a comforting thing for people to be walking around talking to each other' - Man-PhD-SW8

"if there weren't people sounds it would sound like a ghost city' - Man-PhD-SW10

To summarise the results and expand on the process flow model provided in figure 6-1, a proposed soundscape expectation model is provided in figure 6-2. The model shows how a person competence of a space from learnt experience leads to the expectation of a context. This expectation is made up of an expectation about a number of factors within in that space, this then leads to a choice to enter that space. Upon entering the space there is a choice made about whether on not the space matches the expectation that the person has about the context from their competence. If the space matches the person's expectation then there is no negative perception of the space and the soundscape is generally not noticed. If on the other hand the person's expectation is not met, this may be down to a number of factors as described above, if the person feels that they can control the sound source or element then there is a positive association, whereas if there is a feeling that they cannot control the source, then there is a negative perception and the soundscape becomes noticed. The model does not take into account the situation where a person finds themselves without the choice to enter a space. This factor was not investigated but could provide a question for future research.

6.4 Conclusion

In conclusion, this research work has answered a number of questions in relation to expectation and the soundscape, and overcome some but not all of the issues surrounding interdisciplinary collaboration and the combination of qualitative and quantitative methods. The work has produces two distinct methods, which can link together if required and be used to inform one another. There is much potential for further development of the methods, both in answering questions on expectation, but also in furthering soundscape research.

In conducting the research, additional and new questions have arisen, which do need to be addressed and could in future form the basis of new research projects, in particular, the questions which have arisen are as follows:-

- How do we define contexts? Is the definition of context solely based on location, users, and social/place norms or does activity or listening state play a role?
- How do people using these locations listen? How much is this dependent on activity?
- What is meant by acceptable/preferable in relation to soundscapes? When discussing the concept of acceptable and preferable, for whom is this so?
- Can we further categorise and find objective measures for the parameters of expectation?
- For a given soundscape (context) would a similar sounding (parameterised) soundscape be accepted or designed by a group?
- Does the psychology of experience as proposed by Huron (Huron, 2007), reinforce soundscape competence?
- What is the importance of semantic and episodic memory in soundscape perception and preference?
- Can we define 'context' and 'value' indices for soundscapes?

Additionally forming a link between the psychology of expectation and how this interlinks with competence, could extend the research further into the field of psychology and psychoacoustics. To further knowledge in this area, it is imperative that there is an enhancement which progresses the field of psychoacoustics. In understanding how people experience space and investigating their expectations, the inherent value placed on soundscapes and associated acoustic parameters can perhaps be quantified.

Finally, researching the importance of sound to people living within their environment, and whilst, like many environmental issues, they may not be aware initially of the pollution taking place or how much it is affecting them.

7 Conclusion

7.1 Introduction

This chapter summarises the outcomes and achievements of this thesis. This thesis has presented an investigation as part of a process to develop both knowledge and research methods into the effects of expectation on the perception of soundscapes, as well as seeking to further understand the factors associated with soundscape perception. This approach was undertaken to gain a better understanding of the contributory factors which may help to improve future soundscape research and potentially integrate the findings and methods developed from this work into consideration for urban design and local planning. The first stage is to look at the methods used in this work and how they contributed to research findings.

7.2 Summary of Methods

In investigating the effects of expectation on the perception of soundscapes, this work used a number of interdisciplinary methodological approaches and a combination of qualitative and quantitative methods, as a foundation to further knowledge in this field and to develop a mixed methodology for soundscape research. The primary approach taken for the quantitative work used grounded theory, the iterative nature of which, allowed for theory development to occur throughout the process of undertaking research and for new avenues to be explored during the course of the research to provide a better understanding of the factors affecting perception. The immersive soundwalks provided an opportunity to gain detailed insights into participant's views, considerations and attitudes towards 'soundscape' and in addition the ability to gain an in-depth understanding and reasoning of how factors which go beyond traditional acoustic measurements influence the perception of a space. The rich data collected from the soundwalks also informed the both the development of the qualitative soundscape simulator to test participants in the laboratory and targeted semi-structured interview questions for participants in focus groups.

The approach taken for the quantitative laboratory work of this research used a combination of questionnaires, semantic differential scales, real-time data collection and sampling, with data being fed in from the soundwalks. The soundscape simulator was continually under development during the course of this work, and as such did not fully provide a perfect solution, with a number of problems which need to be addressed in further work, it provided a tool by which participants were able to interact with the soundscape and provide meaningful

and relevant data for analysis. The ability of the soundscape simulator to manipulate a wide range of parameters easily allowed for soundscape ideas and concepts to be tested easily and facilitated group discussion to take place. The methods employed in the work provided flexibility to gain new insights into the psycho-acoustic, social and psychological factors which form subjective evaluation of the soundscape.

7.3 Contributions

This thesis has shown that whilst soundscape research is a developing epistemology, the concept and understanding of soundscapes is gaining ground and importance within the academic community. Soundscape research provides a holistic and inclusive approach to analysis of the sound environment, and as such confronts conventional methods of relating to the sound environment and environmental noise. Soundscapes research potentially enables a better understanding and management of environmental sound and noise control, by understanding the nature of how sounds are perceived, and the meanings attributed to the sonic environment.

Contributing to the field of soundscape research, this thesis has presented methodologies which can be utilised to gain a better understanding of how people perceive their sound environment. Soundwalking has proved to be an insightful and robust experimental method, providing rich subjective data for analysis, with links to objective measures recorded in the field for corroboration. Soundwalking not only proves a useful research method, but also raises awareness of the soundscape for participants on the soundwalks. They gained a better understanding and appreciation of their sound environment, meeting one of the original aims set by R. Murray Schafer and the World Soundscapes Project (Schafer, 1977; 1984). So far there is no indication of how long this awareness lasts for the participant, or if it results in any personal action taken in their interaction with the soundscape, but anecdotally later conversations with some of the participants of this study suggests that it had had some impact on their attitude to the soundscape and how they thought about their sonic environment.

Soundwalking, as Schafer suggests could be a way of educating children (Schafer, 1988) to change attitudes towards the soundscape, although this would require a number of considerations to Schafer's suggested education methods (Bruce, 2007). Education in the soundscape, Schafer suggests, provides children with a consideration for the sonic environment, and this may ultimately result in a reduction in 'noise' (Schafer, 1988). This thesis highlights noise or a negative association with a sound or soundscape is a result of a

number of factors which relate to a person's expectation of the context, and their attitudes towards and ability to control the 'noise' producer, be it mechanical or natural in nature. Education about the soundscape as suggested by Schafer may go a small way to achieving this aim, and perhaps influence or change a child's competence. Ultimately however, learning appropriate social behaviours for set contexts may be more beneficial, as the awareness that there is 'a time and a place' and 'consideration of others or the context' for sound generation is probably more prevalent in achieving this goal.

The results have shown that context of the environment plays a key role in how the soundscape is perceived. This reinforces Botteldooren's model of perception Figure 3-4 in showing that expectation of the norms and purposes in the environment of a specific place affects how that space is perceived. The context also relates to the users of the space, and social norms within a space. This work has shown that distinct contexts were perceived by the participants on soundwalks relating to the spaces visited during the field work.

In this thesis the contexts were defined as shopping, socialising, transitory activity, and relaxation. Participants' responses to the differing contexts within a transitory space revealed that the soundscape did not matter much, and the general attitude shown towards the soundscape in that space was that it was okay if it was loud.. However the contrasting response to spaces thought of as 'relaxation' contexts was that the perception of the soundscape was more important, but far more important was the participant's expectation of the place, of social norms, and their sense of ability of control, than the actual level of the soundscape.

Participants expectations of the spaces visited were shown, on the whole to have met, which was the central theme of this thesis. Through this it was shown that competence to changes to a context, also resulted in a new expectation and generally this was also met. The work has shown that participants had a general idea of how different types of space should sound, depending on the type of space, the physical makeup of the space, the users of the space, and location of the space. This is also applicable to events which occur within the space, for example, the expectation that a street cleaner will perform a task within a certain time-frame, and then exit the space. This expectation, stemming from experience, meant that a typically unpleasant sound source is tolerated. This tolerance is also reinforced by the nature of the task being undertaken by the agent, for example again, the street cleaner is performing a civic duty which results in a cleaner and more pleasant environment.

