Creating Soundscapes:

A Creative, Technological and Theoretical Investigation of Binaural Technology Usage

Submitted by **Ruth Farrar**, to the University of Exeter as a thesis for the degree of *Doctor of Philosophy in Film* [November 2014]

I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

Signature................................

ACKNOWLEDGEMENTS

ABSTRACT

Through its portfolio of practical case studies and its engagement with critical thinking from a range of disciplines, the PhD investigates the following key question: what are the technical, aesthetic and conceptual impacts of using binaural technology to create a soundscape?

'Using binaural technology' implies users and users are essentially at the heart of this impact because users mediate the technical and aesthetic aspects of binaural technology and also inherently shape the theoretical ideology of this technology. By analysing users' interactions with binaural technology from a social constructivist perspective, this thesis gains rich insights into the impact of using binaural technology when creating soundscapes.

Chapter One explores sound artists' and field recordists' work that use binaural technology for the shared purpose of documenting urban soundwalks. The first case study "Audio Postcards" is also informed by questions drawn from acoustic ecology, socio-political theories on the practices of everyday life and the challenges that arise in finding, recording and preserving 'soundmarks'.

Chapter Two outlines practitioners' applications of binaural technology to create an intimate connection to an art piece such as theatre director David Rosenberg's productions. Peter Salvatore Petralia's concept of *headspace* is

applied to the chapter's case study: "From Austria To America" to further understand binaural technology's psychoacoustic effects.

Chapter Three studies the impact of social groups who use binaural technology to record classical music performances. Traditional stereo and binaural classical music recording conventions are shaped in a new direction in two case studies: "Point of Audition" and "From Page to Stage". Questions of 'fidelity' also arise from this creative practice.

The outcomes of this reflective binaural practice unearth deep layers of understanding. This thesis discovers the impact of binaural technology moves beyond the effect it has on a listener to realise this recording practice also impacts a recordist's decisions in the field and a sound artist's creative choices when crafting soundscapes. The beneficial impact of binaural technology including its inconspicuous nature, the ability to imprint an artist's subjective signature on recordings and its lifelike immersive qualities in playback are revealed through practice and reflection. Representing the real, the role of artist and point of audition are also themes explored throughout each chapter. Ultimately, insights gained are woven together as a means of constructing an original theoretical framework for an under-theorised subject: understanding how social user groups shape the impact of using binaural technology when creating soundscapes.

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INVENTORY OF SUBMITTED PRACTICAL PORTFOLIO

CHAPTER ONE: "AUDIO POSTCARDS: FROM BRISTOL TO BROOKLYN"

- Two interactive websites featuring audio postcards.

	Type	Length	Location
Bristol Shopping Area	Audio Postcard	1:18	http://www.audiopostcardsbristol.com/
Bristol Park Area	Audio Postcard	1:07	http://www.audiopostcardsbristol.com/
Bristol Market Area	Audio Postcard	1:14	http://www.audiopostcardsbristol.com/
Bristol Harbourside Area	Audio Postcard	1:15	http://www.audiopostcardsbristol.com/
Bristol Alternative Area	Audio Postcard	2:10	http://www.audiopostcardsbristol.com/
Brooklyn Park Area	Audio Postcard	1:51	http://audiopostcardsbrooklyn.com/
Brooklyn Shopping Area	Audio Postcard	2:03	http://audiopostcardsbrooklyn.com/
Brooklyn Harbourside Area	Audio Postcard	1:46	http://audiopostcardsbrooklyn.com/
Brooklyn Market Area	Audio Postcard	1:46	http://audiopostcardsbrooklyn.com/
Brooklyn Alternative Area	Audio Postcard	1:48	http://audiopostcardsbrooklyn.com/

CHAPTER TWO: "FROM AUSTRIA TO AMERICA"

- One site-specific sound art installation piece exhibited at *Moving Sounds Festival 2013* at the Austrian Cultural Forum Library in New York.

Title	Type	Length	Location
"From Austria to America"	Sound art installation	03:00 – 09:00	Exhibited at Austrian Cultural Forum, 11 East 52nd St, New York, NY 10022, as part of *Moving Sounds Festival 2013*: Marketing material for the installation can be found here: http://www.acfny.org/event/kenji-ouellet-piece-touchee-no-2/
Audio-visual documentation of "From Austria to America"	Film	06:44	Documentary made by me of the installation build, exhibition and captured listener responses. https://vimeo.com/105296120 When prompted by Vimeo, please use the following password to access the video: soundswept

CHAPTER THREE: "POINT OF AUDITION" and "PAGE TO STAGE"

- Two app prototypes.

	Type	Length	Location
"Point of Audition"	App prototype	01:00 – 30:00	The app prototype is located on the AppFurnace server. To experience "Point of Audition", there are four steps: Step 1: Download & Install the Apple or Android version of the AppFurnace Player. It is a free app. Search 'AppFurnace Player' on Apple's app store for an Apple version or Google Play for an android version. (Please note: there is no space between 'App' and 'Furnace'. It is all one word and spelled 'AppFurnace Player'.) Alternatively, Apple version of AppFurnace Player is here: https://itunes.apple.com/gb/app/calvium-player/id387022138?mt=8 Android version of AppFurnace Player is here: https://play.google.com/store/apps/details?id=com.calvium.player&feature=search_result#?t=W251bGwsMSwxLDEsImNvbS5jYWx2aXVtLnBsYXllciJd Step 2: Load AppFurnace Player, and click the **+** icon beside the 'AppFurnace Player' logo. Step 3: In the white text box above the 'Add from URL' black button, please type in the following url: http://the.appfurnace.com/test/bVs5s/ Then, hit the 'Add from URL' black button to activate the download. Step 4: When it has downloaded, tap the entry in the list and press PLAY.
Audio-visual documentation of Hack	Film	05:36	The documentary is made by Pervasive Media Studio filmmaker Benji Croce. It explains the hack's two day process, documents the Sacconi Quartet wearing binaural microphones that I set up

the Quartet two day event when "Point of Audition' was conceived.			and features me listening to the Sacconi Quartet in the binaural hot seat. https://vimeo.com/73298845
"Point of Audition" Viola	Binaural Recording	33:13	The app prototype occasionally contain bugs on playback. So you can still get an audio flavour of the content recorded, here is a link to the binaural recording from the point of audition of the viola player during Tuesday's performance: https://soundcloud.com/ruth-farrar/viola-poa This binaural recording is private and for examination purposes only.
"Point of Audition" Violin	Binaural Recording	28:53	The app prototype occasionally contain bugs on playback. So you can still get an audio flavour of the content recorded, here is a link to the binaural recording from the point of audition of the violinist during Tuesday's performance: https://soundcloud.com/ruth-farrar/violin-poa This binaural recording is private and for examination purposes only.
"Point of Audition" 2nd Violin	Binaural Recording	29:32	The app prototype occasionally contain bugs on playback. So you can still get an audio flavour of the content recorded, here is a link to the binaural recording from the point of audition of the 2nd violinist during Tuesday's performance: https://soundcloud.com/ruth-farrar/2nd-violin-poa This binaural recording is private and for examination purposes only.
"Point of Audition" Cello	Binaural recording	33:13	The app prototype occasionally contain bugs on playback. So you can still get an audio flavour of the content recorded, here is a link to the binaural recording from the point of audition of the cellist during Tuesday's performance: https://soundcloud.com/ruth-farrar/cello-poa This binaural recording is private and for examination purposes only.
"Point of Audition" Stage	Binaural recording	26:33	The app prototype occasionally contain bugs on playback. So you can still get an audio flavour of the content recorded, here is a link to the binaural recording from the point of audition of the stage

			during Tuesday's performance:
			https://soundcloud.com/ruth-farrar/stage-poa
			This binaural recording is private and for examination purposes only.
"Point of Audition" Audience	Binaural recording	21:13	The app prototype occasionally contain bugs on playback. So you can still get an audio flavour of the content recorded, here is a link to the binaural recording from the point of audition of the audience during Tuesday's performance:
			https://soundcloud.com/ruth-farrar/audience-poa
			This binaural recording is private and for examination purposes only.
"Page to Stage"	App prototype	00:30 – 10:00	"Page to Stage" app prototype is copyright of the Orchestra of the Age of Enlightenment. It is not published but instead is stored on the TestFlight server.
			The app prototype is not accessible to the public; only people who worked on the project are invited and given access to the app prototype.
			I have kindly been granted permission from the Orchestra of the Age of Enlightenment and Sheila Hayman from REACT to allow my PhD examiners access to the app prototype for examination purposes only. There are two steps to gain access:
			Step 1: The app prototype's developer Henry Cooke has authorised and sent a TestFlight e-mail invitation to the internal and external examiners' university email addresses on 10th and 11th November 2014 respectively. Please check your university email inbox as this email from Henry Cooke: me@prehensile.co.uk contains a link to the TestFlight server.
			On your smartphone or tablet device, open the e-mail. Then, please click on the link in the email to install the app prototype from the TestFlight server.
			Step 2: A UDID is a Unique Device Identifier number. To activate your individual smartphone or tablet device to receive "Page to Stage", you must email your smartphone or tablet device's UDID to Henry Cooke at me@prehensile.co.uk
			The method of finding your UDID occasionally changes due to technological developments. However, to locate your UDID on your smartphone or tablet device, here are three of the latest online 'how to' guides for reference:
			https://www.innerfence.com/howto/find-iphone-unique-device-

			identifier-udid http://whatsmyudid.com/ http://bjango.com/help/iphoneudid/
Audio-visual documentation of "Page to Stage"	Film	06:44	The documentary made by Pervasive Media Studio filmmaker Greg Browning explains the app prototype making process, exhibits the app prototype's features and contains a short interview on my input as a binaural sound artist into the collaborative app prototype. The documentary can be found embedded on the following website page: can be found embedded in a video here: http://www.react-hub.org.uk/future-doc- sandbox/projects/2013/page-to-stage/

APPENDIX B: SUSPENSE SOUND EXPERIMENTS

- Seven originally produced audio-visual experiments.

Title	Type	Length	Location
Suspense Experiment A	Audio-visual video experiment	00:58	https://vimeo.com/42606392 When prompted by Vimeo, please use the following password to access the video: Hitchcock8
Suspense Experiment B	Audio-visual video experiment	01:30	https://vimeo.com/40668034 When prompted by Vimeo, please use the following password to access the video: Hitchcock8
Suspense Experiment C1	Audio-visual video experiment	01:35	https://vimeo.com/42606393 When prompted by Vimeo, please use the following password to access the video: Hitchcock8
Suspense Experiment C2	Audio-visual video experiment	01:35	https://vimeo.com/61904760 When prompted by Vimeo, please use the following password to access the video: Hitchcock8
Suspense Experiment D1	Audio-visual video experiment	01:31	https://vimeo.com/42606394 When prompted by Vimeo, please use the following password to access the video: Hitchcock8
Suspense Experiment D2	Audio-visual video experiment	01:10	https://vimeo.com/42606397 When prompted by Vimeo, please use the following password to access the video: Hitchcock8
Suspense Experiment E	Audio-visual video experiment	00:26	https://vimeo.com/61903355 When prompted by Vimeo, please use the following password to access the video: Hitchcock8

INTRODUCTION

Despite the emergence of fascinating individual projects including Janet Cardiff's binaural soundwalks (such as *Her Long Black Hair*) and Des Coulam's binaural sound map of Paris (*Soundlandscapes*), binaural technologies are, for the most part, under-used by sound recordists and artists. The recording practices associated with using binaural technologies are also rarely theorised. This introduction outlines the initial steps taken during this research project to answer this thesis' central question: what are the technical, aesthetic and conceptual impacts of using binaural technology to create a soundscape?

To consider the impact of using binaural technology to create soundscapes, it is worthwhile to first examine what is a soundscape? Sound by its nature is constantly shifting, and sound studies as a discipline is still an emerging and exciting area of academia. For these reasons, there is occasionally a tendency to discuss sonic concepts by comparing sound to long-established lexicons of the visual. One definition of a soundscape exemplifies this approach as a soundscape is defined as the sonic equivalent of a visual landscape (Norman).

In his 1977 book *Our Sonic Environment and the Soundscape: The Tuning of the World*, acoustic ecologist R. Murray Schafer is credited with coining the term soundscape. In Barry Truax's *The Handbook for Acoustic Ecology*, a soundscape is defined as 'an environment of sound (or sonic

environment) with emphasis on the way it is perceived and understood by the individual, or by a society. It thus depends on the relationship between the individual and any such environment' (Truax).

Sound theorist Rick Altman highlights the temporal aspect of an auditory environment when defining a soundscape as 'the characteristic types of sound commonly heard in a given period or location' noting the 'particularities' between 'morning and late evening soundscapes' and soundscapes from different historical periods. He notes 'the late nineteenth-century American soundscape was largely limited to unamplified, live sounds, while the soundscape of the mid-twenties include radio, electrically recorded disks…and an increasing number of unmuffled motors' (252).

Soundscape is a key concept in the theories and practices of field recording. Natural soundscape recordist Bernie Krause studies the richness of natural sonic environments by creating sub-categories of sound to understand and study soundscapes. Krause classifies the sounds we hear in a soundscape 'into geophony (non-living sounds of the Earth produced by wind, water, etc.); biophony (the sounds of life); and anthrophony (the sounds produced by human technology)' (Wild Music).

Overall, a soundscape may be made up of all these above aspects. The disciplinary diversity of nuanced definitions of a soundscape reflect the concept of a soundscape: a combination of the diverse sounds within an environment. A soundscape's diverse sounds receive cultural value by the way sonic environments are 'perceived and understood by the individual, or

by a society. It thus depends on the relationship between the individual and any such environment' (Truax).

It is worth distinguishing between understanding a soundscape as a listener and perceiving a soundscape as a recordist. They denote different relationships to sound and place. For instance, the cultural value a listener may make from listening to a London urban soundscape featuring Big Ben is distinct from the activity of a recordist when creating specific recordings of urban soundscapes featuring Big Ben. For a listener, the sound of Big Ben may form a cultural achetype, whereas, for a recordist each and every recording is distinct, dependent on factors such as microphone position, time of day, weather and so on and importantly each recording is mediated by technology.

The creative process and physical shape of wearing binaural technology is an individual act and thus acknowledging the binaural recordist's individual position will shape this thesis' study of soundscapes to examine listening, recording and understanding notions of soundscapes as subjective creative processes.

The thesis moves forwards with the notion of soundscape as subjective when understood as a facet of binaural technology use, which will be investigated in greater detail throughout the chapters, this introduction is a map to position this thesis as an examination of binaural technology

conventions, and provides the reader with directions on how this original research is structured.

The introduction is in three sections. First, the thesis' methodology will be mapped out to explain why theories of social constructivism of technology have been selected as the primary methodological tool to examine the impact of using binaural technology. Second, literature on binaural technology will be reviewed. This includes a history of binaural technology and a scientific explanation of binaural technology. Once this PhD research is contextualised, the final part of this map will introduce the reader to the three main practice-based research projects, which have been designed to provide insights towards answering this thesis' central question.

MAPPING METHODOLOGY

Trevor J. Pinch and Wiebe E. Bijker's 1984 study of science and technology in the article, 'The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Technology of Science Might Benefit Each Other' is the cornerstone of this project's theorisation of binaural technology and its' methodology will be repeatedly revisited throughout this research. Pinch and Bijker's 1984 article marks the birth of an empirical approach called social constructivism.

Social constructivism is the critical framework that Bijker and Pinch drew upon in this article. They called this framework the Social Construction of Technology (SCOT). This methodology proposes one may gain a more rewarding understanding of technology if it is studied as a social construction rather than simply studying its scientific and technical aspects.

Analysing a technology's sociological aspects means eschewing an objective scientific 'real truth' about a technology in favour of understanding how a technology's development is socially shaped and interpreted in a multitude of ways by its many users and social groups. Thus, social constructivism promotes interpretative flexibility and a methodological symmetry where an analyst equally studies 'true' and 'false' claims about a technology. In other words, this approach looks equally at how users may differently define a technology's developments as 'successes' and 'failures' because they are all social factors that reveal how a technology is socially constructed.

The SCOT framework also examines how and why a technology's development reaches a closed design. According to academics Hans K. Klein and Daniel Lee Kleinman, the SCOT framework includes studying how technology socially reaches 'closure and stabilization' (30). They explain this process further as follows:

A multigroup design process can experience controversies when different interpretations lead to conflicting images of an artifact. Design continues until such conflicts are resolved and the artifact no longer poses a problem to any relevant

social group. The multigroup process achieves closure, no further design modifications occur, and the artifact stabilizes in its final form. Somehow a final decision—or at least a cessation of further decision— occurs (30).

This brief above sketch of the SCOT framework has since been adopted by subsequent theorists from Eda Kranakis' study on the construction of bridges (87 - 105) to Donald MacKenzie's application of social constructivism in theorising the abolition of nuclear weapons (419 - 442). Like any single critical theory, social constructivism has also evolved since the SCOT framework to include different approaches.

In Philip Brey's 'shopper's guide' to the variations that exist within social constructivism, he highlights three categories of social constructivism in technology studies: strong social constructivism, mild social constructivism and actor-network theory (98 - 99). Strong social constructivism follows the SCOT framework exclusively examining social factors of technology. Mild social constructivism considers the social shaping of technology and is open to discussing the nonsocial factors affecting technology such as politics and power, while conceding that these factors are also themselves arguably social constructs. Actor-network theory focuses on the social network that uses technology while also taking into account natural and technical networks of actants. Overall though, these three types of social constructivism share common characteristics and are united in sharing the same aim: to sociologically study technology.

These key characteristics of social constructivism are relevant when searching for answers to this thesis' central question: what are the technical, aesthetic and theoretical impacts of using binaural technology to create a soundscape? 'Using binaural technology' implies users. These users are undeniably at the heart of effecting and shaping this impact. Binaural technology users mediate the practical technical and aesthetic aspects of this technology. In addition, users also inherently shape the theoretical ideology of binaural technology. For these reasons, this thesis seeks to analyse users' interactions and applications of binaural technology from a social constructivist perspective in order to to gain rich insights into the impact of using binaural technology when creating soundscapes.

In Pinch and Bijker's 1984 social constructivist study of technology, they examine how different users impacted the development of the bicycle. They highlight the importance of studying social groups and the meaning those groups create about the artefacts that they interact with. They define a social group as 'institutions and organisations…as well as organised or unorganised groups of individuals. The key requirement is that all members of a certain social group share the same set of meanings 'attached to a specific artefact' (414).

It is worth noting at this point that the term 'artefact' can be slippery to define in relation to binaural sound recording technologies. Binaural microphones may be considered a tangible artefact or object that users may physically hold. However they record sound, which is fleeting, invisible and

unstable by nature. This inherently problematises the notion of artefact or object. In relation to the philosophy of sound, theorist Salomé Voegelin proposes that 'the object…under consideration is by necessity considered not as an artefact but in its dynamic production' (xii). This philosophical approach is adopted in the thesis because this 'dynamic production' requires users to produce sounds and users to produce meaning through listening. Voegelin's proposition is inspired by Merleau-Ponty's *Primacy of Perception* which reflects on how 'we approach the world and through which we construct and are constructed in that world' (191). Highlighting this construction is key to social constructivist analysis because users essentially construct how we perceive binaural technology and binaural soundscapes.

This thesis will focus on how users shape binaural technology and binaural soundscapes. Rather than analysing my project's practical work in isolation, links will be made from my own creative practice to the practices (and usages) of binaural technology in other creators' work. In considering the contrasts and similarities in practice and application, I aim to build a critical framework that explores the conventions of using binaural technology: a topic that has yet to be extensively analysed.

The thesis also aims to venture into fresh terrain in its approach to a social constructivist study of media technologies. It is evident this is not the first social constructivist study of media technology. Film studies scholars are becoming aware of social constructivism's use value when approaching the study of media histories. Within this emerging field, a notable study is Deac

Rossell's *Living Pictures: the Origins of the Movies*, which is a film history of the social influences shaping the origins and international development of the first moving pictures (1998). Rossell's study adopts Pinch and Bijker's socialist constructivist approach by emphasising both the 'successes' and 'failures' that socially shaped the invention of films because 'looking with equal interest at both "successful" and "failed" artifacts, retrospective distortion of the historical record can be avoided' (11). Rick Altman's 'crisis historigraphy' model of silent film sound also applies social constructivist elements. Altman emphasises how social changes such as new technologies at the time caused an 'identity crisis' to previous established silent cinema systems but over time these systems became stabilised again through social users' application, negotiations and redefinitions of technology (2004).

It is arguably easier to gain insights on the social complexities that lead to a technology becoming stabilised retrospectively. In comparison, binaural technology usage is still in formation. Therefore, the position of this thesis' social constructivist study of binaural technology is innovative. It is not a retrospective study of technological change. Instead, it is exciting to investigate the emerging social shaping of a technology, which is active, open and still being defined by its users.

This thesis will draw upon binaural technology usage from a variety of different disciplines to exemplify its current flexible interpretative state of development.

In the next section I will introduce historical examples of binaural technology applications as a means of demonstrating the interpretative flexibility and experimentation, which is characteristic of binaural technology usage to date. The following historical section will also contextualise this research by examining what has preceded this PhD research in terms of binaural technology users.

MAPPING WHAT HAS COME BEFORE

<u>Using Binaural Technology: A Historical Approach</u>

Inventor Clement Ader was a pioneer in binaural and stereo sound. He invented a carbon pencil transmitter that could be used for the telephone. During the World Exhibition in Paris in 1881, he utilised this technology to broadcast sound from an opera performance. His experiment was based on a system dubbed the Theatrophone. He used 'twelve of his highly sensitive transmitters mounted in two groups at either side of the stage to broadcast sound from the Paris Opera and the Comedie Francaise to the International Electrical Exhibition two miles away. Phone wires were laid through the sewers between the two sites. At the Exhibition, visitors were rostered to listen to the opera for short periods on banks of paired receivers' (Estreich).

Visitors had to put two receivers (telephones) to each ear. This experience of listening to two audio channels at once created a 'stereophonic effect, a world first' (Estreich). At the time, Adler's stereophonic phenomenon was called 'binauriclar auduition' (sic) (White). Historian Bob Estreich notes in

the December 1881 journal of *Scientific American*, participant Monsieur Hospitaller provided an account of his 'binauriclar auduiton' (sic) experience: 'the sound takes on a special character of relief and localisation that a single receiver cannot reproduce...As soon as the experiment commences the singers place themselves, in the mind of the listener…some to the right and others to the left. It is easy to follow their movements…' (Estreich).

In the history of using binaural technology, sound did not 'take on a special character' (Estreich) again on a public listening level until the 1920s. During this decade: 'a few American radio stations set up crude but effective systems with each microphone feeding a separate AM transmitter, each tuned to two different frequencies' (Bowers and Wilkins). The requirement of two radio sets in a home to listen to this binaural system meant this experiment had financial limitations.

The next binaural development occurred on 14th December 1931 when Alan Blumlein applied for his patent, No.394,325: Binaural Sound. Historian Robert Charles Alexander explains that in the patent Blumlein outlines 'an electronic method of reproducing sound from two microphones and two loudspeakers' (Alexander). Alexander notes that Blumlein called this system 'binaural from the human factor of having two ears by which we hear sound' (Alexander). The patent also formed part of Blumlein's pioneering research in to stereo for EMI. In the patent, Blumlein wrote the fundamental object of the invention is to 'provide a sound recording and reproducing system whereby a true directional impression may be conveyed to a listener' (Alexander). This

directional impression formed the blueprints of stereophonic audio recordings, which in turn also influenced the blueprints of stereophonic cinematic sound. From a social constructivist perspective, it is interesting to note how binaural technology research in one media industry, the music recording industry, then flowed through to become adapted, developed and shaped by users of another media industry: film.

Since EMI's binaural research in 1931, users from different industries have applied and shaped binaural technology for their own purposes, such as the A T & T telephone company using binaural technology in 1939 as an enterprising advertisement to showcase their company's sonic research to a public audience. In 1939 at the Chicago World Fair, A T & T garnered much attention for creating the world's first head-based binaural system: a mechanical dummy head that had microphones as ears. 'Oscar' the dummy head became a new face for binaural sound. Notably 'at the 1939 World's Fair, 'Oscar' was a major attraction, with people lining up to don headphones and experience what was happening in the room in which Oscar was placed' (Sunier). In the 1940s, Oscar was moved to a museum in Chicago owned by Bell Telephones. Adrian Hope describes a typical visitor's experience:

> 'an audience equipped with primitive stereo headphones would sit and watch a demonstrator behind soundproof glass speaking to Oscar, a dummy head with microphones in each ear. They thus hear what Oscar heard in startling reality. Half way through the demonstration a woman's voice would hiss into an unseen microphone secretly feeding the left headphone of every listener. "Would you please move a little to the right" she exhorted angrily. Like a field of corn the whole audience

swayed to the right' (610).

Fig. 1: Example of a Neumann dummy head binaural microphone

In 1972, binaural sound moved in a new commercial direction. That year, the telephone company Neumann introduced the KU-80 at the International Radio and Television Exhibition in Berlin. It marked 'the first generation of commercial dummy head microphones. It was designed to test environmental acoustics, but listeners quickly discovered the potential it had for recording realistic radio drama' (Kall).

Since then, binaural technology has been applied and used in creative industries including radio, games and film. The thesis does not intend to be an encyclopedic list of all binaural sound examples in these industries. However in the thesis' Documentation of Experimentation: Appendix A, key case studies have been selected and discussed to illuminate pivotal developments in radio, games and film industries. In summary, main points of interest include a shared pattern, which emerges when marketing binaural sound in

radio and games is analysed. For example, an American radio drama produced by ZBS: *Sticks* by Karl Edward Wagner and the world's first audio-only video game *Papa Sangre* both use the term '3D' in their marketing material to describe the binaural listening experience (ZBS and McIntosh) perhaps as a means of highlighting the experience that binaural technology offers its users a different experience beyond the conventions of stereo radio dramas or stereo game design.

In contrast to gaming, the film industry is remarkably lacking in rich binaural technology examples perhaps because binaural technology requires individual listeners to wear headphones and standard cinemas are not technically equipped to provide this experience. Wiring a cinema to feature mini-jack sockets for each participant's chair would prove more costly than other special cinematic features such as 3D visual films, which simply require cinema owners to distribute plastic 3D glasses to customers.[1] Perhaps cinema-goers are also psychologically accustomed to the convention of listening as a collective, which includes hearing other audience members' reactions to the film such as collective laughter when watching a comedy film, and therefore may be hesitant to break these cinematic listening conventions when opting to experience a film's sound design individually through headphones in a cinema.

Overall, this brief history of binaural technology has showcased the development of binaural technology, from wires trailing through sewers in

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[1] One example of a cinema being fitted with headphone sockets occurred on 22nd November, 2009 at the independent cinema space The Cube in Bristol, UK. For one night only, *Audible*

Clement Ader's experiments to the birth of the first binaural video game: *Papa Sangre*. This historical analysis provides my study with a foundational understanding of what has come before this thesis. However, one may argue this history of binaural technology does not bring one closer to a theory of binaural technology or shed much light on this thesis' aim: to understand the creative, technical and theoretical impact of using binaural technology to create soundscapes.

In their social constructivist study of science and technology, Pinch and Bijker note 'descriptive historiography is endemic in this field. Very few scholars…seem concerned to generalise beyond historical instances, and it is difficult to discern overall patterns upon which to build a theory of technology' (405). Pinch and Bijker note that the usual approach to tracing a historical pattern of technology is linear. They argue that existing histories of technology show a 'preference for successful innovations' (406) without also taking into account the failures that have happened in the process of a technology's development. They demonstrate that this preference results in a historical approach that measures development only in terms of success, and essentially does not deeply analyse or theorise how the development of any technology is conditioned by its contexts. Pinch and Bijker's solution to theorising technology is the proposal of a social constructivist approach to technology: a 'multi-directional' model that takes in to account that 'the 'successful' stages in the development are not the only ones' (411). Success and failures are given equal weighting when studying a technology from this perspective. Both aspects provide insights into how social groups find uses for

a technology and how these groups construct notions of a particular technology's successes and failures.

To date, historical accounts of binaural technology have been dominated by a focus on its successful developments. However, this thesis aims to give equal weighting to successes and failures because rich insights can be gained from studying both the emergence of binaural technology, and by studying how different users define 'success' and 'failure' when using binaural technology to create soundscapes.

A challenge I confronted in tracing the development of binaural technology was realising that existing histories had failed to include the pitfalls that inherently shape the technology in conjunction with its successes. Thus this historical approach proved limiting. To shed further light on answering this research project's central aim, to understand the impact of using binaural technology to create soundscapes, this thesis then turned its spotlight on science. Perhaps understanding the science behind why binaural technology works will help explain the impact it may have when creating soundscapes.

Using Binaural Sound Technology: A Scientific Approach

Importantly, our natural ability to hear 3-D sound continuously is a vital human survival mechanism as:

sound travels around corners - not just in straight lines as light rays do. Thus we are warned even of invisible dangers….nature did not supply us with "ear-lids" to shut ourselves off from the sounds of approaching disaster….our ears are always on guard (Manfred R. Schroeder).

Taking the filmmaking industry as one illustrative example to explain binaural technology scientifically, how does the sound designer stimulate our on-guard ears to replicate 3D sound in film? There are two main recording and exhibition options: stereophonic and binaural sound. Stereophonic sound (two sound channels) is often the industry standard method of delivering sound to audiences. The difference between stereophonic and binaural sounds is that:

stereo recreates the directionality of sources by separating audio channels into distinct speakers. This may be as simple as left and right channels heard through a pair of headphones or more complex like 7.1-channel surround sound. Binaural, on the other hand, uses only two audio sources that are tailored to simulate the reception of sound by the human ear in physical space (Bobby Schweizer).

Binaural recordings sound like natural 3D sound to a listener when played back because it utilises a multi-disciplinary approach: physical acoustics, psychoacoustics, and auditory neurophysiology (the anatomy of the ear).[2] In relation to physical acoustics, binaural recordings work because they 'take into account the propagation of sound waves through the space around the

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[2] The anatomy of the ear is basically the outer ear (pinna and auditory canal) and middle ear (eardrum) is filled with air molecules. Sound is caused by vibrations in the air. Vibrations are 'collected by the outer ear…through the middle ear…and transferred to fluid in the cochlea of the inner ear. The cochlea contains receptors, which…cause electrical impulses to be sent to the brain which interprets them as sound' (O' Callaghan, 1998).

head and shape of the outer ear' (Schweizer). Furthermore, as Kendall explains:

the sound waves that reach the listener's two eardrums are affected by the interaction of the original sound wave with the listener's torso, head, pinnae (outer ears), and ear canals. The composite of these properties can be measured and captured as a head-related transfer function (HRTF)...the acoustics of the listener's body... (Kendall).[3]
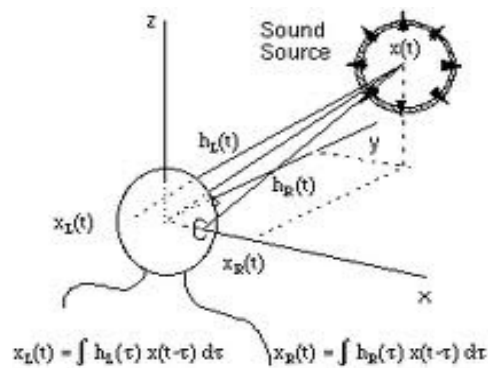
Fig. 2: Diagram of a HRTF algorithm

Binaural recording also replicates another key element of physical acoustics: interaural intensity difference (IID) and the interaural time difference (ITD): the signal arrives at each ear from a different direction and the HRTFs are from identical ears. The differences 'between the two ears are called the interaural intensity difference (IID) and the interaural time difference (ITD), respectively' (Kendall).

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[3] Formally, a single HRTF is 'defined as a particular subject's left or right far-field frequency response as measured from a specific point in the ear canal' (Cheng, 2001).
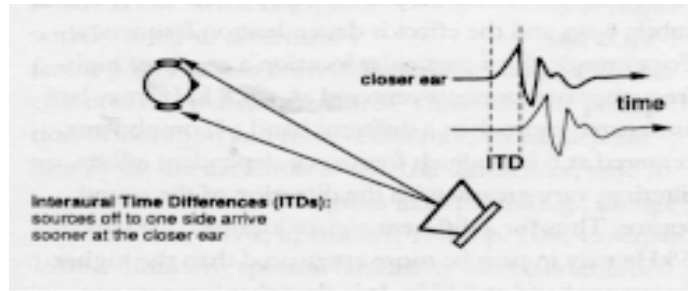
Fig. 3: Diagram of Interaural Time Difference.
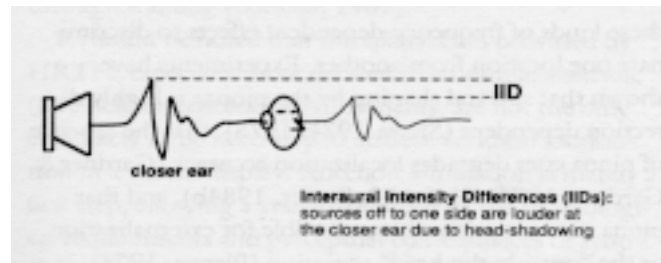
Fig. 4: Diagram of Interaural Intensity Difference.

Alongside replicating physical acoustics' key components, HRTF, IID and ITD, binaural recording also utilizes psychoacoustics such as: 'the perception of spatial imagery reported by the listeners' (Kendall). A binaural listening experience involves a participant taking in separate audio stimuli from the left and right headphones to create a personal, internal and interwoven soundscape. Furthermore, I agree with Kendall when he notes 'the auditory system performs the phenomenal task of integrating the information arriving at the two ears into a single, fused perceptual image of the acoustic event in space…' (Kendall).

As an artist, it is useful to understand the science behind binaural technology. However, the issue with investigating this thesis' projects solely from a scientific perspective is it fails to acknowledge the impact the user has on shaping binaural technology.

A scientific perspective is also shaped by its users: scientists. In their study on the histories of science, Pinch and Bijker argue scientific knowledge is often positioned as 'truth' such as the above research on the science explaining binaural technology. However, these scientific 'truths' are in fact conditioned by how scientists choose to shape, edit and disseminate their findings. For this reason, Pinch and Bijker recommend that 'all knowledge claims are to be treated as socially constructed' (401). The scientific process demonstrates how the development of technologies can be shaped by social groups and users such as scientists.

