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DOCTORAL THESIS

Listening to yourself listen: spatial experience in music for acoustic instruments and electronic sound

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A thesis submitted in fulfillment of the requirements

for the degree of Doctor of Philosophy

in the

Department of Music

School of Arts and Social Science

June 26, 2020

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Acknowledgements

Declaration of Authorship

I, Georgia RODGERS, declare that this thesis titled, "Listening to yourself listen: spatial experience in music for acoustic instruments and electronic sound" and the work presented in it is my own. Where I have consulted the published work of others, this is always clearly attributed.

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Abstract

This is a theoretical and practical research project which explores the listener's experience of space in contemporary music for acoustic instruments both with and without electronic sound. Existing critical frameworks relating to spatial experience in music are reviewed and potential deficiencies identified. Suggestions are made as to novel approaches which could be used to characterise and abstract spatial experience, moving away from a focus on the geometric and instead based on a conceptualisation of space as fundamentally *embodied*, *dynamic*, and *co-created*. Three new descriptive terms are proposed to be used as lexical tools in both generative and analytical contexts. The thesis is completed by a discussion of the author's portfolio of original compositions, music written from the author's personal engagement with spatial experience as a key compositional concern, which both informed, and was informed by, the theoretical elements in an iterative process of experimentation, research and reflection.

Chapter 1

Introduction

1.1 Overview

This project explores the use of electronic sound in contemporary music for acoustic instruments. It examines the implications of this music, sometimes called *electroacoustic*, *electro-instrumental* or *mixed* music (Dean, 2009), on the listener's experience of space and the associated listening strategies which are deployed. It appraises evolving compositional methodologies developed in response to audio technologies and the consequent increase in the potential for spatial experience to be explored as a compositional dimension, and the traces these techniques might leave when then composing for acoustic instruments *without* electronic sound.

The project proposes a phenomenological approach to listening and a modern conception of space as *dynamic*, *embodied*, and *co-created*. It attempts to go beyond geometrical and physical acoustic considerations to gain a greater understanding of the human experience of space as it is informed by sound. The project is led by my interest in the use of the term space in music and the theoretical frameworks which are used to underpin it. Far from a single and fixed concept, space in music has multiple and varied aspects — the geometric, atmospheric, metaphoric, social and personal, for example. Thus in exploring the theory of space further, it became a key instigator for my composing-as-research, and this is reflected in the variety of pieces presented

in my portfolio of original compositions, and the different ways in which they each relate to spatial experience.

The project identifies and addresses deficiencies in the theoretical frameworks which surround spatial experience in music, and proposes ways in which the discussion can be moved forward. The project aims to create new and useful analytical and generative tools which will contribute to the development of the field. The project aims are achieved through complementary strands of theoretical and practical research. The resulting project outputs are twofold: a written thesis and a portfolio of original compositions. The practical element of the project both informs, and is informed by, the theoretical element, in a reciprocal process of experimentation, research and reflection.

After an introductory chapter, the thesis sets out the theoretical context in which the project is situated. This is divided across two chapters. First, in Chapter 2, a review of key existing frameworks used to analyse spatial experience in music. This discussion is set in the broader context of developments in the conceptualisation of human spatial experience more generally, drawing on the work of critical thinkers from a range of disciplines including philosophy, geography and anthropology.

Second, in Chapter 3, the thesis examines significant theoretical developments in phenomenological descriptions of listening. Artists and composers have long explored ideas related to the nature of perception, thus the theoretical descriptions in this chapter are contextualised by a discussion of the examination of sound and listening in music, and light and vision in visual art, with reference to the work of specific artists and composers.

Once the research context has been established, the thesis goes on in Chapter 4 to present proposals for theoretical developments in the field. The proposed developments take the form of three new terms to describe spatial experience in music. The terms are defined with reference to specific listening processes and are illustrated with examples from musical compositions. The terms are intended as useful lexical tools for others working in the field, in both analytical and generative contexts.

The practical element of the research project is presented as a portfolio of original compositions, consisting of seven new works for acoustic instruments with and without electronic sound. The portfolio is analysed in Chapters 5 and 6, with specific emphasis on spatial experience, compositional methodologies and their relationship to the proposed new terms.

The thesis concludes with a reflection on the project as a whole, a critique of its success, and possible directions for future work.

1.2   Music, space and technology

We shall, therefore, be exploring aspects of electronics and acoustics in relationship not only to the composition of music, but also to the world in which we find ourselves.

Daphne Oram, 1974 (Oram, 2016: 2)

The question of space in music is, of course, not a new one. It has intrigued composers, musicians and listeners alike for centuries. But what exactly do we mean by the term 'space' in music? Composers have long used antiphony and the location of instruments themselves to create compelling spatial experiences — music which surrounds the listener, where sounds appear from multiple directions and may move around them. There are many examples from the Gabriellis' arrangement of vocal ensembles in sixteenth century Venice, to Stockhausen's trio of orchestras in *Gruppen* (1957).

Similarly, the physical breadth and depth occupied by a symphony orchestra has been used by composers to emphasise the space of performance, as musical energy flows across the stage from one group of instruments to another. At an extreme, instruments might be located off-stage to imply distance or to allude to another, ethereal world. For example, the cowbells in Mahler's sixth symphony (1904) or the chorus in Bartók's *Miraculous Mandarin* (1924).

More recently, sophisticated electronic spatialisation techniques have been used to control the shaping and movement of electronically produced sound around the listener. We may think of Stockhausen's classic *Kontakte* (1960) for piano and multi-channel electronic sound, or the many acousmatic works which have taken these techniques to a virtuosic level, such as Smalley's *Clarinet Threads* (1985). More recently, developments such as vector based amplitude panning (VBAP), ambisonics or wavefield synthesis allow precise control of where a listener perceives a sound to have originated, the size of the sound source and its movement (Dean, 2009).

But music is often perceived — or at least described — as spatial even when it does not feature unusual layouts of instruments or complex arrays of loudspeakers. Harmony and orchestration techniques, for example, are often described in terms of space. Words like 'expansive', 'narrow' or 'vast' are commonly used by listeners and writers on music. At its simplest, if a very high note accompanies a very low note, we may say that there is a 'gap' in the middle. If this high note takes the form of a staccato burst and the low note is a continuous drone, we might even imagine an open plane, onto which the high note is 'dropped'. In the first minute of Ravel's *Tombeau De Couperin* (1917) the woodwind's opening melody creates a feeling of constraint or narrowness, before the rising wave of strings causes a dramatic outward 'expansion'. The listener does not simply understand that the instrumental sound is more complex and louder than before, but that the feeling of space is much bigger. It seems that our experience of music is intimately bound up with the spatial, whether or not electronic sound is involved.

Sound, of course, is profoundly physical. It arrives at our body as a fluctuating wave of pressure variation. Sound is created by the very motion of molecules of air, and at times we can feel the deep bass resonating in our chest cavity, a rumble vibrating under the soles of our feet, or a piercing high pitch feeling as though it might be inside our own head. But whilst the physicality of sound certainly deeply informs the listener's experience of space, spatial experience is equally reliant on the psychological and relational experience of sound: in the darkness of an strange room, an expanding pipe creates a feeling of menace; in a familiar place, muffled

conversations through the floorboards reinforce the feeling of safety and comfort. Spatiality is not simply *spatialisation*.[1] Beyond localisation, the perception of sound leads to complex experiential phenomena which together create a feeling of space related not simply to the physical acoustic characteristics of sound but also to the personal: to memory, expectation, mood, relations; to before and after; to place and time; to the many complexities of *being alive*. Space in music is thus profoundly physical and, simultaneously, uniquely psychological. It is a paradox of the concrete and the intangible, the shared and the personal, the internal and the external all at once, and our descriptions of it similarly flit between metaphors for the 'real' and the 'imaginary', mixing the one and the other without clear boundaries, for these boundaries do not exist in our experience.

Jean-François Augoyard and Henry Torgue, writing from the perspective of urban sound environments, argue that the terms *sound object* and *soundscape*, although useful, are not fully adequate to describe the *experience* of sound (Augoyard and Torgue, 2006). They introduce the concept of the *sonic effect*, stating that:

> The concept of the sonic effect seemed to describe this interaction between the physical sound environment, the sound milieu of a socio-cultural community, and the 'internal soundscape' of every individual. What is the nature of this operative concept? (Augoyard and Torgue, 2006: 30)

Augoyard and Torgue's description of the physical, psychological and relational character of the sonic effect is compelling. But they leave open the question of the precise nature of this concept. Can we postulate that the nature of the sonic effect is *spatial*? German philosopher Gernot Böhme has written that music, "is a spatial art" (Böhme, 2017: 127). Space thus becomes not simply an aspect of music, but the listener's primary means of experiencing music as a perceptual phenomenon. Böhme has also written that, "music is the modification of *bodily felt* space" (ibid.: 127, my italics), and that it, "intervenes directly into one's bodily economy" (ibid.:

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[1]The term *spatialisation* is used separately to *spatial experience* Spatialisation refers to the electronic control of the location and motion of a sound, using techniques such as those mentioned earlier — vector based amplitude panning (VBAP), ambisonics or wavefield synthesis.

127). Thus, if we are to understand music as experienced spatially, then we must also understand that spatial experience is fundamentally *embodied*.

Moving beyond purely geometrical considerations then, what can we say about spatial experience in music, about this *embodiment*, this complex *feeling* of space? Although significant work has been carried out in this area, notably by Emmerson and Smalley (Emmerson, 1998a, 1998b, 2007, Smalley, 1996, 1997, 2007), the discussion of space in music nevertheless remains somewhat difficult, and the terminology somewhat vague. Assumptions continue to be made about the nature of listening and spatial experience. The description of spatial experience in music seems to resist a single schema or theory. As Curtis Roads has written, "while pitch and rhythm have been codified and schematized for centuries, there is little formal theory with respect to spatial relationships" (Roads, 2001: 241).

It is clear that developments in audio technology over the last century have presented composers with a huge range of new possibilities. Using simple recording and playback techniques, composers can defy the acoustic characteristics of the performance space; cause sounds to overlap, merge and repeat; introduce sounds from another place, another time. A typical electro-instrumental piece will require loudspeakers to be positioned on stage with the instrumental ensemble or soloist, or perhaps multiple loudspeakers will surround the audience. Perhaps listeners will be wearing headphones. The electronic sound might take the form of sound files to be played back, or to be constructed in real-time from live processing of sound, instrumental or otherwise.

By mixing acoustic and electronic, sampled and synthesised, pre-recorded and live, 'real' and 'virtual', electro-instrumental music can create complex and compelling sound worlds, stretch and confound the listener's expectations. Spatial experience can be radically altered from the familiar condition of an ensemble on stage, to something completely different created in dialogue with the electronic sound. What implications does this mixed music have for our experience of space? What effect does this spatial potential and fluidity have on how we listen and how we experience

music?

Given the ever expanding possibilities afforded by these technologies it becomes even more important to ask questions, to continually critique and develop our theoretical frameworks in response to technological and theoretical advancement. As Lawrence Kramer has written, "these advances need to be complemented by a new examination of how sound is represented and imagined" (Kramer, 2019: 1). This thesis seeks to examine these questions in order to deepen our understanding of spatial experience in music, starting from the particularly intriguing case of music for the combined forces of acoustic instruments and electronic sound.

1.3 Embodied space

Central to this thesis is the conceptualisation of space as *dynamic*, *embodied*, and *co-created*. This conceptualisation is rooted in a phenomenological understanding of space and draws on the work of critical thinkers from disciplines including philosophy, geography and anthropology. Embodied space sits in opposition to a conceptualisation of space rooted in Cartesian metaphysics. Cartesian space is characterised by homogeneity — a void in which bodies are located (Kane, 2007: 17). This shift in conceptualisations of space pivots on a radical change in the role of the body, one which allows the body to become an agent of change in the dynamism of space — the body as 'co-creator' of space.

Cartesian metaphysics rests upon an ontological dualism, that is, the separation of mind and body. Here, the internal mind of thought and consciousness is entirely separate to external matter. In this representational view the mind has no direct experience of the material world, not even of the body, but only with the ideas that represent it (Watson, 2018, Secada, 2004). The role of space is simply to exist as a blank slate onto which the movement of matter is written.

In a phenomenological description of space, however, the body is a *fundamental* and *co-creative* element of space: it is *because* we have a body that we have space. As

Merleau-Ponty put it, in this conceptualisation the body is, "not primarily *in* space, but is rather *of* space" (Merleau-Ponty, 2012: 149, my italics), or to put it another way, "the body is our general medium for having a world" (ibid.: 149). It is, in essence, a shift from a universally fixed and determinate *space* to a constantly created and embodied *spatial experience*.

This pervasive philosophical shift seems to be reflected across various disciplines, either through a conscious adoption of the framework or through seemingly unrelated developments and discoveries. In theoretical physics, for example, there is a clear turning point from Newton's Laws of Dynamics to Einstein's General Relativity. Newtonian physics is associated with the nineteenth century idea of the *clockwork universe*, where space is homogeneous and every movement of every particle is pre-determined; given sufficient computational power all trajectories could be calculated. Space after Einstein is much less certain, however, a heterogeneous and curved space which can never be fully known (Hodgkinson, 2016: 63, Rovelli, 2019).

In language, spatial descriptions are often used to characterise a broad range of ideas, even when the explicit focus is not spatial experience. However, the terms used are often somewhat vague or ill-defined. Formulations tend, in the end, to boil down to a Cartesian conception of space. This Cartesian bedrock is so well established that it is often not fully consciously appreciated as the root of our so called 'intuitive' imaginings of space: space seems so obvious that it does not need further elaboration. Indeed, nearly fifty years after the first publication of Lefebvre's famous book (Lefebvre, 1991), the concept of the *production* of space stills seems very strange, set against the deeply ingrained and inherited belief that space is fixed and empty.

But perhaps we *should* delve further into this apparent transparency, in order to better appreciate the foundations of our impressions of space. What happens if we step away from our culturally embedded, 'intuitive' understanding, and open up our spatial imagination to new possibilities? Where might this take us?

Geographer Doreen Massey has written extensively on reimagining space in her

book, *For Space*. In it she highlights the implicit assumptions which continue to be made about space and the ways in which this influences broader critical and cultural thinking. I will paraphrase and borrow several direct quotations (the quotations are in italics) from Massey's text here which together set out the challenge.