The results suggest that expectation and context form what Truax labelled soundscape competence, and whilst there was no explicit test of the nature of where this knowledge comes from, the results show that knowledge and thus competence were present in the participants. This fact was reinforced by the descriptions and expectations of the sounds heard in an urban environment, combined with a cognitive application of competence in new un-experienced spaces. Anomalies arose in the data, primarily when dealing with Phoenix Gardens in London, where there was some lack of correlation in the responses provided. However further exploration of the answers given revealed further discoveries, showing that it was in fact other factors beyond those initially under test which affected the participants' experience when undertaking the field work. These factors included attitudes towards the space and other users of the space; uncertainly about personal safety and the general state of the environment, primarily from a visual perspective. This also gave an important indication that participants did not fully understand or immediately perceive the purpose of the community space, and in fact their immediate negative reaction was in direct opposition to the intended ethos of the place. It has been shown through this work that the individual's experience of a space, based on multi-sensory perception, plays an important role in perception of that space. In particular, a participant's expectation of the space and their ability to control either elements or take action to remove or enter the space is a prime factor in evaluation of that space. On the whole, the soundscape is not noticed as an entity in its own right, but is constantly being perceived and cognitively processed for matches with expectation.

The soundscape becomes a point of focus when elements are in conflict with an expectation of the context. When this conflict occurs, and the ability to control the conflict is not easily achieved, that is when emotional discomfort occurs, that is synergetic with the level of control an individual feels that they have over a space or elements within that space. The research has reinforced the work of Schafer, demonstrating that the soundscape is multi-dimensional in nature with numerous factors affecting its perception. Crucially, this work has shown that it is not simple acoustic factors which play the main roles in perception of the soundscape. Psychological and social factors relating to expectation, learnt experience and thus competence are of primary importance, along with contextualisation of spaces. This in a sense removes the onus from acousticians reducing noise levels as the only factor in producing 'positive' soundscapes. The main factor relates to what we might call 'sonic rules' or simply that there is an acceptance that 'there is a time and a place' for certain sound sources or unexpected soundscapes etc.

Choice and control are two factors which emerged from this work as directly influencing a participant's perception of the soundscape. However, it would be useful to test perceived loudness of sound sources where the participant has choice and control, in comparison to a situation where they are unable to control their environment. The elements of control and choice show that when a participant makes a choice to enter a space, be it to live or to enter temporally, this has an effect on how they perceive the soundscape. For example, those who choose to live in a space tend to accept the soundscape, and grow used to the soundscape from the point of entering the space. They could be said to be developing expectation and competence of the space they are in, and annoyance or emotional discomfort tends to occur when something new happens within the space, e.g. new neighbours, new events, changes in patterns of sound events. If the person feels the ability to control these events, then annoyance is minimal, where as when something is not easily controlled, emotional discomfort is greater.

Changes in the place norm can also cause problems, for example, a person who chooses to live in Soho London chooses to accept the soundscape, and whilst they then learn how the soundscape functions and the norms, they may be unprepared for unexpected changes to the soundscape based on changes to the environment, for example the opening of new clubs, changes in noise legislation or patterns of municipal functions, such as rubbish collection. The results from this thesis have shown that these effects are not age or gender-specific. For example whilst the norm would be to state that older people would be more sensitive to noise, in fact all ages seem to be sensitive to the similar issues. The work reinforces Botteldooren's model of perception (Botteldooren & Coensel, 2006) and shows that more work is required in this field, particularly with an awareness of the psychological and environmental effects on perception of soundscapes. This thesis has shown that in agreement with the suggestions of Cain *et al* (Cain *et al.*, 2008) the Soundscape can be broken down into 'Sound' and 'Scape', which also reiterates the points of Truax and Schafer, that the soundscape is more than just acoustics (Truax, 2001; Schafer, 1984; 1988).

What this work ultimately concludes is that the soundscape is more than an acoustic environment based simply on the vibration of molecules; it is more than the data recorded on a sound level meter or an audio field recorder. The soundscape encapsulates the philosophical problem of the nature of experience it is represents the auditory fingerprint of a space. We learn how places should sound through experience, and this forms competence, which affects our unique perception of a space in that specific moment of time and through competence we make decisions about the environment we are in.

Perception of the soundscape is based on this learnt expectation and experience, and we can quickly adapt to new spaces, as they can conform to general contexts. Contexts are based on activity within the space, but also the users and purpose of the space. This work has also shown that there is an understanding of how places should sound depending on their layout. This indicates a basic acoustic understanding, something which is learnt as a child, such as a street with hard surfaces sounds louder than an open space with trees and other organic materials.

Perception of the soundscape is also influenced by a 'socio-acoustic' which relates to assumed sound rules and regulations which relate to a space or context, and our attitude towards other people within the space, as suggested by Kang's acoustic comfort (Kang, 2007). Whilst not tested in this work, the mental state of the person entering the space, such as tiredness, previous irritation, or personal issues etc are likely to also affect how an individual the perceives their environment. If Shafer's idea of making the world a better sounding place is a goal of environmental and community noise, then attacking the problem of 'noise' is not just an issue of reducing acoustic level. Indeed his idea of educating children and adults on the importance of the sound environment is commendable, but ultimately learning other social skills around the production of noise and consideration of others may have a more dramatic effect on the reduction of noise pollution. There is also consideration needed of the norms of the space and the social value of changes which maybe occurring in that space.

When entering into a new space, people accept the norm of a place and grow to become habituated to it. However, when something changes there is a greater sensitivity to that change, and this change also relates to the value that the people place on the new activity. For example someone exhibiting initial annoyance at the noise and disruption of road works may not consider that the potholes are being repaired or traffic flow is being improved. The individual may or may not feel personally involved or a beneficiary of the incident, or may just not perceive the eventual positive results from a temporary inconvenience.

This work has shown that there is a need for a greater understanding of attitudes towards events which occur in a context. The soundscape is something which is always present, but generally goes unnoticed and thus like a film sound track, both reaffirms and enhances the visual narrative. Sound is often something which comes to the forefront only when it interferes with the task that we are trying to achieve or which has our attention, this could be talking, listening or performing a task, relaxing, or sleeping.

Levels of concentration on a task may also influence how important the soundscape is to our perception. For example whilst moving through a space, the soundscape is of little importance, but when sitting in a park it becomes of high importance and/or awareness. This also relates to the individual's choice to enter a space, such as choosing to work in a 'noisy cafe', because of expectation and emotional connection to the space, sound level is not an issue unless there is something out of the ordinary within that space which diverts the individual's attention, and the ability to control this affects their response.

A sonic rule is applied to this space, i.e. quiet as such anyone making noise, which may be perceptually very quiet, e.g. rustling of paper, sound from a mobile bleep, is breaking the expectation and social norm for the space and becomes an annoyance. If the person feels that they can control the source, with for example confrontation, then this will not cause annoyance and the issue will be resolved. If however the person feels that they cannot control the source, i.e. they feel intimidated by the sound maker, then no action will be taken and as such they will become more annoyed. This also relates to the other senses, a person performing a task outside of the norm. This all leads to the consideration for further work to be undertaken to gain an insight into how great the influence of these new factors are on soundscape perception. The next chapter highlights further work which could be carried out and how change to the methods used could enhance this work.

8 Further work

The following chapter provides a discussion of the outcomes from this thesis and proposes a number of questions arising from the thesis, which need to be addressed as research in the topic of expectation progresses. The chapter also highlights some of the problems associated with the implemented research methods and the overall epistemological grounding of soundscape research, as well. This chapter first presents the issues surrounding the work carried out, suggests methods by which these can be addressed, and concludes by considering the potential directions future work could proceed, to explore further the effects of expectation on the perception of the soundscape.

8.1 Methodological Issues

The thesis has so far presented an attempt to bring together both qualitative and quantitative methods in a progressive manner, as well as utilising interdisciplinary methodologies as suggested by Schafer and others (Kang & Zhang 2010; W Davies *et al.* 2007; Schulte-Fortkamp & Fiebig 2006; Kull 2006; Epstein 2003; Lercher & Schulte-Fortkamp 2003; Schulte-Fortkamp & Nitsch 1999). The result of bringing differing methods together highlighted a number of issues which need to be addressed further. The simplicity of Schafer's suggestion of interdisciplinary collaboration is something which this work has shown to be problematic. In particular, given the different methodologies and epistemologies suggested, the main issue surrounds the fact that the different disciplines start from a differing epistemological stand point and this can provide difficulties when trying to find ways in which to bring them together.

In attempting to develop an interdisciplinary methodology, it should be accepted that potentially more questions will arise than those which are answered by the work, this is particularly true when using a grounded theory approach. Throughout the research period of this thesis, and through presenting papers based on the work at conferences (Adams *et al.*, 2008; Adams, *et al.*, 2009; Bruce, 2008; Bruce, 2007; Bruce & Davies, 2009b), there are a number of questions which have arisen from the work. The primary issue is that of epistemological knowledge. Due to the author's limited background in some of discipline subject areas covered in this thesis, it is possible that questions arising from the work are potentially easily addressed or conversely difficult to answer, with a greater grounding in the unfamiliar disciplines.

To overcome these issues, further work and collaborative synergies with the disciplines suggested initially by Schafer and highlighted in chapter four, "*The true acoustic designer must thoroughly understand the environment he is tackling; he must have training in acoustics, psychology, sociology, music and a great deal more besides, as the occasion demand*" (Schafer, 1984) as well as more recently (Kull, 2006), would be crucial to overcome the shortcomings of the knowledge of a single researcher.