Each case study in this thesis involves studying a rich variety of user groups ranging from binaural field recordists in chapter one, to classical musicians in chapter two, and finally sound artists in chapter three. By moving beyond the science of binaural technology to analyse the meanings that social groups attach to binaural technology, this thesis aims to investigate the interaction between users and technology, and the impact of using binaural technology.

MAPPING THREE CREATIVE CASE STUDIES:

My introduction has mapped binaural technology from a historical and scientific perspective and has explained the rationale behind choosing social constructivism as the methodological tool for my critical framework.

In what follows, this social constructivist framework for theorising the impact of using binaural technology is fleshed out and applied to practice in three creative projects of the thesis. Each creative case study will examine a particular user group of binaural technology.

When considering user groups of binaural technology, it is worth noting that the process of binaurally recording sound is a solitary endeavour. The recordist listens to what they are recording individually through binaural microphones in each ear, and play back recorded sounds individually through headphones. This may partially explain why the predominant number of artists and recordists featured throughout this thesis work alone rather than as one part of a creative team. Nevertheless, for the purpose of this thesis, useful critical connections may be drawn between the work of different individuals to build up shared conventions of binaural technology usage. Despite different creative output, individual artists and recordists often share similar reasons for choosing to use binaural technology.

So far, the user groups of filmmakers, radio drama producers and games developers have been briefly mapped out to highlight how they have

shaped the use of binaural technology. This thesis will now turn its attention to three under-discussed though critically-rich user groups of binaural technology.

Chapter One explores individual artists and field recordists' that use binaural technology for the shared geographical and artistic purpose of sonically documenting cities by foot when creating binaural urban soundscapes. Each artist and recordist shares the same desire to use binaural technology as their audio tool for creating urban soundscapes. By drawing connections between these users of binaural technology, patterns of usage emerge, and analysing these patterns allows us to discern conventions of usage that socially shape the development of binaural technology.

Chapter Two analyses the social group who use binaural technology to create soundscapes specifically for its psychoacoustic impact. Examples from the music industry and theatre will be studied to further understand this social group's use of binaural technology. Through this analysis, common conventions are considered as a way to inform, and then push the boundaries of such conventions in my personal practice by testing out the possibility of using binaural technology to create soundscapes of internal psychological soundwalks.

Finally Chapter Three focuses on social groups that use binaural technology to record classical music performances and the ways these usages and applications are shaping and influencing current developments in

classical music delivery in new media 'apps' and in new forms of listening practices.

Each chapter's content will take the shape of first explaining a particular social group's relationship to using binaural technology. This will then be followed by an analysis of my own personal practice in this related field explaining what my work is doing differently and how pushing boundaries results in rich insights gained equally from examining successes and failures.

Examining the impact of using binaural technology to create soundscapes also leads to reflective philosophical discussions of sound concepts including soundscapes; soundmarks; the role of the artist; mediation, audio authenticity and point of audition. This introduction is not intended to be an exhaustive definition of sonic terms. Instead, each of these sonic terms will be introduced and analysed in relation to their application to the research questions pursued throughout this thesis.

Overall, this introduction has demonstrated how existing histories of binaural technology and narrow industry case studies are too limiting. Their linear explanations do not take in to account the failures that also socially shape a technology's development. Examining the impact of binaural technology from a scientific perspective proved equally limiting as it failed to acknowledge the impact the user has on technology and determining how scientific 'truths' about technology are essentially socially constructed by scientists' perceptions. Ultimately, a social constructivist approach such as the

SCOT framework will form this thesis' primary methodology as it allows a focus on users at the heart of shaping binaural technology. Analysing social groups' use of binaural technology including field recordists, sound artists, classical musicians and my personal practice may provide illuminating insights into this thesis' investigation on the impact of using binaural technology to create a soundscape.

CHAPTER ONE

"AUDIO POSTCARDS: FROM BRISTOL TO BROOKLYN"

Despite working individually on specific projects, particular field recordists and sound artists may be considered a social group as they 'share the same set of meanings' when choosing to use binaural technology for common purposes (Pinch and Bijker 414). While working individually with understandably unique results, a social group exists that uses binaural technology for the shared common purpose of documenting urban sounds when on a soundwalk. An introductory survey of users in this social group will be discussed to contextualise my own practice. Then, the first creative case study of my PhD project, "Audio Postcards: From Bristol to Brooklyn", will be discussed to analyse how my own practice also shapes the development of using binaural technology to document urban soundwalks. Insights from the case study will also be reflected upon when investigating this chapter's critical line of enquiry, which examines the effects of using binaural technology to document an urban place's sounds when on a soundwalk.

Fundamentally, a soundwalk involves actively listening to one's surrounding sonic environment while walking. These heard soundscapes are often documented using audio recording equipment while walking. The practice of soundwalks has a rich history, with the term first being used by acoustic ecologist R. Murray Schafer in the 1960s when he prescribes soundwalks as an 'ear cleaning' (teaching how to listen) exercise because for him, soundwalks are 'a walking meditation where the object is to maintain a

high level of sonic awareness' (27). However, sound studies Professor and sound artist Andra McCartney argues soundwalking existed long before the 1960s. She cites examples such as Walter Ruttman's experimental sound piece *Weekend* made in 1930 in which Ruttman recorded Berlin's outdoor urban soundscapes. McCartney also discusses radio producer and theorist Tony Schwartz's soundwalk experiments in the 1940s in which he recorded New York's urban soundscapes using a homemade recording device (McCartney). Schwartz comments

> I developed a portable recorder…It was battery-operated, could be used while walking or running, and weighed about fourteen pounds. Once I was free of Mr. Edison's cables, I could explore the beauty of language in everyday situations and the sounds of life around us (xiii).

Recording everyday sounds evolved in the 1970s with the development of portable recording technologies. For example, the Sony TC-100 portable cassette recorder, shaped the practice of soundwalking as it gave recordists the freedom to move out of the studio to record soundwalks on the city streets and beyond.

The development of portable recording technology and the subject of urban soundwalks are worthy of their own theses. However, this thesis is primarily interested in the technical, aesthetic, conceptual impact of why recordists choose to use binaural technology as their audio tool to document urban sounds when on a soundwalk.

Sound artist Janet Cardiff uses binaural technology in her soundwalk practice. In a survey of Cardiff's work, Carolyn Christov-Bakargiev cites Cardiff's belief that

> audio changes our perception of the physical world. We understand three-dimensional space by using our vision, but also by the character of sounds we hear. If these sounds are manipulated and changed, then our perception of reality can be drastically affected (Carolyn Christov-Bakargiev).

Her work plays with one's perceptions of place. Cardiff specialises in transforming humdrum everyday sounds in to suspenseful soundscapes by mixing location binaural recordings with her voiceover laden with instructions for the listener on a soundwalk.

Many of Cardiff's soundwalks, which are co-created with her husband and creative collaborator George Bures Miller, are binaurally recorded and experienced in site-specific urban places including meandering through a historic German town in *Münster Walk*, playing on noir-esque urban paranoia in London in *The Missing Voice (Case Study B)* and Central Park in New York in Cardiff's *Her Long Black Hair*. The impact of Cardiff using binaural technology is evident in the soundwalk's reviews. For instance, Public Art Fund note how Cardiff's use of binaural technology in *Her Long Black Hair* leads her 'to create an experience of physical immediacy and complexity' (Public Art Fund) and Megan Ratner comments in *Her Long Black Hair*: 'Cardiff's voice seems to emanate from within your head…a level of intimacy both beguiling and invasive…Cardiff uses binaural recording techniques that

envelop you in crisp, freshly minted sound' (Ratner). Cardiff arguably uses binaural technology as a means of creating an intimate connection with her listener.[4]

Like Cardiff, field recordist Des Coulam chooses to use binaural technology as his primary audio tool to record urban soundwalks. Cardiff uses binaural technology as a way of closely connecting to her listeners in order to immerse them in her narrative during a soundwalk. Coulam is also drawn to the immersive qualities of binaural technology.[5] However, he adapts and shapes this feature of binaural technology for a different aim: to archive our urban sonic environments. Here Bijker's social constructivist notion of 'technological frame' is evident because Cardiff and Coulam share the same overall purpose for using binaural technology, to document urban soundwalks, though their different aims for how they frame their binaural work demonstrate 'how individuals may deviate from the shared group meaning' within a social user group (Kline and Pinch 114). Essentially, their individual interpretative frames highlight how this application of binaural technology usage, to document soundwalks, is not fixed but rather still in formation.

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[4] Using binaural technology as a method of creating a soundscape of intimate connection for a listener will be discussed in greater detail in Chapter Two.

[5] In an interview carried out with Coulam for this PhD, he reflects on the immersive qualities of his binaural technology practice when he comments 'listening to a binaural recording of a sound tapestry, especially through headphones, transports the listener right to the heart of the scene in quasi-3D…[the] quasi 3-D effect brings the sound tapestry to life but being physically attached to the sounds by wearing headphones seems to add a further dimension – it's as if one is physically present at the scene. Even the best surround sound doesn't convey this sense of physical presence in the same way that binaural sounds do when listened to through headphones' (Coulam). Like Cardiff, he is also drawn to use binaural technology for its immersive qualities.

In an original interview carried out with Coulam in Paris in July, 2013 as part of this PhD research, Coulam elaborates on his personal technological framing of binaural technology used to achieve his archival aims:

> for most of our history we have used artefacts, architecture, pictures and words to create a vision of our past. It's only in the last ten seconds or so on our historical clock that we've been able to capture and archive sound. I think it's important that today's sound tapestry is recorded and archived so that future generations will have the sounds of our time to explore, to study and to enjoy (Coulam).

Coulam's binaural technology practice has taken the shape of a database of soundwalks, which he has recorded in the city of Paris. Coulam shares his database on his regularly updated website: http://soundlandscapes.eu/ which includes comprehensive sections on Paris Street Music, Paris Soundwalks and a Paris Sound Map embedded with soundwalks.[6]

Sharing sonic documentation and soundwalks online is understandably a different delivery method to Cardiff's site-specific guided soundwalks, as listeners can choose to listen to Des Coulam's urban soundwalks at any time or anywhere with Internet connection. This exhibition choice inherently shapes

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[6] It is worth noting creating online maps as a means of exhibiting audio recordings also appears in other practitioners' work including Trevor Cox's 'Sound Tourism: A Travel Guide to Sonic Wonders' http://www.sonicwonders.org/sound-map/, Ian Rawes' 'The London Sound Survey' http://www.soundsurvey.org.uk/index.php/survey/soundmaps/ and in my own practice exhibited on "Storymap" http://storymap.ie where I carried out field recordings and sound designed a commissioned Roddy Doyle short story documenting a specific area of Dublin city: *The Spire*. It is interesting to observe how the rise of new media technology and consumption is shaping and developing recordists' and artists' modes of exhibition.

the soundwalk experience for listeners, opening up questions on the development of new media listening conventions.

However, this thesis is most interested in why does Coulam choose binaural technology to carry out his Parisian soundwalks? Discretion and immersion. According to Coulam 'to capture a sound tapestry authentically it is necessary to become part of the sound tapestry without changing it. That means getting close to the sounds but without changing the sounds. The great photographer Robert Capa said "If your pictures aren't good enough, you're not close enough" – a dictum that applies equally to recording an urban sound tapestry'[7] (Interview with Coulam).

It is worth noting, being present in an environment naturally changes the shape of a sound tapestry or soundscape as the recordist mediates urban places when weaving in and out and by reacting to unfolding circumstances in a unique way that inherently changes the shape of a recording. However, is it perhaps more accurate to note that Coulam is searching for a recording method that minimises the subjects around him changing their natural movements because of his recording process. He admits that after failed experiments with stereo equipment that involved 'walking the streets with a furry microphone on a stick or even pointing a handheld recorder at a subject changes people's behavior…I know to my cost!' (Interview with Coulam). Instead, using binaural technology allows Coulam discretion: 'binaural technology allowed me to achieve authenticity by being discreet and

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[7] Coulam uses the term sound tapestry when discussing soundscapes as it reminds him of all the interweaving threads that make up a whole soundscape.

becoming part of the sound tapestry without changing it' (Interview with Coulam). The binaural microphones Coulam uses look like mp3 headphones in his ears so people around him assume he is listening to music rather than recording them. This desire for documenting audio authenticity, discretion and immersion in Coulam's work will be revisited and analysed in my own binaural urban soundwalk practice later in this chapter.

Another user from this social group of binaural urban soundwalk practice is media sciences researcher and sound artist Lewis Kaye. He plays with acoustic layering of time in his project *Toronto Transit Soundscapes.* Participants listen to pre-recorded binaural recordings of a commute while moving on public transport. The aim of these binaural mp3 soundscapes listened to on a mobile device 'attempts to refocus the listening habits of subway commuters on the latent musicality of the transit experience' (Kaye).

For Kaye:

> by superimposing the sounds of a recorded commute with the listeners' own, a creative confusion of sound events creates a temporal juxtaposition that reveals the complexities and nuances of the aural experience of public transit' by attempting 'to refocus the listening habits of subway commuters on the latent musicality of the transit experience (2013).

Kaye shapes binaural technology for his own creative purpose to invite listeners to become more aware of their everyday sonic environments.

As one can see when analysing the uses of binaural technology, this social user group have shaped and adapted binaural technology for their individual urban soundwalks. Their shared purposes in using this audio tool have emerged including the ability to record soundscapes discreetly and deepen the level of immersion of a listener when experiencing the sonic environment of an urban soundwalk. Binaural technology affords a practitioner a level of discretion when recording, and a level of immersion when listening back, which appeals to Coulam and Cardiff. Users have also displayed how the role of the artist or recordist shapes binaural technology particularly at exhibition stage. Site-specific work exhibited in physical places such as Cardiff and Kaye's work and archival online sound maps like Coulam's have been highlighted as the two main strategies, which artists use to document a place sonically.

Throughout this case study, I am interested in pushing beyond this pattern of exhibiting the sounds of places to investigate the creative potential of connecting remote listeners to an urban place's sounds online using binaural technology and interactive online platforms. The role of the artist in shaping binaural technology's usage, a desire for audio authenticity and recording discretion are themes that will also become apparent within my own urban soundwalk practice: "Audio Postcards".

My case study will be analysed chronologically from pre-production to exhibition. Each stage will highlight how theory informs practice-based decisions, and equally how practice may shift theoretical perspectives. A rich

dialogue between personal reflections on practice and theory will emerge when reflecting on the impact of using binaural technology to create a soundscape of an urban soundwalk. The case study also considers secondary questions including what is the impact of binaural technologies on field recording practices? In what way does binaural technology reshape or challenge field recording conventions and our notion of representing the real when sonically documenting a place?

Pre-production: Methodology

Recording a place's sounds is a large-scale task as demonstrated by the British Library's UK sound map.[8] Within the scope of my thesis, I realised it would be beneficial to be selective in binaurally recording urban soundscapes. This selectivity raises interesting issues in binaurally recording the sonic character of a place, particularly questions about 'documentation' that will be addressed later in the discussion.

During pre-production, my investigation on documenting urban sounds led me to the concept of soundmarks. In the acoustic ecology discipline, soundmarks are identified as the 'audio counterparts of landmarks' (Truax 54). In 1977, R. Murray Schafer first coined and defined a soundmark as 'a community sound, which is unique or possesses qualities which make it

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[8] While the British Library's sound map is predominately in stereo, it does include a selection of binaural urban soundscapes like the tram system in Sheffield: http://britishlibrary.typepad.co.uk/archival_sounds/2011/05/binaural-stereo-on-the-uk-soundmap.html (2014).

specially regarded' (83). *The Handbook of Acoustic Ecology* further emphasises its sociological aspect by adding a soundmark 'possesses qualities which make it specially regarded or noticed by the people in that community' (CD-ROM Edition CSR-CDR 9901).

Three decades later, Blesser and Salter similarly define soundmarks as 'sounds that are unique and high status, often with important social, historical, symbolic and, practical value' citing examples of soundmarks as 'the sounds of church bells, foghorns, railroad signals, factory whistles, fire sirens...' (29).

Acoustic ecologists are keen to protect soundmarks in the form of sonic preservation amidst a city's often-increasing noise pollution.[9] For Schafer: 'once a soundmark has been identified, it deserves to be protected, for soundmarks make the acoustic life of a community unique' (57).

I chose to locate unique soundmarks, a micro aspect of a place's everyday sounds, on my soundwalks for numerous reasons. First, hunting for soundmarks provided me with an opportunity to improve my listening skills, as it would involve deeply listening to everyday sonic environments. Second, searching for soundmarks appealed to me because it puts theory into practice. My field recording aims to identify the implications of applying acoustic ecology's definition of a soundmark to the real world we listen to

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[9] Noise pollution has become an increasing issue facing cities such as Brooklyn with the city's 311 citizen service hotline receiving over 1000 phone calls a day reporting noise pollution (Fecht).

every day. Third and most importantly, the case study allows me to actively learn-by-practice in order to understand why this chapter's social group uses binaural technology as their primary audio tool to document urban soundwalks and the impact this has on their field recording practice.

Why choose an urban environment for the case study's soundwalks? This decision is shaped by an established tradition of the urban environment inspiring and informing sound-oriented artistic practice arguably beginning with the Futurist Luigi Russolo's noise music concert of urban sounds: *Risveglio di una città (Awakening of a City)* traced through to contemporary sound-oriented practitioners as evident in Cardiff, Coulam and Keyes' practice in which cities' sonic environments continue to be an enduring source of inspiration. The city of Bristol was my first source of inspiration for the case study "Audio Postcards". It is my local city, which initially made production more manageable.

The production of my binaural recording practice was also shaped by the conventions of this social group and soundwalk practice. Rather than binaurally documenting the city's sonic environment standing in stationary places, my field recording was shaped by the process of walking while recording.

Therefore, I chose to listen out for soundmarks amongst Bristol's everyday sounds on foot. When encountering urban territories, tourists are often drawn to high 'look-out points' to experience a city. Michel de Certeau,

an influential writer in forging critical ways of discussing 'everyday life' and its practices, describes this experience of looking at New York City from the World Trade Center as allowing 'one to read it, to be a solar Eye, looking down like a god' (92). The tourist becomes the 'all-seeing power' and the action of gazing down from high up 'makes the complexity of the city readable' (92). However, this concept of making the complexities of a city 'readable' by viewing it from high vantage points is deceptively simple and not necessarily applicable in practice.

Even de Certeau concedes that 'escaping the imaginary totalizations produced by the eye, the everyday has a certain strangeness that does not surface' (93). Instead, de Certeau proposes walking as a method of reading and experiencing a city's complex reality: 'the act of walking is to the urban system what the speech act is to language or to the statements uttered' (97). He describes pedestrians as 'their swarming mass is an innumerable collection of singularities. Their intertwined paths give their shape to spaces. They weave places together. In that respect, pedestrian movements form one of these 'real systems whose existence in fact makes up the city' (97). Therefore, it seems appropriate to binaurally record on foot because walking around the city is a process in itself, which is arguably a 'real system…whose existence in fact makes up the city' (97).

However, when documenting a city's everyday existence, one must acknowledge that everyday life as a concept is complex from a theoretical perspective. Everyday life theorist Ben Highmore argues 'any assumption that

it is simply 'out there', as a palpable reality to be gathered up and described, should face the immediate question: whose everyday life?' (1). When documenting urban soundwalks of Bristol and Brooklyn, it is ideologically impossible to document an objective everyday life. Rather the case study's documentation of everyday life is presented at a micro level: the recordist's subjective sonic perspective of Bristol and Brooklyn.

The process of binaurally recording these two cities while traversing them on foot taps into questions of 'making strange' and 'estrangement' that Highmore considers 'a crucial tool for everyday studies' (21). Highmore defines everyday as things that 'become 'everyday' by becoming invisible, unnoticed, part of the furniture' (21). An 'antidote to our negligence towards the everyday' is a Brechtian influenced transformation of 'something as overly familiar and everyday as a car into something strange' (22). Highmore cites Bertolt Brecht's 'Eskimo definition' of a car to highlight this point: 'a car is a wingless aircraft that crawls along the ground (Brecht 145). The case study's methodology mirrors this aspect of everyday studies. By recording everyday sounds in the context of a particular city and then later exhibiting these sounds to the listener removed from their contextualised everyday accompanying visual cues, "Audio Postcards" provides a creative invitation for a listener to notice the often tuned out, thus inaudible, ignored aspects of sonic everyday environments. With fresh attentive ears, this in turn may impact how a listener later defines and experiences their everyday sonic environments.

The final stage of pre-production involved examining why I chose binaural technology to document urban soundwalks. In contrast to de Certeau's concept of walking practices as a method of become immersed in a place and understanding a sense of the city, for acoustic ecologists, notably Schafer, the 'real problem of soundscape recording is that the recordist is always outside the environment being recorded' (Sensing The City). Like a street photographer wanting to get close to a subject for a close-up shot, Des Coulam desires to be as close as possible to the sonic environment when discreetly recording his binaural urban soundwalks. In a similar vein, binaural sound technology was selected over stereo microphones for this case study for its inclusive, invisible qualities, which will be discussed in greater detail in the production section of this chapter.

This binaural method of recording marks a significant break from the industry standard methods of field recordings. Instead of holding a microphone with a boom pole, the field recordist holds a tiny microphone in each ear. The lightweight binaural equipment looks similar to mp3 player headphones. The inconspicuous nature of using binaural microphones is advantageous over stereo microphones when recording in public spaces. It allows one the freedom to approach areas and subjects without drawing too much, if any, attention to the act of recording thus allowing a seamless immersion of a field recordist into a sonic territory.

I first became immersed in my local sonic territory: Bristol. I carried out an initial test run implementing the above-mentioned methodology. I explored

Bristol's everyday sounds when searched for soundmarks on foot. I recorded my soundwalk using binaural technology.

Reflecting on this initial test run, I realised I would have to expand my sonic horizons. This search for soundmarks began by listening to my local soundscape in Bristol, United Kingdom. However, to distinguish soundmarks unique to a particular city over everyday sounds in any city, the research became a comparative field recording study of Bristol in the United Kingdom and Brooklyn in the United States.

I was interested in understanding if it is easier, or indeed more difficult, to identify soundmarks in personally familiar sonic territories for me, such as my local city of Bristol, over personally unfamiliar sonic territories to me like Brooklyn, to analyse if Schafer is correct in stating 'a tourist is often more perceptive of the environment than a native inhabitant, who has grown weary of the daily soundscape and tries to shut most of it out' (Sensing The City).

Brooklyn was also selected as a comparison city to Bristol because this research is tapping into emerging creative links between these two cities, which occurred during my residency at Pervasive Media Studio.[10] The aim of Bristol Exchange of Arts & Music (BEAM) is to encourage cultural links between Bristol and Brooklyn. Despite socio-geographic differences, BEAM believe 'much like Brooklyn itself, the city of Bristol has long been regarded as

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[10] The idea of cities being linked is not a new concept: 'since 1950 more than 11,000 pairs of sister cities in some 159 countries have entered into twinning agreements' (Zelinsky 1). These agreements initially occurred post-Second World War as 'means of developing friendships and cultural ties' (Cremer, de Bruin and Dupuis).

a place of innovation, radical creativity, and independence' (BEAM). Alongside BEAM, Clare Reddington, the director at Pervasive Media Studio, and Mark Cosgrove, Head of Programming at Watershed, set up 'Bristol to Brooklyn' to enrich knowledge exchange between these two cities' creative communities and 'explore…the creative connections across film and music and between filmmakers and musicians' in Bristol and Brooklyn' (Reddington and Cosgrove).

It was in this environment of exploration that I developed 'Audio Postcards' at Pervasive Media Studio. While BEAM, Watershed Cinema and Pervasive Media Studio are preoccupied with Bristol and Brooklyn's connections 'across film and music', I considered Bristol's connection with Brooklyn from the perspective of everyday sonic environments.

To fairly compare Bristol and Brooklyn's everyday sounds, a creative decision was made to record sonically rich areas of urban everyday life found in Bristol and Brooklyn: namely a market place, a park; business area; shopping district; alternative/creative area and water side area. I carried out extensive research on comparable sonic sites from reading guidebooks to carrying out informal interviews with local inhabitants of Bristol and Brooklyn. During the pre-production phase, I mapped out specific areas on the following grid, which I methodically followed during production in October 2012 spending one day recording at each "Audio Postcard" location:[11]

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[11] To view two of my soundwalks GPS-located on a map, please see Appendix B: Part B.

PLACE	BRISTOL	BROOKLYN
Market	St. Nicholas Markets	Smorgasburg - Brooklyn Food and Flea Market.
Park	Castle Park and Brandon Hill Park	Prospect Park and Brooklyn Botanical Gardens
Shopping	Broadmead and Cabot Circus	Park Slope and DUMBO[12]
Business Area	Temple Quay and Temple Meads	DUMBO
Water Harbourside area	Harbourside beside the Watershed	East River Ferry North 6th Street / North Williamsburg Terminal
Alternative/Creative Area	Stokes Croft and Gloucester Road	Williamsburg

Following this plan proved a practical method of sampling everyday urban environments and sonically comparing field recordings when binaurally documenting a place's sounds on a soundwalk.

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[12] DUMBO is an acronym used to describe the geographical area of Down Under the Manhattan Bridge Overpass.

Production:

The conventions of field recording shaped the production phase of 'Audio Postcards'. Arguably, the craft of field recording came to fruition during the early history of natural history field recordings. During production, I discovered the practical, technical and aesthetic concerns of recording and exhibiting recordings, which these pioneering natural history recordists faced, still remain challenging issues for contemporary sound artists, binaural field recordists and my practice.

The beginning of natural history recording exemplifies how users shape the development of technologies in their different approaches to achieve the shared goal of carrying out field recording. Sound recordist Ludwig Koch's field recordings of animal noises were initially fuelled by a childhood curiosity of studying birds.[13] In contrast at the same time in 1929, Cornell University researchers' desire to document birds in the field was fuelled by a financial collaboration with an American studio: the studio wanted to record the sound of birds in their natural habitat as opposed to being caged in a studio space (Bruyninckx). Despite their different intentions, Koch and Cornell researchers were drawn to field recording as a way of recording sound naturally in the real world. This aim is empirically questionable as a recordist. The choices they make in what technology to use and how to the exhibit recordings inherently shape, mediate and alter the natural environment they are attempting to

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[13] Aged eight, Koch created the world's first wildlife recording of birds in his private menagerie using an Edison phonograph and wax cylinders his father purchased in 1889 at the Leipzig Fair (Wildlife Sound Recording Society: Burton: 1974).

record. Nevertheless, the preoccupation with representing the real and fidelity is interlinked with the craft of field recording.

Both teams differed in their approach to record the sound of wildlife naturally. Koch's soundwaves were cut into a phonograph's wax discs rather than cylinders as they captured the birds' soundscape (Stap 28). In contrast, Cornell's research team recorded sound on film stock. They mounted a microphone on to a plaster shape, which became a reflective focal point as a way of trying to focus the sound recording to create a point of audition so the bird sounds would be in a close up foreground (Bruyninckx). This technical choice produced a more sterile sound devoid of natural background noises that exemplifies a key point: the technology a user chooses inherently mediates the 'natural' environment.

Koch and Cornell also played with microphone positioning as both teams battled technicalities of working with the 'objective microphone', which is more sensitive than real human hearing. In pursuit of recording the fidelity of birdsong, these 'objective' microphones additionally picked up sounds of planes, trains and everyday hums of our real world that our natural hearing filters out. Despite technology advancements, the issues of representing the real; fidelity; point of audition and impact of technology on field recordings all emerged within my own binaural field recording practice, which will also be revisited in greater depth in the third chapter of this thesis.

Field recordists now have a wide array of recorders, microphones and mixers to choose from when going out to capture sound in the field from the Tascam DR-680 that is capable of recording eight audio tracks to the more lightweight handheld recorders like Zoom H4N. However on an aesthetic level, field recordists often decide which kit to use based on the site and subjects they want to record. For example, if the goal is to record an atmosphere recording of an urban street, a stereo microphone may be selected because it will pick up a wider angle of sounds rather than a shotgun microphone, which is highly directional and would only pick up a specific sound source on a street as opposed to a general atmosphere. When considering the impact of technical choices made during production, I examined the process of recording Bristol and Brooklyn binaurally.

I consider binaural technology an audio equivalent of a writer's pen to write and create my sound-focused research portfolio. In this sense, I have adopted James Lastra's ideology on audio recording as a form of writing when he proposes the effects of Edison's phonograph 'embodies several of the basic features of writing…it does away...with the necessary "presence" of a speaker…it functions as a storage medium, archive, and a means of exact repetition' (28). Just as one's handwriting is visibly distinctive and identifiable, choosing to use binaural technology 'writes' sounds in an often audibly identifiable manner with its life-like quasi-3D texture. So what is the impact of choosing to write/record using binaural microphones and why do this chapter's user group select binaural technology to document their urban soundwalks?

It is arguably a creative decision which microphone a sound artist chooses for their field recordings. In an interview on 'the Pleasure of Microphony' with Pali Meursault, sound artist Manu Holterbach discusses the difference between the terms microphony and phonography in relation to his field recording work:

> About 'microphony', this is a word I'm using because I don't like the term 'phonography'. It seems to me that 'phonography' emphasizes on fixating sound (with a syntactic connotation that bothers me), while I'm more interested in using different types of microphones. There is something there to play with, while capturing sounds, like you would play an instrument. I'm already composing as I am recording sounds and as I choose this or that microphone to confront with a given event. What really interests me is this play that comes with the recording, rather than any kind of '-graphy'… But maybe this is only quibbling (Interview with Holterbach by Meursault).

Reading this interview made me reflect on why sound artists choose to use binaural microphones over standard stereo microphones to carry out field recordings. Rather than it simply being a novelty or gimmick, my recordings revealed binaural microphones are an audio writing 'instrument' used to creatively play with capturing a place's everyday sounds. My decision to use SoundMan OKM Mark II binaural microphones connected to a Zoom H1 recorder, simultaneously restricted and increased my level of play with the urban soundwalks I recorded.

Typically, field recordists capture sound waves in the air using a microphone and listen to this recorded sound within the closed environment of

headphones. The sound field recordists hear from the microphone is far more sensitive than our usual hearing range. In other words, if 'the ear functions as a "lens" for spatial perception, to mirror the physical world in the mind' (Grzinich), listening to a live microphone recording through headphones essentially provides the field recordist's ears with a close up lens as the microphone is capable of amplifying the tiniest of sonic vibrations. Headphones are an essential piece of kit because they guide the field recordist's ears in what the microphone is picking up. Without wearing headphones, it is like a cinematographer recording a shot without looking through the viewfinder.

Binaural recording marks a break in this field recording convention. Instead of holding the microphone with a boom pole, I held the microphones in my two ears. Thus, a potential drawback of this binaural recording technique is not being able to hear what you are recording through headphones. This meant I repeatedly checked my Zoom H1 recorder's levels and intuitively adjusted levels accordingly. The visual bars on the recorder allowed me to keep my recordings within the recommended audio range of 12db. As my ears did not have the close up lens of hearing precisely what the binaural microphones were picking up, in some respects this allowed me to carry out more authentic field recordings as I followed the sounds I heard in my typical human audio range.

On a practical level, my decision to use binaural microphones was advantageous as a solo field recordist. Unlike Koch's mobile studio van, which

weighed seven tonnes (Bruyninckx) requiring a large team of engineers or a contemporary film sound recordist's heavy cases and cables, my binaural equipment was lightweight and quick to assemble. I enjoyed the freedom of not being connected to clunky mixers and long cables. Instead, my binaural microphones were attached to a Zoom H1 recorder, which snugly fit inside my coat pocket. The binaural microphones I used were effortlessly light. They looked like typical mp3 player headphones so sometimes I even forgot I was still recording.

The advantage of recording sounds with binaural equipment meant that I could record in public places without drawing much attention to the recording act. The visible presence of a microphone inherently shapes one's field recordings often to its the detriment. For example, Coulam reveals he stopped using stereo microphones as people changed their natural patterns on the street when they spotted him carrying a 'furry' stereo microphone (Interview with Coulam). This perhaps sheds insight on the consistent drive to remain hidden for sounds to feel more 'natural'. From musicians in a cock pit obscured from a theatre audience's view to Koch's early natural recordings in which 'a microphone connected to a long lead would be attached to the required enclosure, meaning that the van could be positioned out of view so as not to disturb the animal in question (Tipp), this feeling of being hidden is arguably considered advantageous.

Fig. 5. Visual documentation of my binaurally recorded soundwalk along the harbourside in Brooklyn. My binaural microphones are inconspicuous apart from a thin black wire that looks similar to headphone wires and is draped over my coat attaching the binaural microphones in my ears to a zoom H1 recorder in my coat pocket.

Fig. 6. Visual documentation of my binaurally recorded walk at Smorgasburg Market in Brooklyn in October, 2012. Situated on the right of this photographic frame, my binaural soundwalk recording goes unnoticed by the city's inhabitants.

My desire to document urban soundwalks by going unnoticed is influenced by Direct Cinema, a documentary practice that originated in America between 1958 and 1962. When documenting real places and people, American Direct Cinema shares a similar aesthetic style with French Cinema Vérité (truthful cinema): a documentary practice led by sociologist Edgar Morin and anthropologist Jean Rouch in the 1960s. Direct Cinema and cinema vérité are not concerned with creating a glossy slick cinematic product so often out-of-focus grainy shots make the final cut when fulfilling their shared desire to naturally capture reality.

However, Direct Cinema vastly differs in its principles to cinema vérité when considering the position of filmmaker during the process of recording reality. While Cinema Vérité 'interviewed their subjects and intervened constantly in the filming' when attempting to uncover the truth of their documentary's subject matter (Cousins and Macdonald 250), Direct Cinema promoted a different approach. American journalist Robert Drew, a pioneer of Direct Cinema, 'was radically opposed to interviewing, and believed that his film crews were so unobtrusive and mobile that they could record 'reality' without influencing it' (Cousins and Macdonald 250). This proved a practical method of carrying out audio recordings in my own practice. For instance, when recording in Stokes Croft in Bristol, I explained to a group of people that I was recording a soundwalk. Instantly, they changed their natural behavior. The new staged behavior then jarred with their initial natural behaviour rendering the recording unusable. I audibly altered the place's rhythm by making visible my role as field recordist. From that key moment, I took the

creative decision to follow in Direct Cinema's unobtrusive footsteps and not draw attention to the act of documentation when mapping out the sound of places.

The technological advancement of portable recording equipment that did not have to be attached to a camera, such as the unobtrusive Nagra III invented in 1957, enabled Direct Cinema to achieve their documentary principles of authenticity. Similarly, the size and shape of binaural technology affords a field recordist an opportunity to walk through the cities of Brooklyn and Bristol without drawing attention to the act of recording thus arguably recording more natural recordings of a place.