I have become convinced that

the implicit assumptions we make about space are important

and that maybe

it could be productive to think about space differently.

What happens if

we try to let go of those, by now almost intuitive, understandings

and

face up to the challenges of space?

Space is not

a container for always-already constituted identities

nor

a completed closure of holism.

We must

recognise space as the product of interrelations

and

take on board its coeval multiplicities.

It is necessary to

accept its radical contemporaneity

and to

deal with its constitutive complexity.

Let us

pursue an alternative imagination.

(Massey, 2008: 1, 8–9, 12–13)

In this thesis I aim to develop descriptions of spatial experience in music which are rooted in a modern conception of space — space as dynamic, embodied and co-created. These characterisations will move away from language of stasis, closure and representation and instead be situated amongst ideas of *flux*, *becoming*, *relationality*, *multiplicity* and *embodiment*.

1.4 Listening to yourself listen

1.4.1 What is it like to listen? And why is it important?

Sitting alongside this reimagining of space — and in many ways prior to it, of course — comes *listening*. In an embodied conceptualisation of space, aural perception is a co-creative element of spatial experience. Thinking about listening has been fundamental to this project. Sound, through listening, is one way in which space *happens*. Listening, through whatever mechanisms enables the perception of sound, is critical to each individual's spatial experience. The phrase *listening to yourself listen* points towards the moment of this *happening*; a moment of self-awareness, of perceptual alterity. It is a key phrase and is demonstrative of the approach I have used throughout this project.

I use the phrase *listening to yourself listen* to imply a duality of listening: listening whilst at the same time understanding what it is to listen. It is to use listening to become aware of your own experience of listening. We may call it a self-reflective mode of listening, one which frames the act of listening itself, enabling a conscious understanding of our perception of sound, drawing us closer to the human experience of listening. By asking the question *what is it like to listen?*, we place sound at the centre of an active process, in communion with the creation of space, as opposed to

a passive 'reading' of the sonic environment. As Alvin Lucier says of his music, the idea is that, "the experience of perceiving the piece is the experience of being aware of yourself perceiving it" (Denyer, 2005).

This may seem like a subtle readjustment, but the implications are manifold. It seems that sound and listening have, strangely enough, been slightly 'overlooked', as it were, in music, and that tacit assumptions continue to be made about the nature of listening. Of course sounds, perhaps especially instrumental sounds, possess many layers of meaning beyond the 'purely' aural: cultural, historical and personal, for example. But by returning to the human experience of listening, rooted in the dynamism of perception, there is much to learn. As Helmut Lachenmann has written:

> Listening is ultimately something other than the mere act of hearing contained in understanding. It means the capacity to hear differently, to discover in oneself new antennae, new sensors, new sensibilities; to discover one's own alterability and use it to resist the unfreedom which it uncovers. Listening means discovering oneself anew; it means changing oneself. (Lachenmann, 2003: 29)

This approach draws on many precedents; composers who state an explicit focus on sound and listening in their work, who have sought to penetrate the musical note in order to understand sound from first principles. As Morton Feldman said:

> What John Cage did, and what I have done, is to extract music from the conceptual domain and to place it in the purely physiological sensation of sound. (Ilić, 2015: 51)

However, phenomenological approaches to music seem to have resisted codification according to existing critical frameworks. Christoph Cox asks the related question, "why does sound art remain so profoundly undertheorized, and why has it failed to generate a rich and compelling critical literature?" (Cox, 2011: 146). Although Cox refers to sound art, we can consider his question in the context of electro-instrumental music. His answer is the following:

It is because the prevailing theoretical models are inadequate to it. Developed to account for the textual and the visual, they fail to capture the nature of the sonic. (ibid.: 146)

Cox asserts that the sonic arts are not abstract, but are in fact quite concrete, as it were, in dealing with sound directly as a material. As Cox says:

Sound is not a world apart, a unique domain of non-signification and non-representation. Rather, sound and the sonic arts are firmly rooted in the material world and the powers, forces, intensities, and becomings of which it is composed ... Sound is thoroughly immanent, differential, and ever in flux. (ibid.: 157)

Cox argues that it is deficiencies in the theoretical frameworks, rather than the works themselves, which result in difficulties in developing the critical literature. Cox calls for a return to sound to bring forward new critical theories which are not rooted in the visuo-centric realm of signification and representation, but rather in the realm of flux and becoming: in other words, I would argue, rooted in *listening*.

Focusing on the human experience of listening is therefore important because it could lead to the emergence of very different compositional agendas and conceptual frameworks; ones which are concerned with becoming, change, and flux, and which are rooted in a phenomenological understanding of sound and listening. Furthermore, since auditory perception is critical to the embodied model of spatial experience presented, listening could well be fruitful in our reimagining of *space*. Through listening we may move away from the concrete, homogeneous and fixed, towards the dynamic and co-created.

1.4.2 Listening as a material

The phrase, *listening as a material*, is taken from the title of a lecture given by Newton Armstrong at the Conservatoire Royal de Mons, Belgium, in 2015. It refers to music which:

requires a listener in order to be complete; in this instance, the act of listening becomes a constitutive element of the work itself. When listening takes on this constitutive aspect, one could say that it also takes on the attributes of a *material*. (Armstrong, 2015: 1)

This leads us to music which is:

concerned not with the combinational mechanics of notes and rhythms, but with the primary mechanics of sensation and perception. It would be a music that is incomplete without an active listener, requiring engaged participation before it could be said to take on form and structure. (ibid.: 1)

Listening as a material describes compositional strategies centred on the human experience of listening. It foregrounds the physical behaviour of sound, psychoacoustic mechanisms and modes of listening. It can be thought of as complementary to the idea of *listening to yourself listen*. Where *listening to yourself listen* is more concerned with the audience's perspective, *listening as a material* is related to compositional agendas. In a way, *listening to yourself listen* and *listening as a material*, are twinned concepts, perhaps pointing towards a networked or self-referencing system of interwoven listening and creation.

There are of course well known precedents for this explicit compositional concern with listening. To list some key figures: Pierre Schaeffer's *musique concréte* and the concept of *écoute réduite* (Schaeffer, 1966); Stockhausen's work on duration and electronic spatialisation (Cott, 1974, Maconie, 2005), R. Murray Schafer, Hildegard Westerkamp, and the *World Soundscape Project* (Schafer, 1977); significant efforts have been made to explore listening in electroacoustic music, for example, the work of Denis Smalley and Simon Emmerson (Smalley, 2007, Emmerson, 2007); Pauline Oliveros' practice of *deep listening*, created to enhance listening skills and draw attention to how this affects consciousness (Oliveros, 2005); Daphne Oram's *Oramics*, an early

investigation into the relationship between music, electronic sound and human perception (Oram, 2016); Maryanne Amacher's *Third Ear Music* investigating otoacoustic emissions — sounds which are generated within the inner ear (Amacher, 1999). Certainly notable composers have developed these ideas instrumentally. Key figures include John Cage, Alvin Lucier and James Tenney (Cage, 2009, LaBelle, 2006, Tenney, 1988); Gérard Grisey and the broader spectral movement (Grisey, 1987, Hasegawa, 2009); Helmut Lachenmann's *musique concrète instrumentale* which seeks, through the use of extended techniques and musical context, to renew our hearing of instrumental sounds (Lachenmann, 2003); Morton Feldman sought to penetrate the note to find what Catherine Costello Hirata refers to as, "the sounds of the sounds themselves" (Hirata, 1996); Frank Denyer's music, described by Bob Gilmore as, "more concerned with what can be heard than with an interest in systems, or drama, or 'ideas'" (Gilmore, 2014).

The work of these composers, whilst of course hugely diverse, is unified by a central concern with that flexible and intangible boundary between the physical nature of the sound wave and the perceived auditory result. Where and how does sound become listening, and how can music disrupt this?

1.4.3   Listening embodied

Auditory perception is part of the complex network of cross-modal interactions which constitute our bodily sensibility. When space is embodied, the flux of sound informs the continuous *process* of space. To borrow from Merleau-Ponty and anthropologist Tim Ingold, we don't so much listen *to* sound but rather we listen *in* sound; as listeners we do not passively receive acoustic information, but we are actively *ensounded* (Merleau-Ponty, 2012, Ingold, 2011). Thus music which explores the nature of sound and listening, music which creates moments of self-reflection, can equally be understood as an exploration of embodied spatial experience. In listening to ourselves listen, we are listening to this dynamic and relational space.

Yet the compositional and theoretical frameworks surrounding a phenomenological description of listening in music remain somewhat underdeveloped, particularly descriptions which relate listening and spatial experience, which go beyond geometrical spatialisation models with their focus on source localisation. How do we describe the spatial experience of listening to acoustic instruments plus electronic sound, in the vast array of forms in which it is presented to us as audience? How can we rationalise it, and understand our own strategies of listening to it? The terms *sound object* and *soundscape*, although useful in certain contexts, are not sufficient to capture the reciprocal relationship between listening and continuously-created space. Even the linguistic syntax, 'listening to', implies externality and opposition, and denies embodiment. The language points at all times towards a *fixity* of sound and space, an already-determined sound located in a static void. What is the language which could be used to describe embodied, dynamic and co-created spatial experience in music?

1.5   New metaphors for spatial experience

In seeking to reimagine spatial experience in music, it is necessary to find the language to describe it. New metaphors are likely to be needed, if our strategies of conceptualisation change. In Chapter 4 of this thesis I present three terms which I developed for this purpose during this project. I use them in relation to my own compositions as well as to discuss work by others. I hope that these terms could be useful lexical tools for other practitioners in the field, in both analytical and generative contexts, when describing spatial experience in music for acoustic instruments with or without electronic sound.

The terms seek to develop the theoretical frameworks surrounding spatial experience in music, to reflect advances in the conceptualisation of spatial experience more generally towards space as dynamic and embodied. The descriptions are rooted in a phenomenological approach to listening, and draw on language of process, flux and becoming, as opposed to stasis, the geometric and the already-rendered. The

new terms aim to provide lexical tools based on new and innovative metaphors for spatial experience in music.

I have identified three distinct descriptive terms — *focus*, *multiplicity* and *extension* — through an iterative process of composition, research and self-reflective listening. Of course in practice, spatial experience in music is much more subjective and fluid than implied here, and aspects of these descriptions may or may not be present in any particular work. The three terms are derived from a particular way of listening to music, not the only way of listening. They are centred on perception and the experience of space, and will of course be different for individuals. In application the boundaries between focus, multiplicity and extension are not fixed, and music will make its way between or around these terms, overlapping and moving through different characteristics, or not going near them at all. Yet it is hoped that the process of defining some specific characteristics may help to make some progress in establishing compositional agendas and theoretical frameworks concerned with spatial experience in electro-instrumental music, which are firmly based in sound and listening. The terms are introduced below and examined in greater depth in Chapter 4.

Focus

Focus describes spatial experiences which are related to transformations of the listener's auditory field. Focus alters the apparent spatial characteristics of a sound with respect to the listener by requiring a recalibration of the listener's perception. Using a variety of techniques, different instrumental sounds — or different aspects of the same sound — are made central in our perception. A common example is a very quiet instrumental sound which is amplified to fill a room. This sound, normally heard as a point source from the direction of the stage, now engulfs and surrounds the listener. Microtextures are revealed. In this way focus enables the listener to attain a new experience of the instrumental sound, and requires a recalibration of the listening experience with respect to initial expectations.

Alternatively, over a period of listening, sounds which initially seemed to be at the limit of my hearing may appear louder as my auditory field narrows and yet quieter sounds are revealed. Conversely, the sudden occurrence of a very loud sound may precipitate an expansion of my auditory field, leaving previous sounds quieter in comparison. By creating new spatial perspectives, presenting sounds at different scales, and enabling both to undergo change, focus problematises spatial experience and calls into question exactly what I am hearing, and how I am hearing it. Focus can be understood then, as a spatial experience resulting from the contraction or expansion of the auditory field; a recalibration or transformation.

Focus is intimately connected with the psychological, the *feeling* of space. Does the sound seem large and far away? Immense and close up? Tiny and expanded? Denis Smalley refers to this aspect as "the listening imagination" (Smalley, 1996), and calls to mind Bachelard's poetic descriptions of the *miniature* and *intimate immensity* (Bachelard, 1994). Smalley describes the listening imagination in relation to acousmatic music:

> Is the listener in the midst of musical activity within the space? Is it a case of 'reaching out' or of 'closing in'? ... Is the musical context psychically close or is it remote? (Smalley, 1996: 91)

Focus in electro-instrumental music offers a new experience of the instrumental sound. Extremes of relative scale transform the auditory field, revealing new aspects of the sonic material, invoking memory, imagination, and feelings of space in flux.

Multiplicity

Multiplicity is the experience of multiple spaces at the same time: of two or more distinct spaces at once. Through electronic or other means, the sound of one or more other spaces is rendered within the performance space concurrent with the instrumental ensemble. It could be the same space at a different time, or somewhere different, but it is a recognisable 'elsewhere'. As Denis Smalley has said, "sounds in

general carry their space with them, ... they are space-bearers" (Smalley, 2007: 38). This is particularly evident in music which entails multiplicity.

The sophisticated mechanisms of auditory scene analysis enable us to separate the sounds we hear into distinct streams (Bregman, 1990) and consequently, when you hear sounds from different places layered on top of each other, "you are inhabiting at least two acoustic spaces" at the same time (Cardiff, 2005). A common example of this experience is that of the headphone wearer, who listens to her music whilst walking down a busy road. The virtual sonic space created by the headphones is distinct and coexistent with the sounds of her immediate surrounding environment, the passing traffic and the other pedestrians. To borrow a term from electronics, we listen 'in parallel'. Electro-instrumental music is well placed to take advantage of this aspect of listening, using electronic means such as loudspeakers to introduce a new space into the space inhabited by the instrumental musicians.

Extension

Extension refers to a listening experience in which the combined electro-instrumental forces have fused to form a single, unified instrument which retains some causal link to the original acoustic instrument. It can therefore be understood as an extension of the acoustic instrument. The electronic sound may take various forms but the resultant combined sound field is an expansion or other transformation of the acoustic instrument's specific and idiosyncratic spatial fingerprint.