This section highlights the issues which arose from the different methods employed as part of this work. The methods used are fundamentally new or enhanced methods which were developed during the course of this work, and as such problems were found during and after the research period. Due to the grounded theory methodology used, it was possible in the early stages to adjust the methods based on outcomes of method trials, and initial fieldwork. As such, there were still issues which are highlighted below, and areas where the methods could be improved in the future.

8.1.1 Soundwalking

Soundwalking as a methodology has been a fundamental part of this research, but as a robust methodology is still very much in its infancy, from its beginnings as an arts discipline (Westerkamp, 2002) to more recent applications in social science research(Adams *et al.*, 2008; Adams *et al.*, 2006; Semidor, 2006). The research undertaken trialled different soundwalking methods during the course of the work and throughout the soundwalking trials and subsequent usage during the fieldwork, a number of potential issues with the presented method were highlighted as problematic. There were also a number of areas which would allow for the expansion of the soundwalking method, ultimately improving the robustness of the method and combination with emerging soundscapes methods.

The first area where further work could be applied is in investigating listening state of participants on the soundwalk. At no point during the soundwalk was listening state fully considered. Primarily, this was due to the difficulties surrounding interpreting and understanding the different states (Truax, 2001; Sonnenschein, 2001). The soundwalking method developed for this work tried to not force the participant to actively listen, but to try and take in the environment as a whole. Although, as the soundwalk progressed and similar questions were asked in the different space, there was no doubt that that participants were listening more actively to the soundscape, and focusing on what they were hearing, rather than in a state of casual listening.

Whilst active listening can be used to educate and inform participants about the soundscape (Bruce, 2007), it can potentially skew and bias their answers in favour of sound sources which in another listening state would or may not be noticed. It is also unclear as to which listening state participants were in when taking part on the soundwalks, throughout the work it would seem that the majority of soundwalking participants were changing to semantic listening from causal listening (Sonnenschein, 2001), and the very act of soundwalking changed their perceptual approach to the environment. This was highlighted by a question asked at the end of the interview, "*Has being on this sound walk changed your perception of or understanding of urban soundscapes in any way?*" responses were considered, and showed changes in listening state, for example

> *"and the surprising nature of how quiet relatively it was in Soho Square and you know, yeah just having the awareness and thinking about things, it was very good." LON-PSP-SW2F*

> *"I think every time you do something like that...I mean I've done things like that before but it's really, it's almost like a meditative practice isn't it, it reminds you and it sensitizes you and yeah it reveals something about your value system and it reveals something about what your, you know how you're making your hierarchies of what you want, yeah so I think it's a very valuable thing to do, it's been a really interesting experience" - LON-PSP-SW8*

> *"It's certainly made me think about it a lot more." - MAN-PSP-SW2*

> *"Yeah it's made me listen a bit more. " - MAN-PSP-SW7*

The act of being in the experiment changed the results, as would be expected from qualitative fieldwork carried out in-situ, but conversely the method provided in-depth and interesting data of a participant's evaluation of their soundscape. Returning to the question of expectation, it would seem it is no less valid independent of listening state.

Therefore, it would be possible to redevelop the soundwalking method where walking is primarily the act of getting from each of the chosen research locations, the idea being that this would allow participants to pick up on elements within the environment without prompting by questioning in the interview.

Of particular interest to this research, and any further work based on this work, would be the ability to enable soundwalkers to discuss further their expectation of a space, not wholly limited to the soundscape and landscape.

Although a soundwalk did not explicitly focus on the soundscape at the outset, it was sound focused, and this was evident as participants grew familiar with the questions being asked. Whilst the open semi-structured interview format allowed for discussion around the spaces and events happening at the time, there was no explicit exploration of attitudes to the soundscape, users of the space and participants control within the space for example. These were factors which emerged from the coding of the data, and formed the results given in the previous chapter, an explicit study of the amount to which these factors influences perception would be a logical next step. Ultimately this could be seen as a bigger part of the grounded theory approach, where this work forms a starting point for a further study to take place.

Targeting new questions on a soundwalk which only incorporates listening spaces visited could provide a richer view of the space in question and allow for a more detailed semantic analysis of the responses, the goal being to find synergy between the expectation and the factors resulting from this study and ultimately the effects of the multi-modal senses. For example, does a smell or visual stimulus result in a heightened perception of the soundscape and how it is the related to the factors of expectation, competence and social norms of a context. The work presented has tackled the question of expectation on perception, and as the results have shown, expectation is also multi-dimensional, with personal values, beliefs and experience playing a part in the perception of the space in question, this is linked with the control the participant feels they have of the soundscape, and how closely matched the space is to the social and places norms for that context.

Some rigour could be given to the soundwalking practice by 'setting up' spaces to allow for repeatability. This could involve blocking off certain spaces and getting 'actors' or 'agents; to perform the same task within the space, for each of the participants on the walk, this method would allow for experimentation with changing social and place norms within the context. This may be an ethical area which would be difficult to enter into, but would allow for clarification on some of the factors and test their repeatability. For example, did the '*tramps in Soho Square*' results in a participants negative perception of the soundscape and perception of a higher sound level, and is this repeatable for all participants.

Other questions arising from the trials of the soundwalking methodology, and subsequent usage as part of this work, relate to the conditions of the walk itself and specifically temporal issues, for example, how long should the interval of allowing the participant to listen be? and how long should they be in the environment before beginning the questioning?

The method used, allowed the participant one minute of silence in the space before the interview questioning began. It was not clear if the participant, especially those who had never experienced the space, could fully get a clear impression of the space in that period.

Of course there is a difficulty with the nature of soundscapes, given their temporal nature. It is possible to walk through a space once and never experience what may be the key sonic characteristic of the space, or alternatively enter a space at the one and only time that a certain sonic or other event is occurring. Longitudinal studies of the spaces in question would allow for a better understanding of times when key events or normal events are occurring. This would allow soundwalks to be planned to enter the spaces at those times.

The timing of the walks is also potentially problematic, and it is not clear through the results of this work, for example, if there was fatigue and even listening fatigue taking place towards the end of the walk and following on from this, was an hour to an hour and a half too long for a participant. This was addressed during the trial period, and led to the development of the method presented, where it was evident that walking in silence for an hour was not an appropriate method, and that stopping and questioning the participants in the defined space worked much more successfully, but ultimately, there was no consideration to whether the participant was tired at any point during the walk, and if this affected their answers to the questions.

Given the temporality of the soundscape, ultimately the main problem with the soundwalking method generally, is that there is no repeatability in the walks. All environmental conditions are in a continual state of flux, and it would be impossible predict or control these circumstances. A method by which multiple researchers conducted multiple soundwalks at the same time would allow for potentially more consistency in the data collection. Although the analysis of these results has shown that ultimately there is consistency of responses given for each of the different spaces, allowing for deductions to be made.

Conversely, variations which occurred during the walks provided an interesting insight into conditions which may have affected a participant's perception of the space, and could be explored further in further work, for example, the effects of other users of the space, and views towards those users by the participant. On the whole, soundwalking has proved to be a useful method which can be furthered explored and developed.

8.1.2 Soundwalking Expansion

To immerse the participant in the soundscape for a longer period of time could be beneficial, allowing for them to become more acclimatised to the space, getting a longer sample of the soundscape present in the location, and for nuances in the soundscape to be observed in-situ. To achieve this, a shorter soundwalk with a prolonged 'sound-sit' within chosen spaces would allow a greater degree of habituation. The requirement for habituation was discovered when trailing a street-based questionnaire as part of the pilot for this project, as short term immersion and asking participants questions without allowing for acclimatisation resulted in answers which were related to events occurring at the moment of questioning. The sound-sitting method could be developed and would require testing to determine if a 5 or 10 minute sound-sit is either too long or too short to allow the participant to gain an immersive appreciation of the soundscape. Initially working on the 5 minute sound-sit, with 10 minutes of questions after could provide the basis for this method.

To gain further understanding of the correlation between expectation and experience, soundwalks could incorporate a higher number of known and unknown spaces to the participants. Work carried out by the Positive Soundscapes Project, showed a physiological response occurred when listening to different sounds (Hume *et al.*, 2008) these experiments were carried out in a control laboratory setting, but potentially could be carried out during a soundwalk.

For example, parameters such as heart rate or galvanic skin response could be measured in the differing spaces, giving a deeper understanding as to the response of the participant in the space. It has been noted that there would be background better word than noise? present in the data, for example due to the physical exertion of walking etc, but this could be counter balanced by a period of rest at locations on the soundwalk or alternatively during a sound-sit.