As inhabitants of Bristol and Brooklyn thought I was walking around the city presumably listening to music through headphones, they often continued quite private conversations. On some conscious or subconscious level, I enjoyed this audio voyeurism and chose to record these conversations in the moment.

Perhaps it is this sense of audiophilia, which draws sound artists towards using binaural technology to document urban soundwalks. Capturing this unguarded natural behaviour proved fascinating as I recorded real conversations like in Brooklyn when friends deconstructed another friend's relationship or when a young boy asked his slim father if he thinks he should lose some weight.

In these instances, I felt somewhat like an audio equivalent of a street photographer who chanced their luck to record an interesting moment in every day life. From this practice, I now understand why Des Coulam positions his binaural field recordings within 'the tradition of nineteenth and early twentieth-century Parisian street photographers' (Coulam). Like a street photographer, a binaural recordist does not to wait to ask permission but rather takes the creative decision to capture the moment. The impact of binaural technology's lightweight, invisible qualities and working as an individual rather than as a crew affords a binaural recordist more opportunities to instantly respond and capture real spontaneous sonic moments. An artist's decision to influence a sound document by choosing what to include and exclude in the field during recording perhaps has legal ramifications.

When delving into the legal aspects of recording audio in public places, especially as I was recording in two different countries, it became apparent there is no standardised procedure. For instance in America, laws on recording audio in public even vary vastly from state to state.

The British Library's sound library legal and ethics section only refer to the legal aspect of exhibiting recorded sounds in public as opposed to the act of recording in public.[14] While this covers the legal aspect of recording in

[14] The British Library is sensitive to the fact that their recordings may include copyrighted music that was playing in public at the time of recording. On their public website, the British Library clarify 'where possible we have employed local media such as radio stations and newspapers to inform communities of our intention to make material available. We are using await claim statements to enable rights holders to contact us, Notice and Takedown clauses so that material can be removed if a copyright holder objects to its inclusion, and agreements with local musician's unions and collection bodies where appropriate to clear rights in musical and literary works' (British Library).

public places, it does not examine the ethical position of recording in public.

When interviewing Des Coulam, a binaural user from this chapter's social group, I asked him about this issue. Admittedly 'this type of recording is open to abuse' (Coulam). Currently, there is no agreed guidelines on binaural technology usage in public. Instead, Coulam chooses to follow:

'Guidelines I've set for myself.

i)   I never record people in distress.

ii)   I never record people's private conversations.

        I often record snatches of half-heard conversations as I pass people or they pass me but this is always in the context of a wider recording and they are only snatches of a conversation.

iii)   I never record people at worship unless it's a very public act of worship' (Coulam).

Using binaural technology inherently reveals recordists' ethical boundaries on recording in public urban places. During production, I was acutely aware of the ethical aspects of recording participants in public. For instance, I carried out my pre-planned soundwalks in the unexpected direct aftermath of Hurricane Sandy in New York in October 2012. By accident, I walked past sensitive conversations as inhabitants explained their personal loss and

devastation caused by Hurricane Sandy to their properties and I chose to

quickly walk on or cease binaurally recording to respect their privacy.[15] When

I reached the editing phase, I also made the decision to exclude certain

recorded conversations if they accidentally contained any identifiable

elements such as names and places in the sonic background of my

soundwalks.[16] This ethical aspect of field recording is rarely discussed and is

an aspect of using binaural technology that social users have yet to reach a

shared agreement upon.

From an ethical perspective, a parallel may be drawn with the

conventions of documentary filmmaking. Issues on how to ethically record and

represent people also persistently affects documentary filmmakers. It is an

aspect filmmakers cannot ignore because documentary studies researcher

Bill Nichols stresses 'developing a sense of ethical regard becomes a vital

part of the documentary filmmaker's professionalism' (17). Based on the

variety of documentary formats from reality TV series to news reports, this

sense of 'professionalism' is evidently open to subjective interpretation.

Perhaps like documentary, binaural practice has yet to reach an agreed

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[15] My actions to either walk away from a subject and / or stop recording during my soundwalks are guided by the principles outlined in University of Exeter's Ethics Policy (2014) that I have a responsibility to uphold and practice throughout my PhD research. For instance, my soundwalk practice adheres to the Ethics Policy outlining principles such as 'integrity' (2) and how the University 'strives to protect the rights, dignity, confidentiality and anonymity of research subjects' (3). I felt a responsibility to the subjects who crossed my path during my soundwalks to not record any private, revealing or sensitive information about their lives especially as they were unaware of the recording process due to the inconspicuous nature of binaural recording.

[16] In my own work from a legal perspective, I also decided to claim responsibility for my public recordings by making clear my role as recordist and allowing listeners a method of contacting me directly online. Just as the British Library have 'Notice and Takedown' clauses, listeners of my work may contact me if they wish the recordings to be removed.

ethical consensus because binaural technology calls upon a user to make a personal choice navigating one's ethical boundaries and the responsibility one personally feels to the people they record and represent in their creative audio practice.

Post-Production: Part A

During production, I was a field recordist in search of soundmarks. Acoustic ecologists' definition of a soundmark may be summarised as a unique, noticeable community sound. My search for soundmarks resulted in the exploration of its 'noticeable' elements, the concept of community listening and the idea of a 'unique' sound.

This definition proved problematic when I became an audio detective in post-production listening back to my soundwalks in search of soundmarks in Bristol and Brooklyn's urban communities. First, what does it practically mean for a sound to be elevated by a community to the status of 'noticeable' sound?

Arguably, the term 'noticeable' is applicable to a large number of urban sounds. The divide between public and personal space is regularly eroded in cities particularly in relation to noise pollution. Just open your apartment window and the city's noticeable sounds seep into your bedroom. For example, the banging sounds of construction work recorded in Bristol were just as loud and noticeable as the sound of construction work recorded in Brooklyn. However, I am reluctant to define these 'noticeable' high decibel

sounds as soundmarks unique to each area. Despite minor timbre nuances, it was easy to find an audio equivalent of noticeable sounds like construction work in Bristol and Brooklyn respectively. In fact, I found several sonic similarities between the two cities. Rather than discovering sounds that were 'specially regarded' and exclusive to each city, this research uncovered similar sounds included in each city's everyday soundscapes.

It was fascinating to realise that inhabitants in Brooklyn and Bristol regularly share the experience of listening to similar sounds every day, which illuminates the connective nature of exploring territories sonically. This discovery supports Brandon LaBelle's proposition: 'sound creates a relational geography' (89). This sonic paradigm is evident in my practical research. For instance, it was difficult to distinguish the difference between listening to my recording of footsteps crunching leaves in Bristol's Castle Park and listening to the sound of different leaves, footsteps and pavements in Brooklyn's Prospect Park. These separate soundwalks recorded on separate days sound very similar; it would be difficult for a listener to identify the sound of crunched leaves as either uniquely Bristol or Brooklyn. Instead, these similar sounds, in a way, connect these two territories sonically together. There is a shared urban everyday sonic terrain, which is inclusive; everybody in the community has the opportunity (or misfortune depending on the sound in question) to listen to these common everyday sounds. These shared sounds connect a person to the environment and city's community.

Perhaps the majority of sounds I recorded in Brooklyn and Bristol are community sounds. For Schafer, a soundmark, 'possesses qualities which make it specially regarded' by a community (57). This definition is perhaps restrictive because it does not permit sonic space for an individual to discover soundmarks, which they may notice as unique to an area.   Listening may be considered a subjective psychological experience; one individually interprets sounds and makes personal connections with the world we hear around us.

On this search for soundmarks, I discovered sounds I subjectively associated as unique to Bristol or Brooklyn respectively. The sound of voices and accents felt unique to an area; itself constituting a community sound. Retrospectively listening to recordings in an edit suite, one could identify the sound of Brooklyn over Bristol by listening to crowds' accents. Each city shared a wonderfully rich mix of accents. Though, in many recordings I was able to decipher distinctive Bristolian accents meandering through St. Nicholas Markets or hear on noticeable Brooklyn accents on an overcrowded bus heading towards Graham Avenue. These two accents act as an audio watermark for my recordings marking them identifiable and 'noticeable' as either recorded in Brooklyn or Bristol.

A Bristol or Brooklyn accent sounds distinctively different to my Irish accent so I find it 'noticeable' from my subjective listening perspective. However, I wonder if a Bristolian consciously notices the sound of Bristol accents as much as a tourist's fresh ears? It may prove problematic categorising such accents as specially regarded by a 'community' because

these accents may not sound as noticeable and thus may not qualify as a soundmark. For acoustic ecologists, the sound of crowds instead may be defined as a 'keynote'. Schafer defines a keynote as sounds that 'may not always be heard consciously, but they outline the character of the people living there' (57).

While field recording on this search for soundmarks, my attentive ears felt opened up as they became aware and noticed unfolding and unexpected moments. This process inspired me and helped reveal how the everyday may become transformed into a rich source of creative inspiration for an artist.

Brooklyn was also overflowing with sonic beauty - sharawadji. In the seventeenth century, this aesthetic term was brought back to Europe from China by travellers. It means the unexpected beauty that occurs in the absence of any discernable order or arrangement (Augoyard and Torgue). In Brooklyn as a pedestrian briskly walked along the boardwalk to get a ferry, the loose change in their pockets jangled by accident to the same beat of the jangling chains of a sign being blown by the wind thus creating a synchronous, unique and tingling moment of subjective sonic beauty.

Is this moment of subjective sonic beauty a unique soundmark which sound uniquely from Brooklyn? On this quest for soundmarks, it struck me how different it is interpreting urban territories through audio instead of visuals. Landmarks remain in the urban skyline for a substantial period of time; you can visit them at any time of day or night such as Bristol's Clifton

Suspension Bridge or Brooklyn Bridge. In contrast, sound does not operate in such a fixed place or space. Sound has a 'spatial dimension' because it comes from a source (Bordwell and Thompson 1985 187). However, this source is constantly shifting and mutating because 'sound disregards the particular visual and material delineations of spatial arrangements' as the 'temporal and evanescent nature of sound imparts great flexibility, an uncertainty to the stability of space' (LaBelle xxi).

The process of field recording is a process of attempting to capture this unstable space. Unlike landmarks, you cannot physically touch soundmarks; they are sound waves moving through the air. I cannot recommend a tourist or inhabitant go visit the exact place I listened to the above-mentioned moments of sonic sharawadji. Instead, if one wants to hear this unique sonic moment, they may listen to my field recordings.

Listening back to these recordings of unique sonic sharawadji, I realised every sound I recorded is arguably unique because one cannot replicate it or listen to it in that exact same way again. The fleeting sonic moment has passed and one cannot revisit it. Despite trying to preserve its authenticity by recording it binaurally, the sound waves have changed shape and have become a different physical format in the shape of digital audio data.

This raises the question of preservation in relation to soundmarks. Once a soundmark has been identified, a problematic task in itself as previously discussed, 'it deserves to be preserved' (Schafer 1977). However, this proves

a futile aim; one cannot authentically preserve a sound (let alone a soundmark) as each sound is a unique fleeting moment. One may preserve a recording of a sound as an impressionistic reproduction of a sound like someone may preserve photographs of a landmark. However, there is a marked difference between the sound and its reproduction.

Interestingly, Schafer employs the term schizophonia to 'refer to the split between an original sound and its electroacoustic reproduction. Original sounds are tied to the mechanisms that produce them. Electroacoustically reproduced sounds are copies...' (Schafer 1977). Therefore from an ideological and practical perspective, it appears impossible to preserve soundmarks.

Post-Production: Part B

When investigating the impact of using binaural technology to document soundwalks, I reflected on why I selected this audio tool for my soundwalk practice. I was drawn to binaural technology's ability to capture sounds from the position of where human ears naturally hear the world thus giving a listener a tantalisingly real sense of a place. For instance, in post-production when listening back to one of my soundwalks, I instantly swiveled around in my chair to look out the window to see a noisy motorbike going down the street, which was disturbing my listening. However, when peering out the window, I realised this loud noise was in fact embedded in my binaurally

recorded soundwalk. I have discovered binaural recordings often short-circuit logic as your body reacts to these recorded sounds as if they are real.

Listening to the recorded soundwalks instantly placed me back in Brooklyn running to get the ferry at Greenpoint or wandering around the harbourside in Bristol. These recordings felt 'real' for me because I recorded them. The two binaural microphones captured sounds using my head-related-transfer-functions: HRTFs as defined in the introduction. The recordings were specifically tailored to the way my body and brain represent real sound so from my subjective listening, these binaural recordings represent real soundwalks I recorded in Bristol and Brooklyn.

Herein lies a positive aspect for the individual artist's ears, however it is also simultaneously a drawback for a sound artist's audience because with audiences different, uniquely shaped HRTFs, these recordings may not feel as 'real' as the artist's audio representation of the real.

If social users are drawn to binaural technology in a bid to represent the real, they should be aware this audio reality is created by their individual HRTFs, which become imprinted in the recording thus becoming a type of audio signature when documenting soundwalks. These embedded HRTFs in the soundwalk recordings underlines the physical individual position of the recordist in a place and illustrates the notion of soundscape as subjective from the perspective of binaural technology usage.

During production, I was influenced by Direct Cinema's unobtrusive approach ensuring the documenter is almost invisible when documenting reality. However, in binaural recordings, my body's individual HRTFs are inherently audible in my audio documentation. Direct Cinema's approach to documenting reality proved redundant for my practice when considering the presence of the artist during post-production.

To understand the complexities of an artist's role in capturing the real using binaural technology, I delved deeper into the history of documentary film's enduring debate on representing the real.

For Henrik Juel:

> a film is not a mere representation, but a willed presentation of something made by someone in a specific way and for someone. The phrase "representation of reality" is utterly mistaken as a definition of documentary, because the idea of film as mirroring is a false one and a very misleading ideal (Juel).

Equally, the process of documenting soundwalks is itself an active 'willed presentation of something made by someone…' (Juel) and how does using binaural technology affect this presentation of reality?

I initially aimed to maintain the realness of my binaural recordings by taking the creative decision to not augment levels or play with equalization (the volume for frequencies' levels) and instead present my recorded soundwalks to listeners as I really recorded them in Bristol and Brooklyn.

However, as I spliced the natural temporality of my soundwalks to make cuts and occasional cross fades on my editing timeline, I questioned if these binaural recordings are a representation of reality or is this simply a 'very misleading ideal'?

I came to the realisation it is arguably always just one subjective position that binaural technology is capable of recording rather than an objective representation of sonic reality. Instead of thinking my soundwalks as capturing sonic reality, I re-conceived my work as having a creative intervention. I am presenting my creative vision or, in this case, creative sound of how I experienced these urban soundwalks.

Just as previously cited Highmore challenges the idea that an objective everyday can be 'gathered up and described' by immediately questioning 'whose everyday life?' (1), my soundwalks are not portraying an objective reality of everyday urban environments but rather are a crafted documentation of reality from my audio perspective.

The craft of documenting reality is made visible in pioneering documentary maker John Grierson's definition of documentary as 'the creative treatment of actuality' (qtd. in Ellis 347). This definition is influential for my binaural practice because it makes visible and audible my role in creating audio actuality using binaural microphones. For example, I chose to include moments where the listener may hear my breath or reactive laugh to make audible that my recordings are a subjective artistic treatment of audio actuality.

The creative decision to make the sound artist audible in field recordings is evident in the work of Davide Tidoni. In a presentation at *In The Field* symposium,[17] Tidoni addressed hearing the unheard in field recording by playing audio clips of him breathing heavily into microphones even inserting a radio microphone in his nostril which highlight the 'performative aspects of recording – intended as site-specific intervention that embeds physicality, relational agency, and on-going process of growth and exchange' (Tidoni). Arguably, the 'physicality' of my HRTFs or occasional sound of breathing is 'embedded' in my binaural urban soundwalks making heard the role of artist in creating a recording.

Binaural technology also provides listeners with an artist's physical point of audition. When listeners put on a pair of headphones to experience binaural recordings, they experience the audio equivalent of stepping into another person's shoes. Just as audience members may enjoy point-of-view shots in visual media like TV show *Peep Show*, perhaps there is an element of audio voyeurism attached to binaural technology which explains its appeal for artists as discussed during production and also later for audiences during exhibition. There is vast creative potential for playing with point of audition and perhaps this is another reason why sound artists are drawn to use binaural technology which is re-visited in greater detail in Chapter Three.

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[17] *In The Field* was an International Symposium for Field Recording held in London by Creative Research Into sound Art Practice (CRISAP) and The British Library from 15-16 February, 2013.

Exhibition:

I decided to edit my soundwalks of Bristol and Brooklyn in the shape of interactive online audio postcards for a variety of creative, practical and theoretical reasons. The first reason is temporality. Exhibiting my full soundwalk documentation would involve listening to hours of binaural audio footage. This may not prove interesting or temporally possible for a listener to sift through my extensive soundwalks. Instead, I created and edited a summary of my actual soundwalk experiences. This phase of the case study marked the most 'creative' aspect of my 'creative treatment of actuality' (qtd. in Ellis 347) as I began choosing what to include, exclude and mediate what remote listeners may hear at the exhibition stage.[18]

I listened back to my field recordings of Bristol and Brooklyn in a different city: Dublin. This geographical distance helped me to listen to my soundwalks with somewhat fresh ears. When listening back, I was initially worried I would find hours of banal audio footage where nothing intrigues my ears. Instead, I unwittingly became an audio detective uncovering the unusual beauty of the everyday through the act of re-listening to my soundwalks.

When re-listening, unusual aspects of the everyday revealed themselves. In his studies on the everyday, Highmore believes alongside the banal and boredom of the everyday:

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[18] My creative treatment of my soundwalks required compression as the original recording data was too large to be exhibited on the website's platform. Even at exhibition stage, I was still editing as some of my binaural soundwalks' rich life-like details were lost through the necessary technical act of compression in to smaller Internet-compatible audio files.

the everyday is also the home of the bizarre and the mysterious. The 'commonplaces of existence' are filled with strange occurrences…The non-everyday (the exceptional) is there to be found in the heart of the everyday (3).

I found this 'strange…heart' was embedded in my binaural recordings of Bristol and Brooklyn's everyday sonic territories. It was these moments of 'strange occurrences' that felt the most memorable moments of my sonic journey. For instance during my soundwalk of Bristol's alternative area in October 2012, there was a strange moment when I recorded city dwellers shouting 'brains' to passers-by dressed up in zombie costumes in Bristol during a zombie walk felt more memorable than the sound of a can being opened in a park that same day. At exhibition phase, I began highlighting these 'strange occurrences' for the audio postcards' content.

This highlighted summary of my soundwalks documenting the everyday in Bristol and Brooklyn triggered personal memories of sharing journeys with friends and family by writing them postcards. One does not explain the lengthy banal aspects of a journey but rather the interesting or unusual moments of the everyday they experience of a different place. This highlighted brevity of communication is the hallmark convention of a postcard.[19]

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[19] When postcards were first invented, they were essentially the prototype for the modern day mobile text message. It was cheaper to send a postcard over a mailed letter, which meant the postcard soared in popularity as a means of communicating short messages quickly. The Act of Congress on May 19, 1898, enabled 'publishers of privately printed mailing cards, or postcards...permission to sell cards to the general public that could be mailed at the same one-cent rate as the penny postal cards that were issued by the US post office. This heralded the Golden Era of Postcards just before World War One and before the rise of the telephone.

Communicating what I heard on my soundwalks thus creating my audio postcards' content became an intuitive process when my audio detective work uncovered a natural rhythm of my binaural field recordings. I felt it was essential to be guided by two levels of rhythms. The first level of rhythm is my body as field recordist. I found the impact of using binaural field recording is the field recordist's natural bodily rhythm of footsteps and breathing are imprinted on recordings thus making it a personal journey. I decided to include moments of inhalation and footstep sounds on leaves in my audio postcards as this bodily rhythm was an integral part of my documenting process. By choosing to not audio 'airbrush' these bodily rhythms out, I felt I was making audible my role as artist in shaping the binaurally recorded soundwalk.

The second rhythm, which guided my exhibited postcards is the rhythm of everyday sounds recorded in Bristol and Brooklyn. Highmore notes that 'it is only when two different rhythms intersect that a rhythm can be recognised at all' (147). This moment of recognition occurred when I audibly noticed how the recording of my footsteps sped up when I became part of a crowd of people in a rush to get to a ferry by Brooklyn's harbourside. This micro rhythmic moment highlights the macro rhythms, which are part of the texture of everyday. Highmore cites philosophers and sociologists Henri Lefebvre and Catherine Régulier's ideology of the everyday when noting 'everyday life is shot through and cut across the larger rhythms of life and the cosmos: days
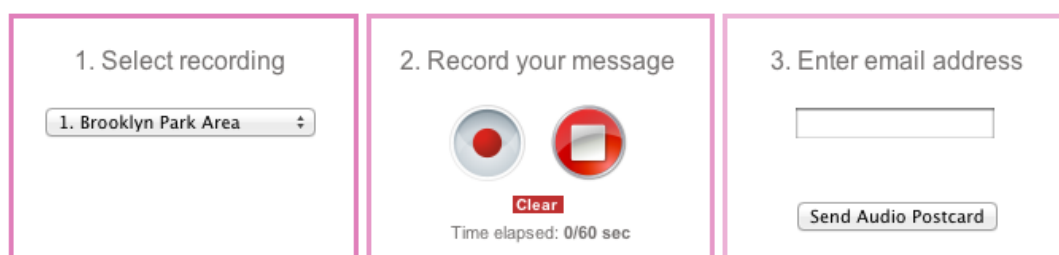
These privately printed postcards featured newer designs, which allowed further space to write more detailed messages. They took the form of souvenir cards featuring "greetings from" typography. They became a popular way of sharing one's impressions of a space or place and details of one's journey to a recipient. Such postcards often display images of city landmarks visited by the postcard's writer. My own work taps in to this particular postcard tradition but with an audio twist.

and nights, months and seasons, and more specifically still, biological rhythms. In everyday life, this results in constant interaction between these rhythms and repetitive processes…' (Highmore 148).

The awareness of everyday rhythms became a useful editing tool during the exhibition stage. Like editing a music video's pictures to the beats of a song, I edited my audio postcard content to the everyday rhythms inherent in my binaural recordings. My bodily rhythms and everyday rhythms discovered in Bristol and Brooklyn influenced me in knowing the point at which to cut or extend certain clips for the creation of the audio postcards' content of highlighted everyday rhythms of often 'strange occurrences' (Highmore: 3). For example, the rhythmic everyday nature of a café in Williamsburg in Brooklyn contained a surprisingly pleasing rhythm of banging doors, milk being steamed and sugar packets being rustled.

Following on from hearing everyday rhythms interact with each other, I was keen to create an exhibition place where listeners may interact and be inspired by my highlighted soundwalks to create their unique highlighted soundwalk. While my subjective perspective did not discover soundmarks, rather the more enjoyable strangeness of the everyday, I wanted to provide a free audio platform, which allows listeners a place to respond to my soundwalks from their personal point of audition so they may choose if soundmarks exist or not.

When a listener arrives at my website, they have the option to listen to six crafted soundwalks.[20] A listener selects one of soundwalk to act as their postcard 'front cover' and are then guided to the next stage of sending an audio postcard online: record an online message of their response to the soundwalk through the website.

Fig. 7: Visual documentation from Audio Postcards' Brooklyn website detailing the 'Create Audio Postcard' programme.

Here the listener is providing their own personal impression of the track selected, their journey online or their impressions of that particular city. I was mindful of keeping my highlighted journeys' length short by taking on board online media producer and academic Lance Dann's advice: 'the received wisdom of how best to generate content for the Web is to assume that your audience has a zero attention span, you must work in as short a form as possible' (6). Then just as one may write a recipient's postal address on a postcard, the listener then types in a recipient's email address. Hitting the press send button then activates sharing the audio postcard as the Internet becomes a modern day postman. Each audio postcard containing a

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[20] These six soundwalks are based on six categories I decided upon during pre-production: Park area, Business area, Alternative/Creative are, Harbour side area, Market Area and Shopping Area.

personalised voice message essentially creates a unique audio postcard just as sound itself is unique.

My initial aim is that when the recipient receives a personalised audio postcard of my soundwalk, and the listener's response, it may encourage the audio postcard's recipient to actively listen out for potential soundmarks and become more aurally aware of the everyday strange rhythms in sonic environments. In this respect, 'Audio Postcards' echoes the ideals of acoustic ecology

> to support and enhance the ability and willingness to listen to the environment's sonic manifestations and to evaluate them' and 'to extend critical listening capabilities in order to encourage a wide range of sonic modes of expression and creation (Breitsameter).

My exhibition format enables listeners to travel on my highlighted soundwalk, 'evaluate' it by creating a personalised recorded message and 'extend' the invitation to 'encourage' more listeners to actively listen to everyday sonic environments from their personalised point of audition.

While I provide the audio postcard front cover soundwalks, listeners are then invited to create, record and send a variety of unique and different audio postcards. This notion of variability in my online case study is characteristic of new media as a distinguishing factor different from old media. Professor of new media Lev Manovich notes:

old media involved a human creator who manually assembled…a particular composition or a sequence. This sequence was stored…its order determined once and for all. Numerous copies could be run off from the master…new media, in contrast, is characterized by variability. Instead of identical copies a new media object typically gives rise to many different versions (56).

A variety of different audio postcards may be produced and sent on my two new media Wordpress websites: www.audiopostcardsbristol.com and www.audiopostcardsbrooklyn.com
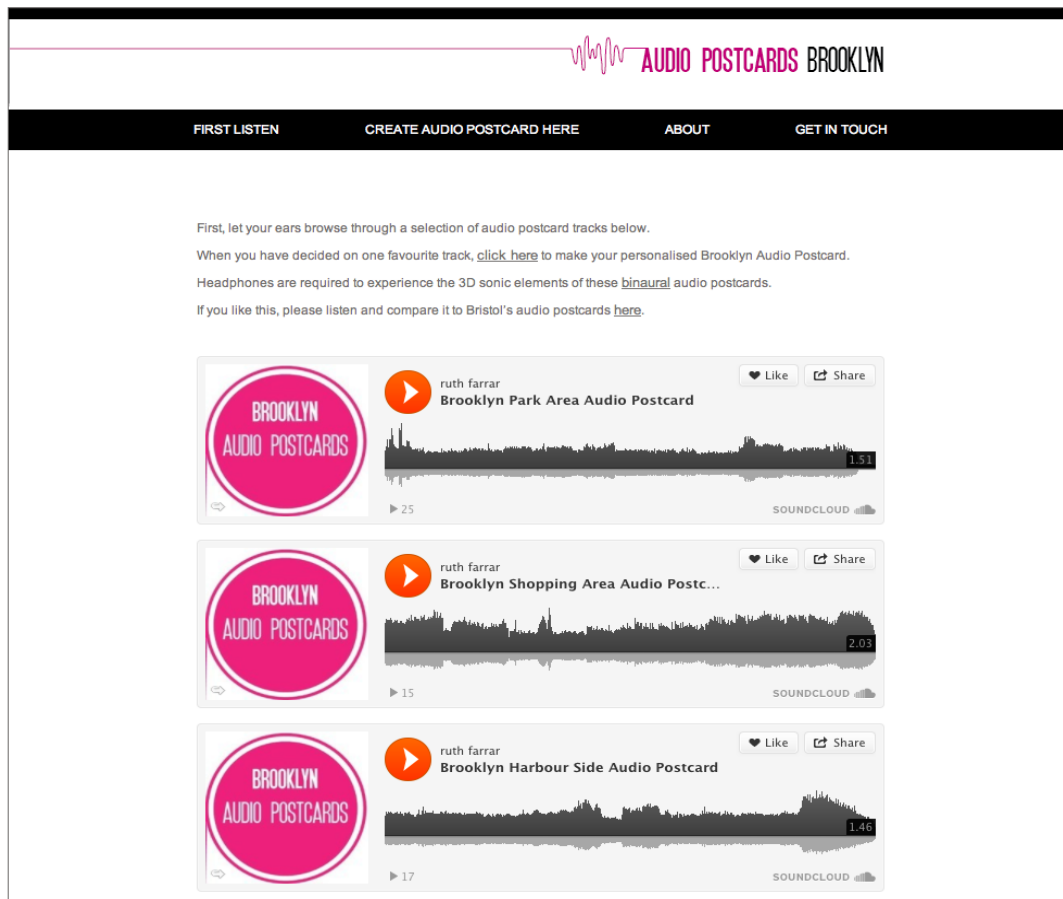
Fig. 8: Visual Documentation of Audio Postcards: Brooklyn website.

When a user has a choice from a variety of audio postcard soundwalks and a choice of what audio postcard message to record and send, these choices may potentially have ethical implications. Manovich states

> as the pioneer of interactive filmmaking Graham Weinbren argued in relation to interactive media, making a choice involves a moral responsibility. By passing these choices to the user, the author also passes the responsibility to represent the world and the human condition in it (62).

With regards to interactivity, it is clear I cannot control exactly how users choose to engage with the websites' content. Just as binaural field recording in public places proved a blurry ground for ethics, creating online audio interactive pieces is ethically illuminating. As author of the two websites, I am passing the moral 'responsibility' on to the remote listeners to create, record and send audio postcards that the recipients will not find offensive or insensitive.

When one weighs up the ethical pros and cons of online interaction as an exhibition choice, I decided I prefer letting go of controlling an experience in favour of providing a listener with the opportunity to personally create their own unique postcard front cover and message. By interacting with the websites, the listener becomes their own sound artist by choosing from a selection of front cover soundwalks, audio editor when they record their message (and listen back to it online so they can choose to record it again) and online exhibitor when they press the 'send audio postcard' button. I enjoy providing remote listeners the freedom to play with roles I have experienced

throughout this case study. Furthermore, just as I gave myself the freedom to wander around the city's every day sounds to gain a more realistic sense of the city as influenced by de Certeau's concepts, a listener is also afforded the freedom to walk and wander around my websites, click on any page and listen to any track they choose thus carving out their own unique digital audio paths. This freedom of choice contrasts with guided audio tours targeted at a tourist market, which are designed to have an ordered route to follow around the city such as Bristol's tourist board Visit Bristol's "The Bristol Quayside Adventure" which physically begins outside the Merchants Venturers Almshouses on King Street and ends at another specific location: a pub called The Ostrich Inn (Visit Bristol).

In comparison, online audio exhibition hands over much of an artist's control during exhibition to the listener. In a discussion about online audio drama, Dann notes:

> the audience to a downloaded audio piece has the freedom to choose when and where to listen. It still cannot be assumed that they will be focusing on the work in a manner that the writer may wish, listening may still be a secondary activity, but they will be able to control their sonic environment (6).

In my practice, I believe this loss of controlling listening environments is an advantage for choosing online exhibition. For Manovich, the 'Internet is the most material and visible sign of globalization' (32). While I may lose control

over a physically specific listening environment, exhibiting my work online opens my binaural practice open to potentially a global audience.[21]

I chose to exhibit the audio postcards online because this method of exhibition also reflects my philosophy on sound. Sound's relationship to space is constantly changing as 'the temporal and evanescent nature of sound imparts great flexibility, and uncertainty, to the stability of space' (La Belle xxi). A virtual place allows my binaural practice a greater 'flexibility' over traditional gallery exhibition methods. Sound space is a 'sphere without fixed boundaries, space made by the thing itself, not space containing a thing. It is not a pictorial space boxed in, but dynamic, always in flux, creating its own dimensions moment by moment' (La Belle xxii). Providing the opportunity to listen to the audio postcards remotely online means the experience is not limited by geographical 'boundaries' and each remote listener provides their own personal impression or dimension when making and sending an audio postcard of their choice. Each created and sent audio postcard is unique thus reflecting my belief that every fleeting sound is unique.

This connective aspect of sharing my sound work online for remote listeners feeds into my belief that sound is relational. In other words, sound creates a 'relational geography that is most often emotional, contentious, fluid,

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[21] For example in April 2013, Google analytics revealed that 92.11% of the two websites' users were from the United States. If I had chosen to exhibit my audio postcards in a gallery exclusively in Bristol, this project would not have reached the ears of remote listeners across the Atlantic Ocean. As long as there is Internet access, a remote listener can tune in and listen to these audio postcards potentially anywhere in the world. To date, based on my Google Analytics monthly reports, each "Audio Postcards" website receives on average 17 visitors every month since launching the two websites in March, 2013.

and which stimulates a form of knowledge that moves in and out of the body' (xxv). In this case, the body or vessel is the website. The Brooklyn audio postcards website contains hyperlinks to the Bristol audio postcards website thus encouraging a flow of sonic 'knowledge' and sound's relational aspect. Listeners are encouraged to compare impressions of Bristol's sounds with impressions of Brooklyn's sounds seamlessly over the two websites. Interestingly, Pervasive Media Studio producer Verity McIntosh informed me that she listened to the Brooklyn harbourside audio postcard coincidentally on her smartphone by the harbourside in Bristol. Despite looking at the river and boats in Bristol, she felt as if she had sonically travelled to Brooklyn's harbourside. In the audio postcard, when the ferry worker shouted for passengers to come aboard a ferry in Brooklyn, she told me she instantly turned around to try and spot the man. Binaural technology tricked her mind into merging Bristol's visuals with Brooklyn's audio to create a remote sonic tourist experience, which she thoroughly enjoyed.

By placing audio postcards online, I am providing listeners with the creative freedom to choose when and how they interpret the soundwalks. While I believe soundmarks, arguably, do not exist, the websites allow a free online space for listeners' personal impressions to decide if soundmarks exist or not.

Conclusion

Rich insights have been gained from attempting to answer the chapter's central critical questions: what is the impact of binaural technologies on field recording practices? In what way does binaural technology reshape or challenge our notion of representing reality when documenting everyday urban places?

First during production, I discovered binaural recording is advantageous for documenting a place's sounds because its unobtrusive qualities enabled me to record in a public place without disturbing its natural rhythm as people generally behaved naturally because they were unaware of being recorded. This audio eavesdropping which binaural technology affords a recordist triggered ethical questions about recording in public places; an under-discussed aspect of field recording because there is no universal code of ethics. It is instead often a personal choice what to record and later exhibit.

While it initially proved advantageous to go largely undetected when field recording in Bristol and Brooklyn, I discovered my position as a field recordist is inherently audible in my binaural recordings. As I placed the binaural microphone in my ears, my individual HRTFs directly shaped the recordings, which is advantageous from my subjective point of audition.