For the illusion of fusion to happen in a convincing manner, the electronic sound, whilst extending or transforming the instrumental sound, must also remain linked to temporal, gestural, and psychological cues embedded within the instrumental performance, and, furthermore, insofar as extension is concerned, must preserve the specific spatial characteristics of the acoustic instrument in a recognisable, dynamic form.

Extension can also be experienced in an inverted form, where the instrumental sound stretches or distorts a set of spatial qualities created by the electronic sound. This

could be audible as 'beating' or some other perturbation.

1.6 Composing spatial experience

In parallel with the theoretical research and proposed new terms, this project seeks to fulfil its aims through compositional practice. This is presented as a portfolio of seven new pieces of music for acoustic instruments with and without electronic sound. These pieces were created through a personal engagement with spatial experience as a central compositional concern.

Over the course of the project I have developed various compositional methodologies which enable an exploration of spatial experience in music. In general, these methods can be characterised by an interest in composing listening *situations*. These are moments of change where the listener reflects on what they are hearing, where one mode of listening is held up against another. It is in these moments that the listener may notice a change in the feeling of space created by their shifting listening experience. This creates not simply juxtaposition, but tension — a dialectical relationship between modes of listening and associated dynamic spatial experience. Listening is the material, giving the potential for self-reflection and a changing experience of space.

These situations, or changes in state, are assembled as a series. The moments combine to create the formal experience of the piece, thus self-reflective potential is used as a method of ordering the music. The form of a piece can be characterised as an emergent phenomenon, i.e. "a new quality or gestalt that evolves from the system interactions" (Schröder, 2014: 38). The system interactions are the perceptual shifts which happen at these moments. Whilst some aspects of the moments are composed, for example, when to stop playing, others are not entirely fixed, for example the interactions between live sound and computer processing, the background sound in the performance space, and the behaviour of sound in the performance space. The moment can be as simple as a significant drop in amplitude, for example,

a loud sound which is suddenly switched off, revealing sounds which were previously inaudible. Or perhaps it is constructed from a more complex and subtle shift in timbre, spectral density, or spatialisation. There is a further aspect to emergence, that of temporal non-linearity, because "to perceive an emerging quality one must attend to the whole" (ibid.: 38). The full emergent spatial aspects of the music may be most apparent when considering the piece holistically.

When these liminal moments are the guiding principle for a piece, the compositional strategies used must be developed in response to the approach. The specific techniques which have been developed as part of this project are discussed in more detail in Chapters 5 and 6 in relation to particular pieces. The two pieces discussed in Chapter 5, which were composed at the beginning of the project, use live processing of the instrumental sound and diffusion across multiple loudspeakers to gradually transform the listener's spatial experience of the instrument as compared to the acoustic sound alone. There emergence would also relate to the sense that the electronic sound is different at every performance, the grains of sound are a by-product of an interaction between instrument and computer. The five pieces discussed in Chapter 6, which were composed in the second half of the project, use much more limited electronic techniques, but are nevertheless concerned with foregrounding spatial experience through listening. This is achieved through emergence derived from the form, moving away from a linear dynamic flow of sound energy towards constant shifting and re-framing of similar sonic materials.

1.7 Conclusion

Sound is ever-present, pervasive, persistent; we can't close our ears as we can our eyes. There is no acoustic blindfold, even the most sophisticated ear defenders or anechoic chambers leave us with the residual sounds of our own bodies, or low frequency rumblings invading from outside. Our dreaming selves are affected by sound when we sleep, even if we don't remember it in the morning, our circulatory system is always ready to respond to sound (WHO, 2018). Perhaps, then,

sound is more essential to human experience than we have previously supposed. As Lawrence Kramer has recently written:

> Sound is the primary medium through which the presence and persistence of life assumes tangible form. The sense of life spreads outwards from sound, which conveys it as feeling and imparts it as meaning. This relationship is primary. The positive experience of aliveness is not merely in accord with sound but inaccessible and perhaps inconceivable without it. (Kramer, 2019: 1)

And yet, if sound is quintessential, listening is not always something we have the words for. In music, and particularly, for me, in music with electronic sound, we have the potential to create new spaces through sound; new listening experiences in the world. These technological advances, "need to be complemented by a new examination of how sound is represented and imagined" (ibid.: 1). Musical theoretical frameworks need to be reconsidered in order to take account of these new potentialities. It is for this reason that I want to explore the themes presented here.

Chapter 2

Conceptualising space

2.1 Introduction

In this chapter we focus on evolving conceptualisations of space. It is the first of two chapters which set out the research context in which my work is situated. This chapter sets out the key frameworks related to spatial experience and is divided into three sections.

The first section gives a brief overview of evolving conceptualisations of space, with reference to key philosophical, geographical, and anthropological thinkers, to set the scene in a broad sense. Section two focuses on key theories of spatial experience in music specifically, particularly music involving electronic sound. The last section summarises what we have covered and presents ways in which the discussion can be developed, namely through a reconceptualisation of spatial experience in music from the static, geometric and homogeneous to the dynamic, embodied and co-created.

In Chapter 3 we move on to the second half of the research context — an examination of phenomenological approaches to listening. As we shall discover, it is in many ways difficult to separate listening and spatial experience in the manner attempted here. In our dynamic and embodied conceptualisation of spatial experience, auditory perception is a key, co-creative element. Thus listening becomes central in the

production of space. Listening is not simply a gathering sense, which receives information about a finished, external space, but it is through listening that we create spatial experience. This draws heavily on the ideas of phenomenological philosophers Maurice Merleau-Ponty and Don Ihde. Embodiment can be seen as fundamental to modern conceptions of space *and* listening. Therefore, it is not always possible to preserve a clear distinction between listening and spatial experience, codependent as they are.

2.2 Evolving concepts of space

Space itself has a history in western experience. (Foucault, 1986)

In this section it is necessary to trace back some of the key points in the history of western conceptualisations of space. Although a brief survey, it is nonetheless important to relate in order to situate the more specific theories of spatial experience in music in the next section, and the proposals which follow in Chapter 4. Beginning with the isotropic and inert space of the Natural Standpoint, we move on to phenomenologically based understandings of space as lived and living, heterogeneous and layered.

2.2.1 The Natural Standpoint

German philosopher Edmund Husserl coined the term the *Natural Standpoint* in order to distinguish it from his emerging phenomenological project (Kane, 2007: 17).[1] Space in the *Natural Standpoint* is isotropic, homogeneous and inert. It is a void within which things are situated. It can be measured following the laws of Euclidean geometry, and things move within it following the laws of Newtonian dynamics. Husserl argued that in the Natural Standpoint we, "faithfully assume ourselves to be subjects situated within the external world; we take the reports of our senses to be causal effects of externally existent things" (ibid.: 17).

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[1]Alternatively translated as the "natural attitude" (Casey, 1996: 13).

The Natural Standpoint entails the "ontological dualism" (Watson, 2018) of subject and object upon which Cartesian philosophy is founded: the internal mind, the essence of which is "thought or consciousness", and external matter, the essence of which is projection in three-dimensions (Secada, 2004: 14). Thus in this *Cartesian space* we have, "no direct acquaintance with the material world, not even with our own bodies, but only with ideas that *represent* the material world" (Watson, 2018, my italics).

This representational view of space has been hugely influential in Western philosophy, theology and other disciplines. As Hodgkinson puts it:

> The secure, clockwork Cartesian world, in which a rational God directs
> an ordered universe, lasted from the Renaissance to the late nineteenth
> century. It was a formative pattern that permeated the thinking and the
> way of life of all educated European society. (Hodgkinson, 2016: 63)

Indeed, Cartesian influence is so widespread that it is difficult to shake off, pervading as it does our unconscious understanding of space. As Henri Lefebvre has written, "to speak of 'producing space' sounds bizarre, so great is the sway still held by the idea that empty space is prior to whatever ends up filling it" (Lefebvre, 1991: 15).

Indeed, long before Descartes (1596–1650), the conceptualisation of space as homogenous and inert gained traction with Democritus (ca.460–370 BC) and Aristotle (ca.384–322 BC) (Panofsky, 1991: 44). Space was described by the Italian Renaissance art theorist Gauricus as a:

> Continuous quantity, consisting of three physical dimensions, existing
> by nature before all bodies and beyond all bodies, indifferently receiving
> everything. (Panofsky, 1991: 66)

The techniques of linear perspective in painting and sculpture developed by, for example, Da Vinci (1452–1519), elevated art, "to a science", and for the Renaissance, "that was an elevation" (ibid.: 66). The result was:

> A translation of psychophysiological space into mathematical space; in
> other words, an objectification of the subjective. (ibid.: 66)

Thus by the sixteenth century, space in Western cultures had already become inert,
systematic — transformed into a "homogenizing fluid, immeasurable and indeed
dimensionless" (ibid.: 49).

The Cartesian conceptualisation of space has received significant criticism, particu-
larly regarding the notion of space as inert and homogenous. This quote from
Lefebvre gives a flavour of the opposition.

> What is the meaning of this thesis of Descartes's? (He says) the laws of
> space, which are mathematical laws, are laid down by God and upheld
> by him; nothing escapes them, and mathematical calculation reigns in na-
> ture because such calculation is coextensive with the space produced by
> God... The Cartesian subject nevertheless miraculously, thanks to divine
> intervention, grasps an 'object' — space — which is the result neither of
> intellectual construction nor of sensory elaboration but which is, rather,
> given *en-bloc* as suprasensory purity. (ibid.: 283).

Husserl also criticised the natural standpoint in his work, pointing towards what
he saw as a minimising of, "the contribution made to knowledge by the observer's
experience". In the Natural Standpoint, phenomena are reduced to, "effects of stim-
uli upon an organ", and human experience becomes "hopelessly subjective" (Kane,
2007: 17). Husserl's theoretical work of course proposed a *phenomenological* basis for
knowledge.

2.2.2 Phenomenological space

The project of phenomenological philosophers is to seek understanding through per-
ceptual experience, which might, through a process of reduction, reveal *primordial
experience* itself (Liu, 2009). For Maurice Merleau-Ponty in particular, this strategy is
to characterise the existential structure of human beings as *being-in-the-world*, with

the lived body as fundamental to experience, and thus existence. Merleau-Ponty described this by saying, "the body is our general medium for having a world" (Merleau-Ponty, 2012).

The implications of this philosophical shift towards embodiment for conceptualisations of space are significant. In every movement, the body gives, "possibilities for action". The instantaneous restructuring of space is thus a "*response* to the body's action towards a world". Since embodied movement is constant, space is continually reformed. There is a necessary "mutual constitution between body and space" (Liu, 2009). Therefore, "our body is not primarily in space, but is rather of space" (Merleau-Ponty, 2012: 149). It is perhaps after Merleau-Ponty that *space* becomes rather more, *spatial experience*.

2.2.3   Lived space

Lived space is a description of the human experience of space, rooted in a phenomenological understanding and developed by critical thinkers such as Lefebvre, De Certeau and Foucault as well as geographers, anthropologists, artists and others. It requires not only the physical but the social, human memory, feeling, environment, weather, even, and is therefore not determinate but constantly created. For Lefebvre, lived space has "a structure far more reminiscent of flaky *mille-feuille* pastry than of the homogeneous and isotropic space of classical (Euclidean/Cartesian) mathematics" (Lefebvre, 1991: 86). Lived or "inhabited" space, as Gaston Bachelard puts it, "transcends geometrical space" (Bachelard, 1994: 47).

Lived space is "more than distance", it is, "the sphere of openended configurations within multiplicities" says geographer Doreen Massey (Massey, 2008: 91). It is continually emerging, never complete, never fixed, always under construction. For De Certeau, "*space is a practiced place*" (De Certeau, 1984: 117). Foucault summarises, "we do not live in a homogenous and empty space ... We do not live in a kind of void ... We live inside a set of relations" (Foucault, 1986).

In some ways, lived space is synonymous with *being alive*, and therefore "has the virtue, and all the disadvantages, of appearing obvious" (Massey, 2008: 9). And yet we must examine this apparent transparency in order to understand the implicit assumptions we make about space, and therefore open up the possibility of thinking about space differently. Massey summarises the challenge:

> It is necessary to uproot 'space' from that constellation of concepts in which it has so unquestioningly so often been embedded (stasis; closure; representation) and to settle it among another set of ideas (heterogeneity; relationality; coevalness; liveliness). (Massey, 2008: 13)

One of the early contributors to a theory of lived space was anthropologist Edward T. Hall, who established the field of Proxemics in the 1960s, most notably in his book, *The Hidden Dimension* (Hall, 1990). Hall postulated that:

> Humans have an innate distancing mechanism, modified by culture, that helps to regulate contact in social situations. Conceptualized as a bubble surrounding each individual, personal space varies in size according to the type of social relationship and situation. (Low, 2003: 13)

Hall summarised the importance of his research, saying that virtually everything which humans are and do "is associated with the experience of space", and that the experience of space is, "a synthesis of many sensory inputs (which each) constitute a complex system" (Hall, 1990: 181).

Henri Lefebvre developed the theory of lived space in the 1990s, most notably in his book *The Production of Space* (Lefebvre, 1991). Key to Lefebvre's work is the notion of space as a "field of action" (Low, 2003). Lefebvre alludes to the constant process of the production of space and the embodiment of this process, when he says that, "both imaginary and real, (space) is forever insinuating itself 'in between' — and specifically into the unassignable interstice between bodily space and bodies-in-space" (Lefebvre, 1991: 251).

Philosopher Edward Casey writes on the role of the body in lived space, although he uses the term 'place' where I would use 'space'. Paraphrased by Katharine Norman

in her 2012 article *Listening together, making place*, Casey says "Place — how we sense and make it — is a process. We move, and in moving create place; places not only *are*, they *happen*" (Norman, 2012: 258). Going on, Casey emphasises the intrinsic nature of the body's relationship to place:

> While places are something that we form through perceptual experience, and in which we move, they are not external to us: they enter and form us through our being in the environment ... Through this dynamic relationship, bodies and places interanimate each other. (Casey quoted in Norman, 2012: 258)

The human body in the environment can thus be described as simultaneously "emplaced and *making place*" (ibid.: 258). The relationship between body and space is dynamic and co-creative. Anthropologist Tim Ingold develops this conceptualisation when he writes that:

> The world we inhabit, far from having crystallised into fixed and final forms, is a world of becoming, of fluxes and flows. (Ingold, 2012: 81)

For Ingold, lived space is, in the terminology of Deleuze and Guattari, a *smooth space*, as opposed to a homogeneous and volumetric *striated space*. In striated space, "diverse things are laid out, each in its assigned location"; smooth space on the contrary, "has no layout" and presents instead, "a patchwork of continuous variation" extending omnidirectionally (ibid.: 81). Thus we do not perceive a stable visual space, but co-create it through our looking. As Ingold writes:

> The eye, in smooth space, does not look *at* things but roams *among* them, finding a way through rather than aiming at a fixed target. (ibid.: 81)

Lived space is thus again conceptualised as an embodied space, and, visually, a *dynamic* and *co-created* space. Similarly, in our listening we do not perceive a fixed auditory field but continuously co-create and evolve a unique, dynamically changing space. In Ingold's words, our ears *find a way through*.