Further to this, using a sound-sitting method could allow for a longer appreciation of the space norms, and events which occur. Questions asked after the sound-sit could then focus on a participant's attitude towards the space and other users, and on their understanding of the values attributed to the space. This would allow for work to be carried out in correlating participants' attitudes and value systems, and the impact that this has on their perception of soundscapes.

8.1.3 Field Recordings

The use of field recordings formed another key component of the method presented in this thesis. Field recordings were used to document soundwalks and as research data to form the basis of the soundscape simulator. Though the development of this work and the field studies, it is important to highlight some issues of the technique which need to considered when using field recordings.

The first issue with field recording is that the microphone offers an indiscriminate view of the soundscape; this view is independent of all social/cultural or personal experience factors that may be present in the space under study. The recording is limited by physical, mechanical and acoustical specifications of the equipment used, which also vary depending on the type of microphone and budget for the microphone and recording equipment. Each microphone has its own acoustic bounding factors, such as frequency response and sensitivity.

Generally, these parameters produce a smaller dynamic range than those of the human ear, which has a non-linear frequency response, which also diminishes with age, and environmental conditions the participant may have experienced during their life. Whilst microphones generally have a measurable frequency response, which can cover the range of human hearing (20Hz to 20kHz theoretically), the microphone is unable to capture psychoacoustic phenomena, such as low frequency vibrations <10Hz, which would be felt rather than heard by the participant and may impact on the listening experience in the field.

The reproduction of these low frequencies is difficult to replicate in the laboratory, as well as the hepatic sensations that low frequencies may produce in the real world. This issue is an important one to address when performing laboratory based work based on field recordings, as the removal of these physical experiences could have an impact when it comes to analysing how a participant has answered.

Other issues with field recordings relate to how close a source can be captured and what the end result required is. Recordings in the field of individual sounds cannot be removed from the space that they were captured in; the effects of the space will always be present in the recording. This may not be a problem when the sound source is being played against a background of ambience which would potentially mask any additional reflections or features within the recording, but would be an issue if post processing, such as the addition of reverb to the sound were to be attempted, for example in an auralisation set up.

Along with the space's signature being recorded with the sound source, there is also the additional consideration that other sound sources present at the time of recording would also be present, even with the source being closely recorded. Ultimately, field recordings will always contain the soundscape that they are captured in, albeit to a lesser degree depending on how close it is possible to record the sound.

8.1.4 Language

Language and semantics is an issue which was highlighted at the start of this work, and something which could form a large piece of work in itself and is something which has been explored previously (Dubois, *et al.*, 2006; Guastavino & Dubois, 2006). Analysis of the interview transcripts has shown that there is a small but varying vocabulary used when talking about sounds, but there is no explicit language used to exactly describe sounds or soundscapes.

It became apparent during the research period that even though there is no common language being used, the most common series of descriptors used were adjectives, quantifiers and onomatopoeia. For example, common terms were, faint, little, far away, background, light, squeal, hum, rustle, buzzing and honking. Work from the positive soundscapes project showed that it is possible to begin to get closer to a sound language through examination of usage in context, as well as developing levels of hierarchy for terms (Cain *et al.*, 2008).

The development and understanding of sound semantics could form the basis of future work and this seems to be a fundamental issue which needs to be addressed, to allow for a more robust interpretation of a participants views.

8.1.5 Soundscape Simulator

There are a number of limitations which need to be considered when discussing the future design of the simulator as well as issues which arose during the research. It is obvious that there are not an infinite number of sources available for the user to choose from, although through soundwalking, the sounds actually being heard can be recorded and used in the simulator, although in a design process a much wider palette of city centre sounds would be required. The flexibility of the digital audio workstation software to allow unlimited tracks (more than 999) (Cakewalk, 2009), and the ability to add multiple controllers, gives access to more sources than may actually be controllable by a participant. The grouping of sources into the categories formed as part of this work would be a way of tackling this alternatively these categories could then be analysed in isolation.

There is also an issue with the source recordings as discussed earlier, as a sound cannot be recorded in total isolation of the background. This means that even with close recording, a sound will have some element of background present, the task of the field-recordist is to minimise this. There is also difficulty in creating realistic outdoor reverberation for use in the convolution reverberation experiment, one method is to create an impulse response in the location, but logistically this has been difficult to achieve. Finally, the soundwalks interviews have highlighted that being immersed in the location is crucial in perception and the listening environment recreated in the laboratory is lacking in the multi-sensory real world perception which it would seem affects the perception of the soundscape. This poses the question of if listening in-situ is the best method for soundscape research, as potentially, this method provides a move away from 'forced' listening, which being in a room with headphones and loudspeakers may encourage.

The field recordings for this work were captured using a number of different techniques, which were used to contribute to the best sense of immersion that current technology could offer. Some of the issues surrounding the reproduction relate to these technological limitations. For example, whilst the use of Ambisonics provides the participant with the best sense of immersion in the soundscape (Guastavino & Dubois, 2005), the participant is limited to a spatial area bounded by the circle of speakers. The participant is unable to move or perceive sounds beyond the limit of the circle of speakers. Additionally, there is no real measured distance of the source from the central point, and due to the nature of the ambisonic set-up, it is impossible to move the source beyond the perceived distance of the circle of loudspeakers.

Other issues surrounding the soundscape simulator are in relation to the nature of the software, and the limitations thereof. The ability to manipulate the position of the source during demonstrations of the soundscape simulator was easy to do, but as it required the use of two controls on the controller, the participants found it difficult to completely achieve the desired outcome. In particular, the control of source focus, which moves the source backwards or forwards from the central position, the software reduces the level accordingly as the source moves away from the central point, but there is no change in the frequency content of the sound as it is moved further away, and this is seen as a problem with this method, although is something which could be addressed through the plug-in architecture, and specifically developed code.

There was also an issue with the panning law (Cakewalk, 2009), which is the amount by which the software reduces the level of the sound as it is moved through spatial positioning. The problem highlighted by the method uses, was that the software reduced level in relation to distance from the central spot, this meant in effect that there were two level differences occurring for the source. In addition to this point, the sound sources weren't being rendered correctly as part of the ambisonic playback, but rather just as point sources, this lead to a potential problem with the level being inaccurate for all spaces in the sound-field.

For the experiments carried out, sources were positioned as closely in the virtual space to where they were in the actual space (for those which were recorded in the space), and the others in suitable places. The level for each was then calibrated to match their recorded level, but this is something which would require further work to enable more flexibility and accuracy in sound source movement.

8.1.6 Soundscape Simulator: Future

The design and development of a soundscape simulator has been a key factor in this research work. The development of the soundscape simulator, as part of this project and the larger Positive Soundscapes Project, has demonstrated that it is a useful research and design tool when evaluated by design professionals, architects and planners (Bruce, 2009), with a view to a possible commercial application.

The feedback from demonstrations of the soundscape simulator has showed that as a mock-up design tool, which provides people with an estimated idea of the effects of sound sources in a space, that it is very useful and convenient tool. The availability of the DAW software, being a commercial product, and the ability to run on a laptop and small soundcard, mean that it is possible to easily set up and demonstrate designed spaces to a wide range of stakeholders.

The ability for the software to include video footage means that the visual aspects of the environment could be manipulated as well, and the effects on perception could also be measured. There are issues with using a full ambisonic reproduction set up and its portability, as well as the need for an acoustically treated room, or a room that has little sound reflection, but with this in mind and given the feedback from potential users, one possibility is that headphones could be used, as its use is purely to gain opinion and allow for the promotion of discussion.

Since the start of the project, the advent of tablet and mobile based computing, in particular gesture based manipulation has become prevalent. The advent of this technology has resulted in a number of controllers now being available to control DAWs via midi, using touch screen technology. Ultimately, this would replace the controller used in this work, and allow for easier manipulation of the soundscape simulator. In particular, the issues surrounding positioning of the sound source in 3D space would be resolved, as a participant could simply move the sound source with their finger to the desired location. Touch-screen technology would also make the soundscape simulator more portable, and therefore increase its potential for a design tool.

The other potential usage for the soundscape simulator is that of an educational tool, in keeping with the ideals put forward by Schafer and the World Soundscape Project (Schafer, 1984; 1988). Throughout the project, the soundscape simulator has been praised in its ability to allow people to 'play' with the soundscape. This factor was important during the research phase, and as such is something which could be developed further. The ability of the simulator to allow people to experiment with soundscapes should not be underestimated as a learning tool (Bruce, 2009), not only about soundscapes, but about the interactions of sound and acoustics.

Further to this ability to allow people to play with the soundscape, by introducing a visual element, as a video or photograph, the question of whether a different soundscape produces a different meaning or expectation could be explored, and a study of the impact of the visual modality could be researched. In summary, the development of a soundscape simulator, whilst by no means a perfect solution, which has a number of issues, provides a tool by which participants can design, test, educate and play with the soundscape. The ability to manipulate a number of parameters easily allows the creation of soundscape ideas to be tested, and group discussion to take place. It is this factor which makes this tool of use for design professionals, such as architects and town planners. The simulator's flexibility also allows for laboratory based investigation into psycho-acoustic, social and psychological factors within subjective evaluation of the soundscape.