My research also zoomed in on a micro aspect of a place's sounds: soundmarks. Within the confines of this study, my practice-led research has demonstrated the acoustic ecological definition of a soundmark and desire for

authentically preserving soundmarks proves problematic when practically applied to the urban territories of Bristol and Brooklyn.

The building blocks of a supposed soundmark: its unique, noticeable sound specially regarded by a community has been deconstructed in this chapter to expose the definition's unstable foundation. Sound's physical make up is vastly different to visual landmarks. One cannot revisit a supposed soundmark in the way one visits a landmark due to sound's constantly changing nature.

Using binaural technology as a method to record and preserve soundmarks was in vain. The process of recording inherently mutates invisible unique sound waves into different, physical and visible audio tracks. Acoustic ecologists' goal to preserve soundmarks is problematic as one cannot preserve a sound's uniqueness; only a recorded audio impression of one.

When recording my urban soundwalks, I also gained beneficial insights into the philosophy of field recording. When one lets go of the futile struggle to define, fix and preserve soundmarks, one's ears are instead afforded the opportunity to experience its connective nature, delight in its rhythms and accept sound's unique fleeting fluidity.

This theme of letting go continued at the exhibition phase. By sharing my binaural soundwalks online, my point of audition acts as a gateway for a

global audience to remotely listen and engage with my binaural soundwalks of Bristol or Brooklyn.

Overall, I created "Audio Postcards" to examine the technical, aesthetic and conceptual impacts of using binaural technology to document an urban soundwalk. However, ultimately this critical line of enquiry has triggered deeper questions on the ethics of field recording, the existence of soundmarks and the role of sound artist in representing the real.

CHAPTER TWO:

"FROM AUSTRIA TO AMERICA"

The thesis' second case study evolved from Chapter One's "Audio Postcards" case study. Moving beyond sonically documenting the geographic places of Bristol and Brooklyn, the research for Chapter Two delves deeper into exploring the potential of sonically documenting interior personal places. This chapter focuses on insights gained from creating a sound art installation, "From Austria to America" which was exhibited as part of the *Moving Sounds Festival 2013* at the Austrian Cultural Forum in Manhattan, New York. The primary research question of this case study asks: what are the technical, aesthetic and conceptual impacts of using binaural technology to create a soundscape of *intimate* connection for a listener? The word *intimate* here is used on two levels: namely the sensation of feeling physically close to a binaural sound source, which is facilitated by the listener's ears being enveloped in headphones, and also the psychological process of drawing a personal close connection to content featured in a soundscape.

"From Austria to America" experiments with documenting interior personal places, one's inner thoughts, and with developing techniques on how to invite a listener to make an intimate connection when experiencing an installation piece. It draws upon the established convention of using binaural technology for its psychoacoustic effects. When exploring the psychoacoustic effects of binaural technology, one must acknowledge all sounds are subject to a psychoacoustic response. Psychoacoustics is fundamentally the study of

how one subjectively perceives sound. It takes into account the physiological and psychological effects when listening to sound.

Using binaural technology to experiment with psychoacoustics is not a new practice. Rather, a social group pre-exists this research that use binaural technology specifically to play with binaural technology's quasi-3D life-like texture in order to create a psychological 'trick of the mind' on the listener.[22] Some of the richest examples of this binaural technology usage are created by theatre practitioners.

British theatre director and producer David Rosenberg regularly uses binaural technology. His work experiments with the uses and applications of sound technology, shaping the impact binaural technology may have on a theatre audience. Binaural technology's life-like quasi-3D qualities are often a major draw for practitioners to use this particular method of audio recording. Chapter One outlines why Des Coulam uses binaural technology because for him, binaural technology's life-like texture adds 'authenticity' to his sonic mapping of Paris. Rosenberg is also drawn to binaural technology's life-like texture but he uses this technology for a different purpose: to create a sense of intimacy in his work. In an interview with journalist Charlie Kenber, Rosenberg states:

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[22] An oft-cited example that exemplifies this audio 'trick of the mind' is a Youtube video where listeners put on headphones and feel like they are getting their hair cut by a barber, which can be listened to here: https://www.youtube.com/watch?v=IUDTlvagjJA

I've been working on various projects using binaural sound recording for a number of years…to try and create intimacy in a large-scale outdoor event, so a way to bridge the gap between the audience and distant action. The first show I did using this technology was *Contains Violence* at the Lyric Hammersmith, where the performance was taking place in an office block over the road. People sat on the terrace outside looking through the windows of the office block and listening in to a very intimate audio of what was going on inside (2013).

Binaural technology continues to be used as 'a way to bridge the gap between the audience and distant action' (Rosenberg) in *Electric Hotel.* Audience members sat outdoors in rows wearing headphones looking up at a four-storey set of hotel rooms constructed from shipping containers. The binaural sound pumping through the audience's headphones was designed to prompt audience members to imagine an unseen and private space beyond a hotel's do-not-disturb barriers. The sound design also offered them knowledge of the hotel room occupant's private thoughts.

Reviews of *Electric Hotel* highlight the impact of binaural technology on the listener. Luke Jennings found listening to binaural sound design in headphones 'an intense auditory experience' (Jennings) and theatre critic Vera Liber considered the binaural listening experience as

cinema surround sound happening inside our own heads. A woman in front of me turned around deceived by audience noises part of the soundscape. Most impressive. (Liber).

This last review demonstrates how binaural technology's psychoacoustic

effects can play psychological tricks on the mind when an audience member mistakes the intimate aural connection to the binaural recording as 'real'.

Rosenberg pushes the sense of intimacy further in later work *Ring*. The piece involved audience members sitting in pitch darkness listening to a story unfold wearing headphones. Again, Rosenberg uses binaural technology to connect an audience member to a place but rather than it being a physically distant place such as a far-off office block in *Contains Violence* or a block of hotel rooms in *Electric Hotel*, this time Rosenberg uses binaural technology to connect audience members to their own imagination.

When discussing *Ring*, Rosenberg notes:

> I've been using binaural sound to try and transport the audience into a place that they can see. This project really is a continuation of that, but this time it's for the audience to create those places in their own mind, their own imagination (Rosenberg).

Journalist and editor Olivia Solon describes the experience of *Ring* as an 'isolating, theatrical sound journey' (Solon). It is interesting how the impact of binaural sound delivery, listening individually through headphones, may have resulted in this sense of isolation. Solon highlights the psychoacoustic effects of listening to the binaural sounds when she admits:

> there's a terrifyingly intimate moment when someone whispers in your ear, the distant sound of someone crunching crisps, coughs coming from people sitting behind me -- it's not clear to me whether they are real sounds or recorded ones. I

later find out that everything is recorded' (Solon).

Here Solon pinpoints the effectiveness of Rosenberg's use of binaural technology, suggesting he deploys its immersive effects to create a strong connection with the audience member to the point that their perception of boundaries between real, recorded and imagined sounds become blurred.

One method of understanding blurring the boundaries between real, recorded and imagined in a creative piece is through the concept of *headspace*. Theatre practitioner, theorist and binaural technology user, Peter Salvatore Petralia has invented the term when he discovered a pattern emerge in binaural technology users' creative work. For example, he argues *headspace* is evident in Cardiff's binaural soundwalks such as the 'seductive...intimate psychologically absorbing' *The Missing Voice: Case Study B*, a binaural soundwalk experienced through headphones walking around London's East End (Artangel) and his own work *Whisper*: a theatrical piece where performers speak into microphones and create live foley effects for audience members listening wearing headphones.[23]

For Petralia, *headspace* 'is not a *type* of theatre, but rather a feature present in certain types of performance, and a concept that when understood can be utilized to create incredibly seductive…work' (97). He further states:

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[23] For a detailed analysis on headspace in Cardiff's The Missing Voice: Case Study B and Petralia's Whisper, please refer to Contemporary Theatre Review 2010 Vol. 20 Issue 1 p. 96 – 108.

headspace is a feature of performance work that takes place largely *in* the head of an audience member by using a set of techniques and technologies that subvert physical space. Those techniques/technologies include (and there are certainly others):

- The use of stereo headphones, sensors, and interactive environments that blur the boundary between the performance space and the receptive space of the audience, bringing the performance closer to an audience member in a personal, tangible way, so that the performance seems to physically reside with the head of the audience member.

- Using high-quality stereo surround sound and binaural sound to create spatial relationships with an audience member that may not be based on actual physical proximity but which nonetheless have the features of architecture.

- Eliminating or obfuscating physical performers to replace them with virtual or imagined ones represented sonically, or otherwise placing a primacy on the sonic elements of the performers…(97).

The technical framework of *headspace* highlights an interesting emerging convention of binaural technology usage. Here binaural technology and its sonic delivery through headphones, are used as a creative tool to intimately connect an audience member to a performance piece 'so that the performance seems to physically reside with the head of the audience member' (97). This chapter's case study, "From Austria to America", applies these elements of Petralia's methodological framework to my own practice to

deepen an understanding of this user group's application of binaural technology.

Cardiff, Rosenberg and Petralia all use binaural technology as a creative tool to intimately connect a participant to a creative piece. My case study, "From Austria to America" develops this convention of binaural technology usage. It applies the concept of *headspace* to examine the critical question: what is the impact of using binaural technology to create a soundscape of *intimate* connection for a listener?

Creating this connective experience began with a chance connection I made with *Moving Sounds Festival* curator Melanie Maar. She was in the audience when I delivered a paper at a conference in New York about "Audio Postcards". She was interested in my research and invited me to submit a proposal for the upcoming *Festival* at the Austrian Cultural Forum in New York. The proposal got commissioned and I began work on developing "From Austria to America".

The thematic content of my sound art installation echoes the aim of my thesis to experiment with binaural technology's creative potential for intimate connection. The installation's universal theme is 'Home' and its content draws upon the experiences and philosophies of three Austrian emigrants, Melanie, Maria and Andreas. The subjects were selected from a pool of connections I made with the Austrian Cultural Forum in New York and participants willing to be interviewed for the installation. Andreas was Head of the Austrian Cultural

Forum. Melanie is a choreographer and Maria is a visual artist.

While all three subjects made the same decision to move from their home country, Austria, to create a new home in America, each subject's story and circumstances created divergent paths. The installation develops and explores the ways in which Andreas, Melanie and Maria define home after leaving their homeland in Austria to create a new home in America and the personal connections they have between these two places.

My role of sound artist for this piece was creating a method of shaping this material to invite a listener to intimately connect to Melanie, Maria and Andreas' personal reflections of home. My methodology involved carrying out sound experiments, interviews and binaural soundwalks, and finally, the construction of a sound art installation. The following sections give an account of the steps I took in developing the project from pre-production to exhibition, and insights gained at each step, when investigating the technical, aesthetic and conceptual impacts of using binaural technology to create a soundscape of close connection for a listener.

PRE-PRODUCTION: SOUND EXPERIMENTS

In "From Austria to America", I was keen to experiment with binaural technology's potential to play with psychoacoustics as a method of connecting a listener to an art piece as Rosenberg does in his theatrical work. One may

read information on psychoacoustics to gain a theoretical understanding. However, to build an installation, I also needed to gain a practical understanding of how binaural technology may be technically used to play on a listener's psychoacoustic perceptions.

I wanted to further my education on this binaural technology usage to improve my practical skills and understand more about the impact binaural technology may have on a listener. This curiosity took the shape of binaural sound experiments.

Over a three-month period, a series of experiments were carried out to explore, firstly the relationship between the 'shape' of sounds and psychoacoustic effects and secondly how different forms of sound delivery impact on audience perception.

The sonic experiments were tested out at in a controlled environment as part of an artist residency at Pervasive Media Studio in Bristol. Twenty-four testers individually listened to, watched and gave feedback on five experiments that I designed to explore how the extent to which different modes of binaural sound design allowed me to engage listeners in a range of ways. [24] The findings from these experiments informed and shaped my

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[24] All five experiments are available to privately watch and listen to on my Vimeo channel here: https://vimeo.com/user8300832 When prompted by Vimeo, please use the following password to access the experiments' audio visual content: Hitchcock8

creative decisions in the construction of "From Austria to America". A thorough analysis of findings from each experiment is included in Appendix E of the thesis. However, to maintain the flow of critical discussion on this case study, three key insights from the experiments may be summarised as follows:

I. In Experiment A and B, participants became more connected and immersed in an experiment when the design involved absent visuals or absent sounds. Results revealed that absence enabled testers to become more involved in the piece as it encouraged them to use their imagination to create their own personal images and sounds to effectively fill in any audio-visual 'gaps'. From this, I learned that utilising absence as a technique may potentially enhance a participant's sense of immersion in an installation piece.

II. When studying binaural directionality, an audio-visual sketch exercise and Experiment C confirm the "sweet spots" for experiencing binaural recording are sounds in which the source is parallel with your ears (for example a bee buzzing beside your ear) or sounds in which the source feels like they are coming from behind your head (for example the sound of footsteps behind you). These experiments revealed that unless you implement these "sweets spots" in your sound design and delivery, there is little point in using binaural technology as a listener cannot decipher the difference between a stereo recording over a

binaural recording. I have discovered I need to weave in these "sweet spot" sounds to enhance binaural sound delivery.

III.   As binaural technology requires headphones, I was curious to examine how this form of sonic delivery affects a tester's experience. In a cinema, the convention is to listen as a collective. For example when watching comedy films, individuals may potentially find sharing group laughter enjoyable. Would wearing personal headphones silence this collective listening experience when absorbing audio-visual content? When asked if testers would find it annoying or more enjoyable to wear headphones in a cinema space for example, over 70% of testers prefer the private immersion listening experience through headphones. This is one minor test with a limited test group. However from these experiments' findings, I found it interesting that testers prefer an immersive individual listening experience over a shared collective listening experience without headphones. Perhaps this hints at changing listening conventions with a rise of users experiencing content on smartphones and tablet devices individually through headphones. Binaural sound delivery requires headphones. Interestingly, this stipulation is not deemed limiting but rather preferable by the majority of testers.

Overall the three main insights learned above informed creative and practical decisions made in the construction of "From Austria to America". Just as an artist plays with form and technique in a sketchbook before composing their

final composition on a canvas, these sonic experiments enabled me to examine ideas to include in the final construction of "From Austria to America". Based on my experiments' findings, the storytelling technique of absence, using binaural technology's "sweet spots" and headphone delivery are featured in the design of "From Austria to America" to encourage a participant to closely connect and become immersed in the sound art installation.

PRODUCTION

The production of the installation piece occurred in two stages: first audio interviews and then binaural soundwalks. To document the personal thoughts of the three subjects on their sense of home, one-on-one audio interviews were carried out. I asked each subject the same list of questions about the concept of home, which I prepared before the interview, which were designed to reveal thoughtful open responses as opposed to closed 'yes' or 'no' replies.[25] Due to the subjects' different work and travel commitments, the three interviews were carried out over Skype. Using this new media technology inherently shapes the outcome of this case study as the Skype process involved the interviewer and interviewee being in two different geographical locations for the interview. Rather than this being a potential drawback for creating a sense of connection, the liminal space that Skype provides of 'being there but not there' with a voice's live sound waves emanating from a computer's speakers physically bouncing around the room

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[25] The list of questions I asked Andreas, Maria and Melanie when interviewing them is in Appendix C: Part B of the thesis.

without the physical body being present proved a perfectly fitting listening and recording device for the interviews on the subjects' fractured and multiple sense of home.

Traditionally, when carrying out interviews face-to-face, the interviewer has the opportunity to decode body language to gain a deeper understanding of the subject. There is an option on Skype to have a video feed of the conversation where both callers can see each other's faces. I gave each subject this option. However, interestingly all three subjects opted out of the video feed. I was concerned this would be a drawback for this interviewing process over Skype as I was unable to read their body language or micro facial expressions. However, the opposite occurred. By removing accompanying visuals, I was encouraged to engage in a deeper more intimate connection. Researcher, sound artist and composer Cathy Lane notes 'listening is not easy, it is something that requires full concentration and the engagement of all our faculties' (153). Removing the visual feed enabled me to become fully concentrated on the interviewee's voice. As I actively listened for pauses, hesitations, repetitions and differences in voice levels, I felt more alert and involved in the interviewing process, asking open questions and actively listening to the responses. Ultimately, Skype proved to be a productive listening device to create a close connection with the subjects.

At my request, the Skype conversations were recorded on the subjects' personal computers. I purposely selected mono recordings to document the interviews over binaural technology for three main reasons. First, I felt the

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singular mono recording may potentially create an audio atmosphere where the listener later experiencing the installation piece may feel like the mono recording is artistically akin to listening to a singular voice inside someone's head. Second, I also wanted to experiment with contrasting the singular mono voice recording with the lifelike surround sound movement of binaural recordings to understand further the impact of binaural technology on a listener. Third, after discovering the 'sweet spots' for recording binaurally from Sound Experiment C in pre-production, there was little technical point in using binaural technology as the subject's voice was not coming directionally from the same plane beside the listener's ears or behind their head so based on my experiment's findings, a listener would not be able to decipher the difference between a mono or stereo recording with a binaural recording of the interview.

Instead, I used binaural technology for documenting the soundwalk element of this production as there are sound sources surrounding a recordist from every direction, which will capture the 'sweet spots' of using binaural technology in my practice.

Based on the three interviews, I collected a list of places that had proved personally meaningful for each participant when they first moved from Austria to America, and which they had mentioned in their interviews. As previously stated, binaural technology is often used for its life-like texture, so to evoke the meaningful places I used binaural technology to bring sentences from the recorded interview 'to life' with corresponding binaural soundscapes

of the places in New York the subject discussed. I felt the inclusion of 'on location' binaural soundscapes would enable a listener to feel more connected to the subject as they become sonically immersed in the places of personal significance for the subject.

During the production phase, I learned that becoming so focused on the eventual listener's experience of the installation resulted in underestimating the effect the recording process would have on me as an artist and listener. In contrast to "Audio Postcards", where I documented large geographical areas during binaural soundwalks while actively listening and meandering through big areas of Brooklyn, this time my binaural soundwalks for "From Austria to America" were around much smaller specific sites in New York that were personal to another subject. Furthermore, "Audio Postcards" involved soundwalking to gather sounds to document the sounds of a geographical place whereas "From Austria to America" involved soundwalking to gather specific sounds to create a personal sonic portrait of someone's memories. This resulted in the recording process feeling like a more intimate binaural soundwalk experience.

For composer Hildegard Westerkamp, 'a soundwalk is any excursion whose main purpose is listening to the environment' (2006). However, this definition of a soundwalk does not take into account the critical question of who is listening to the environment on a soundwalk? The convention of a soundwalk practice assumes one listens to the environment from one's unique point of audition. From a physiological perspective this is scientifically

accurate as I can only hear sounds on a soundwalk from my two ears. However, this process is more complex when one takes into account using binaural technology to create a soundwalk for this case study.

The sounds transmitted into my ears are first transmitted through the two binaural microphones that are resting in my ears before my brain interprets the audio data. Binaural technology mediates my listening experience to the environment on a soundwalk as I hear the sounds as they are being recorded. If I am using Roland CS-10 binaural microphones, I hear the sounds slightly more amplified than my natural listening range and if I use Soundman OKM Mark II binaural headphones, the sounds are slightly less loud than my natural hearing range as its foam microphone covers block some of the sound waves entering my ears. Therefore, a binaural recordist's listening experience is inherently mediated by the technology used to document the process.

My listening experience is also mediated on this project as I found myself listening to the environment from my point of audition but also listening to the environment from the imagined point of audition of the interviewee subject. An example of this double-perspective listening experience occurred at an Austrian and Hungarian pastry shop in New York. Binaural microphones look similar to mp3 headphones so I was able to discreetly wear binaural microphones to record my soundwalk of entering and experiencing this bustling pastry shop. This specific site is personal to one subject, choreographer and dancer Melanie. When she first arrived in New York, she

created a routine of ordering a coffee at the pastry shop and writing in her journal there. When I arrived, from my perspective I listened to the whooshing coffee machine and clanking sounds of spoons placed on saucers. However, I also found myself listening to the experience from Melanie's point of audition. The Austrian accents and voices I overheard may have proved a comforting familiar aural trace of home for Melanie as she was establishing a new home in New York City. I likened the experience to the colloquial expression of taking a walk in somebody else's shoes. Instead, binaurally recording the soundwalk enabled me to 'step into' the ears of Melanie's point of audition. While this soundwalk eventually did not make the cut in post-production for creative reasons, this surprising form of double perspective listening left a lasting mark. I discovered a deep empathy for Melanie on this particular soundwalk.

While I connected with Melanie over Skype when she described the pastry shop experience of cherishing the daily morning ritual of writing down her thoughts and attempting to formulate a plan of action in a new environment, I felt a deeper sense of connection to Melanie's memory when I recorded the aural environment on site. On a practical level, I understood I was not experiencing the exact same soundscape Melanie experienced years ago. However, the sonic tapestry of the Austrian pastry shop I heard on the day I captured enabled my ears and mind to imaginatively reconstruct the experience through my recording choices.

Fig. 9: Visual documentation of outside the bakery pastry shop in New York.

This experience lends itself to a convention of documentary practice: reconstruction. Reconstructing events enables viewers to experience moments from the personal perspective of the documentary's subject. The viewers are aware that it is not the 'real' event but the reconstruction provides a viewer with a creative space to imagine how a particular experience may have felt for the subject of a documentary. This in turn may produce a deeper understanding and empathy for a subject.

The convention of reconstruction in documentary practice may be applied to my binaural soundwalks. Rather than simply documenting the binaural soundwalk from my unique point of audition, I am also simultaneously

reconstructing aural aspects of Melanie's memories. Deploying binaural technology within my practice adapts this audio tool as a form of recording to new applications and uses it as a way of mediating memories and reconstructing aural environments for a listener. This forms an exciting evolution of soundwalk conventions, as discussed in Chapter One, which only take into account a singular point of audition of the walker. A convention of soundwalks is to simply pay attention to one's aural environment in the present day such as the soundwalk led by acoustic engineering professor Trevor Cox at the *Festival of Ideas* event: *Sonic Bristol Walk*. During the soundwalk, Cox invited members of the public to actively listen to their contemporary environment while walking around Bristol. However, one may argue there is creative experimental potential to go on a soundwalk of a place to specifically listen to an environment with a particular person's point of audition in mind such as hearing everyday sounds that inspired an artist or poet to produce a piece of work.

Similarly the fact that the sound recording was informed by a 'double-perspective' that of the interviewees and then my own perspective as a creative sound recordist, developed the social application of binaural technology. One may create a binaural soundwalk specifically so a listener may experience walking in a significant person's footsteps, or in this case ears, for the specific application of reconstructing a sonic event from a particular person's point of audition. Using binaural technology for reconstruction purposes has potential future applications for historians, sound artists, documentary makers and recordists to intimately connect a subject's

past aural experience bringing memories to audible 'life' for a listener in the present. Bringing memories to 'life' also involves an artist mediating binaural recordings through creative choices made in post-production and exhibition.

POST-PRODUCTION

Post-production involved weaving together the mono recordings of the interviews with binaural recordings of soundwalks to create a memory-based soundscape that walks a listener through each of subject's experiences of home. As discussed in pre-production, I recorded the interviews in mono because initially I wanted to design an intimate experience in which the mono voice recordings would intentionally contrast with the surround sound binaural recordings so the mono recording of the voice may artistically be akin to listening to a singular voice inside someone's head. As I began layering each subject's mono voice recording with corresponding binaural soundscapes I quickly realized that this creative concept did not work in practice. Just as I was drawn to hear Bristolian or Brooklyn accents as audio watermarks of my recorded soundwalks during post-production in "Audio Postcards", I became fascinated by the theme of voice again during this case study's editing phase. Listening back to recordings of Melanie, Maria and Andreas' voices richly revealed so much of their life stories as emigrants because each of their voices was inflected with an unusual blending of their original Austrian accent and adopted American accent.

It became evident despite experimenting with audio volume levels, the

rich binaural soundwalks drowned out the sound of the voice. At this point, I made the creative decision to choose intelligibility of the voice over highlighting binaural soundscapes in the installation. The voice is spotlighted because it becomes an important guide for listeners as they psychologically meander through Andreas, Melanie and Maria's personal thoughts about home, Austria and America.

This creative decision saw the installation moving from one model of creating life-like sound space to another model of sound space characterised by audibly intelligible dialogue. Interestingly, this decision between choosing either life-like audio 'authenticity' or audio 'intelligibility' is not a new issue in sound recording and editing. It can be traced back to creative decisions made by Hollywood's film sound personnel in the early sound era. James Lastra discusses the competing models of film sound space during early Hollywood sound cinema by noting filmmakers chose one of two models of sound space practice:

> the first, heir, to metaphors of human simulation and described in terms of perceptual fidelity, emphasizes the literal duplication of a real and embodied (but invisible) auditor's experience of an acoustic event. Its watchwords are presence and immediacy…The second model traces its roots to the metaphor of writing, and emphasizes the mediacy, constructedness, and derived character of representation…its watchwords are…intelligibility… (181).

Arguably the 'watchword' of 'mediacy' in the second model applies to Lastra's first model as well because a sound designer's role also involves mediating

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volume levels and directionality in attempting to achieve a 'real' 'duplication' of 'an acoustic event' as outlined in the first model (181). Nonetheless, the decision to choose either a 'real' duplication' model or a 'intelligibility' model existed in this case study.

When creating soundscapes, informed by the subjects' personal memories of what home means to them, I decided despite my intention set out in production to edit the first model with binaural sounds' 'realistic-sounding' documented places, in post-production the second model championing 'intelligibility' proved more fitting for the installation. To clearly guide the listener through the memory-based soundscapes and create a close bond for the listener, they must be able to clearly hear the subject's voice to understand their memories. The voice alone tells so much about the journey each subject has made from moving from Austria to America. For example, some subjects have maintained their Austrian accents whereas one subject's voice clearly embodies the blurred liminal space between her sense of two homes as her Austrian accent is now blended with an American lilt.

By foregrounding the subjects' voices in audio close up, I was able to position the binaural soundscapes in the background. This was a useful exercise in employing binaural technology. One must be vigilant in not using binaural technology as an audio gimmick. Instead in my practice, I use binaural soundscapes only if it is relevant and propels the installation forward. There is a tendency in Rosenberg's work that listeners marvel at the binaural sound design but leave the experience unfulfilled as the narrative story is

unclear. For example, in Rosenberg's *Electric Hotel*, critic Luke Jennings points out that the binaural experience 'is long on suggestive atmosphere and short on explanation' (Jennings). Critic Elizabeth Mahoney similarly comments 'you admire how it looks and sounds, but can't really connect with the characters…' (Mahoney).

My experience of binaural technology 'failure' is also included at this stage because a social constructivist approach takes into account both 'successes' and 'failures' as they are all social factors that reveal how a technology is socially constructed (Pinch and Bijker 22).

My installation was shaped by this perceived fear of 'failure' of primarily using binaural technology as a gimmick to create a noticeable sonic atmosphere. Instead, I was interested in using binaural technology to create a personal connection between the listener and the subject's constructed soundwalk. In this case, it meant using binaural soundscapes sparingly and instead relying on other psychoacoustic sound design techniques learned from the sound experiments in pre-production. For instance, rather than loading each soundwalk with layers of binaural recordings, there are moments in the three soundscapes where one can only hear the subject's voice like when Melanie is describing the sterile quiet nature of subways in Vienna in contrast to subways in New York. The absence of referential sound provides the listener with a space to imagine their own accompanying sounds personal to them, which has been shown in previous sonic experiments to increase the level of connection a listener may have when listening to the soundscape.

EXHIBITION

The decisions I made in the exhibition phase also reflect my desire to create a intimate connection with the listener and the installation's content. In Chapter One, the audio postcards exhibition of two interactive websites connected by hyperlinks, which can be openly accessed globally, was informed by its produced soundscape content. The interactive experience was designed to mirror insights gained from the case study on the philosophy of sound as relational and fluid. Similarly in this case study, the inspiration for the physical shape and immersive design of the installation was informed by this chapter's recorded soundscapes and specifically the binaural technology user group: theatre practitioners. "From Austria to America" is based on *Theatre Jukebox*: an 'arcade-style cabinet that plays stories in a unique way' created by Stand and Stare: a British theatre production company I previously collaborated with during artist residencies at Pervasive Media Studio in Bristol (Stand and Stare). *Theatre Jukebox* is experienced individually or in a pair sitting down and wearing headphones. Participants are invited to choose from a selection of cards on a shelf in front of them. Each card brings an artifact such as a photograph or a letter to life 'through projections mapped to the images' and a sound designed track delivered through headphones (Stand and Stare).

For my installation, I re-conceptualised the jukebox from sharing stories about artifacts to sharing the three subjects' soundscapes. To encourage a listener to connect to the installation, the design of the experience involves listeners physically connecting with a piece of card. Each card is embedded

with an RFID microchip tag. When a listener places a card on the table in front of them, it triggers original software on a laptop connected to an RFID tag reader, hidden shelf below the table top to play the corresponding soundscape through the listener's headphones.[26] Each card represents one soundwalk. The listener can play the soundwalks in any order of their personal choosing.

Fig. 10: Visual documentation of Maria's, Andreas' and Melanie's RFID-tagged cards.

The RFID technology, laptop's software and binaural recordings playing through headphones enables this installation to be experienced without Andreas, Melanie and Maria being physically present. The technological feature of the exhibition mirrors Petralia's *headspace* methodology: *headspace* involves 'eliminating or obfuscating physical performers to replace them with virtual or imagined ones represented sonically' (97).

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[26] RFID is a type of technology that uses electromagnetic radio waves to wirelessly transfers data.

What is the impact of using technology to sonically represent physically absent performers when attempting to create an intimate connection between a listener and creative piece? An insight may be gained from examining binaural technology's sound delivery requirement: headphones. When experiencing "From Austria to America", a listener is required to physically wear headphones. Petralia suggests that wearing headphones creates 'the obvious interaction…in the physical contact of tiny amplification devices (speakers) with each ear' (100). The amplification of sound through headphones reduces the volume of sounds heard from the external environment. I intentionally provided noise-cancelling headphones for the listeners of "From Austria to America" so the connection they may form with the installation's audio content was not interrupted by sounds heard in the external environment and not intended to be part of the installation exhibition.

Alongside headphones providing a listener with a physically close connection to audio material, Petralia suggests headphone delivery may also produce a psychoacoustic effect: sonic intertwining. Petralia argues

> headphones become intertwined with our hearing system…the closeness of the amplified sound to the body requires our hearing systems to embrace the apparatus as an extension of our natural hearing systems, to often-hypnotic effect. Indeed as Akeroyd argues, 'when sounds are presented over headphones, the sounds are usually perceived as being within the head' (qtd. in Petralia 100).

Petralia and Akeroyd's shared ideology on headphones' sonic intertwined capability was put into practice in "From Austria to America". Although Andreas, Melanie and Maria were not physically present, their recorded voices were intentionally designed to be played through headphones so a sonic intertwining may potentially occur. In other words, the physical act of wearing headphones provided listeners with a psychoacoustically suggested space to intimately connect with the subject as the subject's voice enclosed a listener's ears to produce the almost 'hypnotic' effect that 'the sounds are usually perceived as being within the head' (100).

Did this aspect of *headspace* and headphone delivery, produce the desired effect of listeners becoming sonically intertwined and closely connected with the exhibited content? In Chapter One's "Audio Postcards" case study, the exhibition phase was exclusively online and accessible anywhere in the world with available Internet connection. In contrast, this case study's mode of binaural exhibition is in one geographical location, the Austrian Cultural Forum's library in New York. "Audio Postcards" may reach a larger audience as it is published online with access to a global audience. However while "From Austria to America" was experienced by less people, (approximately 30 participants), there was a surprising advantage for a sound artist to create an interactive experience designed to be experienced exclusively in one geographical site.

I remained on site with the installation and when listeners realised I was the artist of the piece, many wanted to interact and share their listening

experiences afterwards with me. This exhibition format helped me directly understand listeners' different user experiences and what part headphone delivery played in connecting listeners to the installation's content. My original aim of using binaural technology to create an intimate connection for the listener proved successful as many participants felt deeply moved by the experience. One listener's deep empathy resulted in tears when listening to Melanie's soundscape. Many listeners also commented on the impact of sonic intertwining produced by headphone delivery:

'I felt like I was in a cocoon with someone's voice inside my head';

"I forgot I was in the library and instead felt very 'in' their thoughts'

'I felt like I was with them…walking through Central Park with Andreas…on the subway with Melanie' ("From Austria to America").

However, at the exhibition phase, I realised it wasn't exclusively binaural technology's headphone delivery that fostered this close connection with the installation's material. In reality, it was a culmination of carefully considered artistic choices mediated throughout the process. For example, after carrying out a recreational visit to the Austrian Cultural Forum, the *Moving Sounds Festival*'s primary site, I selected the building's small library as the place to exhibit my installation because it has a calm enclosed atmosphere away from the bustling streets of New York City. I measured and designed the installation's width so it would precisely fit in between two bookcases in the library. This quiet almost hidden away place created a cocoon for listeners to connect to the installation, which mirrors the cocoon-like sensation of enclosing one's ears in headphones.

Fig. 11: Visual documentation of the installation at the Austrian Cultural Forum's library.

Furthermore, the installation was experienced individually. Rather than experiencing Andreas, Melanie and Maria sharing their memories on a traditional stage as part of a collective audience; listeners were instead invited into the internal minds of the three subjects individually. Although the subjects were physically absent, arguably technology enabled a more intimate experience between the listener and the subjects as the subjects' voices cocooned their ears during a private individual experience.

Through a projector triggered at key times, a listener was occasionally given representational artistic images of what the subject was speaking about such as autumn leaves falling to imaginatively represent the point of view of

Andreas when he discussed his experiences of Central Park in New York. As discussed in pre-production sound tests, absence of accompanying visuals encouraged participants to become more immersed in the piece as they use their imagination to fill in any audio-visual 'gaps'. The visuals were intended to act as minor cue guides in order to invite listeners to internally recall their own images of parks, which makes for a more personal experience of the installation. In "From Austria to America", I also intentionally didn't include the faces of the subjects because I wanted listeners to focus on their voices and create their own personal image of each subject in their heads. All of these elements from absent visuals to headphone delivery were designed so a listener may make a close connection with the installation's material. However, while an artist may mediate material, adopt methodology such as Petralia's *headspace* and exhibit in a particular mode to encourage a close connection, it is ultimately up to the individual on how they interpret and connect with an installation.

Fig.12: A selection of visual documentation of the installation.

CONCLUSION

"From Austria to America" was designed to gain insights on the effects of using binaural technology to create a soundscape of intimate connection for a listener.