2.2.4 Multiplicity

Central to lived space is the concept of multiplicity. I repurpose this term in a specifically musical sense in Chapter 4, but here I will touch upon the Bergsonian and Deleuzian meaning of the word. It is beyond the scope of this thesis to present a full philosophical description of multiplicity, but what follows will suffice for our purposes.

Deleuze and Guattari relate multiplicity to their philosophical concept of the rhizome, saying "multiplicities are rhizomatic" (Deleuze and Guattari, 1987: 8). The rhizome, "connects any point to any other point". It is a dynamic feedback network. A multiplicity is unlike a fixed structure, which is "defined by a set of points and positions" (ibid.: 8). A multiplicity has neither:

> beginning nor end, but always a middle from which it grows and from
> which it overspills. (ibid.: 8)

When there is any change in a multiplicity, the multiplicity "necessarily changes in nature as well" (ibid.: 21). The multiplicity thus has the quality of being more than the sum of its parts. A change in any part necessitates a change in the whole (Deleuze, 1991).

Lived space, the *emplaced-and-making-place*, is therefore a "dynamic simultaneous multiplicity" (Massey, 2008: 61), as opposed to the closed fixity of Cartesian space. Or to put it another way, "the body is best conceived as a multiplicity" (Low, 2003).

2.2.5 Atmosphere

Returning again to the writing of anthropologist Tim Ingold, he has postulated that atmosphere, "holds the key to the way we, as living, breathing beings, embrace and are embraced by the world around us" (Ingold, 2012: 75). Of course atmosphere is a word with two sets of meanings, the meteorological and the affective. In its meteorological guise, the atmosphere is a spherical envelope around the Earth, a zone which can be measured and calculated, understood and predicted in terms of

physical forces. It is separated from the body, from things *in* the atmosphere. In its affective sense, an atmosphere is a space created through feeling or mood. It is generated by bodies or things in their environment. For Ingold, though, it is the air that is central, the air which is the medium that makes perception possible.

> The air is not just an element we interact *with*, as we might with other things. It is the very medium that makes interaction possible. (Ingold, 2012: 77)

Ingold has developed lived space — the space of fluxes and flows, Deleuze's smooth space — into a haptic weather-world. Spatial experience is atmospheric. As atmospheric phenomena, light, sound, the wind, the rain, are not enfolded into the body (embodied), but rather the body is swept up into their currents.

> Immersed in the fluxes of the medium, the body is enlightened, ensounded and enraptured. (Ingold, 2012: 135)

We hear fluxes in the medium of sound as auditory experience, just as we feel fluxes in the the air as wind. German Philosopher Gernot Böhme, approaching from the point of view of aesthetic theory, also uses the term atmosphere to develop an aesthetics of *felt spaces* (Böhme, 2017). Böhme's theory starts with the *ecstasies of things*, which refers to, "the way in which a thing steps out of itself and into the surrounding space ... and, through its appearance as presence, generates an atmosphere" (ibid.: 8). Therefore atmospheres can also be called, "bodily felt spaces of presence" (ibid.: 29). In this atmospheric conceptualisation of spatial experience, the elements of *body* and *flux* are foregrounded.

2.2.6 Space versus time

In much of the discourse regarding lived space we find an implicit separation of space and time. Space is conceptualised as a slice through time, and spatial experience is understood as a sequence of these slices. Although perhaps intuitively understandable, this reduction has the consequence of impoverishing space. Space

becomes 'merely' the opposite of time, to be regarded as static until animated by time. This paradigm is potentially problematic: space may seem an afterthought, a residual of time. It is robbed of any inherent dynamism. The following quote from Doreen Massey summarises the issue:

> Through many twentieth-century debates in philosophy and social theory runs the idea that spatial framing is a way of containing the temporal. For a moment, you hold the world still. And in this moment you can analyse its structure. You hold the world still in order to look at it in cross-section. It seems a small, and perhaps even intuitively obvious, gesture, yet it has a multitude of resonances and implications. It connects with ideas of structure and system, of distance and the all-seeing eye, of totality and completeness, of the relation between synchrony and space. And — or so I want to argue — the assumptions which may lie within it and the logics to which it can give rise run off in a whole range of problematical directions. (Massey, 2008: 36).

The implicit separation of time and space does not, I would argue, fit with a phenomenological understanding of spatial experience. We cannot experience a 'snapshot' of space, space cannot be experienced as a frozen instant; in short we cannot remove time from space or space from time. As Massey points out, there is often to be found in spatial discourse, "a language of victory" — victory of time over space or vice versa — which "reinforces an imagination of enmity between the two" (ibid. p29). Boundas goes as far as to state that, "the great dualism inherited from the classical rationalists and empiricists — matter and mind — is repositioned now on the distinction between duration and space" (Boundas, 1996: 92). Perhaps this distinction is carried over into discourse on music. Space is rendered as stasis and fixity, as lacking in temporality. Time is rendered as a straight line, a continuous 'arrow'. It would surely be preferable to posit a phenomenological conception of space which *includes* the temporal, rather than one which places space and time in opposition. This is not to say that space and time are equivalent, but rather that their interpenetration is so great as to render their separation unviable in any reasonable

conception of human spatial experience — "the division of space and time are not, strictly speaking, primitive experiential significations" (Ihde, 2007: 61). In order to open up the possibility of new conceptions of space and time together, not opposed, "a reimagining of things as processes" is necessary (Massey, 2008: 20).

2.2.7 Quantum space

As a short aside, theoretical physicists are now beginning to understand space and time at the subatomic Planck scale — many times smaller than a proton or electron — to be *quantized* in the same way that we know light to be. Space and time are *granular*.

One theory gaining traction is that space is built up in discrete loops. These loops are not *in* space, but *are* space. At this incredibly small scale (10^{-35}m), reality is a frenzied swarm of these quanta which are continuously appearing and disappearing (Rovelli, 2019). Using strikingly similar language to that used by the philosophers and geographers we have discussed in earlier sections, physicist Carlo Rovelli proposes that the world is made up of events rather than things, and that we should think of the world, "as a succession of happenings, as a process." [2]

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[2] Carlo Rovelli interviewed by Jim Al-Khalili on BBC Radio 4 *The Life Scientific*, broadcast 08.05.18.

2.3 Theories of space in music

2.3.1 Context and scope

We now move on from more general conceptions of space to examine theories of space in music, specifically music involving electronic sound. Spatial experience has always been of interest to music makers and listeners, from early experiments with antiphony to twentieth century developments in electronic spatialisation. However, spatial experience in music has resisted formalisation into a broadly accepted theory or schema, and remains somewhat underdeveloped compositionally and in much of the musical literature. As Denis Smalley wrote in 2007, "as yet there is no substantial, unified text on the topic, nor any solid framework which might provide a reasonably secure basis for investigating space" (Smalley, 2007: 35). Somehow sonic spatial experience seems to have defied codification according to existing (or new) critical frameworks.

Having said that, there are of course many significant historical examples where spatial experience is formally examined in music. There is even evidence to suggest that spatial acoustic effects were of importance at Stonehenge and other prehistorical sites (Till, 2014). And it was in the first century BC that Pythagoras first noted the relationship between the lengths of vibrating strings and the "perceived quality of musical consonance between them" (Wishart, 1996: 45). This observation led (indirectly) to the concept of the *Harmony of the Spheres*, whereby "heavenly bodies were assumed to be transported around the earth on giant spheres whose motion generated a heavenly music, governed in some way by the Pythagorean laws of proportion" (ibid.: 46). This notion of a divine relationship between music (in particular harmony) and space (in particular geometry) was significant right up until the Renaissance and beyond.

The use of antiphony in early ecclesiastical music, combined with the architectural acoustic characteristics of the churches in which it was performed, was certainly

consciously adopted to produce spatial effects. The sixteenth century Venetian composers Andrea and Giovanni Gabrieli would on occasion specify that sections of the choir should be located in different positions around St. Mark's Cathedral in Venice, to "take advantage of its unique architectural features" (Long, 2014: 12). The spatial separation, combined with long reverberation which varied by location, would create an overlapping spatialised harmony. Thomas Tallis' *Spem in Allium* for forty voices divided into eight choirs, was, according to composer Gerard Pape, composed to bring the space of performance alive, and to create a "multi-directional, spatialised type of listening" (Pape, 1999: 61). As Lawrence Kramer describes it:

> The polyphony of the work is thus not primarily between voices but between choirs. Especially insofar as the latter sing from separate spaces, the course of the motet is not the kind of continuous combination of parts that one would expect from a normal choral work but instead a pulsation of massed voices swelling and subsiding and swelling again. Sound in its materiality assumes the force of spirit. (Kramer, 2019: 117)

In orchestration, timbre is often used to create spatial imagery. For example, in Sibelius' orchestral writing, "a low bass line moves against a high melody with little or nothing in the intervening 'space'". This generates, "a sense of a vast and empty landscape" (Wishart, 1996 p191). There are also many examples of off-stage effects used to imply distance, another place or the ethereal and other-worldly. For example, the fourteen offstage brass instruments in Richard Strauss' *Alpine Symphony* (1915), or the single offstage oboe in the third movement of Berlioz' *Symphonie Fantastique* (1830).

In architectural acoustics, spatial perception has long been accepted as a "crucial element of the experience" in musical listening (Barron, 2001). For example, it has recently been demonstrated that a listener's "sense of envelopment" is "almost solely produced" by late reflections of sound (those arriving at the listener after 80ms) from lateral directions. Objective measurements have been established to quantify and compare this across concert halls, for example the *late lateral energy fraction*, LG_{80}

(ibid.).

It is perhaps unsurprising that the most developed theories of spatial experience in music stem from the acousmatic or electro-instrumental realms. Denis Smalley calls acousmatic music, "the only sonic medium that concentrates on space and spatial experience as aesthetically central" (Smalley, 2007: 35). It is true that revolutions in audio technology have presented composers with ever greater control of electronic sound recording, manipulation, synthesis and diffusion. In acousmatic music in particular, where all the sound of the music is produced by loudspeakers, there may be a greater potential to create and control musical spaces which surround the listener. In the following sections I will review the key points of significant theories of spatial experience in music involving electronic sound.

2.3.2 Spatialisation

First of all, we must revisit the term *spatialisation* to distinguish it from *spatial experience*. The most usual meaning of the term spatialisation refers to the use of electronic techniques to spread sound across an array of loudspeakers in order to articulate a coherent sonic 'image', as exemplified by electroacoustic music.

Various techniques are used to enable a sound to be localised by the listener to a particular position, to create width, depth and movement in the image. By contrast, *spatial experience*, in this thesis, is a term used to encapsulate a conception of space as dynamic, embodied and co-created, leading to a *feeling* of space where specific sound location or movement may be one of many important factors.

Theories of spatialisation tend to be principally concerned with space in the geometric sense — whether a sound is identified as being located to the left, right, above, below, in front of or behind the listener. This quickly becomes much more complex as additional factors such as movement between locations, associated velocity and acceleration, envelopment, stratification, dispersion, density and change over time are considered.[3] Literature on spatialisation tends to be contingent on a visual

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[3]As described in detail in Smalley's thesis of *spectromorphology* (Smalley, 1997).

and geometric metaphorical basis for spatial experience. For example, a stereo field is described as a 'window frame', with sonic perspective understood as analogous to the painter's single point perspective (Smalley, 2007: 50). This conception is extrapolated when considering multi-channel configurations, to arrive at descriptions of dynamic 'landscaping' of a spatial 'image' in three cartesian dimensions (Bayle, 1989: 167, Kendall, 2010: 233).

Achieving spatialisation with any level of sophistication is not, however, simply a geometric problem. Many psychoacoustic and spectral effects must be accounted for. The precedence effect must be overcome, generally by utilising a 'sweet spot' in the centre of the loudspeaker array, which is the point at which the effect of spatialisation is optimal (Rayleigh, 1875, Wallach and Rosenzweig, 1949, Haas, 1951, Blauert, 1983). The resolution of the spatialisation system depends on various factors including the particular technique used, its implementation and the number of loudspeakers in the array. Some of the principle theories used to develop spatialisation techniques are vector based amplitude panning (VBAP), ambisonics, wavefield synthesis, and binaural sound, each of which has associated mathematical descriptions. Key practitioners of spatialisation techniques include Stockhausen, Chowning, Boulez, Bayle, Smalley, Emmerson and Oram.

2.3.3 Space frames

Composer Simon Emmerson conceives of space in music as a series of "mobile, flexible and even overlapping" frames (Emmerson, 2007: 97). Moving outwards from the locus of performance, Emmerson defines the *event, stage, arena* and *landscape* frames, within which all musical activity is located. See Figure 2.1 for Emmerson's illustration of the nested frames.