8.2 Value

In considering semantics and value within the soundscape, it would be prevalent to look at ways in which personal and group held views influence perception of the sound environment. Dubois findings on semantics raise two important questions on furthering a possible

measurement for socio-soundscape evaluation; these questions are '*how much do you VALUE the soundscape'?* and '*how much do you VALUE the experience/context?'* (Guastavino & Dubois, 2006). A library could be an example of a value based soundscape. If, for example, a person values the library soundscape for its 'quiet' context, their experience and expectation could be ruined by those who it would seem do not value the environment.

If values come from knowledge, experience and expectations, one might expect a library to be quiet and get annoyed when that expectation is not met. In the library example, it is sound at low levels which can lead to annoyance, whereas if one chooses a coffee shop to work in, the expectation is that of a high background level of noise. With the high level expected in this location, annoyance could come from other facts such as a loud mobile phone call or loud conversation). The perception of a café may be different for each person; this concept returns us to Kantian philosophy and experience (Kant, 1855). The cafe provides an interesting study location, it is a mixed-purpose environment with people reading, talking or working for example, but generally the main purpose is that of relaxation. It is interesting that people choose a noisy location for relaxation, is this due to the meaning attributed to the noise or the association with the place? This work would suggest that it is the association with the context and the expectation of the context which leads to the choice of a space to perform an activity.

The following section details further work and lists potential research questions which have arisen during the course of this work. This section also details ways in which the methods employed in this thesis could be further enhanced and improved upon. For example, more work with visually impaired, a new research question emerging from this would could be if looking at how a participant's attitudes and values affect perception of the space. Linking visual elements and how perception affects their perception of the soundscape.

Further to this an investigation of the impact of social attitude, for example, the question of the loud music at night being an acoustic issue or a social issue? The quietness of footsteps of the neighbour upstairs, are ok at set times? Or do I like the person making the noise, does this have an impact? Or is a noisy washing machine more acceptable at 2am, 9am on a Sunday morning, or anytime between 12pm and 9pm? These questions could be answered and tested with adaptation and expansion to the methods used in this thesis, the methods could be improved as follows.

Appendices

The following section forms the appendices to the present thesis.

A. Sample Interview Transcript

The following is a transcript from one of the locations visited in Manchester on a soundwalk, this particular example is at location 3.

Man-PhD-SW4-3
Interviewer: I:
Interviewee: Man-PhD-SW4:

I: Have you been to this location before?
Man-PhD-SW4: Yes I have.
I: How would you define this location?
Man-PhD-SW4: This is on the corner of a very busy main street through the centre of Manchester
I: Is it how you would expect it to be?
Man-PhD-SW4: Yes it is.
I: What can you hear at the moment?
Man-PhD-SW4: 1 can hear the noise of the traffic, particularly the buses seem to have some kind of high pressure engine work going on an fans because they do make a bit of a roar when they step on the accelerator, I can hear people talking, just down the man by the fruit stand was talking or speaking quite loudly so there's all the sounds that you would expect in the city.
I: I was going to ask is what you can hear as you expect, is there anything missing or out of place?
Man-PhD-SW4: No it's a city and that's what you would expect, noisy traffic, noisy people, noisy buses, people footsteps, girls with high heels make clack, clack sounds, it's what you'd expect in the city centre.
I: What would you say is the purpose of this space?
Man-PhD-SW4: The purpose of this space here, well it's a crossroads, and it's to allow passage for people to cross the road at the traffic lights and the cars to stop and cross to get from one end of the busy to the other end and out of the city.
I: And how does this location make you feel?
Man-PhD-SW4: Well because I'm familiar with it, I feel OK, I'm quite comfortable with the location, it doesn't bother me.
I: So are your expectations met or not met?
Man-PhD-SW4: No my expectations are as, it's not changed very much this place in many years, so it's always been a busy thoroughfare, and really that's what you would expect of it, a busy crossroads, traffic sounds, people walking, people talking on mobiles.
I: Does anything you can hear make you feel more or less comfortable?
Man-PhD-SW4: Well because I, it's a place where you would expect to hear all the background of being in a city centre, I don't feel uncomfortable.
I: Who would you say uses this location and how do they use it, how would you say they use it?
Man-PhD-SW4: Mainly this is a thoroughfare for shoppers and dining because it's, quite a lot of restaurants, coffee shops and pubs, so I guess at certain times of the day it would be full of people making a bit of a noise because of the drink.
I: Is this place quieter, louder or as you would expect?
Man-PhD-SW4: It's at this very moment it's quite noisy, people are shouting, there's screeching of brakes, but it's a city centre so that's part of normal, normal city centre, it's just that some trucks, lorries and buses, heavy on the accelerator which makes them invade your space when you're trying to have a conversation.
I: What do you think of how this location looks?
Man-PhD-SW4: What can I say, it's a bit of a, compared to the last two locations that we've stopped at, it's a bit of a grubby environment. It's got brash shop signs, it's got people shouting and here's a bus going by that is going to obscure a conversation and the environment is well it's a busy crossroads
I: What impact do you think the layout of this location has on what you can hear?
Man-PhD-SW4: The layout is, the layout that's because it's a crossroads, you've got people and traffic coming and going across four directions.
I: How as an individual would you value this space?
Man-PhD-SW4: The space? The space is serving a purpose it's a crossroads so it has a value for pedestrians to get from one part of the street to the other part and traffic to get in and out of the city.

Man-PhD-SW4-2
Interviewer: I:
Interviewee: Man-PhD-SW4:

I: How would you describe this part of Manchester?
Man-PhD-SW4: It's a busy, precinct, it's a busy precinct in the heart of Manchester, which is used mainly for shopping there are some offices around, I've seen it busier, this is early in the morning so it's reasonably quiet at the moment.
I: In general what would you expect to hear in an urban environment?
Man-PhD-SW4: People talking, mainly people talking, traffic noise, there isn't any traffic noise.
I: And as an individual do you like or dislike any of this?
Man-PhD-SW4: This is very pleasant, it's a very pleasant environment, it's quite calm because, A it's the morning and we've got water running in the background and it's open, it's an open space so it doesn't feel sort of cloistered.
I: I'm going to ask you some specific questions about here, have you ever been to this location before?
Man-PhD-SW4: Yes I have.
I: You kind of answered this, but how would you define this location?
Man-PhD-SW4: This location used to be much busier but they've made it into this wide precinct now, I believe it's after the bombings that it's changed its character a bit but it used to be, the centre of Manchester used to be a real hub, that's what I remember.
I: So is this place how you would expect it to be?
Man-PhD-SW4: It's changed, if I go, if I'm honest because I've been here before a while back and coming here again today, yeah it has changed and it's what I expect because I've been here before.
I: What can you hear at the moment?
Man-PhD-SW4: I can hear many sounds, I can hear music coming from a shop behind me, I can hear people's footsteps, I can hear a motorised probably a street cleaning vehicle with, no I've just seen it, it's a street cleaner pushing a big like a Hoover, a big vacuum street Hoover, which is quite noisy, it's coming up in the background, I can hear water, that's yeah.
I: Is what you can hear as you would expect, or are there any elements out of place or anything missing?
Man-PhD-SW4: Well there's no birdsong but that's a city and you wouldn't really expect it in a city although there are trees where we are, there are no birds and the intrusive part of this place at the moment is this big Hoover, the street Hoover which is invading the whole piece of this environment which is to me, the space here is conductive to a peaceful environment.
I: What would you say is the purpose of this place
Man-PhD-SW4: The purpose of the place I would say because of the changes it's undergone, is to give peace and tranquillity and it's become a precinct, so it's safe for people to walk around and its calm, it would have a calming influence apart from this big thing that's coming towards us with its motorised brushes.
I: How does this location make you feel?
Man-PhD-SW4: My initial feeling walking round here is one of calm.
I: Are your expectations of this location met?
Man-PhD-SW4: Yes.
I: Does anything you can hear make you feel more or less comfortable?
Man-PhD-SW4: More or less comfortable? Well now my whole comfort zone has been totally invaded by the motorised vacuum cleaner that is about now ten feet away from me, so I can't hear anything else the peace and tranquillity of the whole place when we walked in here has been invaded.
I: Would you prefer for the street cleaner not to be present but a dirtier environment?
Man-PhD-SW4: No appreciate that he's got a job to do, but maybe he could do it late at night when everybody's disappeared because now the place is, it's morning time and the place is becoming busier as people come out to shop, they're sitting out having a cup of coffee I'm being interviewed by you and I'm having to raise my voice.
I: If we could just think back to before the street cleaner arrived, is this place quieter or louder or as you would expect?
Man-PhD-SW4: Well it's quieter, it's quieter now we've got the church bells ringing which is another, it's a good sound
I: What do you think of how this location looks?
Man-PhD-SW4: It's an old city centre and because of the precinct and the space here it's got a modern feel of space that is now required in a lot of new developments, space and water, space is accompanied by water.
I: If you look around what impact if any do you think the layout of the buildings, the design of the building or the physical environment has on what you can hear?
Man-PhD-SW4: The buildings are old buildings they've been here for a very, very long time, but again because of the open space in between there is this feeling of a peaceful environment a place where you can calmly walk

pass through.
I: Who would you say uses this location?
Man-PhD-SW4: I would say its shoppers and office people.
I: How do you think they use it?
Man-PhD-SW4: Well they're using it as a walkway to get from one part of Manchester to the other, to access the banks that are around here and the shops and the coffee shops.
I: And the last question for here, how as an individual would you value this space?
Man-PhD-SW4: I think this space in particular is a very pleasant space in the middle of Manchester, it's very wide and it's very, very calming.