I adapted concepts and modes of practice from a specific group of users of binaural technology, theatre practitioners, when creating my second case study. Rosenberg's portfolio of binaural theatre pieces has been used as a case study to analyse its advantages such as aural intensity and employing techniques on how to connect listeners to places geographically distant or inside one's own imaginative mind. However, Rosenberg's work also highlights the pitfalls of centering an entire piece around the use of binaural technology as it resulted in the promotion of a binaural audio aesthetic over narrative content leaving some critics impressed with the life-like sound quality but ultimately confused and dissatisfied with the theatre piece.

In contrast, a series of sonic experiments were first carried out to further understand the psychoacoustic effect of binaural technology and its sonic delivery on a listener. Insights from the experiments informed creative decisions at production and post-production stages of the installation. "From Austria to America" revealed using binaural technology affected both the listener and had an impact on the recordist. Carrying out binaural soundwalks proved a method of connecting an interviewer with their subjects as memories of places are sonically reconstructed. This points to an untapped and

potentially new usage of binaural technology as a personal tool for the reconstruction of an individual's memories.

The impact of using binaural technology also emerged in post-production as creative decisions were made to choose intelligibility over placing binaural soundscapes' like-like texture in the spotlight.

Qualitative data gathered at the exhibition stage discovered adopting Petralia's headspace methodology in conjunction with carefully considered artistic choices produced the impact of listeners forming intimate connections with the installation's content.[27] Ultimately, this practice-based research has found that a measured and considered usage of binaural technology proved an effective audio tool in creating an intimate connection between a listener and an art piece.

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[27] As part of gathering qualitative data, some participants agreed to be filmed when being interviewed about their response to the sound art installation. A selection of responses are featured at the end of the documentation video found here https://vimeo.com/105296120 When prompted by Vimeo, please use the following password to access the private documentation material: soundswept

CHAPTER THREE
"PAGE TO STAGE" AND "POINT OF AUDITION"

The final chapter of the thesis focuses on another social group who use binaural technology for a different purpose, classical music recordists, which exemplifies the social constructivist concept of 'interpretive flexibility of technological artefacts' (Pinch and Bijker 411). Pinch and Bijker highlight how women cyclists interpreted the artefact of the bicycle, when in its early developmental stages, differently to other social user groups such as young men whose 'function of the bicycle was primarily for sport' (415). A parallel may be drawn between the bicycle's early developments and the current shaping of binaural technology. In relation to technological change, binaural technology is evidently still forming and is open to interpretative development from different social user groups. This chapter will illustrate how classical music recordists use and shape binaural technology differently to field recordists and sound artists documenting soundwalks; or theatre practitioners creating intimate connections with a listener.

Investigating classical music recordists' use of binaural technology is undertaken in the creation of two practice-based case studies: one app prototype "Point of Audition" and a second app prototype "Page to Stage". "Point of Audition" explores listening to multiple points of audition of a classical music performance and "Page to Stage" interactively enables listeners to gain insights about a classical music piece and performance from orchestral members' perspectives. The case studies are analysed to find insights from this chapter's critical question: what are the technical, aesthetic

and conceptual impacts of using binaural technology to record classical music?

In chronological order, "Point of Audition" will be examined. Then, ideas explored in the first app prototype will be further developed in the second app prototype "Page To Stage". The chapter starts by contextualising the app prototypes. To explain what the two case studies are doing differently in comparison to industry standard conventions, a brief history of classical music recording, an analysis of binaurally recorded classical music conventions and an examination of current classical music listening habits will be outlined.

There appears an insatiable desire to capture classical music recordings, which dates back to Emil Berliner's gramophone developed between 1887 and 1983. Originally agents for Emil Berliner, Will and Fred Gaisberg were at the forefront of creating a profitable and popular market for this new invention: classical music recordings (Pekka Gronwow and Saunio 11).[28]

A typical recording of classical music in 1920 involved etching grooves on to wax discs 'while the horn itself captured and focussed as much of the performers' sound output as possible' (Beardsley and Leech-Wilkinson). Even during this early stage of classical music recording, an emphasis was placed on positioning recording horns as close as possible to the performers.

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[28] For instance, Fred Gaisberg was the first person to record the Italian tenor Enrico Caruso, in Milan on 11 April 1902, which resulted in financial and critical success for the artist and phonograph company Victor's Red Seal label (Richard James Burgess: 18).

Limiting the distance between the recording device and the performer became a technical convention for increasing the audible quality of a classical music recording.

In the 1920s the Western Electric Recording System, the Westrex, marked the next stage in improving a recording's quality.[29] This electrical method meant 'for the first time something like a full orchestra could be successfully recorded' and 'transients and sibilants were there, studio ambience and atmosphere, and all these things made for far greater fidelity' (Beardsley and Leech-Wilkinson).[30]

Understanding that fidelity is derived from a Latin word *fidēlitās* meaning 'truth', this desire for 'greater fidelity', in other words a faithfulness to recreating the sound of a classical music performance, has consistently driven and shaped recording and listening conventions in classical music recording and music recording technologies. In the 1940s, recording on magnetic tape on reel-to-reel machines led to increased accuracy in reproducing a music recording and thus affected the recording's perceived fidelity. In the 1950s, marketers targeted users' desire for fidelity by coining the term high fidelity or hi-fi when selling high quality audio reproduction systems that provided a higher quality playback than systems typically available then. The rise of hi-fi products resulted in users linking the term high fidelity with high quality.

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[29] The Westrex was developed by Bell Telephone Laboratories engineers J P Maxfield and H C Harrison in the 1920s.

[30] For example, the 31st May 1926 marked the first electrical recording at The Royal Opera House in Covent Garden, London. Sound signals created by orchestral musicians performing extracts from Boito's *Mefistofele* were transmitted by Post Office telephone lines (Beardsley and Leech-Wilkinson).

From playing music on the 'hi-fi', the next development in home music systems adopted was playing music on the 'stereo'. Technology is shaped by users' desire for fidelity because the two-speaker stereo system is designed to play a performance's recording that captures the spatial fidelity of a music performance.[31] Over eighty years later, stereo recording and stereo playback currently remain the predominant industry standard. Stereo recording is 'preferred for classical music…stereo methods have several advantages…stereo…preserves depth, perspective, and hall ambience' (Bartlett).

Conventionally recording a modern orchestra involves a layout of one to three stereo microphones on stands with trailing wires to recreate the fidelity of the performance space and capture a balanced recording of the whole orchestra (Bartlett). In contrast, binaural technology is concerned with one specific point of audition from the live performance. So why verge away from stereo recording conventions to binaurally record classical music?

What is the benefit? Here one may find answers in reviews of binaural classical music records:

- 'the sound is quite beautiful - warm, clear and spatially "real": a High Performance review of "Polish Baroque - Concerto Avenna C-8";

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[31] Stereophonic recordings are recorded on two channels and played back on two speakers. The space in between each speaker is intended to provide a three-dimensional effect because 'during playback of a stereo recording, images of the musical instruments are heard in various locations between the stereo speakers. These images are in the same places, left-to-right, that the instruments were at the recording session' (Bruce Bartlett).

- 'stage depth, often lacking in stereo recordings, is conveyed well here': a FanFare magazine review of "Opera Fantasies - oboe/harp/piano C-13"; and

- 'through phones the effect is stunning; one really is sitting front row center': The Sensible Sound review of "Solid Brass - Gershwin to Sousa C-19" (The Binaural Source).

Many reviews of binaural classical music recordings praise the technology's ability to faithfully capture the performance, which enables a listener to feel as if they are listening to a piece in the 'live' performance space. How does binaural technology capture the fidelity of classical music performances?

For binaural recordist Alex Kall, the advantage of recording binaurally is that it creates 'an honest, clean capture of what comes off of the stage as the audience hears it' (Kall). Unlike live stereo recordings where the recording engineer is making artistic choices on how to mix musical passes from an external booth that is removed from the orchestra on stage, binaural microphones are on stage and not mixed or edited thus meaning that 'every sonic element that the audience experiences live is captured in the recording: the placement of the instruments in the ensemble (including the height/depth/width of the stage, and the distance between each instrument) the placement of the head and its listening perspective (height, distance, angle, etc), and the characteristics of the venue (acoustics, ambient noise, etc.)' (Kall).

Therefore, recording classical music binaurally without live mixing or editing is a convention of binaural technology practice used to try and capture the fidelity of a classical music performance. However, while a binaural recordist may not mediate the performance by live mixing or editing it, mediation of the sound event still occurs. A recordist inherently shapes the recording by selecting which position to place binaural microphones when capturing the sound of a classical music performance.

Placing a dummy head, which has two inserted microphones in the place of the dummy head's two ears, in the middle of the stage where the performers are playing music is the predominant convention when choosing to binaurally record classical music. This is perhaps because the central position is arguably a 'sweet spot' for listening to a balanced recording of all the orchestral instruments on the left and right side sonically merging together. For example, the record "Opera Fantasies - oboe/harp/piano C-13" a selection of seven pieces by Mozart, Verdi, Meyerbeer, Wagner, Donizetti and Bellini were all recorded using a Neumann dummy head. Similarly, a Nuemann head was used to binaurally capture a performance "Greensleeves -flute and harp C-14" at Redeemer Church in Stuttgart from Audio Electronics (The Binaural Source).

While dummy head recordings are the predominant method of binaurally recording classical music, rare exceptions that deviate from this industry standard general rule of binaural recording exist. Headphone maker Joe Grado experimented with recording fifty four minutes of a brass quintet

using a personally made 'spherical mike that lacks the pinna cues but preserves a very natural and airy sound with detailed sonic information in both the horizontal/vertical planes' for the record "Solid Brass - Gershwin to Sousa C-19" on his Signature Recordings label (The Binaural Source). Here Grado's microphone choice mediates his attempt to capture the fidelity of a classical music performance.

Dutch binaural recordist Jon Rellim mediates a classical music performance by using another microphone variation from the binaural standard of expensive Neumann heads, which retail for thousands of dollars. He employs a more cost effective method to binaurally record classical music. He uses his own head related transfer functions (i.e. his body, ears and torso) by placing low-noise binaural condenser microphones in his ears, which are attached to a portable recorder, while attending live classical music concerts. He then self-publishes his recordings on SoundCloud: a free online music platform. These two different variations in recording classical music binaurally suggest that binaural technology conventions in this field are not fixed but rather still evolving and being shaped by individual practitioners.

Classical music listening conventions are also evolving due to emerging technology and contemporary audiences' listening habits. Alongside a persistent desire for fidelity, classical music blogger Bob Shingleton, who has written on classical music trends for over ten years, argues 'new audiences want classical music up close and personal' (Shingleton). The rise of mobile technology has resulted in an increase of listeners experiencing

classical music recordings through headphones rather than traditionally listening to a recording over speakers on home stereo systems. Shingleton notes a spatial difference between these two forms of classical music consumption: 'listening to speakers in the living room from the stereo "sweet spot" creates an image spreading the music between the speakers at a distance in front of the listener; but headphone listening, which is fast becoming the *de facto* standard, creates a very different binaural image which places the music *inside* the listener's head' (Shingleton).

Like Petralia's discussion on *headspace* in Chapter Two in which participants listening through headphones become immersed and connected to a theatrical piece as it is plays out in their internal mind, new audiences' listening habits are affecting the perceived spatiality of classical music recordings as they become internally immersed in classical music when listening individually through headphones. Shingleton elaborates: 'I have come to appreciate that many of classical music's much sought after new audience *would* like to be among the musicians, because that is where headphone listening places them every day' (Shingleton).

This chapter argues the impact of using binaural technology to record classical music may produce a method of attracting new audiences who consume classical music over headphones by creating an experience that is specifically designed to be played through headphones. Attracting new audiences to classical music has become a preoccupation within the industry with record labels such as Universal funding workshops such as *Hack The*

Quartet [32] to explore ways of using technologies to attract new listeners because statistics indicate dwindling numbers of listeners experiencing classical music recordings. [33]

Using binaural technology to create a recording among musicians may also have a beneficial educational impact. Viola player Elaine Fine comments 'if all recordings could be made from my seat on the second viola stand in the orchestra…everyone who is paying attention would understand the way music is put together' (Shingleton). By becoming immersed in a musician's individual audio perspective, one may gain a deeper audio awareness of how individual orchestral musicians' parts weave together to become immersed in a whole orchestral performance.

When further investigating classical music, professors in marketing Antonella Carù and Bernard Cova, note

> immersion can be difficult to achieve - particularly in the case of…classical works that
> from the outset establish a certain distance from the general public, especially if
> presented within the confines of a designated environment such as in a concert hall
> (39).

Binaural technology may provide a practical solution to this issue by minimising the distance between performer and audience member / listener.

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[32] *Hack The Quartet* was a two-day workshop event from 30 – 31st July 2013 carried out at Pervasive Media Studio in Bristol that brought together technologists, artists and classical musicians to explore new ways of engaging with classical music.
[33] For instance, BBC's Radio 3, aimed predominantly at a classical music mass market, lost over a million listeners in 2012 (Rajar).

By positioning binaural microphones in a musician's ears, and by thus recording a performance from the unique audio perspective of a musician on stage, it may potentially increase a listener's sense of immersion in a classical music recording as spatially it fulfils the desire for new audiences listening through headphones to feel 'up close and personal' (Shingleton) to classical music.

"POINT OF AUDITION"

During the two-day hack workshop from 30 - 31st July 2013, I used binaural technology to record a classical music performance and collaborated with the Sacconi Quartet to create an app prototype that experiments with the concept of point of audition to increase a listener's sense of immersion when listening to classical music over headphones.

Point of audition is a term adopted from film sound studies. It is often considered the audio equivalent of point-of-view ("Point of Audition"). In cinema, point-of-view shots are used so the viewer can experience the film's world from the perspective of a particular character as a technique to often build emotional allegiance towards a character or deepen one's understanding of the character's perspective of unfolding events in a film's narrative. A sound designer creating a point of audition sound in the film's soundtrack allows the cinema goer the opportunity to hear the filmic world from a particular character's perspective. Just as changing camera angles

allows an audience member to see a film world from a character's particular perspective, changing volume, pitch and tone invites an audience member to hear a filmic world from the perspective of a character's ears. However, it is worth noting their stylistic differences as Rick Altman notes: 'unlike the point-of-view sequence, which often moves from the viewer to the object or character viewed, the point-of-audition sequence typically begins with a shot of the sound source, introducing point-of-audition sound when we cut to a shot of the auditor' (251).

However, ultimately point of view and point of audition in cinema are united in their purpose of encouraging an audience member to connect and identify with a film's character. When musing on the notion of point of audition, Michel Chion believes point of audition means:

> '1. A spatial sense: from where do I hear, from what point in the space represented on the screen or on the soundtrack?

> 2. A subjective sense: which character, at a given moment of the story, is (apparently) hearing what I hear?' (90).

This definition is in relation to film narrative and film sound theory traditions. My app prototype is not concerned with creating a film narrative but rather capturing the musicians' point of audition during a real performance. Chion argues capturing the spatial perspective of point of audition in real life is problematic 'because of the omnidirectional nature of sound (which, unlike

light, travels in many directions) and also of listening (which picks up sounds in the round), as well as of phenomena involving sound reflection' (91).

Similarly from a field recording and sound art perspective on point of audition, sound theorist and sound artist Professor Angus Carlyle agrees with Chion's opinion on point of audition. Carlyle notes Chion 'cautions us that the long-established cinematic convention of the Point Of View (POV) cannot be readily translated into the sonic equivalent of a point of audition' because of our ears' natural auditory 'radical sensory openness' (15). He cites McLuhan's point that our ears have "no earlids"; rather than the flat, angled, and planer focus of the eyes, our ears are continually, radially, alert - even during sleep - to the sounds that surround' (15). I agree with Chion and Carlyle that point of audition is not merely a sonic version of point of view in real life due to our auditory system's physiology. Nonetheless, it is still a useful concept for sparking debate and reflections on spatial perspectives.

Chion gives an example that is particularly apt for this chapter's case studies on classical music. He urges readers to:

consider a violinist playing in the center of a large round room, her audience grouped in various places against the wall. Most of the listeners, even those standing at diametrically opposite points of the room, will hear roughly the same sound, with slight differences in reverberation. These differences, related to the acoustics of the space, are not sufficient to locate specific points of audition. Every *view* of the violinist, on the other hand, can immediately situate the point from which she is being looked at. So it is not often possible to speak of a point of audition in the sense of a

precise position in space, but rather of a place of audition, or even zone of audition (91).

However, by stating that it is 'not often possible', Chion therefore implies that there are times when it may be possible to 'speak of a point of audition'. Analysing Chion's example again from a different angle, what would it sound like to hear the violinist perform from their unique audio perspective on stage? The violinist's point of audition would clearly sound audibly different and unique to an audience member's audio perspective. In other words, rather than simply stepping into the violinist's shoes during a performance, can one sonically step into their ears? This case study proposes that using binaural technology enables a recordist to capture a specific point of audition: a classical musician's 'precise position in space' during a performance.

It is worth making the distinction: point of audition in film sound studies is a sound design technique that takes into account the film's relationship between sound and vision. However, my first app prototype is not seeking to link sound to vision but rather adapting the point of audition concept to invite listeners to become immersed in the auditory illusion of being in a space 'up close and personal' from the specific audio perspective of an individual performer in a classical music group performance.

In figure 13, historically stereophonic recordings of classical music focus on one point of audition: a dummy head on the centre of the stage. Recordings are rarely from the perspective of a single audience member such as previously-cited Jon Rellim's classical music recordings on Soundcloud

depicted in figure 14. My project aims to push the boundaries which in turn shapes binaural classical music recording conventions by carrying out a recording of the same performance from multiple points of audition.
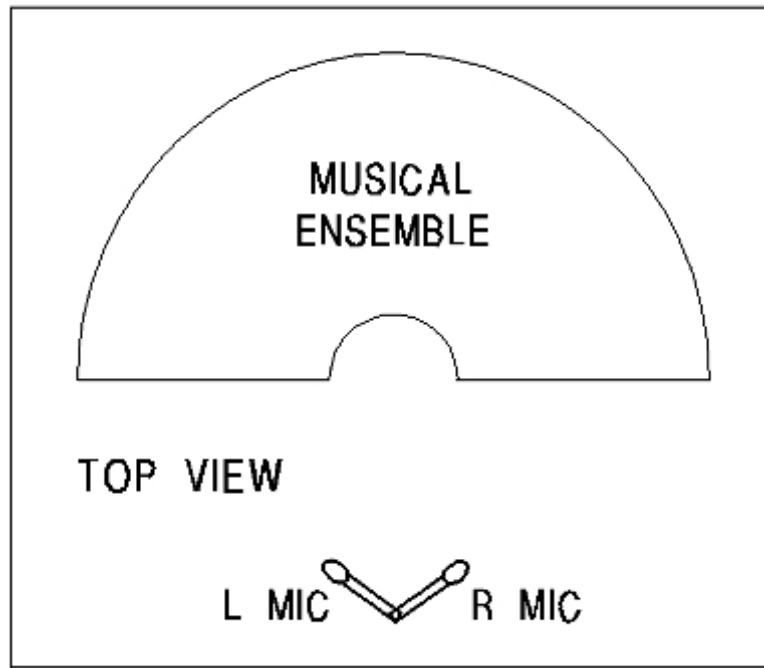
Fig. 13: Diagram of a typical stereo microphone placement for on-location recording of a classical music ensemble.

Orchestra

Recording from one point of audition: dummy head on stage
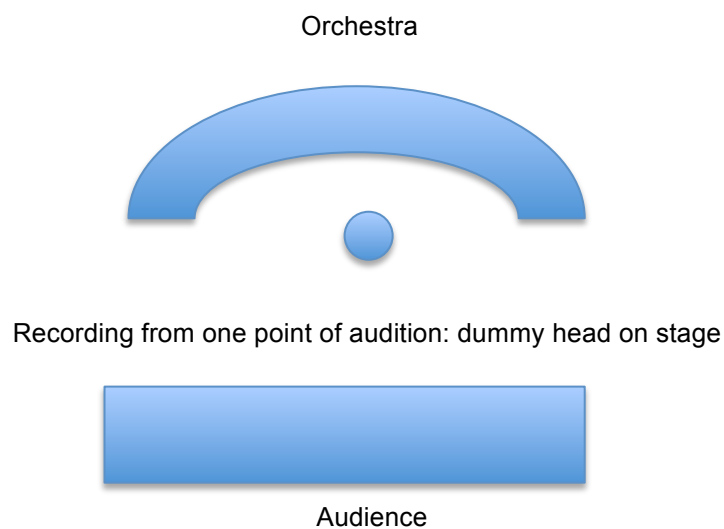
Audience

Fig. 14: Conventional binaural recording of a classical music performance.

Orchestra
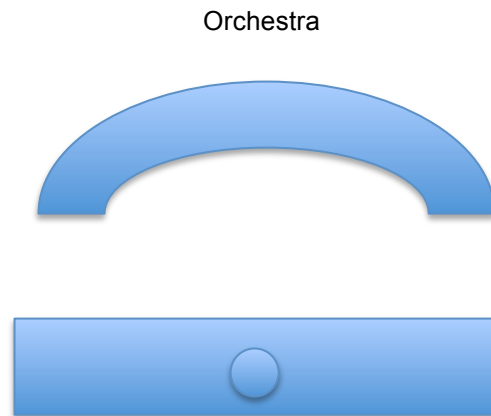
Recording from one point of audition from the live audience's perspective.

Fig. 15: Jon Rellim's adapted binaural recording positioning.

Sacconi Quarter Players
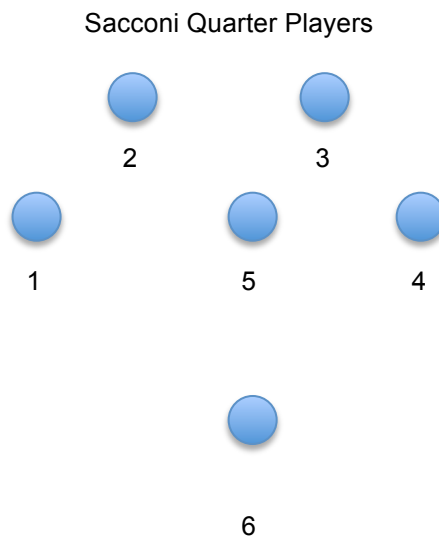
1 = First violinist's point of audition

2 = Second violinist's point of audition

3 = Viola player's point of audition

4 = Cellist's point of audition

5 = Centre of the stage's point of audition

6 = Audience's point of audition

Fig. 16: Layout of my app prototype's unique five points of audition binaural recording positioning.

Instead of listening to one, my "Point of Audition" app prototype enables a listener to sonically move around the Sacconi quartet eavesdropping on exactly how each musician hears the performance.

At the start of *Hack the Quartet*, my app prototype idea caught the attention of a senior producer from Bristol Old Vic who invited me on stage to sit in what was dubbed a 'binaural hot seat' for an introductory performance given by the Quartet. It was considered a binaural hot seat because it was an ideal seat in the room to listen to an even balance of the quartet coming from the position of my left and right ears. In addition, while the rest of the audience were seated at the back of the conference room, I was fortunately given a privileged close up point of audition on stage with the Quartet.

When describing the experience to the audience after the performance, I found myself using words including 'immersive', 'engaging' and 'connected'. While I am not a classical music expert, I found listening from the 'close up' point of audition enabled me to let the performance wash over and surround me and identify the separate parts of the quartet more coherently as they merged together for the performance. One part of the piece felt like I could hear the violinist's chords surprisingly creep up behind my ears in a sinister manner. By limiting the physical distance between the performer and me, the binaural hot seat enabled me to have a more emotional connection to the music. I wanted other audience members who were at the back of the room to

hear what I had just heard close up and this became my drive for the app prototype: to break down the hierarchy of seating arrangements in a typical classical music performance to enable listeners' ears to feel like they are 'live' on stage with the performers.

Pervasive Media Studio producer Verity McIntosh recorded the performance on her smartphone's camera, which allowed her to visually zoom in on the performance giving her a closer image than her natural human vision. Unfortunately, McIntosh had no technology to allow her ears to zoom in on specific points of audition on stage. Just as a camera can roam and zoom in on particular subjects, my app prototype enables a listener's ears to sonically zoom in on specific performers of the quartet so they may listen from intimate close up points of audition.

Fig. 17. Still image of me sitting in the binaural hot seat.

The next stage in production involved a rarely discussed yet vital aspect of recording subjects: building trust. The Sacconi Quartet were unfamiliar with binaural microphones. My introduction involved addressing the Quartet's fear of the unknown and encouraging them to feel comfortable wearing binaural microphones. The recordist's creative role of listening begins long before one presses the record button.

Sound artist and experimental musician Francesco López wrote in a journal extract about a sound recording expedition in Sarapiquí, Costa Rica: 'Following the activities of the leaf-cutter ants…And I feel like a creator; not because I am recording or because I might be later 'composing' something with these sounds, but simply because I am listening to them with dedication and passion' (50). While I was not recording my subject matter in a rain forest like López but rather a conference room at Pervasive Media Studio, this process of feeling like a creator through the act of listening resonated with me.

I started mediating the Sacconi Quartet's performance space by listening to the quartet members' needs. As binaural microphones are worn in the ear, musicians are often initially cautious to try them as they are understandably concerned it may block their aural ability to listen and respond to their fellow musicians. Listening to the subjects' concerns, I was able to create and tweak the recording session as each musician required a slightly different microphone set up. For example, the first violin player preferred placing the portable zoom recorder in his pocket for ease of movement while playing. Ensuring the musicians felt comfortable with microphone and zoom

recorder positioning is ideal practice for a recordist because the musicians are then not distracted by wires and microphones when recording. These considerations shaped my recording choices and essentially meant I started mediating the space before I even began recording.

I also listened to and mediated the natural environment of the place in which I carried out the recordings. I was given a conference room to record the Quartet. The musicians' time was precious so I had to quickly transform the room into a more optimum recording space. This involved closing doors and windows to block out external noises for cleaner sounds. One side of the room was covered in large glass windows so I closed the fabric blinds to try and soften the acoustics of the room. These are all creative decisions the person who listens to the end result of the recordings may never realise but are worth highlighting to explain how tiny rapid creative decisions I made as the recordist all contribute to and mediate the binaural recording of the Quartet's performance.

An interesting convention of classical music recording also shaped the recording process: concealing the presence of the recordist. Unlike "Audio Postcards" where the recordings are imprinted with my point of audition as artist, this app prototype explores the concept of recording others' point of audition, namely the four musicians of the quartet and thus concealing the recordist. While my voice as recordist was not heard in this case study, arguably the musicians' voices were clearly audible. The emerging theme of voice appeared during the recording process. While I did not hear the

musicians talk during the recording, it felt like I heard their 'voices'. Just as I heard inflections within the accent in Melanie, Maria and Andreas' voices in "From Austria to America", I listened to how the musicians used their instruments as their 'voice' in the performance interpreting the piece of music with their own personal intonations. Similarly to "From Austria to America", just as a person raises or lowers their volume of voice during key moments in an interview, each musician in the Quartet played their instrumental 'voice' at varying volumes to reveal emotional insights about the piece being played.

After the recording, the Quartet kindly donated some of their sparse time for an interview on their first encounter with binaural recording and I learned what type of binaural microphones the musicians preferred to wear. My classical music recordings were shaped by economic factors. A social constructivist approach illuminates financial factors' role in socially shaping the construction of technology. For example, Edison's invention of the light bulb was shaped by economic pressures to 'keep his costs as low as possible – not merely because he and his financial backers wished for the largest possible profit, but because to survive at all electricity had to compete with the existing gas systems' (MacKenzie and Wajcman 12). On a micro level, my case study is also affected by economic factors.

It was not feasibly possible for me to locate, buy or hire multiple expensive Neumann dummy heads to record six different points of audition. Instead due to financial reasons of cheaper, more readily reproduced and thus more available binaural equipment coupled with a curiosity to

experiment, I used two types of binaural microphones: two sets of Soundman OKM Mark II microphones and two sets of Roland CS-10EM microphones. They are both in-ear binaural microphones and pre-tests I carried out before the hack revealed one could not identify the difference in the end product recording between which type of microphone was used. However, while carrying out recordings, the two different microphones made a vast difference for the musicians.

The Quartet preferred the Soundman microphones over the Roland microphones simply for their visible make up. The Soundman microphones have a light foam covering that allows the musician to hear more of their surrounding environment and fellow musicians which is crucial for timing in classical music. In contrast, the Roland microphones have a plastic rubber covering that blocked out too much sound so you only really hear yourself close up perhaps likening it to the sensation of hearing oneself more clearly underwater but the external world above water level is too blocked out. I counteracted this challenge during recording by tweaking the microphone set up to allow more room for hearing which in turn mediated the recording. The learning experience proved invaluable as I have since modified my kit for future classical music binaural recordings.

After gathering these insights, I took the creative decision to mediate my .wav audio files into the shape of an app prototype for exhibition. An *app* is 'a self-contained program or piece of software designed to fulfil a particular purpose; an application, especially as downloaded by a user to a mobile

device' ("app"). Why choose the app format for this project? On a practical level, I wanted to evolve my skills as an artist and learn about the implications of using this new media type of exhibition and the impact of this exhibition choice on listeners. I also worked out my exhibition choice by working backwards from my target audience: remote listeners who financially or physically cannot attend live classical music performances.

Online platforms provide a cost-effective global market for sound artists to reach remote listeners. My previous project used a website platform as its method of interaction by inviting listeners to become immersed in soundscapes of Bristol and Brooklyn. The two "Audio Postcards" websites were designed to feature hyper links that interact, weave and connect the Bristol audio postcards to Brooklyn Audio postcards to my own personal website. In contrast, the app by its nature is self-contained and is designed to provide a different form of interactive user experience.

Design theorist Dr. Ian Bogost defines an app by noting

the days of the software office suite are giving way to a new era of individual units, each purpose-built for a specific function... It's no accident that these gadgets also refuse the multitasking and deep integration of traditional graphical computer operating systems...apps are meant to be isolated from one another (Bogost).

Bogost also draws an analogy by comparing a software suite being a music album and an app being a single. Bogost is perhaps too quick to lament the app aesthetic as 'like tic-tacs, always sweet, always there, but usually there

for no reason', as one may argue there are beneficial reasons to utilise the 'isolated' self-contained nature of apps.

My theoretical reason for choosing the app aesthetic as the method of interacting with the listener at the exhibition stage is that it mirrors my binaural recording process at the production stage of capturing an isolated single performance: a self-contained sonic recording. Furthermore, an app's self-contained nature in a way emulates the experience of being audibly immersed, contained and enveloped by sound waves in a single space, typically the concert hall, when listening to live classical music.

Of course, listening to classical music on an app remotely over sitting stationary in one position alters the listening experience. Sound theorist Frances Dyer muses on the position of listener and the 'immersant's body' in new media piece Charlotte Davies' *Ephemere* and *Osmose* when she writes

> listening demands the kind of passivity that has been associated with the nonaggresive, mythologized innocence of sound within certain quarters...The fact that the body is still in this moment of suspended interactivity only serves to highlight the unnaturalness of this construct, and to suggest perhaps the stillness, or inactivity, is the perfect stance for approaching the simulated image (170).

Physiologically our bodies are arguably designed to move. This stillness and 'passive' state often encourages our aural senses to focus on the surrounding sonic environment. However, perhaps the 'unnaturalness' of staying still for a substantial period of time during a classical music

performance with limited accompanying new visual stimuli (in contrast to cinema) inhibits younger audiences from experiencing live classical music. An app instead allows a listener the freedom to choose their position to listen at a time and place that suits their lifestyles from listening in the stillness of their sitting room to weaving though their daily commute on public transport.

The classical music industry has started experimenting with the app format. Currently the majority of apps aimed at a classical music market may be split into two main categories: functional and educational. For example, the Associated Board of the Royal Schools of Music app *ABRSM Aural Trainer Grades 1 - 5* is designed to help students prepare for ABRSM music exams. Apps on the market that are functional tools for composers and musicians include the Steinway *Metronome* app, the sheet music viewer *piaScore* and a playback device *Notion*.

The Orchestra from Touch Press also uses live recordings: eight pieces recorded in stereo at Henry Wood Hall in London. The app aims to demystify orchestral music and educate app users by allowing a participant to watch music notation alongside the performance and includes additional extras such as 3D photographs of particular instruments.

There appears a gap in this emerging market for recording the 3D audio experience of a live performance. These apps' recordings are in stereo, which splits a performance's recording artificially into left and right channels. In contrast, using binaural technology mediates a performance by recording

sound from the position of where one's two ears hear live music thus giving recordings a tantalisingly real, rich and lifelike texture.

The desire to transport remote listeners' ears to feel like they are there at the original performance fuels my binaural research. Part of the inspiration came for this project while at the cinema. When watching a digital audio-visual recording of an opera production captured live at the National Opera House in August 2013 and then played later to a remote audience at Cinema de Lux in Bristol, I noted how the close up camera angles on the opera singers' faces actually provided me with a clearer view of the production than if I was sitting in the audience at the opera hall. I believe binaural technology can provide this audio equivalent in classical music. Remote listeners are given the added value of connecting with performers in close up on stage when they listen to the quartet's four points of audition. Just as I entered the cinema to experience an opera, remote listeners may use the "Point of Audition" app to hear the orchestral piece exactly how the musician hears it when performing live from multiple privileged close up angles that I was not privy to hearing when I recorded the quartet live in the conference room during the hack.

An app format was also selected for an obvious practical advantage. Devices that publish apps including smartphones and tablet devices each have a mini-jack socket enabling a listener to plug in headphones and listening through headphones is mandatory to experience binaural recordings.

Does this impact classical music listening? It appears the preference for individual remote listening over listening as part of a live audience has affected classical music venue sales. On writing about the uncertain future of the arts due to aging patrons, Judith Miller notes:

> two other studies, commissioned by the National Endowment for the Arts...quantify these trends in great detail. They conclude that despite higher incomes and better levels of education, younger Americans are unlikely ever to attend live performances of what one of the authors calls "highbrow" culture -- especially classical music...-- in the same proportions or with the same intensity as the generations before them (Miller).

One way of ensuring the future of classical music listening is for venues and performers to 'diversify and broaden its audience' (Miller). Also Miller cites Judith Arron, the executive director of New York's Carnegie Hall who is implementing this approach aggressively because: "Of course we are anxious... [to maintain] ticket sales and packed performances" (Miller).