The frames can be further subdivided by the distinction of *local* and *field*. *Local* includes the *event* and *stage* frames, and local controls "seek to extend (but not break) the perceived relation of human performer action to sounding result" (ibid.: 92). *Field* functions, by contrast, "create a context, a landscape or an environment within
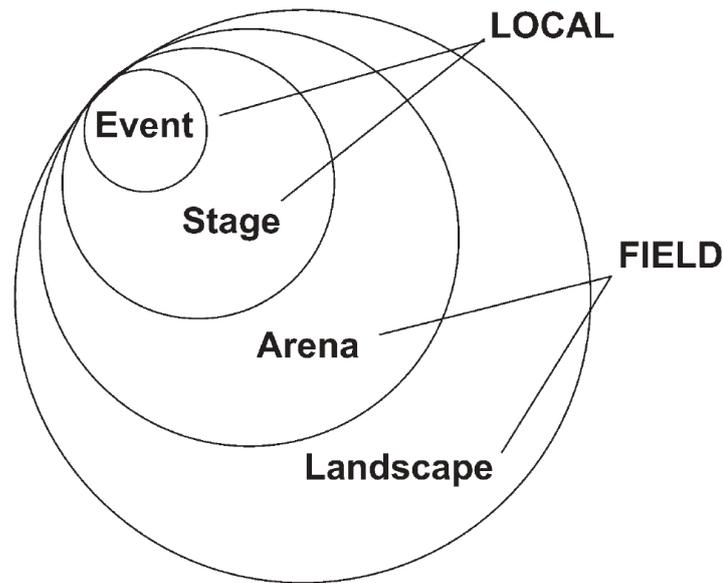
FIGURE 2.1: Local and field space frames (Emmerson, 2007: 98).

which local activity may be found" (ibid.: 92). Field could also be defined as any activity not locatable to the performer as source, and may be characterised sonically by real or virtual objects or spaces, or any combination of such.

Frames are dynamic and can interpenetrate each other, such that events may fill the arena, and landscape may invade the stage. Local may become field, and field may become local. Defined in this way, says Emmerson, frames are a resource both compositionally and analytically: "frames may now become objects of musical discourse" (ibid.: 98).

Although conceived of as flexible, Emmerson's frames tend to preserve the fixed and visual language of static space — they are a landscape within which things happen.

2.3.4 Space-form

Composer Denis Smalley developed and refined the concept of *spectromorphology* in his theoretical work throughout the 1980s and 1990s. The two parts of the term, "refer to the interaction between sound spectra (*spectro-*) and the ways they change and are shaped through time (*-morphology*)" (Smalley, 1997: 107). In his articles on spectromorphology, Smalley "left the discussion of space until last, because it was

so bound up with spectromorphological content: we needed to know about spectromorphology before we were in a position to understand space" (Smalley, 2007: 53).

In his 2007 article 'Space-form and the acousmatic image', Smalley seeks to provide a framework for the analytical discussion of space, given that, as he put it, "we are not used to listening out for spatial attributes, for spatial forms", and that, "we are not sure what space really is, in sonic terms ... We lack a sufficiently comprehensive bundle of concepts to talk about it" (ibid.: 35). In the article Smalley adopts an "integrated ecological approach" because, "we cannot separate space itself from what produces it, nor from our experience of space in nature and culture" (ibid.: 54).

Smalley proposes analysis of acousmatic music based on *space-form*, which "proceeds from a higher level of structure" (ibid.: 54) than analysis based on spectromorphology. One *starts* from a consideration of the space-form process at work - this could be a journey through different spaces; changing views of the same space; or simultaneous spaces — and works backwards to the spectromorphologies used to accomplish the space-form.

Smalley sets out a variety of conceptual categories which spatial experience may be assigned to. A selection of these (the most relevant to electro-instrumental music) are set out in Figure 2.2. At the top level six forms of spatial experience are shown: *source-bonded, enacted, spectral, perspectival, vantage-point shifts* and *containment and transcendence*. Each is broken down into further subcategories. *Enacted space* is of particular relevance to electro-instrumental music as it includes *performed space* — from the level of individual *gestural space* to the group dynamics of *ensemble space*. This is somewhat similar to Emmerson's notion of the *event* and *stage* frames (the 'local').

Emmerson's *arena* and *landscape* (the 'field') are broken down in Smalley's characterisations to include listener perspective (location, breadth, movement, proximal (nearest) and distal (furthest), diagonal forces, planes and gravitation), changes in perspective, spectral size and scale, and source-bonding (nature, culture, mediated).

In following a space-form analysis, it is thus possible to arrive at a *holistic space* for a particular stretch of listening, be that to music, an external landscape, internal environment or other situation. Smalley gives the example of the 'Orbieu Soundscape', a natural landscape in France featuring a river, a road, cars and animals, which he observes from the fixed vantage point of an open window in his house. The holistic space comprises an "array of zoned spaces" (ibid.: 37), including nested spaces (frogs zone within the river zone, two separate cars passing merge into one road zone). Thus in space-form, temporal evolution can be disregarded:

> I can collapse the whole experience into a present moment ... Even though my perception of sound is the product of time, I ultimately sideline time's formative role. So space can be more significant than time ... Time can be placed at the service of space rather than the reverse. (Smalley, 2007: 37)

It is from within this holistic space that the dynamic interplay of all other spaces can be understood.

Smalley's conceptualisation of space, whilst undoubtably powerful, nevertheless refers back to that visuo-centric realm of single-point perspective — a view through a window, a vantage point. It does not fully incorporate certain affordances associated with sound as a dynamic and embodied phenomenon: the auditory field, atmosphere, co-creation. Furthermore, space is placed in opposition to time, a "collapse" of time, rather than an attempt to unite the two in an experiential sense.
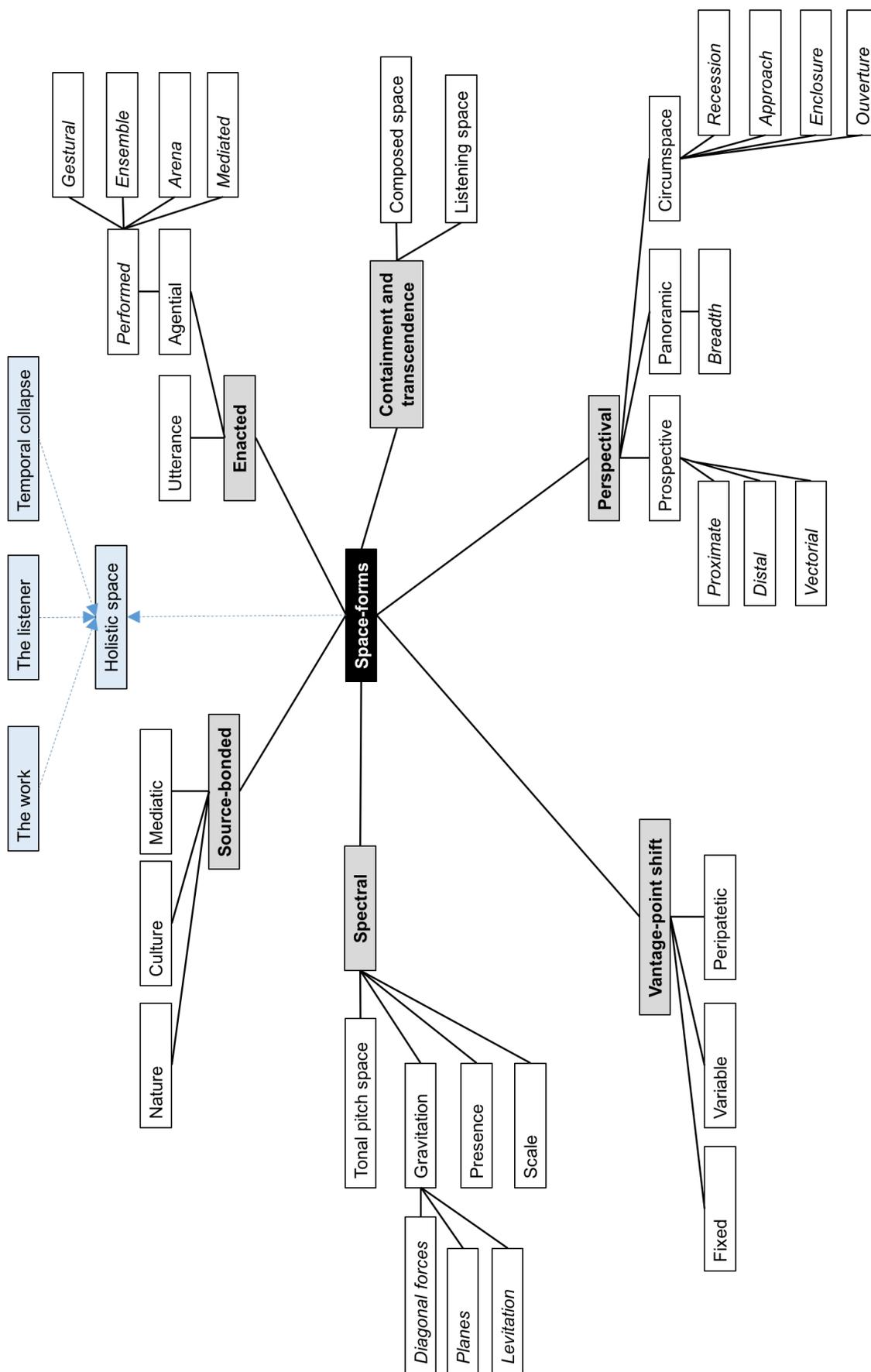
FIGURE 2.2: Selected space-forms and holistic space (Smalley, 2007).

2.4   Conclusion: finding new metaphors

Every metaphor has within it a potential for reversibility. The two poles of a metaphor can play the role of the real and the imaginary alternately.
(Bachelard, 1988: 55)

Perhaps our metaphors for describing auditory space should be derived not from landscape studies but from meteorology.
(Ingold, 2011: 138)

This chapter has presented an examination of significant theories of spatial experience in music, placed in the broader context of the evolution of the conceptualisation of space more generally. It is an attempt to understand how the thread of the history of the conceptualisation of space might relate to the specific case of musical spatial experience, in order to understand where we are in the present day, and to open up possibilities for the future.

In this thesis spatial experience is conceptualised as a dynamic, embodied, co-creative process. Existing theoretical frameworks relating space and music tend to emphasise geometrical aspects of space, relying on visuo-centric metaphors but neglecting the specific affordances of listening in relation to space. Can we find new ways to describe spatial experience, ones which are rooted in a modern conceptualisation of spatial experience?

Metaphor, as Bachelard points out, has the potential to play the role of both the real and the imaginary. Perhaps in the intangible world of sound the paths around these two 'poles' are particularly difficult to unravel. Metaphors enable us not only to describe, but to understand. In questioning the metaphorical basis on which our language is built — as suggested by Ingold — we open up new avenues of potential understanding.

Composer Katharine Norman quotes artist David Dunn in her excellent article 'Listening Together, Making Place'. Dunn suggests that in order to advance our understanding of spatial experience, it is necessary to first become aware of, and then to

critically examine, "*the very metaphors we use to organise reality*" (Norman, 2012: 257).
This is a striking idea, and explains why it was necessary to go back to some early
theories in our examination of listening and space in Chapters 2 and 3, to find where
these organising metaphors — so deeply embedded that we often don't notice them
any more — have their roots. It is from this vantage point that we may be able to
establish new metaphors which develop our understanding of spatial experience in
music. Norman explains:

> I am convinced that electronic sound as part of music can contribute
> uniquely to metaphors for immeasurable space, and that these metaphors
> can issue from images imbedded in the medium, or more properly in the
> ways we listen to it. I believe that through these images our listening can
> be developed and deepened to provide metaphors of great strength and
> meaning. (Norman, 2004 ch.2: 1).

Two key theories of spatial experience in music discussed in the previous section, the
space frame and space-form, are based on a particular metaphor. This metaphor, I
would argue, is rooted in a geometrical understanding of space: space as given, fixed
and inert. Both theories situate an 'ideal' listener at an 'ideal' location. This ideal lis-
tener observes but does not create - she is emplaced but not making place. The ideal
listening location is at the centre of what is essentially a fixed space. Although the
space frames and space-forms are seen to be dynamic and interpenetrating — the
vantage point may move (peripatetic) or the space itself may move (perspective) —
in essence the listener observes an environment from a position external to it, despite
being at the centre of it, creating a toroidal structure. The metaphor used to construct
these theories does not stray far from the ideal Cartesian, representative space: ex-
ternal matter observed by the internal mind, with no direct, relational experience
between either.

I do not wish to argue that these metaphors are incorrect, in the case of acousmatic
music in particular the concept of space-form is an extremely powerful generative

and analytical tool. However, I do mean to suggest that there could be other 'organising metaphors' that we might draw on to construct new theories. Indeed, as Norman says above, electronic sound in music may have a unique role to play in the development of these new metaphors, as we discover the particular affordances of new technologies.

What could our metaphors be if we start from the notion of *lived space*? If we start from a space which is co-created by the listener, a listener who is *emplaced-and-making-place*? If we start from Massey's relational space, or Ingold's atmosphere? Norman again:

> While I think it is no accident that 'soundscape' compositions seeking immersive listening experiences frequently use surround-sound or eight-channel presentation to encompass the 'static' listener, my feeling is that there is equal value in finding ways to encourage listeners to participate in 'making-place', so that they might feel that place is 'happening' to them, and *because* of them, through their movements in the world. (Norman, 2012: 259).

What are the metaphors for spatial experience in music which correspond to an understanding of space as lived, as never finished, as continuously created by the listener? What are the metaphors which do not seek to privilege time over space, or space over time, but which encompass the human experience of their interpenetration; the metaphors for space in which the human body is 'ensounded'; a space which is not external to us, but enters us and is formed through us; an emergent phenomena which requires a listener for its completion?

Chapter 3

Phenomenological approaches to listening

3.1 Introduction

Sound, in the listening ear and the bodily interior, is in the first instance the medium of self-aware sentience, and the mutual sensory opening of life and the world. (Kramer, 2019: 7)

In this chapter I aim to call attention to listening, to delve into established theoretical frameworks surrounding listening, and, potentially, to elevate its status among the sensory. Far from being just a gathering sense, which passively collects sounds as we wander about our places, listening is primary and essential in the creation of the world around us. As Lawrence Kramer puts in, "the sense of hearing grounds the sense of being" (Kramer, 2019: 2).

The chapter is divided into three sections. The first section reviews existing phenomenological frameworks surrounding listening — in particular the theoretical work of Pierre Schaeffer, Don Ihde, and Tim Ingold — and attempts to trace an arc of transition through the work of these critical thinkers.

The second section explores the work of a selection of twentieth century composers and visual artists, in order to form a deeper understanding of how these artists have approached and considered light, sound, vision and listening.

The chapter concludes with a discussion on multistability in perception, stemming from the discoveries of previous sections, and the potential consequences of this in composition.

3.2 A review of key theories

In this section it is necessary to review some of the key critical theories which surround phenomenological approaches to listening, in order to contextualise discussions which come later.