Man-PhD-SW4-2
Interviewer: I:
Interviewee: Man-PhD-SW4:

I: Have you ever been to this location before?
Man-PhD-SW4: No
I: How would you define this location?
Man-PhD-SW4: It's a garden square in the heart of the city.
1: Is it how you would expect it to be?
Man-PhD-SW4: For a city garden square, yes it's exactly as I'd expect it.
I: What can you hear at the moment?
Man-PhD-SW4: Mainly I can hear traffic, mainly traffic.
I: Is it specific traffic or just individual vehicles?
Man-PhD-SW4: There's a drone of far away traffic, and there's a specific vehicle, a big truck that is reversing and it's got quite noisy, well a whole round noisy atmosphere around it.
I: Is what you can hear as you would expect or are there any elements missing or out of place?
Man-PhD-SW4: 1 guess it's what I'd expect because it is a city garden square, so apart from the heavy truck which will move and leave the square, I wouldn't say it's presence is here permanently so that would be removed and you've just got the steady flow of traffic that goes by the side of the square. You can see people sitting here, they come out here for the ambiance of the gardens to sit and enjoy whatever they're doing, eating reading, a guy's listening to his radio but I guess he wouldn't be here on a permanent basis either
I: What would you say is the purpose of this space?
Man-PhD-SW4: It's to give people a place to escape to, where you can sit and relax, it's a city environment and these places usually provide a place for city workers to come out of their offices, sit on the benches or on a good summer day, sit on the grass have their lunch, have a break, relax before they go back and do their work.
I: How does this location make you feel?
Man-PhD-SW4: It's a pleasant location, it's calm, it's a calming environment.
I: Does anything you can hear make you feel more or less comfortable?
Man-PhD-SW4: At the moment the traffic isn't heavy so it's not invading the space and I guess if you were sitting down to read, it's quiet enough that you could sit and read and the city sounds as you could describe the background would actually disappear as you got involved in whatever you were doing.
I: Who would you say uses this location and how do you think they use it?
Man-PhD-SW4: Mostly it's office workers, or people that are shopping and maybe want to sit down quietly before they move off to their various means of transport out of the city.
I: Is this place louder or quieter or as you would expect?
Man-PhD-SW4: Apart from the man with the radio on in the background, this would be a quiet place.
I: What do you think of how this location looks?
Man-PhD-SW4: It's got very clean lines about it even the new building that has gone up on the square, cause mainly it's an old part of the city the redbrick buildings, but even the new building that's gone up just meets the calm of what I believe is the target and purpose of these gardens here.
I: What impact do you think the design of the location, the buildings around it, the physical environment has on what you can hear?
Man-PhD-SW4: It makes it a secluded, the buildings create a secluded garden because it's surrounded by buildings on all four sides, it gives it a place of seclusion, but again it's a tranquil environment despite the buzz of the city behind it and it's also pleasant because actually the sun is shining and it comes straight in here, so that helps to create a feeling with people that they'd like to come and sit here and relax.
I: Do you think any of these aspects make the soundscape better or worse?
Man-PhD-SW4: Personally these places are in need in a city, a city is busy people are in a rush, there's pressure and these little conclaves with greenery and a tree or two, benches they are, they're great because people can actually sit down relax, reflex whatever they need to do, have a cup of tea have a cigarette, people are sitting on a bench having a cigarette, so they create a place for being human I guess.
I: And finally how as an individual do you value this space?

Man-PhD-SW4: Well I've never been in this particular place before, and I find it very pleasant so I would guess for the local population it's a bit of a treasure to get out to.

Man-PhD-SW4-4
Interviewer: I:
Interviewee: Man-PhD-SW4:

I: Have you been to this location before?
Man-PhD-SW4: Yes I have.
I: How would you define this location?
Man-PhD-SW4: It's a larger crossroads than the previous one we talked about and that's it, it's a larger crossroads in the main city centre.
I: Is it how you would expect it to be?
Man-PhD-SW4: It's a city centre crossroads, it provides a function to get across from one to the other and stops the traffic to allow pedestrians to cross the road, it's a wider road it's a wider crossroads.
I: What can you hear at the moment?
Man-PhD-SW4: I can hear mainly only actually, traffic sounds and some people with scaffolding outside the building opposite
I: Is what you can hear as you would expect, is there anything missing or out of place?
Man-PhD-SW4: It's a typical busy junction, nothing out of place, it's serving its function as a crossroads.
I: And what would you say is the purpose of this place is, well you kind of just alluded to that?
Man-PhD-SW4: Well the purpose is to allow the traffic to go across the city in both directions, east, west, north, south and the pedestrians to cross equally the same distance the same north, east, south and west
I: And how does this location make you feel?
Man-PhD-SW4: It's not a pleasant location, I think it's quite aggressive actually, it's an aggressive location because of the type of traffic the buses, the buses are very noisy, I think the new modern buses are much, much noisier than the old buses used to be, they've got some kind of powered generators on board that, even when you're sitting on them they make an invasive sound, it's very intrusive the sounds that these new buses make.
I: Are your expectations of this location met?
Man-PhD-SW4: Well it's a wide busy crossroads junction and my expectations are to cross the road safely so the traffic lights are all functioning and the traffic stops, and then the traffic goes and that's the background noise of this particular junction, it's purely traffic and not much else.
I: Is there anything you can hear make you feel more or less comfortable?
Man-PhD-SW4: Well the only comforting thing is when the traffic stops and there is no roaring, that's it.
I: Who would you say uses this location?
Man-PhD-SW4: This is again It's office workers, there's a lot of office buildings around here and shoppers, it's where shoppers have to come to get to the centre so it's mainly shoppers and office workers.
I: Is this place quieter, louder or as you would expect?
Man-PhD-SW4: It's as I would expect, it's a busy junction
I: What do you think of how this location looks?
Man-PhD-SW4: It's, it's dirty and aggressive, it's not calming, it's a typical city junction of the old type.
I: What impact if any do you think the layout of this buildings, the design of the buildings has on what you can hear?
Man-PhD-SW4: There's no effect because each corner has a different building, there's no continuity, there's nothing here created, this is what you could say it's an evolvement of buildings, different eras, you've got a Victorian pub on one corner maybe earlier, you've got a 60s type building on the other corner, you've got a very old gothic type building on the third corner and then you've got again probably an 80s or 90s building on the fourth corner, so each, each building is different so it contributes different things.
I: And finally how would you value this space?
Man-PhD-SW4: I think it's a horrible space, it's noisy, it's invasive, its purpose is access for crossing the road and traffic crossing the junction.
I: Thanks for that, I've just got a couple of round up questions, we've been back to four locations today, we've been here at the junction of John Dalton Street and Deansgate, we were at the junction of St. Marysgate and Deansgate, we then went to Parsonage Gardens and we started in St. Anne's Square, how would you describe these places?
Man-PhD-SW4: They're all providing a function within the city, the crossroads are essential because people have to cross the city, and the gardens provide a little place of tranquillity within the busy city and the square, the precinct where the shops are, is spacious and therefore has a calming effect away from busy junctions like this which are very aggressive.
I: Would you say we've experienced a number of different soundscapes today or one urban soundscape?
Man-PhD-SW4: Mainly I would say we've experienced traffic noise today.
I: Did the places we visited sound as you would expect them to sound?

Man-PhD-SW4: On the whole yes they did, because we've got junctions with busy traffic, gardens that would be tranquil and a shopping precinct where you wouldn't expect to be invaded by heavy vehicles coming up behind you.