Perhaps apps are a useful way of targeting this younger adult audience. Rather than expecting younger audiences to attend classical music performances in person, why not take this live classical music to the listener instead in a place they already enjoy listening to music: on their smartphone devices through in-ear headphones? Recording classical music binaurally also gives a remote listener the added value of multiple points of audition.

Having mapped out the practical and theoretical reasons for choosing an app format, I then chose which app platform to build the app prototype. In this time-pressured environment of 48 hours, I decided to use an app building programme: App Furnace. Having carried out pre-tests on alternative app building software, I found App Furnace's interface was the most accessible for beginners. After I finished recording the app's content, I began mediating my digital audio content by compressing them into smaller audio files more compatible with an app platform.

I learned how to do basic coding to set up a player on the app, which enabled listeners to stop and start and change from one point of audition to the next musician's point of audition.[34] The reasoning behind this design decision is to encourage the remote listener's interaction with the performance. In Oliver Grau's reading of virtual reality piece "Osmose", he writes: 'The more intensely a participant is involved, interactively and emotionally...the less the computer-generated world appears as a construction; rather it construed a personal experience' (qtd. in Dyson 116). The app prototype is specifically designed to encourage such involvement and interactivity. The listener can choose to create their own 'personal' sonic map of the performance by choosing to move from listening to the cellist's audio perspective for example to the first violin by simply pressing the screen's stop and start activated buttons.

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[34] As this is a basic app prototype and I am not a professional coder, "Point of Audition" is not a polished piece. Despite much research for a solution, it contains a minor bug in which the listener must allow ample time when pressing 'stop' before then moving on to 'play' the next point of audition. Otherwise the first point of audition will keep playing.

While the app prototype's aesthetic style is certainly more raw than polished due to the hack's time constraints and personal technical skills, it still serves the function of showcasing the binaural recording of the Quartet's performance from multiple points of audition for a remote listener.

Fig. 18: Still images of two screens from the *Point of Audition* app prototype.

At the end of the two-day hack, I presented "Point of Audition" to an audience at the Watershed cinema during a public talk and demonstration. Audience members later experienced the app prototype individually as I had set up a collection of Android phones with the app pre-loaded. I received positive feedback from approximately twenty listeners and it was fascinating to watch listeners' reactions to the app. Based on this public talk, I was then invited to showcase the app prototype again at the Bristol Old Vic during an event for *Bristol Proms*. This talk provided me with a valuable platform to discuss

binaural technology's application to classical music and highlight its' creative appeal to target diverse audiences for classical music.

It is perhaps impossible to conclude this research because this app prototype created in two days and the impact of using binaural technology for this case study is still creating ripple effects and growing in development. The head of classical music for Universal personally requested my contact details to learn more about my binaural research after listening to my work at a subsequent public exhibition of Hack the Quartet's findings on 2 August 2013 held at Bristol Old Vic.

The Sacconi Quartet were also keen to experiment with binaural technology again with the first violinist, Ben Hancox, telling the audience at Bristol Old Vic that my Point of Audition app was 'the most exciting project with real potential to come out of Hack the Quartet' (Hancox).

Sheila Hayman, a BAFTA award-winning filmmaker, who was in the audience at the Bristol Old Vic has since hired me as a binaural sound artist and expert for her classical music app prototype, "Page to Stage", which will be discussed as the next case study in this chapter. Ultimately, this basic app prototype contains an original seed of an idea, which has demonstrated the impact of using binaural technology to experiment with multiple points of audition when recording a performances as a means of generating more diverse audiences and immersing remote listeners in classical music recordings.

"PAGE TO STAGE"

My research into the applications of using binaural technology to the recording of classical music research led me to collaboratively work with Sheila Hayman, Kenneth Hamilton (Dean of the College of Arts, Humanities and Social Sciences at Cardiff University) and Amanda Bayley (Professor of Music in the School of Music and Performing Arts at Bath Spa University). It also involved binaurally recording the London-based Orchestra of the Age of Enlightenment (OAE). Working with this orchestra proved a natural meeting of minds. Similar to my intentions behind "Point of Audition", the OAE are also keen to attract a more diverse audience.[35] Their app prototype, "Page to Stage", is funded by Arts and Humanities Research Council's knowledge exchange hub: Research and Enterprise in Arts and Creative Technology (REACT). After the app prototype's director, Sheila Hayman, experienced my presentation on "Point of Audition" at Bristol Old Vic, she felt creating additional points of audition for her app may prove a valuable added feature of her classical music app prototype so I was invited to become part of their project as a binaural sound artist.

I was responsible for carrying out binaural microphone tests with the orchestra and then recording four musicians binaurally during the film shoot. The four musicians were selected by Hayman, the app prototype's producer and director, as she wanted to film four audio-visual segments with musicians

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[35] The OAE's desire to attract diverse audiences to classical music is evident in their string quartet pub events, *The Night Shift*, which interacts with young crowds explaining the context of pieces to listeners in between pieces and drinks in a friendly pub setting. In the orchestra's own words: 'we've ditched those irksome classical rules – so feel free to drink, cough, clap or even boo when you like' (OAE).

who she selected as interesting within the orchestra. In this instance, my use of binaurally recorded point of audition was applied here to match and accompany Hayman's planned visual close-ups of the four orchestral musicians.

Similar to my recordings with the Sacconi quartet, I found building trust quickly was necessary when OAE musicians wore binaural headphones for the first time. While some were excited by this new experience, one musician was particularly hesitant. He was concerned it would compromise his hearing ability and performance. On a side note, having discussed recording classical music with other audio-visual practitioners, it is common to meet challenges when introducing new methods in a genre that has a strong set of recording conventions drawn from stereo recording. Helping the orchestra overcome their resistance to a new convention was key to successful recording process for this project. In her online blog of the app's progress, Sheila notes: 'the binaural sound recording headphones have been subjected to the rigorous scrutiny of the orchestra's approval system (and passed – hooray!)' (REACT).[36]

After the recordings were ingested by the app's editor and synced up to the accompanying visuals with the markers created during the film shoot with clapper sounds, it was time to test out the app on potential users. This proved

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[36] The binaural recording session for OAE also revealed another interesting new challenge. One of the musicians' ears was a different shape from the other which meant the binaural microphone could not physically sit in his ear like a typical mp3 headphone so I had to construct a microphone position draped over his left ear that matched the level of the other microphone is in his right ear. This experience reminded me that wearing binaural microphones and listening back to binaural recordings is limited to listeners who have full functionality in both ears and this ability should not be taken for granted.

illuminating. It is worth noting due to financial and time constraints; the cinematographer filmed the musicians in a single close up frame when each of the four musicians was wearing binaural microphones.

Two versions of the app were tested out. App prototype A involved the user moving from a wide visual shot of the orchestra with an accompanying stereo recording automatically blending to a close up visual with accompanying binaural recording of a musician. In App Prototype B, the user had to manually 'turn on' the binaural recording when it reached the close up of a musician by pressing a pinch gesture button that was in the shape of a small blue circle with two arrows pointing outward. The test users were not told anything about the app and therefore were not aware that binaural recordings featured. Very few users noticed an audible difference when it cut to a close up. The app designer and director believe this is because they did not flag up the binaural feature clearly. So, they decided to re-design the small nondescript blue circle button to feature a button with an ear icon to denote the option to audio 'zoom in' on the musician's binaural audio perspective. However, if you scratch beneath the app's interface, I believe there is a deeper factor at play too: the previously discussed persistent desire for fidelity.

In the film world, filmmakers are conditioned to create audio-visual fidelity on screen. For David Bordwell and Kristen Thompson, fidelity:

refers to the extent to which the sound is faithful to the source as we, the audience conceive it. If a film shows us a barking dog and we hear a barking noise, that sound

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is faithful to its source; the sound maintains fidelity. But if the picture of the barking dog is accompanied by the sound of a cat meowing, there enters a disparity between sound and image – a lack of fidelity (190 – 191).

Matching images with an accompanying 'faithful' sounds has been a filmmaking preoccupation since the 1930s. Altman noted (49) that J.P. Maxfield, West coast chief of Electric Research Products Incorporated (ERPI), 'insisted repeatedly that the eyes and ears of a person viewing a real scene in real life must maintain "a fixed relationship" to one another (Maxfield)'. Adhering to this 'fixed relationship' understandably allows an audience to easily make sense of the represented reality on screen. An audience is more likely to quickly accept the reality of a cat on screen if the image of the cat is synched with a realistic accompanying cat sound.

Michel Chion describes sound's faithful relationship to visuals as a contract; each invaluable to the other (5). They are whole entities in which they individually add value to each other. Sound's 'added value' is the 'expressive and informative value with which a sound enriches a given image so as to create the definite impression, in the immediate or remembered experience' (5).

My binaural recording of a particular musician 'adds value' to the accompanying visual close up of the musician as the app user experiences a visual close up and an audio close up at the same time. In this case, this audio-visual 'contract' is seamless as the audio essentially matches the visual close up thus appearing 'believable' or 'natural' in maintaining sonic fidelity.

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The effect of this fidelity means the binaural recording is subtle for the listener's ears. In contrast, if the app user experienced listening to the same audio close up point of audition of a cellist in a visual wide shot of the entire orchestra; their brains would detect a disparity within the audio-visual contract and therefore draw attention to the binaural feature.

Apart from my audio-visual experiments on suspense outlined in Chapter Two, my previous research on binaural has not been accompanied by moving images and the majority of binaural recordings published online have no accompanying visuals so this app experience proved enlightening. Choosing accompanying visual frames, from close up to extreme wide shot, can dramatically alter the effect you design for binaural listening: either subtle and seamless or jarring yet noticeable.

Being present and experiencing how users creatively play and interact with "Page to Stage" during its user testing sessions also illuminated the impact of choosing an app format to exhibit my binaural recordings. The app prototype is designed for the user to dip in and out of the original timeline of the performance as they have the opportunity to move from the main stereo recording of the performance to experience one of four binaural points of audition of the same performance and also listen to interviews of the four musicians explaining the thoughts about the performance piece. The screen shot below from the app prototype demonstrates one user's experience who has chosen to listen to the performance from Gavin's Horn point of audition as

recorded from the visible binaural microphone positioned by me in Gavin's right ear.[37]

Fig. 19: Visual Documentation of *From Page to Stage* app prototype.

In comparison to a conventional recording of a classical music piece where a listener may only select 'stop' and 'start', the app prototype's interface is designed to give listeners the opportunity to explore the performance from four musicians' points of audition alongside the orchestral stereo recording. This design enables a listener to shape and appropriate the space of the classical music performance. Appropriation 'is considered to be making something "one's own". The 'appropriation of space - be it public or private - is tantamount to acting on something that exists outside of yourself, the goal

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[37] Please note in Appendix D: Part A of the thesis, there are more screen shots documenting one user's experience of the app prototype "Page to Stage".

being to make it your own and to reorganize your own position within this space' (Serfaty-Garzon 89). By providing a user with the ability to select and play different points of audition, the user appropriates the performance space and therefore gains more control over it and becomes more connected to the piece thus decreasing the distance between the listener and the performer.

Hayman notes 'the extra layers allow the user into the musicians' ears, thoughts and world, not mediated by experts or narrators, but presented directly by them to you' (REACT). Instead, the listener directly mediates his/her experience of the performance space. Creating opportunities for listeners to audibly shape and appropriate the performance space by providing multiple points of audition may be an area worth exploring for future considerations on how to attract new audiences and encourage them to feel connected to classical music.

CONCLUSION

"Point of Audition" and "Page to Stage" have explored the impact of using binaural technology to record classical music. Pushing the boundaries by adapting classical music recording conventions resulted in experimenting with recording multiple points of audition from a musician's audio perspective during a performance.

The case studies revealed using binaural technology impacts musicians. In each case study despite musicians' initial reservations arguably

because binaural deviates from 'familiar' stereo recording conventions, each musician agreed that wearing binaural microphones did not impede their hearing during a performance. For future practice, it was also practically useful to learn the Sacconi Quarter preferred using Roland binaural microphones over SoundMan binaural microphones.

The chapter also considered the conceptual issue of fidelity. Upon reflection, the desire for fidelity is inherently shaped by industrial influences such as marketers advertising hi-fi systems as high quality. In attempting to faithfully record a performance using binaural technology, this chapter has deliberately made visible the role of the artist in mediating a recording. The act of using binaural technology means the live performance is fundamentally mediated. The recordist shapes a recording in the microphones he/she selects, where he/she positions the microphones during a performance and how he/she alters a space before recording commences. For instance, in "Point of Audition", creative decisions I made from pulling curtains across windows to 'soften' the room's acoustics to choosing a position I selected for the audience's point of audition all shaped the recording's perceived faithfulness to the live performance.

It was also interesting to discover how adding visuals to binaurally recorded points of audition in "Page To Stage" impacts the fidelity of the recording. Selecting accompanying visual frames from close up to extreme wide shot can dramatically alter the effect you design for binaural listening: either subtle and seamless or jarring yet noticeable.

Using binaural technology to record and thus mediate a classical music performance was used as a method of attempting to limit the distance between a performer and listener of a classical music recording. This technique creates an aesthetic experience, which invites a listener to become immersed in a classical music performance up close and personal from the sonic perspective of a musician on stage.

Ultimately, an analysis of the two case studies suggests that using binaural technology to record classical music performance opens up a rich area for development when considering methods of encouraging new audiences to experience listening to classical music recordings.

THESIS CONCLUSION

A social constructivist methodology was selected to examine the thesis'
critical question: what are the technical, aesthetic and conceptual impacts of
using binaural technology to create a soundscape in different media contexts?
Essentially the thesis analysed how social groups and users interpret,
mediate and shape the technical, aesthetic and theoretical impact of using
binaural technology to create soundscapes.

To contextualise the research, the thesis began with an introductory
brief history of binaural technology, understanding how scientists explain
binaural technology and an overview of binaural users' practice in film, radio
and games respectively.

The PhD thesis then focused on three areas of binaural
technological application: social groups who use binaural technology:

(i) to document soundscapes of geographical places;

(ii) for its psychoacoustic effects to create soundscapes that encourage

a sense of intimate connection between a piece of art and a participant;

and finally

(iii) to record soundscapes of classical music performances.

Each thesis chapter focused on one of these three social groups. The
chapters shared a similar structure by first examining the particular social
group's relationship to using binaural technology. This investigation was then
followed by an analysis of how my binaural technology usage, in the form of

practice-led cases studies, also shapes the impact of selecting binaural technology to create soundscapes.

The first chapter explored individual artists and field recordists, like Paris-based Des Coluam, who use binaural technology for the shared geographical and artistic purpose of sonically documenting cities by foot when creating binaural urban soundscapes. My case study, "Audio Postcards", examined a micro aspect of a place's sounds: soundmarks. Within the confines of this case study, my research indicated the acoustic ecological definition of a soundmark and desire for authentically preserving soundmarks using binaural technology proves problematic when practically applied to the cities of Bristol and Brooklyn. During the production of "Audio Postcards", deeper critical questions on the ethics of binaural field recording and audio voyeurism in public places emerged due to binaural technology's inconspicuous nature. The role of the artist in creating and shaping sonic authenticity was also examined.

Chapter Two outlines practitioners' application of binaural technology to create an intimate connection to an art piece such as theatre director David Rosenberg's productions. A series of sonic experiments were carried out and Peter Salvatore Petralia's concept of *headspace* was applied to the chapter's case study: "From Austria To America" to further understand binaural technology's potential psychoacoustic effects. Insights from the case study included learning that using binaural technology affected both the listener and had an impact on the recordist. Carrying out binaural soundwalks

proved to be a method of connecting an interviewer with their subjects as memories of places are sonically reconstructed. When presenting "From Austria to America" at *Moving Sounds Festival 2013* in New York, qualitative data gathered at the exhibition stage ascertained adopting Petralia's headspace methodology in conjunction with carefully considered artistic choices produced the impact of listeners forming intimate connections with the installation's content.

The third chapter studied the impact of social groups who use binaural technology to record classical music performances. Traditional stereo classical music recording and binaural recording conventions were shaped in a new direction in two case studies. "Point of Audition" and "Page to Stage" experimented with recording multiple points of audition from a musician's audio perspective. The impact of using binaural technology limited the distance between a listener and performer; the listener was invited to become immersed in a classical music performance from the sonic perspective of a musician on stage, offering a specific point of audition from within the orchestra. Producing the app prototypes also revealed conceptual issues on fidelity as a strong convention in classical music recording, and the relationship between sound, vision and immersion. Ultimately, the two case studies reveal recording classical music performances binaurally opens up a rich area for development when considering ways of encouraging new audiences to experience listening to classical music recordings.

The primary focus of each chapter has been an investigation of a social user's shaping of binaural technology. However, the three chapters

share secondary connecting themes including representing the real, the voice and the role of the artist. Most notably, the position of the recordist and the recordist's subsequent imprinted HRTFs on each binaural recording led this thesis to propose considering recording soundscapes and soundmarks as ultimately subjective listening experiences which is perhaps a contentious theoretical notion but nevertheless a practical conclusion gained from the practice of using binaural technology to record soundscapes for this investigation.

Upon further reflection on all three chapters, it also becomes apparent binaural technology has been and can be used for a variety of different purposes. Social constructivists Pinch and Bijker refer to this as the previously discussed concept of technological flexibility. In other words, 'the way in which different groups of people involved with a technology…can have very different understandings of that technology (MacKenzie and Wajcman 21). From this perspective, the thesis has demonstrated the uses and applications of binaural technology are not fixed but rather open to shaping by different users. In other words, it reveals that across a range of media and users that binaural technology, despite having a long history, is continuing to have multiple interpretations and permutations in new media applications.

In a discussion on the development of the bicycle, Pinch and Bijker describe the process of closure and stabilisation in which social groups see a technological problem or issue as closed in the sense that 'closure in technology involves the stabilization of an artefact and the 'disappearance' of

problems' (426).[38] While Pinch and Bijker's study reveals the artefact of the bicycle reached closure and stabilisation with the invention of the air tyre and technological developments which addressed safety issues, binaural technology has arguably not reached a state of closure.

Instead, this thesis has demonstrated the impact of binaural technology is still being shaped and interpreted by different social user groups. The field of social constructivist studies of media technologies is often reflected upon in retrospect when a technology has become fixed such as Deac Rossell's analysis of the first film artefacts as outlined in the thesis' introduction. In contrast, this investigation is unique and original in its social constructivist approach because it is studying the social shaping of a technology as it is still emerging. Upon evaluation of the case studies, it is evident binaural technology usage is not fixed but rather still fluidly in formation. For instance, ethical issues on binaural recording in public places has yet to reach an agreed consensus amongst binaural technology users.

While there are many interpretative variations of binaural technology developments from different social user groups, interestingly binaural technology user groups are beginning to share their expertise, which in turn shapes the impact of using technology. On a minor scale, this is evident when Des Coulam agreed to be interviewed and share his expertise on binaural technology for this thesis. On a larger scale, this occurred in 2013 at a two-day event based in Geneva. Co-hosted by a senior audio scientist from the BBC, Chris Pike, and a Research and Development project manager for

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[38] It is worth noting, Pinch And Bijker do not see closure as a permanent state as a new social group may emerge and interpret and shape an artefact from a different angle.

France Télévisions, Matthieu Parmentier, the workshop discussed the issues, challenges and potential for 'the use of binaural techniques to create an immersive spatial impression for headphone sound' (BBC).

The European Broadcasting Union (EBU) funded the workshop, which suggests industries' financial investments in researching this area will shape the impact of using binaural technology. This is also evident in my thesis with Universal funding my practice and experimentation with using binaural technology to record classical music at a two-day hack as part of Bristol Proms 2013.

Within the scope of a PhD study, the case studies examined by the thesis could not examine every aspect relating to the applications of binaural technology to create soundscapes. For example, from a theoretical perspective, the role of gender in shaping technology has not been discussed as it would be a topic worthy of its own thesis. Also, carrying out experiments and binaurally recording using expensive Neumann dummy heads was not a financial option for the thesis. Nonetheless, rich areas for future development have materialized from my research.

Recommendations for further study include a deeper reflection on the ethical issues of recording binaurally in public places as discovered in chapter one, using binaural technology as a method for sonically reconstructing events and creating a sense of closeness between a subject and recordist as identified in chapter two and finally further experimentation in recording classical music performances that targets new audiences who consume music over headphones.

The thesis has fulfilled its aim in providing an original contribution to a fascinating field that has yet to be extensively analysed: binaural technology usage. While academic writing exists on the science of how binaural technology works (Blauert and Genuit; Trapenskas and Johansson), very little has been academically written on who uses binaural technology, and why, which inherently shapes the development of binaural technology.

Ultimately, the thesis weaves together an investigation on binaural technology users' work from diverse fields including sound art, theatre, field recording and classical music to highlight this area of research is far from closed but rather is still currently in exciting stages of experimentation, research and development.

Contemporary listening habits are also developing and changing as new media content is consumed on a wide range of platforms, with a significant development of audiences utilizing mobile devices and headphones.[39] These developing consumption practices offer a growing market to create soundscapes specifically designed for headphones using binaural technology.

Pike's remarks during the closing presentation at EBU's event on binaural sound perhaps best crystallise the impact of using binaural technology and how it is still actively being shaped: 'what was clear overall from the workshop is that there is a lot of energy and interest in the industry around binaural sound…Frank [Frank Melchoir – Head of Audio Research at the BBC] began by asking how long the participants thought it would be until

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[39] This is perhaps evident with the rapid increase in headphones sales, like Germany selling over eleven million headphones at an average retail price of €30 in 2012 (Pike).

binaural sound was commonplace. Opinions ranged from less than 12 months to more than 5 years' (BBC). While the time frame of binaural technology becoming mainstream may be uncertain, it is certain the technical, theoretical and aesthetic impact of using binaural sound recording will continue to be shaped by diverse users' innovative applications.

DOCUMENTATION OF EXPERIMENTATION

APPENDIX A:

Documentation of Binaural Industry Case Studies: radio, games and film

This section does not intend to be a definitive list of binaural sound industry examples. Instead, key case studies have been selected and analysed to illuminate pivotal developments made in the following three creative industries: radio, games and film.

Binaural recording can be applied to provide radio drama with a sense of immediacy as a listener becomes enveloped in the action as they hear its immersive soundscape through headphones.

BBC radio has also used binaural recording techniques to produce spine-tingling sonic storylines. In 1978, Andrew Sachs directed eleven actors in a thirty minute radio thriller, *The Revenge*, which had no written dialogue or music. The groundbreaking Radio 4 play sought 'to exploit the dramatic possibilities of non-verbal sounds (namely sound effects and acoustics) and prove that a story could be told and, more particularly, could be understood without using any recognisable words' (Shingler and Wieringa). The binaural radio play received mixed reviews. Radio playwright Jonathan Raban dismissed it as 'a wordless sequence of noises' (Shingler and Wieringa). He believed it was 'the fruition of a trend in radio drama which has increasingly

been putting sound effects before dialogue and attempting to evoke the sounds of the real world over and above an articulation of ideas (reality before art)' (Shingler and Wieringa).

It is interesting to note criticism of the BBC using binaural technology perhaps as a gimmick to produce sonic 'reality' over the art creation of shaping sounds to tell a story. It is true the aim behind binaural recording is to provide listeners with a recording, which plays to our ears as tantalizingly life-like. This is because the binaural technology and the recording practices to produce it are designed to deliver sound which mimic the human listening apparatus of two ears. However, other examples exist in which radio producers creatively use binaural technology to increase a listener's immersion in a radio drama's narrative.

One example of binaural radio drama is *Sticks* by Karl Edward Wagner, a 1998 production by ZBS Foundation: a small non-profit American audio production company. It is interesting to note how ZBS promote their use of binaural technology. They attempt to attract an audience of listeners in their marketing material by describing *Sticks*' binaural recorded sounds as '3-D Sound!' (ZBS).

Sticks' binaural audio narrative was adapted from Wagner's short story by editor Thomas Manual Lopez who works under the pseudonym Meatball Fulton. The audio was recorded using a Kunstkopf; the artificial head with microphones for ears was nicknamed Fritz. The short horror story revolves

around a haunted stone burial chamber in a derelict farmhouse. Reviewer Chris Dueker argues the:

> best binaural sequences in "Sticks" take place in the abandoned farmhouse, as characters Colin and Carol go exploring in different directions, leaving the listener feeling stuck between them in a building that you'd really like to leave. The smartest use of binaural effects happens in the cellar, when Lopez uses it to cue the listener in to the uncomfortably close presence of the ghoul long before protagonist Colin even knows it is there (Dueker).

In this case, the story's horror genre is complimented by binaural recording techniques. The radio producers used binaural technology as a narrative device to place listeners in a specific suspenseful setting that plays with sound directions. *Sticks* demonstrates that there is much creative scope for a sound designer to use binaural technology when experimenting with playful use of voice direction and chilling sound effects.

In 2011, BBC Research and Development showcased their own creative experiments in binaural technology by revisiting an audio experiment in their archives from 1958, a pioneering stereo recording of the *Festival of Nine Lessons and Carols* from King's College, Cambridge. They returned to the same site in 2007 and recorded a '4.0' presentation, or 'Quadraphonic Sound' of the Festival again. To maintain fidelity and creative choice, BBC Radio 3 released these recordings in a variety of formats. Listeners were able to choose from surround sound loudspeakers to binaural recordings. Interestingly, to maintain acoustic fidelity they released six different calibrated types of binaural recording to cater for different head, ear and headphone

sizes (BBC).

The video games industry has also utilised binaural technology to increase participants' immersion in the gaming experience. Jean Marc-Jot notes:

'spatial sound processors for virtual reality and multimedia applications (video games, simulation, teleconference, etc...) can benefit substantially from the reproduction of a natural sounding room effect allowing effective control of the subjective distance of sound events...Binaural reproduction over headphones is particularly well suited to such applications, and can be combined with image synthesis in order to immerse a spectator in a virtual environment' (Jot).

There is scope for binaural technology in the gaming industry. For example, technology company Sensuara created a binaural audio delivery: 'a type of audio playback that is more realistic because it sounds like it is coming from all around a listener' and this technology delivery was installed on 24 million game consoles (Plomin). However, the development of this technology was stalled when the global firm Creative Technology bought Sensuara and their patents in 2003 and perhaps due to the economic conditions at that time, Creative Technology chose to focus their finances on other products in their portfolio.

Another notable development of binaural technology applied in the games industry is *Papa Sangre*. In 2010, Channel 4's 4ip programme commissioned the British content design company Somethin' Else to create

Papa Sangre: 'a video game with no video. It's a first-person thriller, done entirely in audio by an award-winning team of game designers, musicians, sound designers and developers. We've created an entire world using the first ever real-time 3D audio engine implemented on a handheld device' (McIntosh). Again like in *Sticks*, the term '3D' is used here to describe binaural technology in marketing material perhaps by highlighting that binaural technology offers its' users a different experience beyond the radio convention of stereo radio dramas or stereo game design.

The creators of *Papa Sangre* admitted it was a daunting challenge as the process involved using complicated HRTF algorithims.

In the marketing material of this audio-only game, *Papa Sangre* uses the tagline: 'you are lost, deep in the darkness of the land of the dead. Your eyes are useless to you here — but your ears are filled with sound. And what is it you can hear…?' (McIntosh). Unlike the film world where visuals are often prioritized over sound, here the binaural audio takes centre stage to create an immersive gaming experience. The delivery of the game is also noteworthy. Gamers can simply download the game as an app and experience the game through headphones. This platform is understandably a cost-effective and appealing method of reaching a mass audience. This method of delivery might also have tremendous application in the blind community for learning and entertainment purposes. Testing sessions and users of the game shaped its ultimate technological design as the games' design team at Somethin' Else utilised legal hacks so iPhone VoiceOver users, particularly within the blind

community, could also use this audio-only game.

In contrast to the gaming industry, the film industry is remarkably lacking in rich binaural technology examples though creative sound designers have toyed with the concept of creating a 3D soundscape. There are of course different listening conventions within these two industries. Traditionally, the exhibition of sound space in film reverberates against a public cinema's walls listening as a large collective audience in comparison to smaller groups or individual game users listening to a game's sound design in more private settings such as one's living room. However, with the rise of users experiencing films and playing games individually through headphones on tablet and smartphone devices and home cinema systems, emerging conventions of listening in both film and gaming industries are increasingly overlapping.

A binaural design example in film experienced individually at home through headphones is Audio Ideas Guide website writer Andew Marshall's DVD review of DVD review of *Being John Malkovich*. In Marshall's Audio Ideas online guide, he comments on the features of binaural sound design edited By Richard L. Anderson. Marshall listened to the film on headphones. He recalls:

> The way the in-Malcovich's-head scenes are done is uncanny when listening this
> way. I really did feel like I was in somebody's head, the sound fully binaural: when he
> scratches the top of his head it seems to come from above; when he drinks his coffee
> or chews his Melba toast, it seems to come from just below and in front…uncanny!
> (Marshall).

While this may not be a classically cinematic example as Marshall is listening to the film's sound design at home through headphones, nonetheless this filmic example on a DVD showcases binaural technology's ability to immerse an audience member within the narrative by enabling them to experience a particular character's point of audition. There is much creative potential for utilising binaural technology to increase immersion within a cinematic experience. However, this industry is lacking in rich examples in comparison to the games and radio industries. As previously discussed in the introduction one reason for this may be because cinemas would incur costs wiring individual mini-jack sockets for each participant's chair in comparison to the cheaper cost of distributing 3D glasses to customers for 3D visual films. Also, wearing headphones would break the convention of listening as a collective in a cinema.

APPENDIX B: Documentation OF Experimentation for "Audio Postcards"

PART A:

Documentation of two passages from a research sketchbook journal kept during the creation of the "Audio Postcards" case study.

PASSAGE 1:

Observations made during editing process / November – March 2012

My editing decisions are informed by the natural beat of everyday life. For example, it feels natural to mark my end point cut to the sound clip when the motorboat engine cuts out.

There is a real sense of being an audio voyeur. The snippets of private conversations captured are often thought-provoking as you want to understand more about the context behind the lines uttered. Many lines would make the start of an excellent novel. It reminded me of the interview I read about Maeve Binchy in which she revealed she got all her best ideas from listening to conversations in public such as long train journeys. There are also ethical considerations when deciding what to include and exclude during the editing process.

Some clips really aurally demonstrate binaural technology's 3Dlike texture. However, I constantly refrain from putting in clips exclusively for their

binaural quality unless they also weave into the geographical tapestry of the place's audio impression.

I am naturally drawn to seeing the comedy in life so I also have to refrain from putting a comical twist on some of the conversations I edited as it is very easy to splice and cut the conversations out of context to create funny statements. I have chosen not to tamper with the order of words too much so I don't believe it's ethically fair to do this to the speakers.

There is a lot of wind interference on the recordings. While one may usually try and clean this interference up, I am keen not to hide the imperfections of recording everyday life. From a technical point of view, it was hard to always gauge the exact correct recordings as there was no device on my binaural kit to listen to the audio as you record it. Instead you are listening to everyday life as your ears hear it. While this provides a more naturalistic interpretation of the experience, it does mean occasionally there are technical glitches like wind microphone interference. When it was windy on location, I tried to use my body as a windshield and this in turn changed the shape of the journey I took wandering around the city.

The constant drone of traffic is audible in nearly all my tracks. Until you take time to actually listen, you don't realise how much these mechanical sounds seep into everyday life soundscapes. For example, in a park scene in a film you may clearly hear tweeting bird effects, leaves rustling through the wind and other natural sounds. However, the day I recorded sounds in the

park it was quite noisy. The sounds of cars and sirens drowned out these delicate natural sounds. My recording essentially reflected the park's urban setting.

When I write out transcriptions and annotated notes of my initial audio impressions of the field recordings, I notice that I use a different vocabulary for some of the descriptions: pavement -> sidewalk etc.

It is interesting how the sounds that I usually try and mask or inhibit recording on location during a film shoot including cars, planes and passers-by talking actually becomes the subject of my recording everyday life. Rather than masking it, I am drawn to these sounds as a field recordist.

My sound work practice has visual influences: namely Impressionism and street photography.

The issue of considering whether a track is usable or not is if it contains popular commercial music?

There is no need to layer sounds on top of each other as everyday life is naturally already so layered. For example, in a two second sonic snapshot: you can hear the sound of a ball being hit on a pool table, babbling conversation, Arabic music in the background and plates being lifted off a table in a bar in Brooklyn.

My field recordings also act as a sonic diary of my time spent in each place. Listening back to the recordings feels like reading back pages from my diary as my mind makes personal connections with the sounds I hear – sonic-triggered memories.

To create a valuable space for perspective and reflection, I left a period of time between recording and listening back to the recordings in post-production. I was amazed at how tiny sounds triggered back my visual memory of places too. I know there has been research on music triggering memories and applying this to Alzheimer's disease patients. However, I wonder if any work has gone in to soundscapes triggering memories?

I have chosen to do very little mixing with the sounds I recorded because everyday life is naturally already mixed with multiple layers. It has a natural rhythm to it. I am aware that I am tampering with the temporality of events by splicing recordings. However, I am keen to leave the recordings as raw as possible so this means no EQ filters etc. so listeners get the chance to hear the soundscape as I experienced it in real life.

Some of my recordings are shorter than others because on the day, I made a judgment call each time how long I would spend in each location. If for example, a loud droning construction work drowned out a lot of other sonic details, I only stayed in such a location for a short period of time. At this production stage, I was already beginning to edit sound temporally.

My presence affects the place I'm recording in. For example, two shop assistants stop their private conversation when I enter the shop. While binaural technology allows you a certain useful invisibility, your present body is still visible in the recording space.

Music plays a huge part in the soundscape of alternative areas in Brooklyn and Bristol. There is constant music coming from speakers in venues, shops and cafes. The music selected is often alternative music. My body acts as a mixer as it walks between two different sound sources.

PASSAGE 2: HANDWRITTEN NOTES

Photographic documentation of the "Audio Postcards" exhibition decision being sketched out for the first time and handwritten notes on listening back to binaural soundwalks in November 2012.

When considering how to exhibit my audio postcards, I have thought long and hard about what I want to gain from the project, how the exhibition may answer some of my critical questions and what the listener is getting out of the experience. I have been toying with the following prototype. I will exhibit the piece online for reasons I will discuss at a later date (themes of online sound space) When the listener arrives on the screen, there will be three sections:

1. CHOOSE YOUR SOUNDMARK AUDIO POSTCARD

| PARK | BUSINESS | SHOPPING |

| MARKET | WATER SIDE | CREATIVE NIGHT LIFE |

using headphones Here, listeners have the option to sift through and select. → making their own creative choice
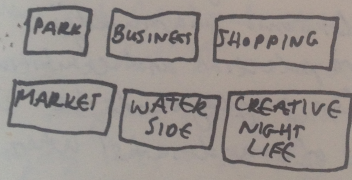
2. RECORD YOUR OWN MESSAGE ON HOW THE CITY'S SOUNDS HAVE EFFECTED YOU, WHAT YOU HEARD ON YOUR TRIP ETC.