3.2.1 Reduced listening

Pierre Schaeffer is a central figure in any discussion of phenomenology and listening. We will briefly revisit the pivotal concepts of his theoretical work, alongside some critical analyses.

The acousmatic is defined by Schaeffer as, "referring to a sound that one hears without seeing the causes behind it" (Schaeffer, 1966: 91). It is derived from the name given to disciples of Pythagoras in ancient Greece, who would listen to their Master's voice while he was hidden behind a curtain. It was thought that this would help concentrate the mind on the meaning of his words, rather than external details. According to Schaeffer, acousmatic listening is a phenomenological reduction or *bracketing-out*, "shifting attention away from the physical object that causes my auditory perception, back towards the *content* of this perception", with the aim of becoming aware of, "precisely what it is in my perception that is given with certainty" (Kane, 2007: 17).

Reduced listening (l'écoute réduite) is a further phenomenological reduction made by Schaeffer which, "bars the appropriation of sounds as indicative or communicative signs" (ibid.: 17). When practicing reduced listening, a sound should not be used to infer a cause (a door slamming, a dog barking), but rather attended to as a thing in

itself. This 'thing' Schaeffer terms *l'objet sonore*, or the *sound object*, which is the correlate of reduced listening (Chion, 2009: 32). The sound object is a perceptual unit or *gestalt*, and is distinct from the cause of the sound and the sound's physical (acoustic) signal. Importantly, the sound object is a, "totality which remains identical through different hearings" (ibid.: 32), which therefore makes it a problematic concept within the framework of listening presented in this thesis. Returning to Schaeffer, a taxonomy of sound objects can be created through the practice of reduced listening, and sound objects can thus be divided into categories according to various sonic traits.

Schaeffer identifies four *modes* of listening: *écouter, comprendre, entendre* and *ouïr* which exist in acousmatic and non-acousmatic experience.[1] The first two modes are common and used for gathering meaning and information, for example the proximity of a passing car, or the semantic meaning of speech. The latter two modes are those in which reduced listening is practiced, although in *ouïr* it is not practiced consciously. In these two modes the listener, "does not seek beyond the sound itself to discover an external object", instead the sound is, "reduced to the sphere of pure immanence" (Kane, 2007: 18). As the active, intentional mode, it is in *entendre* where *l'objet sonore* can truly be grasped, as we focus our listening on the traits of the sound itself. It is to this mode that Schaeffer dedicated his programme of research into the foundations of musical structure, and which led to his development of *musique concrète* (ibid.: 18).

Schaeffer's four modes of listening can be summarised as follows:

1. *écouter (listening)*: Concrete, objective. An information gathering mode. For example, I hear a car coming, and so I wait to cross the road.

2. *comprendre (comprehending)*: Abstract, objective. A meaning gathering mode. For example, when conversing using speech.

3. *entendre (hearing)*: Abstract, subjective. A selective, attentive, intentional mode, where reduced listening is practiced. For example, while hearing acousmatic

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[1]Michel Chion later identified *three* modes of listening: *causal, semantic* and *reduced* (Chion, 1994: 25).

music (although not necessarily).

4. *ouïr (perceiving)*: Concrete, subjective. A passive, inattentive mode, where reduced listening is also operative, but not consciously practiced. For example, not listening.

(Schaeffer, 1966, Chion, 2009)

From this theoretical work, Schaeffer developed *musique concrète*, creating music from recordings of 'real-world' sounds transformed into sound objects by various methods of production and compositional techniques.

Thus Schaeffer, in what has been characterised as a provocative opposition to the "excess of abstraction" of the period (Chion, 2009: 37), sought an approach to music centred on the perception of sound and a phenomenological understanding of listening. An approach to music which starts from hearing and leads to abstract ideas, rather than the classical formula of starting with abstract concepts and notation and leading to a 'concrete' performance. Thus Schaeffer's was not a rejection of the abstract in music as such, but a reclaiming of it (ibid.: 37).

Schaeffer's conceptualisation of sound and listening has been criticised by some recent thinkers, especially Kane, 2007 and 2014. Kane's criticism falls into four main strands:

1. *L'objet sonore perpetuates an ahistorical view about the nature of musical material.* According to this view, the material of musique concrète is, "sound heard for the purpose of trying to extract abstract musical values from it" (Chion, 2009: 37). Thus musical values must remain abstracted from the sonic. The sound object is "essentially inserted" into an "abstract musical discourse" (Norman, 2004: Ch3, 13). This led to Schaeffer's vehement opposition to the use of anecdotal sound in musique concrète (Kane, 2007).

2. *L'objet sonore prevents discussion about the nature of technology.* In Schaeffer's conceptualisation, the differences in listening experienced by Pythagoras' disciples listening behind a curtain, and twentieth century listening to loudspeakers and radios, "in the end become negligible" (Schaeffer, 1966: 93). Schaeffer

omits examination of, "the manner in which new forms of technology produce historically unique affordances" (Kane, 2007: 22).

3. *The fixity of l'objet sonore is not appropriate to the ontological nature of sound.* The sound object reifies auditory experience, and cannot capture certain experiential phenomena such as the Doppler effect. Sounds should more properly be described as *events* in a state of flux, which "bind source, cause and effect together" (Kane, 2014: Ch.3 p32, O'Callaghan, 2007).

4. *Schaeffer's phenomenological reductionism results in an over-simplified model of perception.* There are many more than four modes of listening, which can occur simultaneously, and which operate in a transmodal paradigm (Chion, 1994). Schaeffer overemphasises a split between overtly 'musical' and 'ordinary' listening.

Brian Kane, who posits these objections in his book *Sound Unseen*, argues for a broadening of our understanding of what acousmatic listening means. Rather than becoming synonymous with reduced listening (which was not Schaeffer's intention, but is nonetheless a commonplace error), acousmatic listening should be understood, "as a rubric intended to capture a set of historically situated strategies and techniques for listening to sound unseen" (Kane, 2014: 7). Important examples of acousmatic listening are thus found in musical contexts (including electronic, acoustic and mixed music), and non-musical contexts (Kane's examples include the ecclesiastical, psychoanalytical, phantasmagorical etc.).

Although there are certain aspects of sound which may remain the same when the sound is repeated, when considering listening as embodied, sound can never be 'identical' because it depends so thoroughly on the holistic context of the world in flux around the listener. Therefore, the concept of the sound object does not sit happily within the framework of auditory experience which is developed in this thesis.

3.2.2 The auditory field

In his seminal book *Listening and voice* (Ihde, 2007) Don Ihde sets out a framework for listening within a *field* of auditory perception. In the *auditory field*, sounds present themselves in a situated context, not independently. As listeners we use our *intention* to transform our auditory field and navigate through it using *auditory focus*. Sounds not in focus become *fringe* phenomena, and the ratio of fringe to focus is constantly shifting. Sounds continually emerge over the *auditory horizon*, which expands and contracts depending on the situation. The auditory field can be characterised by the following principles:

The auditory field...

1. *...is embodied, omnidirectional and penetrating.* Sound "*surrounds* me in my embodied positionality" and (literally) "permeates and penetrates my bodily being". Thus the auditory field is definitely *not* "isomorphic with the visual field" (Ihde, 2007: 45 and 75).

2. *...is horizonal, focusable, dynamic and heterogeneous.* We experience an *auditory horizon*, which surrounds the *auditory present*. We cannot hear beyond the auditory horizon, but the auditory horizon is in constant flux as sound emerges from silence. With intention, we can focus on specific phenomena of the auditory present, "such that other phenomena become background or fringe phenomena". There is a constantly varying ratio of fringe to focus phenomena, based on "interest and occasion", rendering the auditory field dynamic and heterogeneous (ibid.: 74).

3. *...is both surrounding and directional.* Auditory experience can be both *global and surrounding* (imagine standing too close to a railway, a passing train creating a very loud, immersive noise) and *located and directional* (imagine a quiet garden, with a solitary bird singing in a tree, above and to the right). Auditory experience can be both of these at once: the global-and-surrounding and the located-and-directional are "*constantly copresent*". This bidimensionality of the

auditory field is, "at once the source of much ambiguity and of a specific richness that subtly pervades the auditory dimension of existence" (ibid.: 77).

In contrast to Schaeffer, Ihde's conceptualisation of listening based on the auditory field comes much closer to the *flux* of embodied auditory experience. The idea of sound as event rather than object (O'Callaghan, 2007) points towards the dynamism and relationality that are key to an understanding of embodied listening. Within the auditory field, no single sound is ever identical to another because it depends on the totality of the field.

3.2.3 Listening in sound, seeing in light

As we have seen, anthropologist Tim Ingold characterises listening as an *atmospheric* phenomenon. In Ingold's conception, rather than listening *to* sound objects, the human body is *ensounded* by an immersive atmosphere of sound.

Ingold's research stems from a concern that the relatively new and emerging discipline of sound studies may be repeating the mistakes of visual culture. Visual culture, Ingold argues, "scarcely deals with the phenomenon of light", and for that reason is impoverished (Ingold, 2011: 136). Ingold posits that the widely used term *soundscape* (Schafer, 1977) sends sound studies down a similar path. Although the term was "undoubtedly useful" when first introduced, soundscape encourages, "the interpretation of a world of things rendered in their acoustic form", and thus severs the 'things' we hear from the *phenomenon* of sound (Ingold, 2011: 136). After all, a landscape tends to be something which we look *at*, rather than something which we are actively *in*, which we can affect and change through a dynamic relationship. Similarly, a soundscape appears as something fixed and distant, which we listen to passively, rather than a process which we — as listeners — are actively involved in through co-creation and interanimation.

Ingold makes the point that the linguistic jump from *land*-scape to *sound*-scape is somewhat unconvincing in the first place. "It is of course to light, and not to vision, that sound should be compared" (ibid.: 137). The fact that sound is so often and

unproblematically compared to sight rather than light reveals a great deal about the implicit assumptions we make regarding the nature of vision and listening: the former being conceptualised as representational and the latter assumed to be directly accessible. In Ingold's words our implicit assumptions rest on:

> The curious idea that the eyes are screens that block out the light, leaving us to reconstruct the world inside our heads, whereas the ears are holes in the skull that let the sound in so that it can mingle with the soul. (ibid.: 137)

Drawing on Merleau-Ponty, Ingold goes on to construct a conception of sound as "neither mental nor material", but instead as a "phenomenon of *experience*". Thus sound is not the object but "the *medium* of our perception". Sound is not "*what* we hear, any more than light is what we see". Ingold develops Ihde's framework for listening in an auditory field into a conception of sound as an immersive medium. Sound is "what we hear *in*", light is what we see *in* (ibid.: 138); listening *in* sound, seeing *in* light. By describing listening as listening to objects, already fixed, the result is that we obscure our own auditory experience. Auditory experience is rather better characterised as a continuity of fluxes in the medium of sound, experienced and engaged with bodily. It is this embodied and dynamic conceptualisation of listening which I take forward in this thesis.

3.3 Phenomenology and music

Having reviewed selected phenomenological frameworks for listening, and developed an embodied and dynamic conceptualisation, we will proceed to a more practical examination of phenomenological approaches to sound and light as materials for art-making. The focus here is not necessarily on spatial experience as articulated through listening or vision, but on the processes of perception itself, and how artists have explored them. Taking our cue from Tim Ingold, we move beyond the *'scaping of things'* to consider how selected artists have engaged more or less directly with sound and light as phenomena, and foregrounded perception in their work. In this way, we discover more about how sound, through listening, contributes to the co-creation of spatial experience.

In the course of my research I have found it extremely helpful to trace phenomenological approaches in both music and visual art. As a composer I have found the ideas of certain visual artists very useful in developing my own thoughts, which is potentially due to the immediacy of the media they were working with. This is not to equate listening and vision, which of course function in fundamentally different ways. (Physically, sound is a longitudinal pressure or matter wave, whilst light is a transverse oscillation in the electromagnetic field. Human aural and optical processing, both physiological and psychological, are likewise distinct.) We can, however, compare the various methods which artists have used to explore sound, light and perception, whilst bearing in mind that perception functions cross modally, and that information gathered through the various sensory channels cannot easily be separated.

We start with a short discussion regarding the development of perceptual methods in art and music, before considering a number of specific aspects of phenomenology in art illustrated by examples from particular artists.

3.3.1   Beyond the *scaping* of *things*: sound and light as material

> *The perception of solid form is entirely a matter of experience.*
>
> John Ruskin, 1865 (Gombrich, 1972: 35)

Art critic and painter John Ruskin, quoted by Gombrich, describes how "sensations of colour" are woven into the perception of objects by the mind (ibid.: 35). Ruskin's contemporary, the German natural scientist Hermann von Helmholtz, had overthrown the notion of the eye's transparency, the eye as a simple *camera obscura* in his 1851 *Treatise on Physiological Optics*. Helmholtz and Ruskin understood that the process of vision is complex — far more complex than a simple rendering of a stable visual field. Ruskin alludes to the already conspicuous move by artists away from the ideal of a 'perfect' representation of objects and towards a preoccupation with vision itself. As Jonathan Crary writes of post-impressionist painter Georges Seurat (1859–91):

> The possibilities of the work are made available only through Seurat's understanding of the unstable physiological conditions of human vision. (Crary, 2001: 151)

And, furthermore:

> Perhaps as much as any nineteenth-century artist's, Seurat's work is inseparable from the consequences of the emergence of models of subjective vision. (Crary, 2001: 152)

Similarly, Maurice Merleau-Ponty wrote of Seurat's contemporary Cézanne (1839–1906), in his essay Cézanne's Doubt:

> He did not want to separate the stable things which we see and the shifting way in which they appear; he wanted to depict matter as it takes on form. (Merleau-Ponty, 1964: 13).

The Impressionists and Post-impressionists rejected the idea of the transparent or 'innocent' eye, and instead devised techniques to use painting to address the experience of visual perception itself: what it is like to see. As Newton Armstrong

describes it, "the specificities and particularities of vision become the material of painting, leading to a revolution in approaches to form, composition, and colour" (Armstrong, 2015: 2). Consequently, the work shifts toward a self-reflective mode, and demands of the viewer an active participation in recognising and understanding the mechanisms of their own perception. As E.H. Gombrich said, it is, "the beholder's share" (Gombrich, 1972: 37).