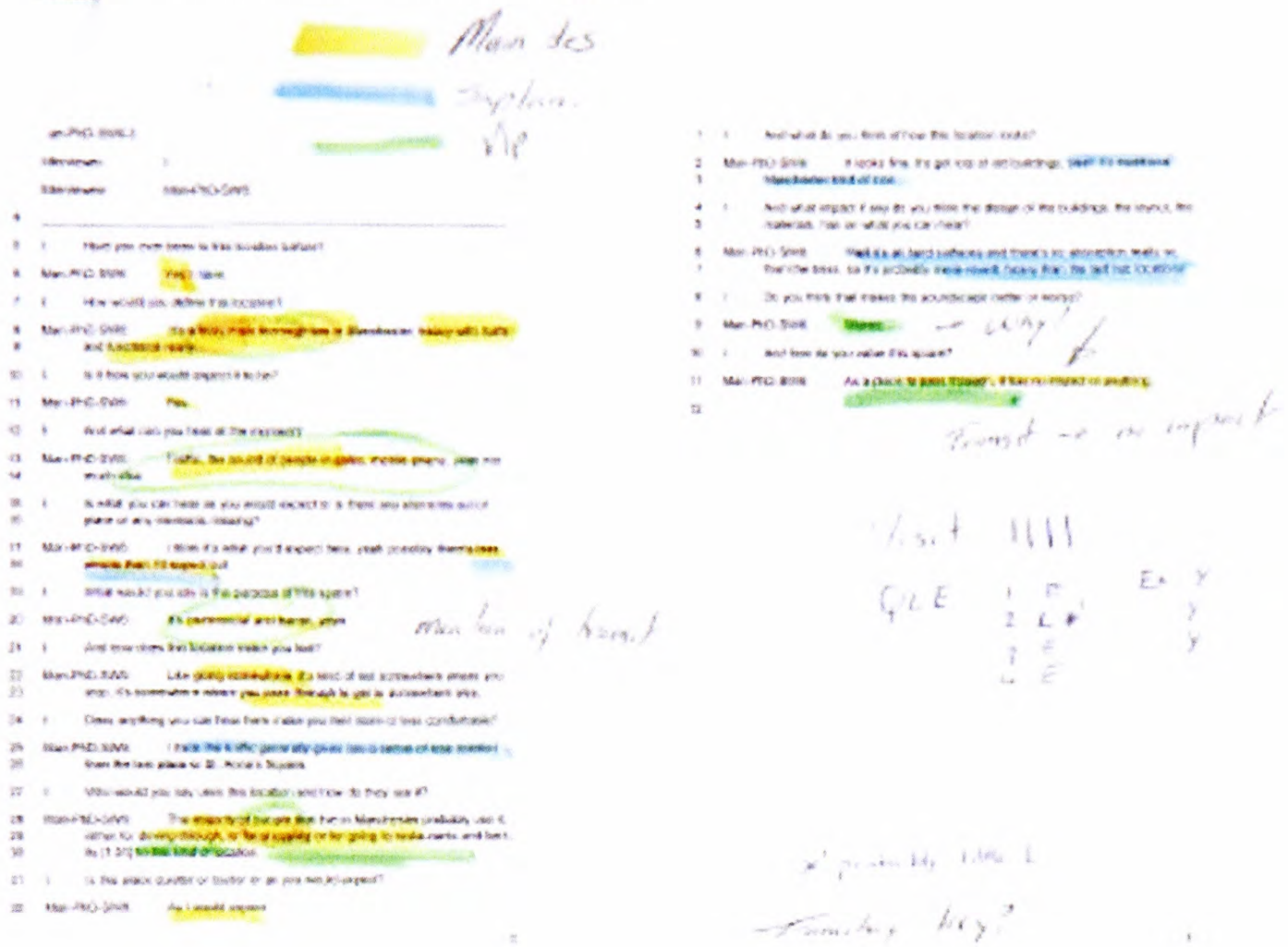
I: Has being on this sound walk changed your perception or understanding of urban soundscapes in any way?

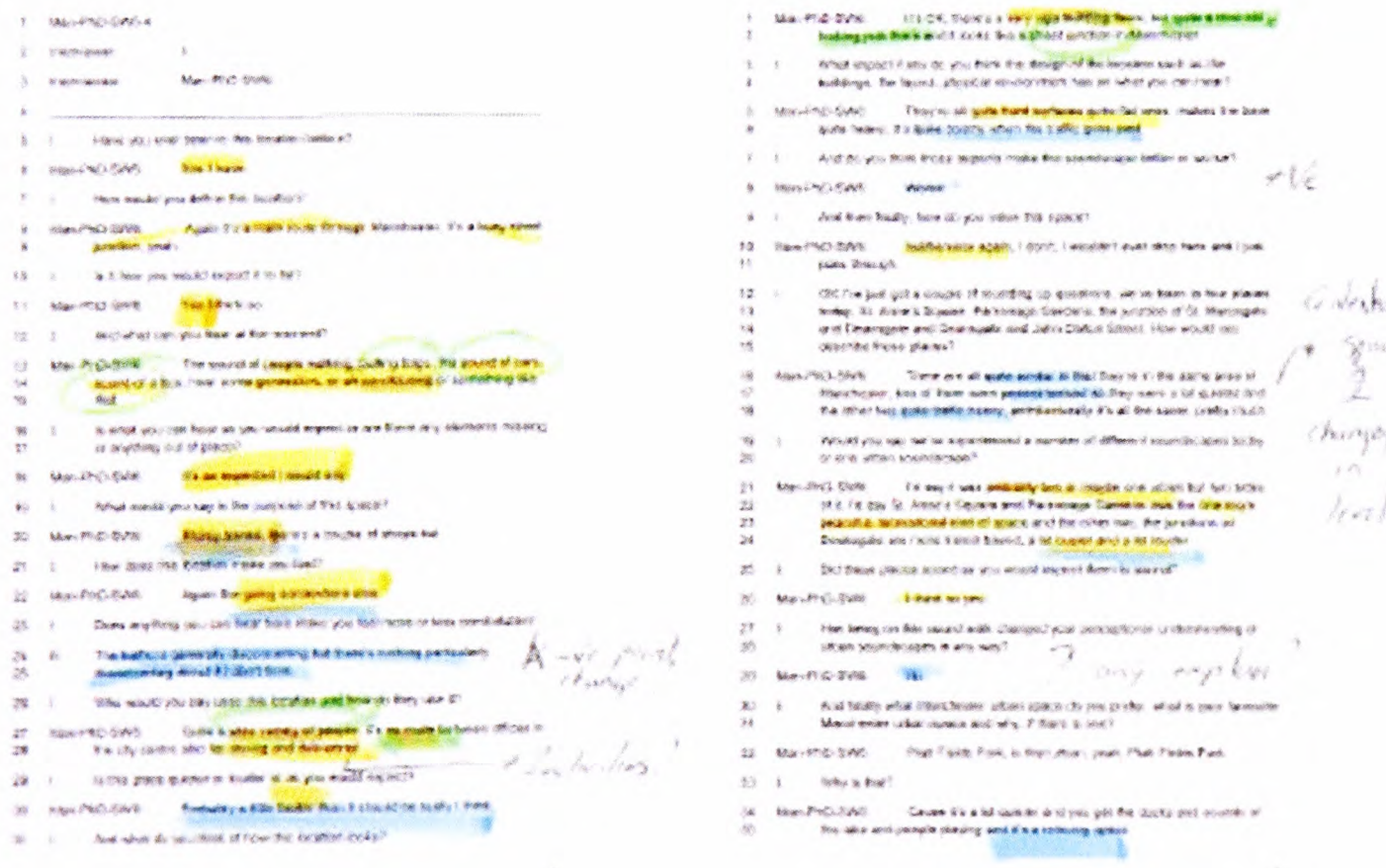
Man-PhD-SW4: Yes it has, it's made me think and become a bit more aware of what's going on around although personally I am a bit of a freak about noise, I do, I don't like big vehicles invading my space or vacuum cleaners being held unnecessarily in spaces, people should just do the job and get on with it and move on, but traffic has to pass, it comes to stops but I do believe that the new buses are much, much noisier than the old ones.

I: And finally, I know you're not actually from Manchester, but is there any Manchester space that you, do you have a favourite Manchester space?

Man-PhD-SW4: If I have a favourite place in Manchester I would say the area where we started off at King Street because they are the heart of the city and again because there's no traffic passing through there, it's a more calming environment away from the busy street of Deansgate and by the Arndale Centre which I don't know the name of the road there, but I would say those places as I said before, precincts and gardens are necessary to give people the choice of escaping from all the noise around them because it is quite noisy on a main thoroughfare.