HERE. LISTENERS DOCUMENT THE PERSONAL EFFECT OF THE CITY'S SOUNDMARKS

Notes on listening to Brooklyn binaural recordings   NOVEMBER 2012.

TRACK 002   16 MINS LONG - DOWN BY PROSPECT PARK.
constant sound of a pick up truck beeping.
"the park is closed - If you don't turn around we're going to issue you
tickets" - police officer
dialogue segments.
so pretty

sit on your butt

and there's two lillies

she destroys that megaphone.

nice blend of children playing and bird song - zoom 008
violent blend of tree being sawed and bird song.
water fountain - zoom 008 - shows off 180° binaural angles. from
right ear behind the back of the head to left ear.
zip - nice sharp sound - maybe at the end of the piece.
footsteps - crackle - whoosh of jacket material - zoom 008
"I can't save any of the data until I access it on the computer.
end of zoom 008 - long swoop of aeroplane - prob too long.
this is a free country you understand? - zoom 012
from Zoom 027 - in McCarren Park.
zoom 027 - sound of baseball bat - two short clips.
girl - I don't like that" perhaps followed by zip at the end
and maybe sirens or trees being sawed before it.
lots of loud sharp car horns - for top track.
Mommy take a picture - enjoys visuals over sound - the park
[   ] relaxing despite nice views.

Fig. 20: Photographic Documentation of two handwritten pages from my research sketchbook journal for "Audio Postcards" case study.

PART B:

Map Documentation of two of my soundwalks that formed the Brooklyn: Park Area audio postcard.

Images were generated from screen shots using an app called *Trip Log*, which marked my precise GPS movements at Prospect Park and Brooklyn Botanical Gardens in September 2012.
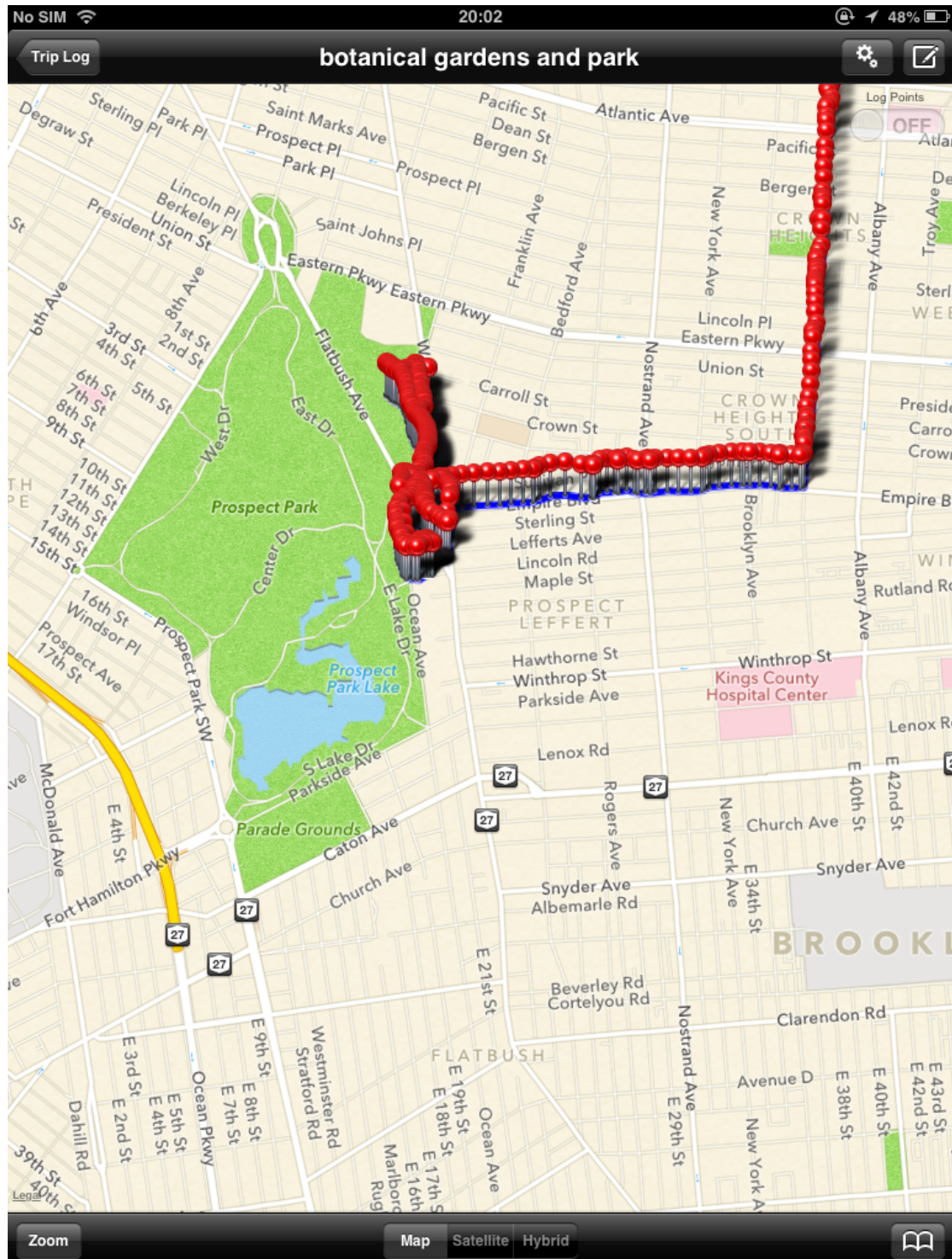
Fig. 21: Screen shots of GPS-located map documentation of two soundwalks carried out in Prospect Park and Brooklyn Botanical Gardens in October 2012.

APPENDIX C: Documentation of Experimentation for "From Austria to America"

PART A:

Documentation of first sketch of a portable Theatre Jukebox for "From Austria to America" sound art installation.

Measurements:

Height: approx.: 1.5 metres

Width: approx. 1 metre

The jukebox sits on a desk at the library.

Drawbacks: table will not fit in between bookshelves and it only has two shelves.

Fig 22: Documentation of initial first sketch of building "From Austria to America" sound art installation

PART B:

LIST OF INTERVIEW QUESTIONS FOR "FROM AUSTRIA TO AMERICA" Interviewees.

Each of the three participants were asked the below list of open-ended questions when I carried out interviews over Skype in July, 2013.

AUSTRIA:

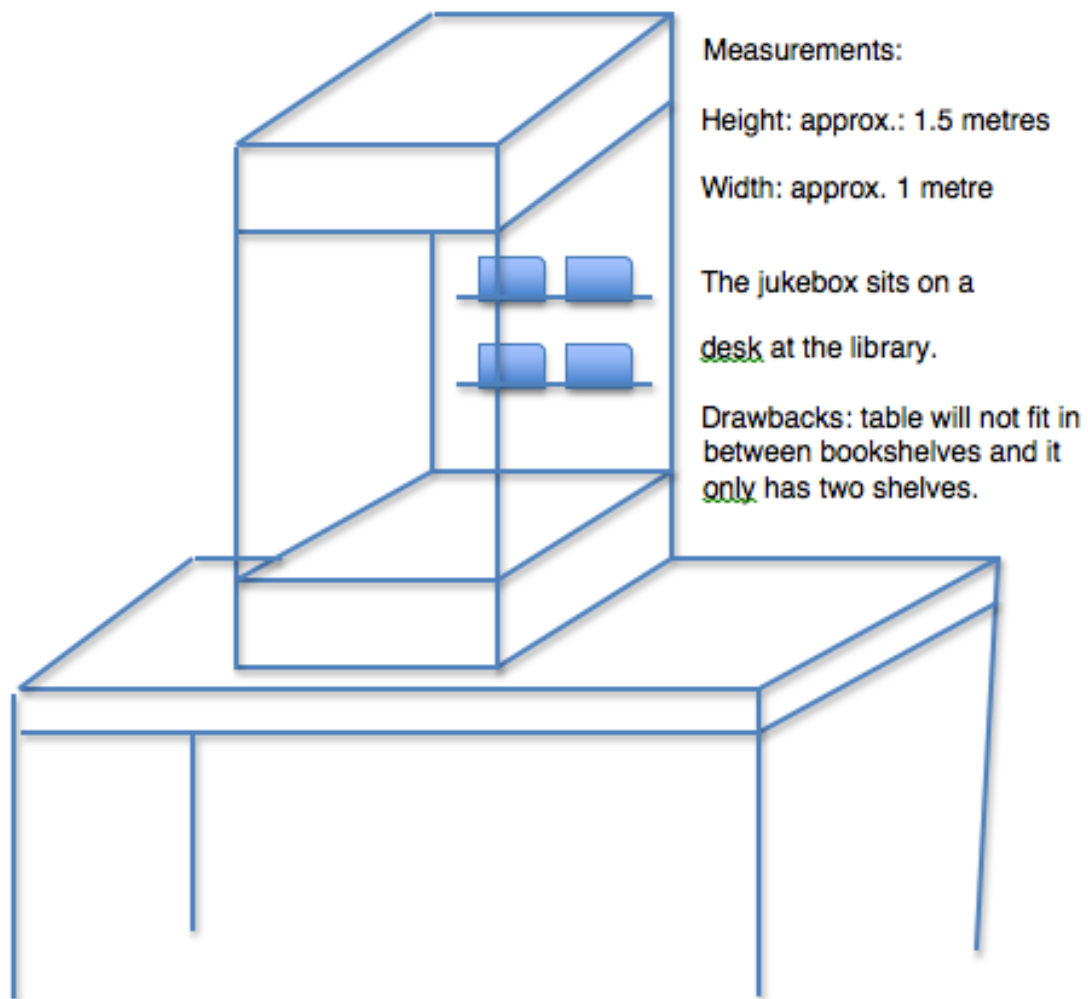Can you tell me a little about your home in Austria and where are you from?

Did you have any favourite places, sounds or sights growing up in Austria?

What do you miss most from Austria?

AMERICA:

When did you emigrate to America?

Can you explain the reasons and circumstances what led you to move to America?

Why did you specifically move to America and not somewhere else in Europe?

What were your first impressions when you moved to America and did these meet your expectations of America?

Do you have any favourite sounds, sights or places you like visiting in America?

HOME:

Do you consider America home now?

Do you visit Austria often or occasionally? What is it like returning home from being away?

Do you ever feel homesick and if yes, how do you overcome your longing for home?

How do you define home? What ingredients do you need to make a home?

APPENDIX D: Documentation of Experimentation for "Page to Stage" AND "Point of Audition"

Documentation screen shots of a user navigating "Point of Audition" and "Page to Stage" app prototypes

PART A: "Point of Audition"
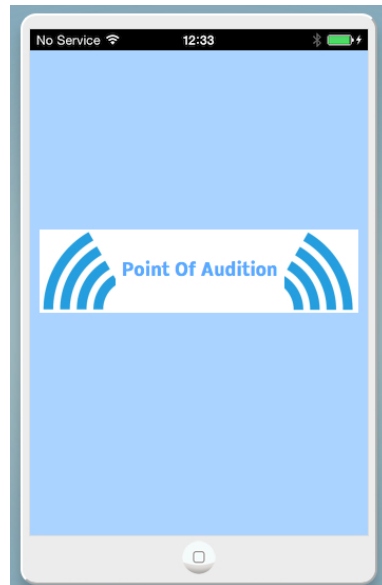
Fig 23: Screen shot 1 of a user navigating "Point of Audition" app prototype
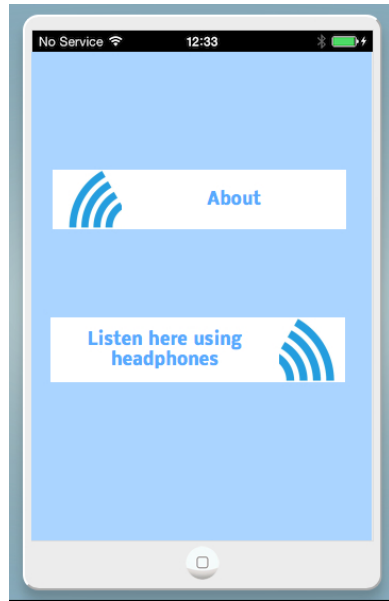
Fig 24: Screen shot 2 of a user navigating "Point of Audition" app prototype
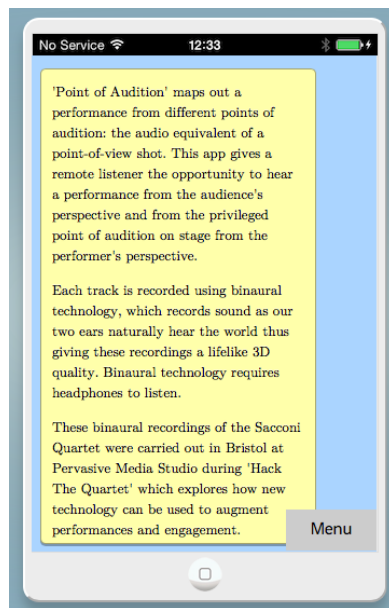
Fig 25: Screen shot 3 of a user navigating "Point of Audition" app prototype
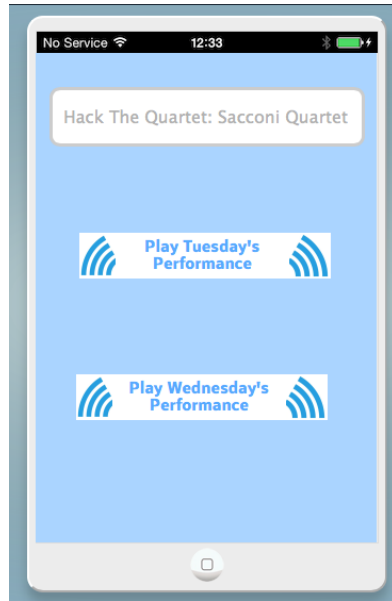
Fig 26: Screen shot 4 of a user navigating "Point of Audition" app prototype
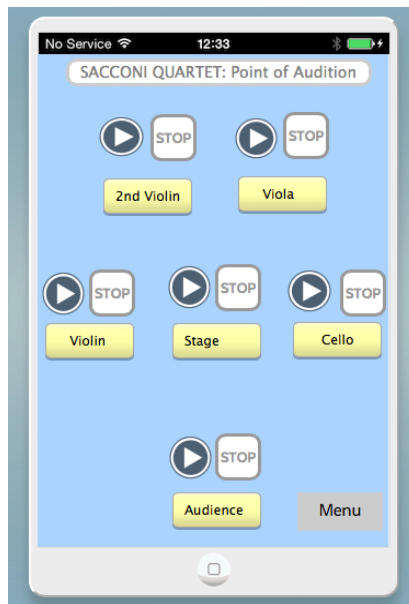
Fig 27: Screen shot 5 of a user navigating "Point of Audition" app prototype

PART B: "Page to Stage"

Fig. 28: Screen shot 1 of a user navigating "Page to Stage" app prototype

Fig. 29: Screen shot 2 of a user navigating "Page to Stage" app prototype demonstrating the ear icon button that triggers the binaural point of audition feature of the app prototype

Fig. 30: Screen shot 3 of a user navigating "Page to Stage" app prototype

Fig. 30 Screen shot 4 of a user navigating "Page to Stage" app prototype demonstrating the ear icon button that triggers the binaural point of audition feature of the app prototype

Fig. 31: Screen shot 5 of a user navigating "Page to Stage" app prototype

Fig. 32: Screen shot 6 of a user navigating "Page to Stage" app prototype

Fig. 33 Screen shot 7 of a user navigating "Page to Stage" app prototype demonstrating the ear icon button that triggers the binaural point of audition feature of the app prototype
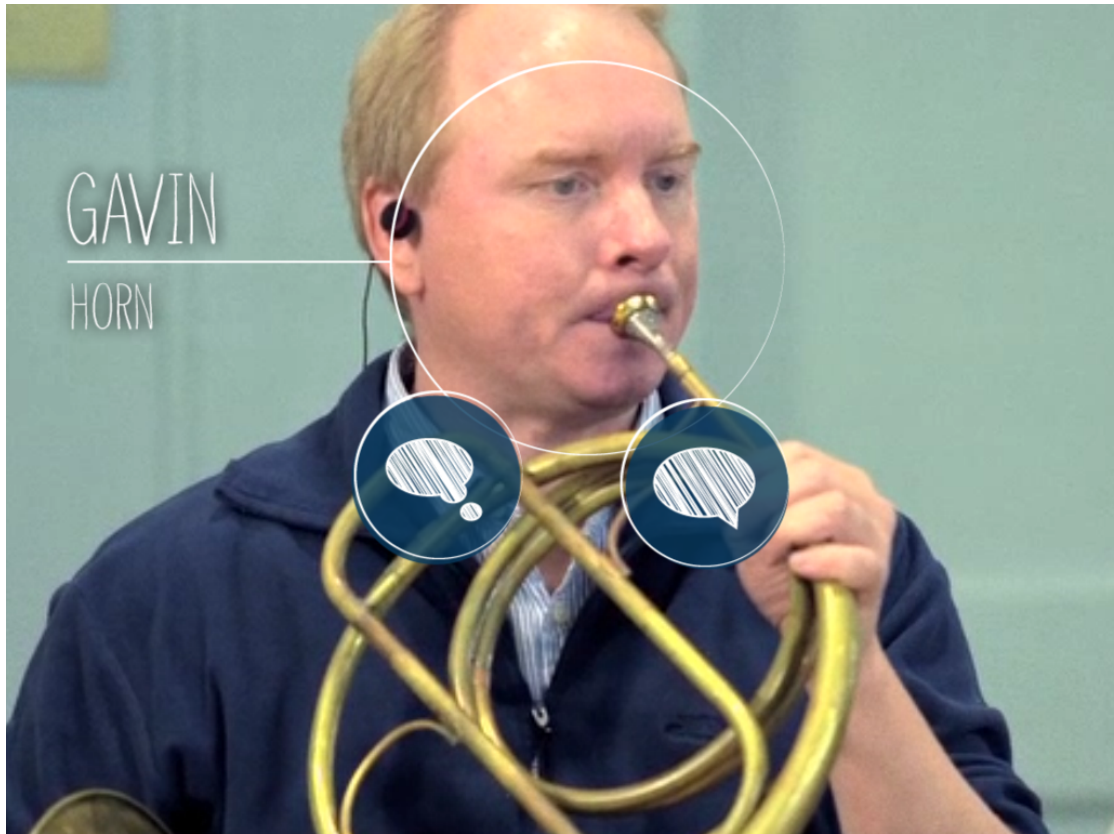
Fig. 34 Screen shot 8 of a user navigating "Page to Stage" app prototype

APPENDIX E: Documentation of Experimentation for Binaural Sound Suspense Experiments

In the first year of my PhD project, I devised a series of sound suspense experiments. They were carried out as an introductory exercise to understand the technical aspects of using binaural technology. Valuable insights gained from these experimental sonic sketches later informed important technical decisions made in the thesis' second case study "From Austria to America".

During this foundational practice-led research on binaural sound, suspense will be referred to under numerous synonyms: 'unease' 'uncomfortable' or tension' as this collection of terms all add to the creation of suspense genre's characteristic atmosphere of uncertainty, anxiety and mystery. With its playful use of pre-emptive sounds, spine-tingling mood music and offscreen sonic terror, the genre of suspense offer a sound designer an exciting creative canvas and it is for this reason that suspense has been selected as the theme of my practical experiments.

Over a three-month period, a series of experiments were carried out to explore, firstly the relationship between the 'shape' of sounds and psychoacoustic effects and secondly how different forms of sound delivery impact on audience perception The sonic experiments were tested out at in a controlled environment at Pervasive Media Studio in Bristol. Twenty-four testers individually listened and watched Suspense Experiment A, B, C, D, E and answered five corresponding surveys. When designing the sound experiments and surveys, the objective was to address specific critical

questions about the sound of suspense and binaural sound technology, which fall under two categories: psychoacoustic and sonic delivery.

SECTION 1: PSYCHOACOUSTICS

In relation to offscreen sounds, absence, frequency and sound patterns, what role can psychoacoustics play in the sound design of suspenseful binaural recordings?

OFFSCREEN SOUNDS

The artistic technique of using offscreen sounds may be traced directly back to the early talkies. A key sequence in Alan Crosland's The Jazz Singer includes offscreen sounds as a device to build tension. Jakie Rabinowitz's desire to become a jazz singer defies his traditional father's wish for his son to follow in his footsteps and become a cantor at their local synagogue. When thirteen-year-old Jakie is caught performing jazz songs in public, his angry father drags him home. The following title card flashes up on the screen: "I'll teach him better than to debase the voice God gave him!" Then Jakie's father drags him in to another room in their home and presumably beats him. At this point, the music score is tense stabbed with violent beats, which perhaps signify Jake's presumed beating behind the closed door. Arguably, the sequence may not have been as harrowing if Crosland chose to visualise the beating. Instead, he intensified the violence by creating a sequence in which

the audience must use their imagination to create their own personal images to accompany the music and action of what happened behind the closed door. Each audience member will imagine slightly different accompanying images and for Walter Much, this is true sound fidelity. In an interview with Frank Paine, Walter Murch proposes:

> the perfect sound film has zero tracks. You try to get the audience to a point, somehow, where they can imagine the sound. They hear the sound in their minds, and it really isn't on the track at all. That's the ideal sound. They hear the sound in their minds, and it really isn't on the track at all. That's the ideal sound, the one that exists totally in the mind, because it's the most intimate. It deals with each person's experience, and it's obviously of the highest fidelity imaginable, because it's not being translated through any kind of medium (359).

Offscreen sounds therefore encourage a personal reading of a film. Perhaps the arguably personal interpretation of offscreen sounds lends itself to being powerfully used in films' domestic personal spaces: characters' homes. *Distant Voices, Still Lives* uses acousmatic sounds to demonstrate a poignant passage of time. A static wide shot of the family home's empty staircase is accompanied by an energetic soundtrack drenched in memories. One of Davies' auteur signature styles, 'memory realism', is brought to life in this sequence's soundtrack, which 'enacts the very process of remembering' (Kuhn). The audience hears waves of memories on this stark stairs from the sounds of children's footsteps running up and down to a dark reminder of the

domestic abuse, which previously occurred in the home. The empty stairs tells the audience the children have now grown up and presumably moved out.

In the cited examples of *The Jazz Singer* and *Distant Voices, Still Lives*, offscreen sounds move beyond the threshold of onscreen sounds where spectators can pinpoint their sources to an unknown and conceivably uncomfortable offscreen sonic space. A sound designer may utilize this uncontained offscreen sonic terrain to build up tension and uneasy mood. This sound technique was emulated in the composition of Suspense Experiment A. The piece charts an alcohol-fueled argument between a couple. The tester is provided with a filmic image of a closed apartment door. The only moving visual cues the tester is given are blurry shadows in the right hand corner of the door where the frosted glass has not been covered by cardboard. The tester listens to the offscreen violent argument unravel behind the closed door through headphones.

The experiment was designed to examine how a tester reacted to offscreen sounds and if it affected their perceived level of suspense. The following bar chart represents question 1 and its results:

On a scale of 1 to 7, how tense did this experiment make you feel? 1 = extremely relaxed
7 = extremely tense
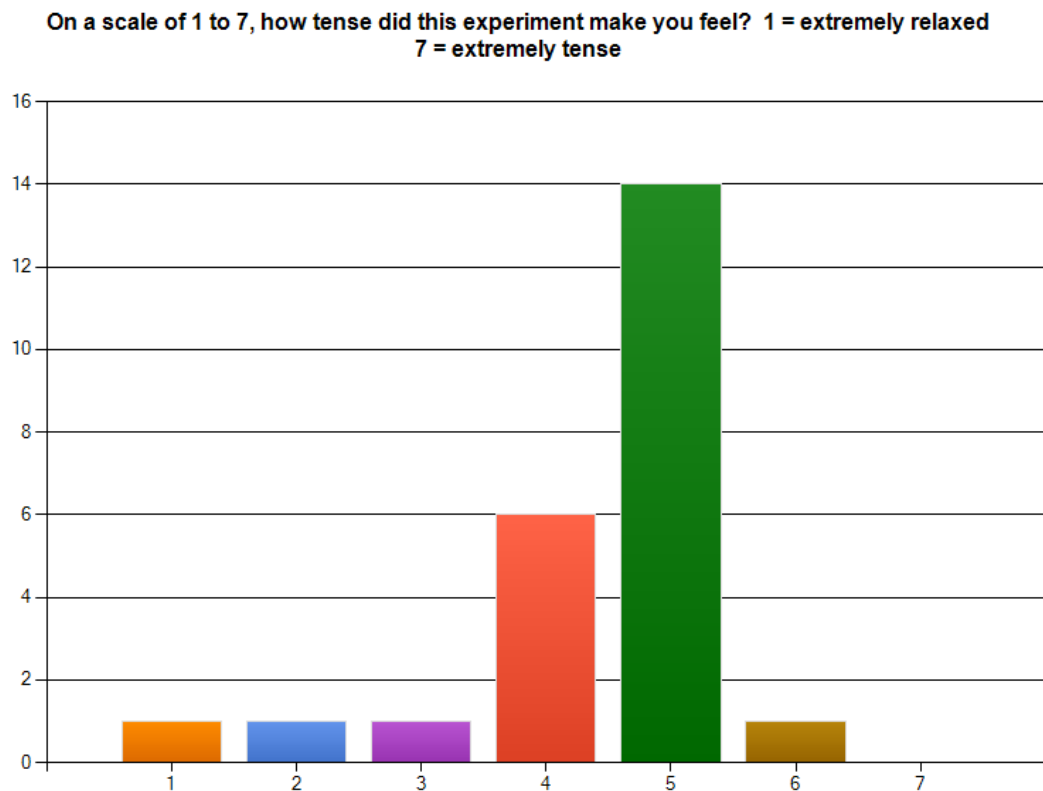
Fig. 35: Visual documentation of Suspense Experiment A's findings.

Only one tester found the offscreen sounds extremely comfortable. Instead the majority, 14 out of the 24 testers, selected number five from the range of one to seven proving in this instance offscreen sounds create more a feeling of tension than comfort. As testers could not see the direct source of the offscreen sounds of the violent argument, Suspense Experiment A also relates to another psychoacoustic element of suspenseful sound: absence.

ABSENCE

The absence of visuals or sounds in an audio-visual film may create a sense of unease for the audience member. In the case of absent sound, David Sonnenschein notes:

> psychologically, humans like to make sounds and surround themselves with them to nourish the concept of perpetual life, so that silence can represent aspects of negative attitudes such as oppression or solemnity. Silence can remind people that they are alone, that they have been rejected, or that there is no hope. The absence of sound can evoke the fear of the absence of life (125).

Francis Ford Coppola's *The Conversation* plays with this connection between absent sound and absent life. Throughout the psychological thriller, a surveillance team's recorded conversation between a couple at San Francisco's Union Square is repeatedly played over and over to decipher the true meaning behind their dialogue. Absent distorted sounds in the recording mark an absence of understanding and potentially absent life as surveillance expert Harry Caul desperately tries to understand the following cryptic sentence: "he'd kill us if he had the chance". This is a fascinating example of how audio can build up a sense of suspense.

Absent visuals are also connected to fear and loss of life in Alejandro González Iñárritu's contribution to the *11'09"01*: a collection of short films, eleven minutes, nine seconds and one frame in length, which consider the terrorist attacks on September 11 from different world perspectives. Inarritu's

"Mexico" short film opens with a black screen, which lasts for one minute and forty-eight seconds before viewers are given a brief flash of an image of the burning towers. Distorted, indecipherable and babbling layers of voices accompany the absent visuals. The lack of pictures in a sense puts the soundscape in 'close up' as the audience member only has audio cues to try and make sense of the short film's narrative. Similar to *The Conversation*, absence in the marriage between audio and visual provokes suspense, anxiety and questions. The creative decision to omit visuals throughout the film is explained in the thought-provoking final image of a quote in Arabic: 'does god's light blind us or guide us?'

The narrative structure underpinning Suspense Experiment B was guided by this technique of absence to build up suspense. It details a distorted walkie-talkie conversation between two Bristol police officers and an assistant commander from Scotland Yard during the Olympic torch ceremony and potential terrorist threat. There were absent visuals throughout the entire experiment in the form of a black screen. The walkie-talkie narrative provided a creative canvas to naturally play with audio distortion and sonic absence. The accompanying survey's questions addressed key critical questions concerning absence. The first question explored if absent sound affected a tester's understanding of the narrative:

Did you fully understand exactly what was happening in the scene you heard?

- Yes
- No
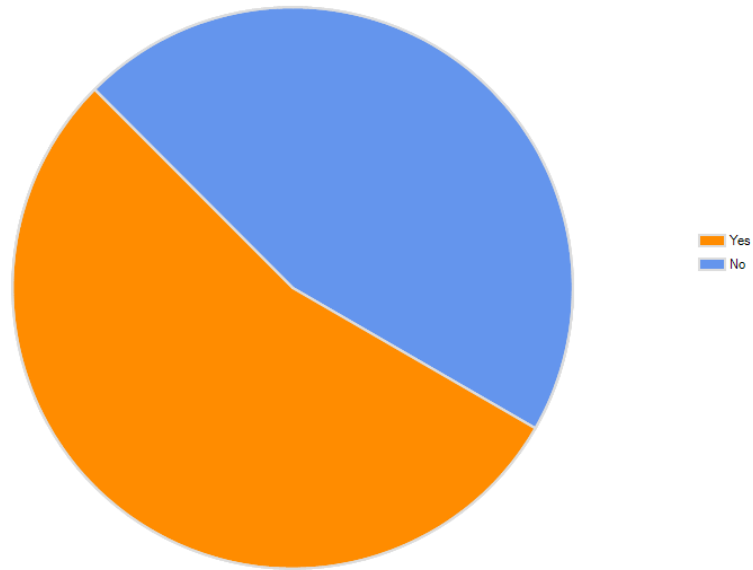
Fig. 36: Visual documentation of Suspense Experiment B's findings.

A slightly higher percentage of testers, 54.2%, of testers did not exactly understand the narrative. The story plot was purposely designed to inhibit clear narrative understanding. I was eager to examine if this lack of narrative understanding caused by absent audio-visuals built up a sense of suspense and piqued one's curiosity or not:

Please select a, b or c.   Did the audio distortion:
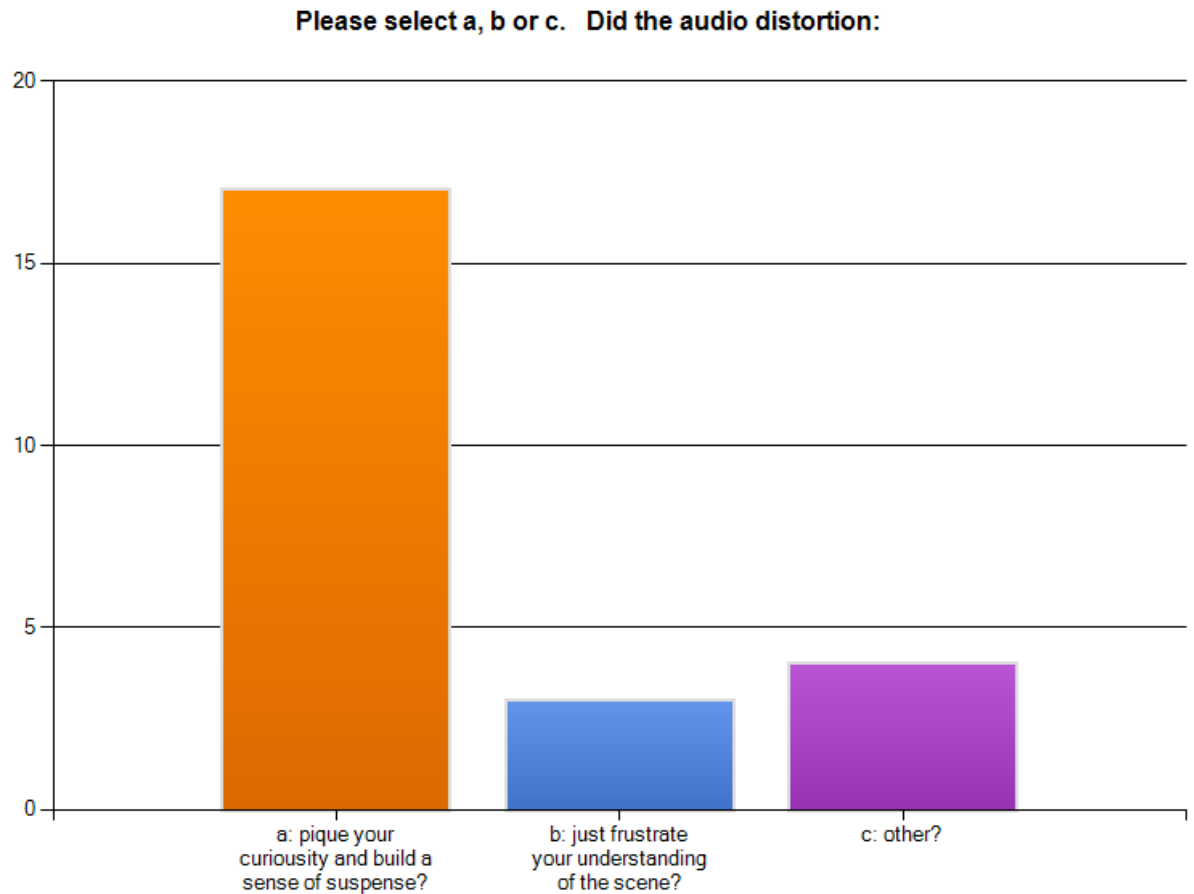
Fig. 37: Visual documentation of Suspense Experiment B's findings: part II.

Interestingly 70.8% of testers chose a thus proving that absence in this case did create a suspenseful atmosphere. The 16.7% of testers who chose 'other' also reflected on absence with comments including: 'very effective, really unsettling, it is worrying to not understand what is happening'.

The previously discussed Experiment A also deals with absent visuals as viewers piece together what is happening behind a covered glass door through offscreen sounds. I wanted to see how testers reacted to this lack of images and attempt to answer one of my original key critical questions: is a binaural soundscape more immersive with or without accompanying visuals?