Composer Peter Ablinger has written, "there has never been a Cézanne of music" (Ablinger, 2014). Ablinger points towards a disjunction between the exploration of the phenomenon of light in visual art and sound in music. Ablinger argues that the visual arts absorbed and made central developments in the understanding of the human experience of vision much more successfully and more quickly than music dealt with the experience of listening. Ablinger and others have suggested that this is rooted in Platonic influence, principally the conception of music as a fundamentally mathematical problem (Ablinger, 2014, Steege, 2012, Wishart, 1996). This distinction is illustrated by Helmholtz's assertion that music borrows, "no part of its material from the experience of the senses", and that it is, "a kind of applied mathematics" (Helmholtz, 1885: 62), whilst during the same period he described visual art as rooted in sensation: "[a painter is a person] whose observation of sensuous impressions is particularly vivid" (Helmholtz, 1881: 75).

The history of visual art in the West is of course deeply associated with the representation of things, objects rendered in still life and portraiture, for example. Music, on the other hand, has much more generally been associated with abstract concepts and internal relationships, harmonic structure and motivic development, for example. When artists began to experiment with self-reflexivity, although visual art and music both clearly had historical traditions to deal with, perhaps music had further to go. In any case, self-reflexivity does certainly become clearer and more widespread sooner in the visual arts. As German Philosopher Gernot Böhme puts it:

> In visual art, this becoming-reflexive had a clear and demonstrable meaning. Many modern works of art were no longer about the representation

of something but about the experience of seeing itself. This may have started with Turner or the Impressionists, but it becomes utterly clear with artists like Joseph Albers, Barnett Newman, or Mark Rothko. In music, this development may not have become so obvious because music is, in a certain sense, far more natural. By contrast with the image, it has always been clear that music is *non-representational*. (Böhme, 2017: 131)

There are of course now many composers who explicitly explore sound and listening in their work, and who have been doing so for almost a century. The twenty-first century has seen a huge growth in interest in sonic art and sound studies more broadly. Böhme goes on to say that, "it seems as though sensibility has been rehabilitated in music" (ibid.: 131). However, Ablinger and Böhme are right to draw attention to the differences in the way visual art and music have incorporated the experiential; the methods used, the critical reception and the timelines over which this developed. In tracing these differences we learn about the implicit assumptions made regarding perception in its different modalities.

We will now examine several aspects of the phenomenological in art through the work of selected visual artists and composers who have taken an explicitly phenomenological approach. By tracing some of the common themes alongside each other, a deeper understanding of how these artists have thought about light, sound, vision and listening is developed.

3.3.2 Stripping back: perceptual revelation

Robert Irwin, James Turrell and the material of light

American visual artists Robert Irwin and James Turrell are part of the loosely affiliated *Light and Space* movement which originated in California in the 1960s. Their works are often large, comprising fairly simple geometric shapes. In contrast to the contemporary New York school of minimalism, the Light and Space group were concerned with the immaterial as opposed to the concrete, using precise arrangements

of colour, light, smoke and reflective surfaces to create works which shimmer in the air around the viewer (Feldman, 2015).

Light and Space artists create *situations* — the works cannot be separated from the space in which they are located. They require the viewer for their completion, and the viewer must allow time for the situation to unfold. It is in the experiencing of these situations that Light and Space works come to fruition, as the fragile and unstable nature of our visual perceptual field becomes apparent before our eyes.

In Robert Irwin's *Late Lines* series of paintings, he isolates simple coloured lines, chosen as the "least Rorschach-able gesture" he could make on his canvas (Weschler, 2008a). By removing all association and possibility of projection we are left with just the lines and the colours, and our perception of them. Irwin conducted extensive tests in his studio, moving the lines up or down a quarter of an inch, changing the shade of the colour a fraction, in order to get the effect right. He was essentially experimenting with optics and the experience of vision, and discovered that the smallest gesture, "changed everything in the field, not only the composition but the colour!" (ibid.: 75). Through these simple gestures, Irwin aims to:

> draw their attention, my attention, to looking at and seeing all of those things that have been going on all along but which previously have been too incidental or too meaningless to enter into our visual structure.

And as a result:

> Those paintings [have] no existence beyond your participation. They are not abstractable in that sense. (Weschler, 2008a: 79)

James Turrell has similar concerns to Irwin, and is well known for his sculptures which use light as a material. His *Skyspace* series, of which there are a number of examples, consists of an enclosed chamber with a simple opening in the roof. Viewers enter the chamber where they can sit or stand and look. Turrell frames a portion of the sky, revealing it to the viewer as if for the first time. In *St. Elmo's Breath* (1992) the viewer enters a room in which the source of light is so faint that at first the room appears to be pitch black, and no dimensions are discernible. After a period of several
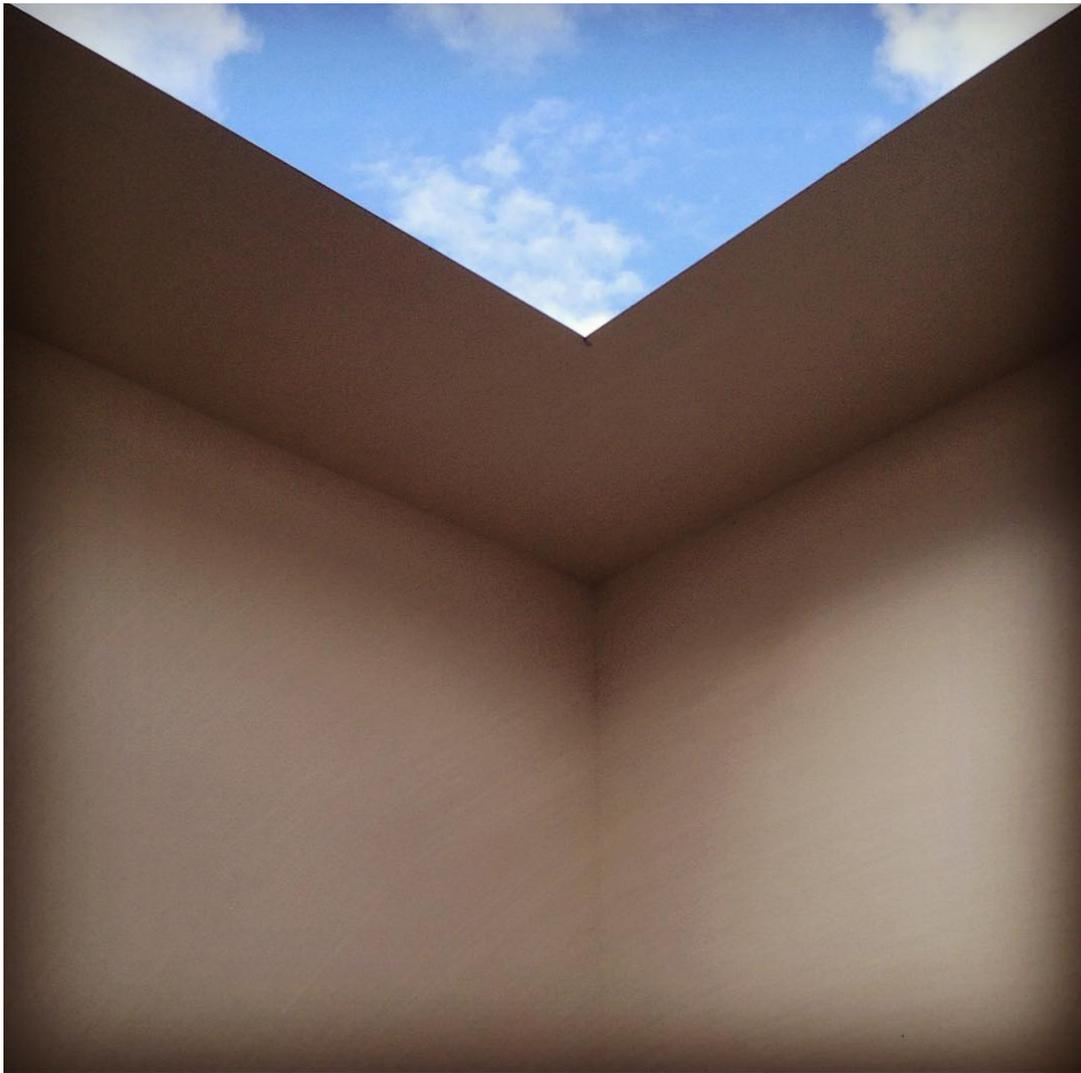
FIGURE 3.1: James Turrell, *Skyspace* at Houghton Hall, Norfolk (2000).
Photograph by the Author.

minutes, the viewer's eyes adjust to the darkness, and a very dim light is perceived. Gradually a large rectangle of soft, purple light forms on a wall which has become apparent opposite the viewer. *St. Elmo's Breath* pushes the viewer to become aware of her own mechanisms of sight, as her visual apparatus adjusts its sensitivity over time. The piece is not static but requires the active participation of the viewer for its completion (Adcock, 1990).

James Tenney immersed in sound

James Tenney's music is distinguished by its "focused concern with phenomenology

and the nature of perception" (Wannamaker, 2008: 123). Robert Wannamaker has described Tenney's music as eschewing "narrative drama in order to highlight the subjective processes and perceptions of the listener" (Wannamaker, 2018: 6).

Tenney's preoccupation with listening is demonstrated in pieces such as *Having Never Written a Note for Percussion* (1971), *For 12 Strings (rising)* (1971) and *Harmonium #1* (1976) amongst others in which sustained, swelling tones overlap and ongoing acoustic processes are audible. The apparently static textures invite, "a radically active and creative approach to listening" (ibid.: 6). As Tenney himself described his work, this is not sound for the sake of sound but rather, "sound for the sake of perceptual insight — some kind of perceptual revelation" (ibid.: 2).
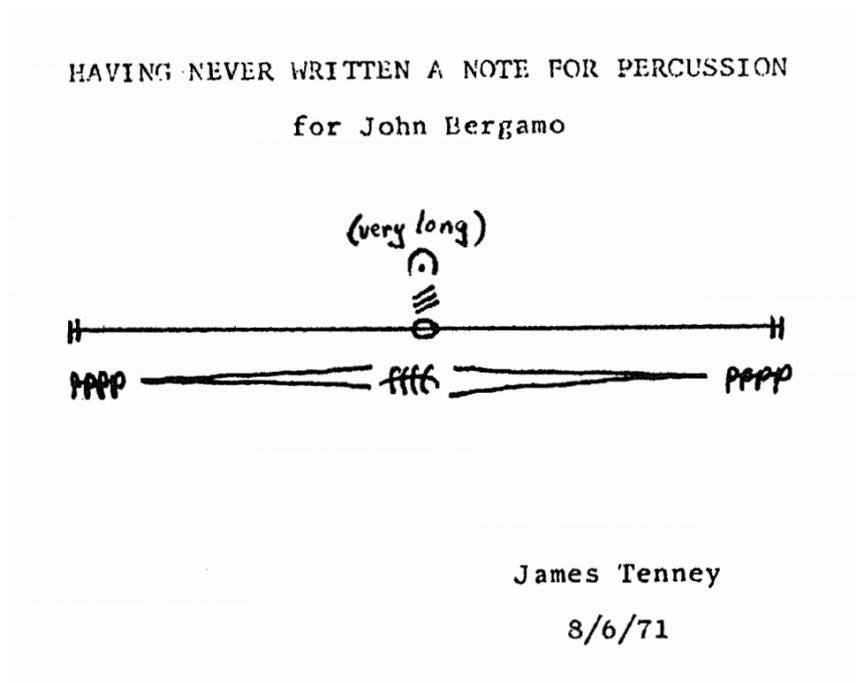
FIGURE 3.2: James Tenney, *Having Never Written a Note for Percussion* (1971).

This focus on the human experience of listening lead Tenney to his original and influential theoretical work on harmonic perception, which retains a, "radical phenomenological orientation" (Wannamaker, 2008: 123). Tenney's concept of harmony was very different to received practices in western music, moving beyond accepted

mathematical relationships towards uniting the harmonic series with an understanding of the complex psychoacoustic processes in the auditory system. Tenney describes the basis of his investigations thus:

> To understand the real relation between the harmonic series and musical perception we must ask the following question: why is it that a compound tone consisting of many harmonic partials is normally and immediately perceived at as *single tone*, rather than as a "chord"? The science of psychoacoustics does not yet provide a satisfactory answer to this question, but I predict that — when it does — it will be seen that it is the nature of harmonic perception in the auditory system that "explains" the unique perceptual character of the harmonic series, not (again) the other way around.
>
> (James Tenney (1983), *John Cage and the Theory of Harmony* p34, in Tenney, 1993)

Tenney's theoretical and compositional output thus affirm that, "the exploration of perception and a self-reflective experience of its operation are subjects proper to the domain of music" (Wannamaker, 2008: 124).

A preoccupation with the physicality of sound also occupies composer Alvin Lucier, and has parallels with Tenney. Many of Lucier's pieces centre on physical resonance, interference, and other acoustic phenomena. For example, *Music on a long thin wire* (1977) and *Music for piano with amplified sonorous vessels* (1990). Two of Lucier's pieces (*Small waves* and *I am sitting in a room*) are explored in more detail in Chapter 4.

The artists presented in this section have shown that by moving away from representational concerns and focusing on perception, novel compositional agendas can be formulated.

3.3.3 Teasing out the mechanisms of perception

Bridget Riley and the operation of the eye

Bridget Riley's abstract *op art* (optical art) paintings of the 1960s and 70s investigated the mechanisms of vision through closely aligned lines and shapes. These patterns seem to move before the viewer, revealing an unstable field of light and unveiling the mechanisms inherent to vision, or the 'eye's mind', as Riley called it (Riley, 2009b). Riley developed her techniques by experimenting with the act of looking. She writes, "while drawing I am watching and simultaneously recording myself looking, discovering things that on the one hand are staring me in the face and on the other I have not yet really seen" (Riley, 2009a: 20).

Riley was clear in the role of the viewer in her paintings, and in her practice is conscious of these two levels simultaneously: "the physical identity of the painted colours and the visual experience of their relationship" (ibid.: 24).

The paintings thus entail something more than what is physically on the canvas, requiring the viewer for their completion. As Morton Feldman said of the paintings of Philip Guston, they exist "somewhere between the canvas and ourselves" (Friedman, 2000).