B. Coded Interview Transcript





C. Simulator Questionnaire

Sound One			
Do you want to keep this sound?			Yes / No
Would you expect to hear this sound in this location			Yes / No
How would you rate this sound? *Unpleasant* *Pleasant* 1 2 3 4 5 6 7 8 9 10			
Level	Reverb	LF Hz	Position Angle Focus

Sound Two			
Do you want to keep this sound?			Yes / No
Would you expect to hear this sound in this location			Yes / No
How would you rate this sound? *Unpleasant* *Pleasant* 1 2 3 4 5 6 7 8 9 10			
Level	Reverb	LF Hz	Position Angle Focus

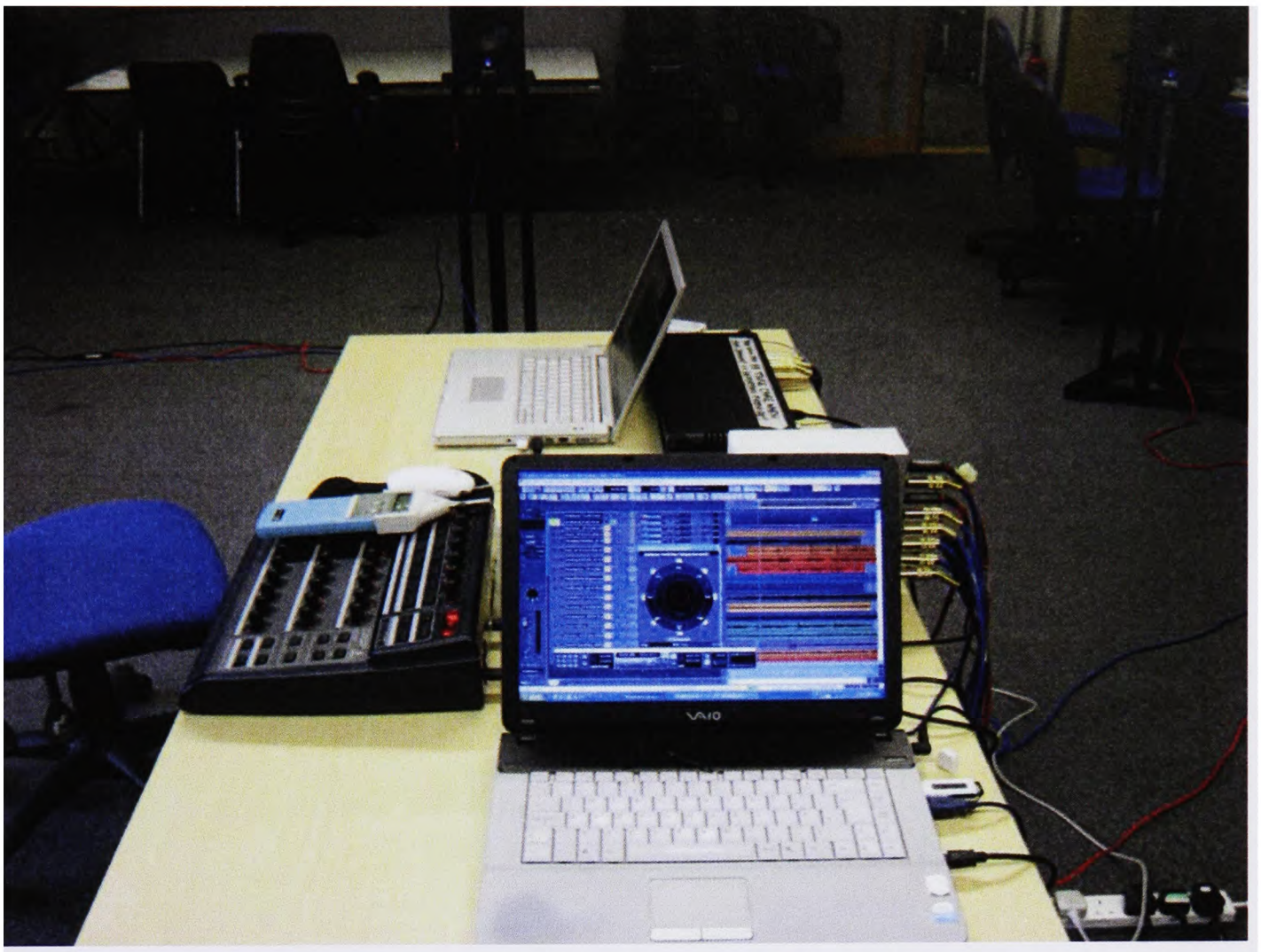
Overall Levels			
Ambient Level			
Low Frequency			

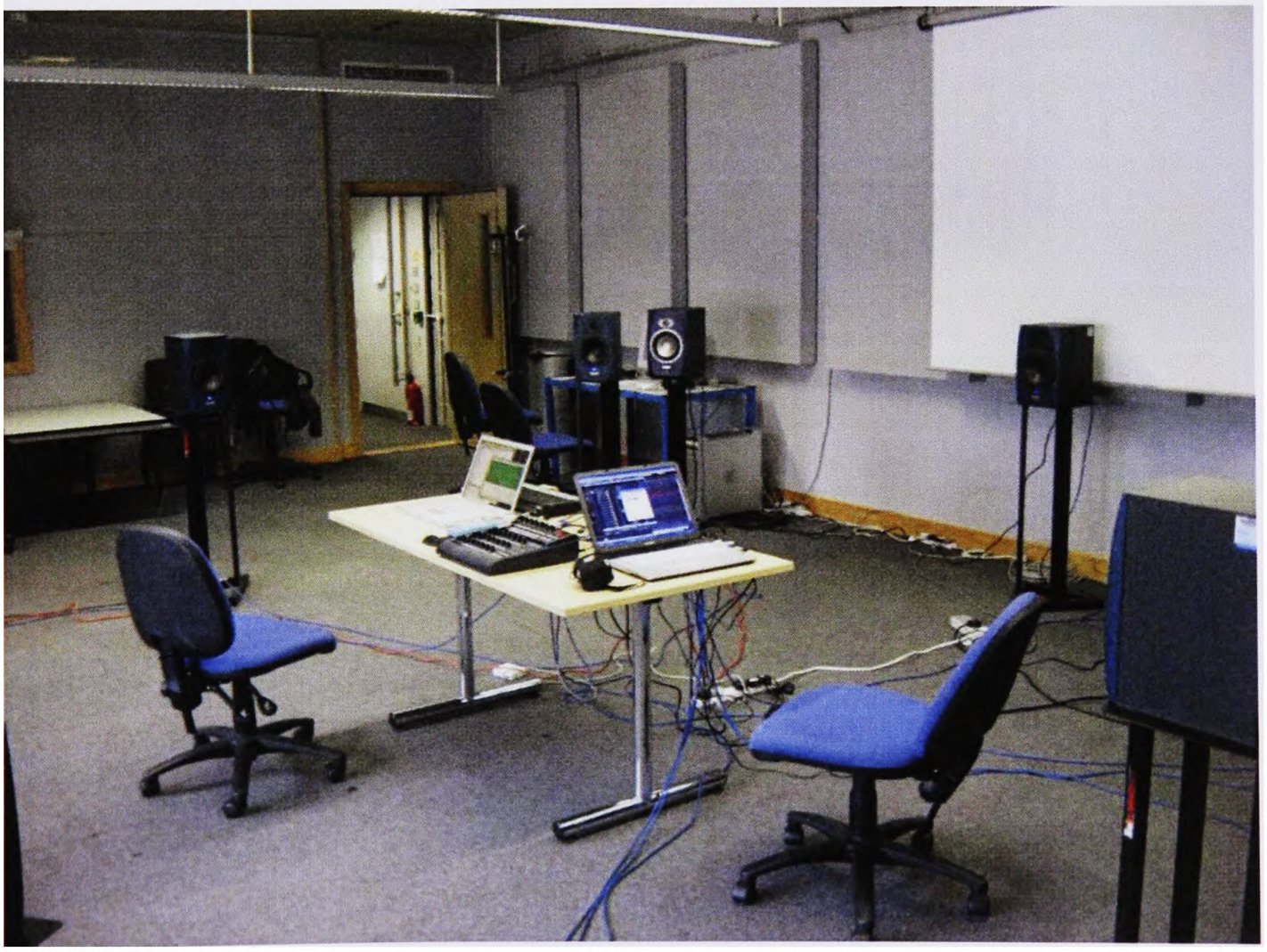
Age :

Gender :

Thank you for your time.

D. Simulator Photographs





E. Word Count Frequencies

The following section provides the word count frequencies from the tag-clouds in tabular form, it only includes words with a frequency greater than one.

London	
Conversations	2
Footsteps	2
Loud	2
Music	2
Road	2
Sirens	2
Work	2
Chatter	3
Pedestrians	4
Cars	5
Talking	5
People	6
Noise	7
Traffic	11

Table 8-1 : London word frequency count

Manchester	
Bags	2
Mobile	2
Music	2
Jam	2
Brakes	3
Fans	3
Footsteps	3
Fountain	3
Rustling	3
Air conditioning	4
Background	4
Chatter	4
Sound	4
Conversation	5
Engines	6
Buses	7
Talking	7
Cars	10
Traffic	16

Table 8-2 : Manchester word frequency count

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