Like Experiment B, results show absent visuals also built up suspense. Rather than switching off due to a lack of visuals, testers became more immersed in the experiment as they had to create their own personal images to accompany the sounds of a violent argument between a couple. 83.3% of testers admitted they used their own imagination to fill in the missing visuals of what was happening behind the door such as picturing what the couple's faces might look like. When asked what would they find potentially more tense: 56.5% of testers found imagining their own image that accompanied the sound of a violent argument more tense over being given a provided clear image to accompany the violent argument.

These two experiments on absence will directly affect the narrative construction of my installation piece on suspense. Results reveal that both absent visuals and sound build up suspense and encourage the participant to become more immersed in the piece as they personally fill in the audio-visual gaps. It begs the question, can I create a more suspenseful film without visuals and if yes, can the piece be considered a film if there are no filmic images?

LOW FREQUENCY SOUNDS

The use of low frequency sounds has changed over time due to evolving technologies. Up until the 1970s, with the exception of Dolby Stereo 70mm film, sound designers and composers largely relied on instruments such as the double bass to produce low frequency sounds. With the introduction of

synthesised instruments in the late 1970s and early 1980s, a new range of low frequency sounds became possible. One such system, Sensurround, employed this fresh range of low frequency possibilities. Sensurrond was a collaborative product made by Cerwin-Vaga, a loudspeaker manufacturer, and Universal Studios. The system was designed to 'enhance the audio experience during film screenings' which directly impacted how audiences responded to low frequency sounds ("Low Frequency Effects").

The system was exclusively created for Universal's 1974 film *Earthquake*. Senssuround emulated the earthquake tremors on screen by emitting low frequency rumbling sounds from large subwoofer speakers. The subwoofers designed for the system were incredibly large because very low frequency sounds:

> in the 20 Hz range, such as those used to simulate the sound of an earthquake…the human ear is not very sensitive to sounds at these low frequencies, so it takes a tremendous amount of amplification for the human ear to hear them. As well, since they are sound effects, they may have a longer duration or sustain than many low-pitched musical notes, which makes them harder to reproduce accurately' ("Low Frequency Effects").

Applying these technical specifications gave viewers the experience of feeling trembles, which proved a success as Senssurround was awarded a special Academy Award and contributed to the increase in sales for subwoofers in the 1970s and 1980s. Senssuround was used for four subsequent films: *Midway*, *Rollercoaster*, and *Saga of a Star World*. However,

the low frequency sound system was then discontinued due to financial reasons such as expensive weekly fees from Universal to fit the speakers. Each cinema theatre also had to be closed for several days before a Senssuround film premiere to undergo a structural check before the system could be installed. Furthermore by 1979:

almost all of the classic movie palaces were closing…many of them were more then 40 or 50 years old and there was too much worry about the structure remaining intact. Smaller one-screen theaters…were not equipped to play movies in Sensurround. Multiplexes had become the rage and owners were not willing to disrupt as many as 5 other auditoriums for one movie (Sanchez).
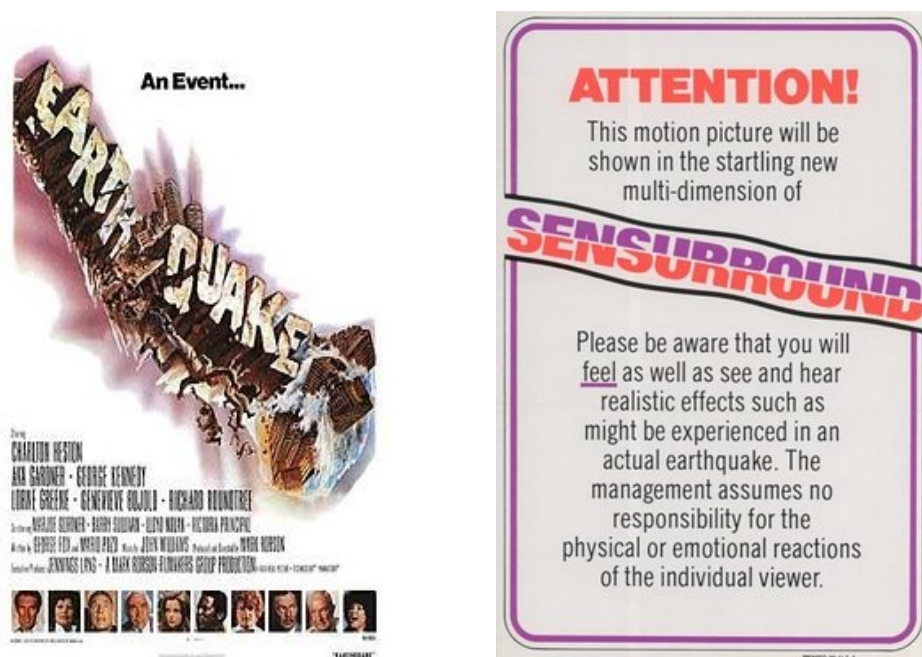
Fig. 38: Marketing Material for *Earthquake* and *Sensurround.*

Ten years later, 5.1 surround sound systems in cinemas and home theatres allowed consumers the opportunity to enjoy listening to low frequency sound trembling effects. The subwoofer speaker, which forms part

of the 5.1 surround sound system, is built to play 'bass information from the center and surround channels when those speakers are unable to adequately reproduce the bass frequencies' (Dolby).

Films have used low frequency technology over the decades to create a sense of suspense. Low frequency sounds are often layered in filmic soundscapes to pre-empt upcoming moments of action. Low rumbling sounds warn viewers of danger ahead, which the protagonists on screen may not see varying from low bass musical trembles in film noir to natural low trembles in disaster films such as the oncoming destructive tornedo in *Twister*.

In Suspense Experiment E, the aim was to analyse listeners' emotional responses to low frequency sounds. In collaboration with a musician, Emily Teague, a layered low frequency soundscape was created lasting 24 seconds. During the production of this experiment, it became apparent this is perhaps too short a time period to build up any real suspense and also does not have any narrative motivation. However, the main objective was to gauge testers' initial gut reactions to the low frequency sound. Testers were invited to describe a picture they would imagine accompanying the deep sound. Some common trends emerged in testers' responses. As many of the testers were cinephiles (33.3% of testers watch more than two films a week), a high proportion of testers instantly linked this low frequency sound to a sci-fi image.

Testing was carried out individually. Though curiously many testers imagined a similar image:

- 'something alien and strange'

- 'A rocky, alien planet at night inhabited by nocturnal creatures.'

- 'Spaceships'

- 'It sounds other-worldly, like it's in a spaceship or in a cave. Definitely alien! The sound which was moving made me think of a creature of some kind...'

- 'Some kind of weird alien emerging from the darkness'

- 'something from a early 90's sci-fi' (Suspense Sound Experiments).

Based on these qualitative findings, it was interesting to note how low frequency sounds have become so popularly linked to one specific film genre: science-fiction. Possibly due to the overuse of this low frequency sound device in media, such as US TV series *The X Files*, listeners' ears have become jaded. One tester notes: 'a range – from an alienscape to a cave setting. It didn't really make me feel suspenseful' (Supense sound experiments). However, the emotional response to the low frequency sound still offers a promising potential reason for using of low frequency sound in creating suspense. Each tester was asked to select three moods from a range of twelve moods, which they associated with the test's low frequency sound. 'Dark', 'mysterious' and strange' proved the most popular and these three moods are key ingredients for creating cinematic suspense.

In my practice, a way forward is to discard stale science-fiction low frequency sound stereotypes and instead re-work low frequency sounds in new environments. One original method may involve utilising infrasound. By definition, *infrasounds* are 'sounds below the human range of hearing, technically 20Hz, but most adults will be hard pressed to hear anything below

40 Hz' ("infrasounds"). To put this in perspective, the main 'resonant frequency of person's internal organs is below 5 Hz' and an average sub-woofer speaker goes down only to 25-40 Hz. A scientific test carried out at Huazhong University of Science and Technology in 2004 revealed that human exposure to infrasound frequencies, 2.14 Hz / 110 dB and 4.10 Hz / 120 dB, for a period of hour has significant physiological and psychological effects. Their results revealed that 'Infrasound can cause the changes of blood pressure and heart rate and psychological reactions include Being exposed to infrasound, a person may feel 'headachy, fretful…uncomfortable and troubled in the room' (Yuan Huang and Qibai Chen).

This sense of unease has been linked to supposed haunted sites. Psychologist Richard Wiseman notes that 'odd sensations that people attribute to ghosts may be caused by infrasonic vibrations' (NBC). There are understandable moral and medical limitations to using infrasound on a mass audience. However, incorporating infrasound into a media soundscape may potentially physically and psychologically create an uneasy atmosphere: a prime environment to tell a story of suspense.

Another rarely explored sonic option is ultrasound. Whereas prolonged exposure to infrasound can cause physiological effects as the low frequency waves slam into one's body tissues, ultrasound can relatively safely bounce off tissues. While infrasound is below the audible range for human ears to hear (usually below 20 hertz), ultrasound is too high for human ears to hear (typically above 18, 000 to 20,000 hertz). Ultrasound is currently being employed in ultra haptics technology. Ultrasound creates an immersive sound

scape in which pressure from the sound waves is translated to the sensation of touch. One facet of ultra haptics research at University of Bristol's BIG (Bristol Interaction and Graphics) is focused on an ipad size device. Testers can view an image on the screen and then feel manipulated ultrasonic pressure waves from the back of the ipad device on the palm of their hand. Perhaps ultrasound may provide a filmmaker the creative potential to allow an audience member to hear and feel the sound of suspense.

SOUND PATTERNS

Sound patterns have been used in poetry for centuries as a means of 'foregrounding the language…to produce poetic heightening' (Love). Similarly, sound patterns are often included in media to 'heighten' a sense of suspense.

When carrying out an audio audit of the US radio drama *Suspense* (1942 – 1962)*,* an observation may be about the creators' use of sound patterns as a device to build up tension. While categorisation understandably has obvious limitations, it still proved worthwhile acknowledging that the radio drama's types of sound patterns can broadly be placed in three categories: *natural* such as footsteps creeping in *The Lodger*, *music* like the spine-tingling melodic clanging bells musical sequence which opened each radio drama and *mechanical* such as the constant low hum of a car in the 1941 radio drama *The Hitchhiker*.

These categories are also applicable to film practice. Hitchcock, the "master of suspense", often selected sound patterns to build up tension. *The Birds* repeats the sounds of birds' manically flapping their wings and screeching to spine-tingling effects. In a key sequence in the film, Hitchcock overlaps grating music to create tension. When Melanie goes to collect Cathy from the school, she hears the students sing in the classroom. The children's repetitive rhyming song increases tension as they keep singing instead of closing the window and hiding as the birds wait to attack. Instead, the children's song innocently calls for their enemies: the birds. More elements of the song are added as more birds congregate on the climbing frame outside. In this scene, the birds are eerily quiet; as previously discussed absent sound is another device to make viewers feel uncomfortable. Here the children's song replaces the bird's absent song. The children's cheery sing-a-long does not emotionally mirror the feeling of pending danger. Therefore, the unempathetic song makes the audience feel uneasy which in turn heightens tension.

While music choice is key in creating cinematic suspense, sounds from the natural world can be equally as terrifying. This is evident in a subsequent scene in *The Birds* when the audience member hears the natural sounds of the birds invading the domestic order of the family home. While Mitch is asking Melanie is she would like some mustard with her meal, the birds' menacing attack is pre-empted by the deceptively sweet tweets of the caged lovebirds in the dining room. Cathy's mother calms the lovebirds by placing a white cloth over the cage. However, the birds outside are not so easily

silenced. One lone bird in the fireplace in a sense calls out to the birds outside. Suddenly a flock of black birds unexpectedly fly down the chimney and cause chaos in the family's sitting room. The incessant fluttering of birds' wings and high-pitched squawks make the family and audience feel tense. The sequence is notably lacking in music. Instead, Hitchcock relies solely on the natural sound pattern of birds to create a menacing atmosphere.

Just as Melanie cannot avoid the sound pattern of birds flapping their wings in *The Birds*, Roger O. Thornhill cannot escape mechanical sound patterns in *North by Northwest*. In one key sequence, Hitchcock bleeds one pre-emptive mechanical sound, a bus's whirring wheels along a dusty road, with another more menacing mechanical sound pattern: a crop duster plane whirring uncomfortably close to the protagonist's head. Hitchcock cleverly avoids using a music score here and instead allows the crop duster's swooping movements form the sonic structure of suspense in this scene. The mechanical sound pattern of the crop duster reaches its climax when it crashes into another mechanical sound pattern: the oncoming screechy breaks of a truck.

Hitchcock's filmic portfolio is potent with rich sonic patterns. Deconstructing sound patterns allows one the opportunity to analyse how, or indeed if, a sound pattern affects one's feeling of suspense during a film. My research on sound patterns in poetry, radio and film informed Suspense Experiment D. The experiment contains three clips, which chart the sound of a faux experiments unraveling. The listener becomes the story's 'experiment

tester'. Each experiment begins with the same segment: a steely cold voice asking the listener to take a seat, thanking them for taking part in the experiment and reminding them not to make any sudden movements during the experiment as it may aggravate the mysterious, unidentified 'it'.

In the three clips, 'it' becomes three different sound patterns: 'a' is a natural sound pattern (a persistent wasp buzz), 'b' is a music pattern (the infamous shower scene music from Hitchcock's 1960 film *Psycho*) and 'c' is a mechanical sound pattern (a grating saw sound). Each sound pattern was recorded using binaural sound technology so the sound pattern could encircle the listener's head, produce a physical feeling of directionality and come uncomfortably close to the listener's ears to increase tension.

Suspense Experiment D aimed to analyse which type sound pattern specifically caused an increased sense of suspense: natural, music or mechanical? Each tester listened to a randomized order of Suspense Experiment D's three clips to avoid bias.

Interestingly, the results reveal that testers found Suspense Experiment D the most tense experiment out of all the experiments with 9 testers rating Suspense Experiment D six out of seven on a scale where one is extremely comfortable and seven is extremely tense:

On a scale of 1 to 7, how tense did this experiment make you feel? 1 = extremely relaxed 7 = extremely tense
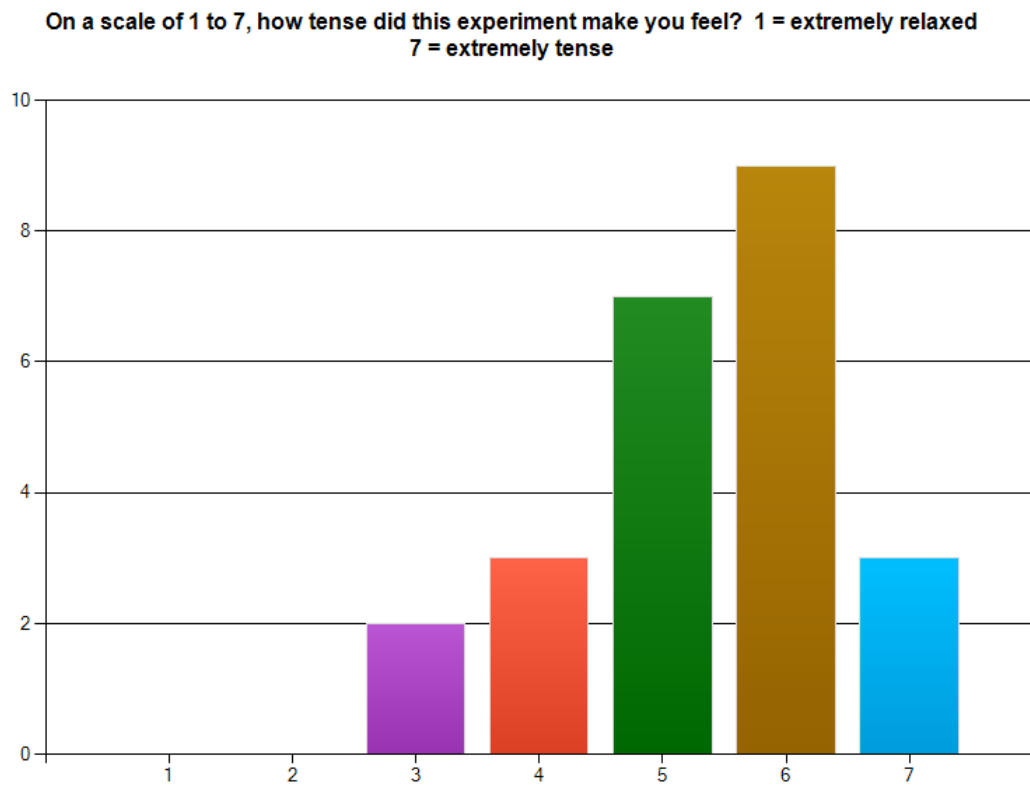
Fig. 39: Visual documentation of Experiment D's findings.

75% of testers ranked the wasp pattern first as the most tense sound pattern.

From 1st to 3rd, please rank how tense each sound effect made you feel. 1st = most tense 2nd = somewhat tense 3rd = least tense
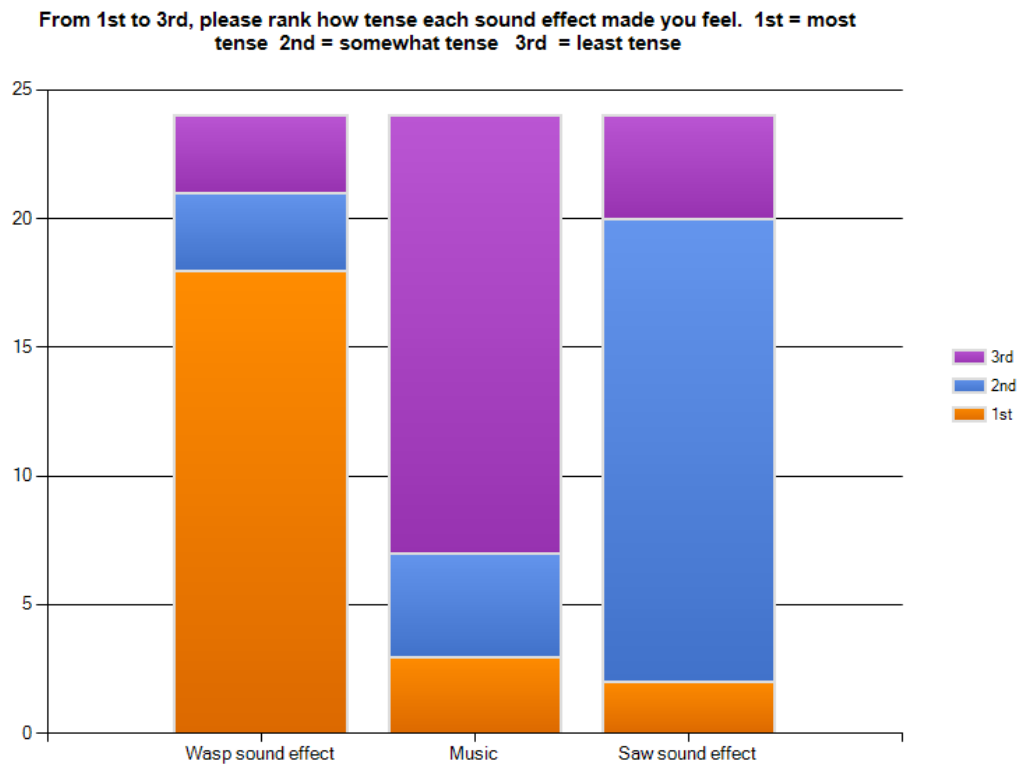
Fig. 40. Visual documentation of experiment's findings: part II.

Testers' qualitative responses for choosing the wasp sound pattern as their first choice ranged from personal associations:

- 'It is an experience I have had - an unseen insect buzzing about your head is threatening without being absurd';

- 'I don't like bugs';

- '[I] was stung on the neck as a child on 2 occasions so hearing that sound around the back of my neck particularly frightens me'

to physical reactions to the binaural recording's audio directionality:

- 'It induced a physical reaction in the form of an unsettling sensation';

- 'The very realistic impression of a wasp being so close to my ear made me feel that there was imminent discomfort, even if rationally I knew that not to be the case' and

- "It felt as if the wasp was inside my skull. It was the most disconcerting by far' (Suspense sound experiments).

Although there are limitations from drawing conclusions from a single sample range (24 participants), an obvious pattern emerged: a preference for natural sound patterns. Maybe the natural sound of the wasp binaural recording proved most suspenseful because it is a real sound one may hear in one's daily life making it easier for the tester to imagine. Rather than relying on artificially composed music or mechanical sounds to build up a sense of suspense, perhaps it is more frightening to re-work sounds one may naturally hear in one's own personal world. Perhaps the bumps and creaks you hear in the middle of the night in your home are more potentially terrifying as there is no safe distance between you and the potential danger. I am hopeful that suspense can be intensified in my next installation piece by including uncomfortably real, personal and natural sound patterns.

SECTION 2: SONIC DELIVERY

This section seeks to address answers to critical issues involving contrasting technologies used in delivering immersive soundscapes to audience members and to determine if the choice of sonic delivery affects one's level of immersion in listening to a soundscape.

Careful consideration was given to the delivery of the sound experiments. Although these experiments are preparatory research for a creative project rather than scientific experiments in a sterile lab, the objective was to ensure honest, consistent and unbiased responses from each tester. This led to conducting every experiment at Pervasive Media Studio's edit suite: a neutral environment. The same instructions were read out to each tester at the beginning of the experiments. It was explained that I would not converse with the tester during the experiments as I did not want to influence their responses. I also carried out the experiments in a randomized order using an online randomizer tool to avoid biased responses. Finally, to maintain sonic delivery equality for each experiment, every tester listened to the experiments through the same headphones.

This experience of listening to the filmic experiments through headphones was addressed in Suspense Experiment C. As binaural technology requires headphones, I was curious to examine how this form of sonic delivery would affect a tester's filmic experience. For instance, when watching comedy films individuals may potentially find group laughter

enjoyable. Would wearing personal headphones in a cinema space silence this collective listening filmic experience? I posed the following question with subsequent results:

How would you feel about wearing headphones to listen to a film in the cinema? Please select one answer.

I would enjoy the private immersive experience of listening to a film...

I would find it annoying having to wear headphones as I prefer listen...
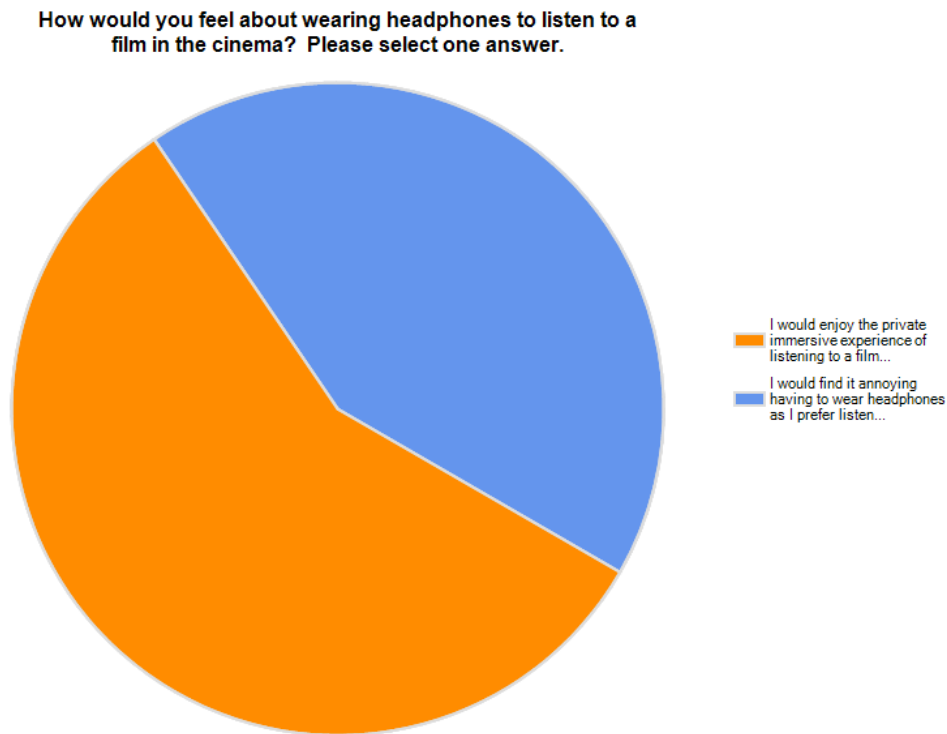
Fig. 41: Visual documentation of findings from Suspense Experiment C.

Suspense Experiment C was produced to analyse the contrast between stereo and binaural sound delivery. Users watched a scene depicting a stressed couple in a car being stopped by a police officer. The camera is in a static position in the back seat of the car. Before the police officer knocks on their window, the male protagonist hides an unidentified important item by giving it to an unidentified 'him' in the back seat / the camera's P.O.V. The user never fully sees the hidden object or see the unidentified 'him'.

Fig. 42: Still image from Suspense Experiment C

In a way, this plot device is similar to a McGuffin; a technique regularly used by Hitchcock to build suspense. A McGuffin is an object, name or person that the viewer knows very little information about. The mysterious McGuffin creates questions in the viewer's minds, which builds up a level of intrigue. At the end of Suspense Experiment C, through the sound effect of a baby crying, listeners realise that the camera's P.O.V. is actually the couple's baby. However, they still never see the baby or fully see the item, which was hidden in the baby's car seat.

The experiment, which employs the McGuffin device, involves users listening to the same scene twice. Experiment C1 is accompanied by a stereo recording of the scene. Experiment C2 is accompanied by a binaural recording of the same scene. From this experiment, I learned that the length of the isolated scene (one minute and thirty-four seconds) turned out to be too

short a period of time to build up any convincing sense of suspense. However, the experiment proved fruitful in responding to the following critical question on sound delivery: what does binaural sound technology offer which stereo recordings cannot?

When using binaural technology it is important to avoid using it as a gimmick. Rather it should be used to enhance the narrative rather than detract from it. In the experiment's corresponding survey, testers were asked:
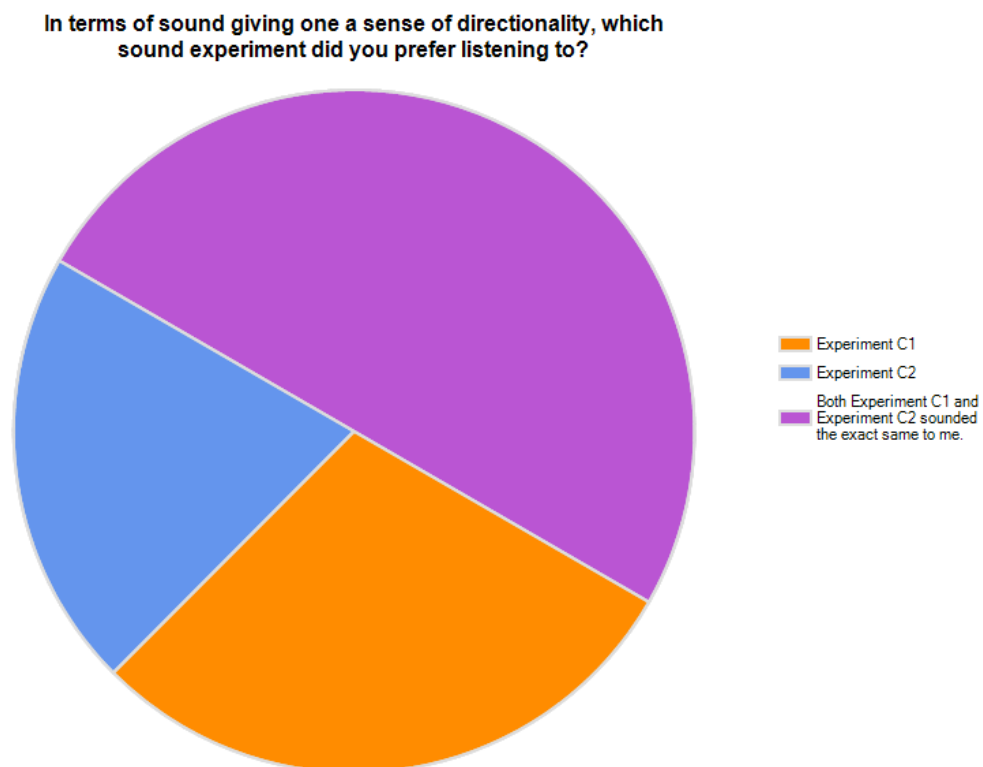

Fig. 43: Visual documentation of Experiment C findings: part II

50% of testers felt Experiment C1 and Experiment C2 sounded 'the exact same'. These results reveal intriguing insights into binaural sound experiments' "sweet spots". Just as there is an optimum viewing position, the "sweet spot" in a cinema when viewing a 3D film, it turns out there is optimum "sweet spot" for binaural sound recording. If the majority of action is happening in front of the viewer on screen and nearly every sound source is visible on screen (like watching a play in a theatre) it makes it markedly harder to distinguish between a binaural and stereo recording. Apart from a police officer speaking off camera to the right, a car boot opening and a baby crying, the majority of sound sources in Suspense Experiment C happen directly in front of the camera as you hear the couple speak. In this instance, using binaural recording is simply a gimmick as it doesn't add any value to the picture so a sound designer should simply use standard stereo recording for delivering this type of scene.

In response to the question: what does binaural sound technology offer which stereo recordings cannot? Suspense Experiment C reveals binaural sound cannot offer any extra value that stereo recordings can't already supply. Instead, this experiment has confirms the "sweet spots" for binaural recording are offscreen sounds in parallel with your ears or offscreen sounds coming from behind your head as utilised by the previously discussed Suspense Experiment D. There is no point delivering a binaural recording of an onscreen dialogue as viewers cannot tell the difference between stereo or binaural in this case. Experiment C's findings will directly affect the future installation's narrative as I have discovered I will have to weave in sweet spot

offscreen sounds to enhance binaural sound delivery. Otherwise, there is no benefit to a sound designer of using binaural over stereo delivery without this sonic play in directionality.

While in pre-production for the suspense experiments, I conducted an exercise on binaural directionality and discovered mobile phones are a creative method of delivering live binaural sound. In the documented experiment, Participant B stood on a noisy main street. Participant A was indoors in a quiet environment. Participant B called Participant A on two phones and placed the phones' speakers away from his ears. Participant A answered two phones and then listened to the soundscape. She was given no visual stimulus and therefore had to imagine the place she was hearing binaurally. She described the sonic authentic immediacy of the binaural experience saying she heard cars going past as if they were "going straight through her head".

Fig. 44: Visual Documentation of Participant A and Participant B.

Participant B then went to Location 2: a quiet city park at night. This time Participant A was provided a picture of the location. Despite having the

visual stimulus, Participant A found it difficult to connect to the quiet location. She preferred the noisier Location 1 as there were more sounds to "relate to" when listening through the binaural devices. When asked if she found the binaural experience more or less immersive when provided with an accompanying visual stimulus, she responded:

'I think having the picture means it's already in your mind what you're going to hear…so the picture is of a dark dusky park so you imagine the sounds that will come from a dark dusky park whereas without the image you're relying purely on your own hearing and what you hear around you to put you in that space…[Location 1 is more immersive] you have to rely on that one sense so your imagination starts to work a little bit more so your mind is imagining everything from what it can hear' (Binaural directionality exercise).

Like Suspense Experiment B, participants seem to prefer imagining their own personal visuals based on what they hear rather than being given an accompanying picture. The production and results from this experiment also revealed how mobile phones proved a cost-effective simple method of successfully creating live binaural sounds. Perhaps this type of live binaural delivery could be creatively interwoven in to a theatre piece, which encourages audience members to take an active role in moving the story forwards in a similar vein to Stand and Stare's *Children of Modernity* theatre installation at Bristol Old Vic, audience members had to hunt for a tape to listen to in order to reveal the next story plot point. However, rather using a pre-recorded tape, phone technology would present an audience member a

real sense of immediacy and authentic sound directionality if listening to live binaural delivery through mobile phones.

CONCLUSION

Producing a series of sound experiments and user testing sessions proved a fruitful method of conducting research. These theoretical findings on specific elements of sonic suspense and binaural sound delivery will inform my future practice. The experiments have also successfully provided answers to key critical questions. Results reveal a binaural sound recording is more immersive and suspenseful without visuals as testers become more involved in the piece by imagining their own personal images to accompany the soundscape. The experiments' responses have also demonstrated what role psychoacoustic effects, namely offscreen sound, absence, low frequency and sound patterns, play in creating a sense of sonic suspense. Careful consideration must also be given to sound delivery to ensure a listener is able to distinguish between a binaural and stereo recording and use binaural recording to enhance a narrative rather than simply use it as a gimmick. Ultimately, these sound experiments have proven by combining the psychoacoustic effects of sound with appropriate sonic delivery, one can create a suspenseful sonic atmosphere.

TABLE OF PUBLIC ENGAGEMENT WITH PhD RESEARCH

EVENT TYPE	EVENT TITLE & VENUE	EVENT DATE	DESCRIPTION
Conference	*Humanities Graduate Conference* at the University of Exeter, UK.	01-05-2012	I gave a presentation entitled "Defining Frontiers: A History of Binaural Technology".
Research Showcase	*Digital Scholarship in the Humanities* at the University of Exeter, UK.	28-05-2012	I delivered a talk in a research showcase entitled "Demonstration of Applied Binaural Technology Research".
Conference	*Philosophy and the Arts Graduate Conference: Defining Soundscapes and Territories* at Stony Brook University in New York, USA.	30-03-2013	I gave a presentation and paper entitled "From Bristol to Brooklyn: In Search of Soundmarks".
Conference	*58th British Association for American Studies Annual Conference* at the University of Exeter, UK.	20-04-2013	I delivered a presentation entitled "From Bristol to Brooklyn: In Search of Soundmarks".
Studio Residency Talk	*Public Studio Talk* at Pervasive Media Studio in Bristol, UK.	16-05-2013	I presented research findings from my graduate artist residency to the public at Pervasive Media Studio focusing on my suspense sound experiments and the thesis' first "Audio Postcards" case study.
Public Talk and Showcase	*Hack the Quartet* at Bristol Old Vic in Bristol, UK.	31-07-2013	I was selected to present my "Point of Audition" app prototype and share my research on binaural technology applied to classical music recording as part of a showcase and talk for Sony music studio directors, technologists and members of the public.
Conference	*Noises of Art* Conference at University of Aberystwth in Wales, UK.	05-11-2013	I explained my research findings on soundmarks as part of a speakers panel entitled "Placing Sound / Sounding Place."

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