Maryanne Amacher and the Third Ear

Dense Boogie from the album *Sound Characters* is an example of what Amacher calls *Third Ear Music* — the music created when our ears act as instruments and emit sounds as well as receive them. Amacher explains:

> Produced interaurally, these virtual tones are a natural and very real
> physical aspect of auditory perception ... They are usually registered sub-
> liminally, and are certainly masked within more complex timbres. I want
> to release this music which is produced by the listener. (Amacher, 1999)
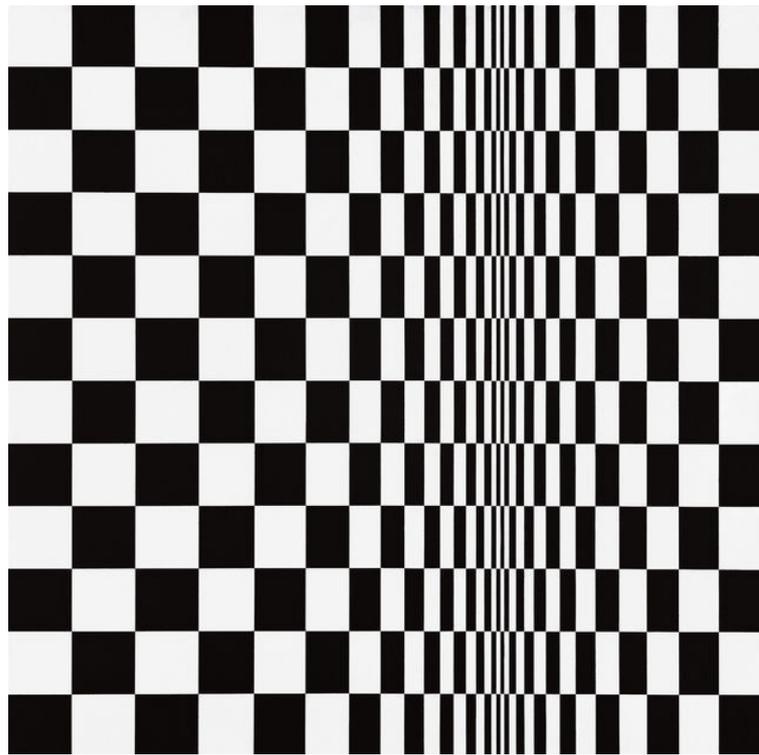
FIGURE 3.3: Bridget Riley, *Movement in Squares* (1961).

During *Dense Boogie* the listener hears tones which originate inside their own head, as well as those emanating from the loud speakers. These are naturally occuring *otoacoustic emissions* produced by the ear and neuroanatomy, stimulated by the particular sine tone frequencies and amplitudes selected by Amacher in the composition.

Like Riley, Amacher's music is more than the sum of its parts. Again it requires the listener for its completion, and unveils one of the mechanisms of our own perception, an aspect of what it means to listen which is often obscured.

Sonia Delaunay and simultaneous colour

Sonia Delaunay and her husband Robert were known for their work in *Simultanism*, or *Orphism* as it is also known, at the turn of the twentieth century. It is characterised by an abstract style and a central concern for colour perception.

Both Sonia and Robert were profoundly influenced in their work by modern optical theory. By this time the notion of the eye as a simple *camera obscura* had been overturned by Helmholtz; Goethe had written on the subject of *after images* — colours

persisting on the retina in the absence of light due to pressure — and Chevreul had published his theory of simultaneous colour contrast, the principle that colour perception is relative to surrounding colours (Hughes, 2007).

These experimental discoveries meant that the idea of a stable external world was breaking down, "the experience of color had no objective condition in an exterior reality" (Slevin, 2013). Furthermore, no longer grounded in a fixed reality, "visual perception becomes irrefutably conditioned by the body" (Hughes, 2007: 310). It was this dynamic and embodied model of vision that the Delaunays sought to investigate through their art.

> Delaunay's paintings emphasize the role of the mind in the act of vision. And in doing so, Delaunay's paintings develop a fundamentally new model of visual realism — a visual realism in which painting serves to bridge the body of the viewer with its ground in the world. (Hughes, 2007: 312)

The quote from Hughes describes a painting by Robert Delaunay, but can equally be applied to Sonia's work. For example, *La Bal Bullier* (1913), shown in Figure 3.4.

Whilst Robert Delaunay focused solely on painting, Sonia Delaunay's oeuvre also includes textiles and collaborations with fashion houses of the day. Her piece *Simultaneous Dress* (1913) is a dress comprised of variously shaped patches of different colours, designed to be worn. An image of Delaunay wearing the dress can be seen in Figure 3.5. *Simultaneous Dress* is an expression of Sonia Delaunay's work in painting taken into another physical dimension. It is designed to be worn by a woman, who exists and moves in time and space. The piece thus articulates, "an embodied, phenomenological position regarding the nature of one's existence as continuous and dynamic with one's environment", and as such was a significant work in developing, "modernity's concern with embodiment as the active producer of experience" (Slevin, 2013).

Riley, Amacher and Delaunay each devoted their work to exploring specific aspects of perception, and in doing so developed a deep understanding of the mechanisms

FIGURE 3.4: Sonia Delaunay, *Le Bal Bullier* (1913).

of bodily sensibility, and their inherent instability.

3.3.4   Taking the time to look, taking the time to listen

David Hockney and spherical vision

British artist David Hockney's work moves beyond the limitations of single point perspective, investigating how vision functions with "two constantly moving eyes, resulting in a spheroid field of vision" (Panofsky, 1991: 31). Hockney's photographic collages of the 1980's, for example *My Mother, Bolton Abbey, Yorkshire* (1982) (see 3.6) and *Pearlblossom Highway* (1986), use multiple or shifting points of perspective to create a work which is closer to the active experience of vision, as opposed to something akin to a window onto a static world. The works are a result of Hockney's exploration of the *experience* of seeing and rigorous critique of single point perspective. The problematic nature of single point perspective is usefully described by Panofsky, who states that:

> Perspective transforms psychophysiological space into mathematical space.
> It negates the differences between front and back, between left and right,

FIGURE 3.5: Sonia Delaunay wearing *Simultaneous Dress* (1913).

between bodies and intervening space ("empty" space), so that the sum
of all the parts of space and all its contents are absorbed into a single
"quantum continuum". (Panofsky, 1991: 31)

The visual artist following a model of single point perspective must choose one point
of focus for the work. This, according to Hockney, "falsifies the experience of look-
ing" (Weschler, 2008b: 31). Human perceptual experience is characterised rather by
multiple points of focus. As Hockney puts it:

Everything we look at is in focus as we look at it. Now the actual size
of the zone the eye can hold in focus at any given moment is relatively
small in relation to the wider visual field, but the eye is always moving
through that field and the focal point of view, though moving, is always
clear. (Weschler, 2008b: 31)

Hockney's biographer, Lawrence Weschler explains the power of the photographic
collages, saying that:

The experience of this kind of looking is preserved in the collages, where
each frame ... is in focus and comprises just about as much of the field
as the eye itself could hold in focus at any one moment in the real world.
(Weschler, 2008b: 31)

Hockney has also used his spheroidal techniques in oil paintings such as *The Road to
York through Sledmere* (1997) (see 3.7). Indeed Hockney traces the technique of shift-
ing perspective back much further, citing the example of 17th Century Chinese scroll
paintings, created before the introduction of Western perspective to Chinese art. In
particular, Hockney points to a 72-foot long scroll entitled, *The Kangxi Emperor's
Southern Inspection Tour (1691–1698)*, scroll seven, painted by Wang Hui (1632–1717)
and assistants. Hockney describes how, through the use of a shifting perspective,
Wang achieves a vivid narrative in the scroll, which teems with images of everyday
life and society in China.[2]

---

[2]This interview with Hockney can be heard in the documentary, *A Day on the Grand Canal with the
Emperor of China or: Surface Is Illusion But So Is Depth* (Haas, 2003).

FIGURE 3.6: David Hockney, *My Mother, Bolton Abbey, Yorkshire, Nov. 1982* (1982). Photographic collage. ©David Hockney. Photo credit: Richard Schmidt

FIGURE 3.7: David Hockney, *The Road to York through Sledmere* (1997). Oil on canvas. ©David Hockney. Photo credit: Richard Schmidt

Pauline Oliveros and the practice of listening

> *Deep listening comes from noticing my listening or listening to my listening.*
>
> (Oliveros, 2005)

Deep listening is a practice developed by Oliveros to facilitate creativity as a composer, improviser and listener. Deep listening is a process and skill which can be "cultivated throughout a lifetime" (ibid.), and which is intended to "heighten and expand consciousness of sound in as many dimensions of awareness and intentional dynamics as humanly possible" (ibid.).

Oliveros' work is rooted in an understanding of the physiological operation of listening — the mechanisms of the ear and auditory nerves. An extract from her poetic response dedicated to John Cage, *The Earth Worm also sings*, presented on page 70 is demonstrative of this engagement, discussing in turn the ossicles, cochlea and basilar membrane which reside in the ear.

Oliveros often used text scores which describe sequences of actions and behaviours designed to bring attention to listening and sound, and an intentional engagement with the processes involved. An example from Oliveros' book *Sonic Meditations* called *Environmental Dialogue* is presented on page 70. This call to attention is a meditation on sound, leading to a practice of listening which is continually self-reflective and continually developing. Through this practice Oliveros reinforces the conceptualisation of listening as fundamentally embodied and dynamic, creating a relational dialogue between listening and the environment, and the creation of spatial experience.

Hockney and Oliveros both built their work on a foundation of perceptual experience and understanding; taking the time to study their own vision and listening and allowing this learning to take them down new avenues of creativity. Through their practices which devote attention to bodily sensibility, both these artists are able to present what they have learnt in their work, enabling others to benefit from their discoveries.

My ear is an acoustic universe

sending and receiving

My ear also sounds

Where are the receivers for these tiny, mysterious signals?

Inside? Outside? The cells?

In my auralizations I hear an alternate self tiny enough to journey inside of my

own ear. In this pleasure of the imagination I go into this labyrinthine cave

Following the sound passageways I wobble in full resonance with the mammoth

vibrations of the tympanic membrane. On the sound wave I ride through the

shuddering porous membrane teetering tottering balancing with the undulating

phenomena

Adventure: on the other side, I narrowly escape the pounding hammer as it

thumps the anvil

Thrilling I glide through the oscillating archways of the stirrups.

Plunged into the spiraling fluid of the inner ear I float marveling at the fleeting

echoes in the bony chambers of the sea shell like cochlea

I sink to the most secret basilar membrane protected by the hardest of bone

armor. Among a myriad field of precious hair cells I grow curious and strum —

fairly fainting at the harmoniousness of this microscopic harp of my being.

<div align="center">Pauline Oliveros, The Earth Worm Also Sings, extract (Oliveros, 1993)</div>

Each person finds a place to be, either near to or distant from the others,
either indoors or out-of-doors. Begin the meditation by observing your
own breathing. As you become aware of sounds from the environment,
gradually begin to reinforce the pitch of the sound source. Re- inforce ei-
ther vocally, mentally or with an instrument. If you lose touch with the
source, wait quietly for another. Reinforce means to strengthen or sus-
tain. If the pitch of the sound source is out of your range, then reinforce
it mentally.

Pauline Oliveros, *Environmental Dialogue* from Sonic Meditations (Oliveros, 1974)

3.4   Conclusion: listening is multistable

> *To hear music is to simultaneously experience it both as directional and as at-*
> *mospheric. ... In the instrumental transformation of these two dimensions, the*
> *multistability of different directions occurs.* (Ihde, 2007: 187)

A multistable image is one that has multiple perceptually (more or less) stable states.
In the Necker cube, for example (see 3.8), it is ambiguous which of the faces of the
cube is in the foreground. In another familiar example, it is possible to see either a
rabbit or a duck. The viewer is able, to some extent, to force herself to collapse the
image onto one or other points of stability at will.
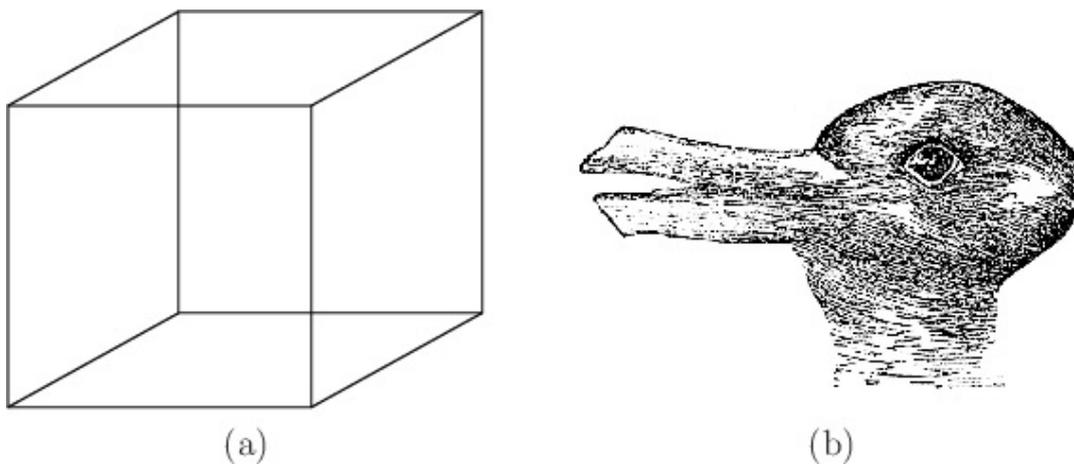
FIGURE 3.8: (a) The Necker Cube (1832) by Louis Albert Necker. (b)
The rabbit duck illusion from Fliegende Blätter

Ihde makes the point that multistability also exsits in the auditory field. Between
two of the 'poles' of auditory spatial experience — the highly directional and the
surrounding or atmospheric — there are multiple stable states which can be per-
ceived by the listener. The nature of these auditory points of stability is informed
by the physical information received by the listener (the perceptual) but also by the
imagination: "two modes of experience, *perceptual* and *imaginative* are possible for
both visual and auditory dimensions" (Ihde, 2007: 204). Exactly which point of sta-
bility we arrive at depends on us (the individual). There is ambiguity here, and the
deeply personal; my auditory experience may be very different from yours. We have

a tendency to impose our own ideas on to what we hear, to translate it into our own frame of reference. How do we tell apart what is perceived and what is imagined? How does one inform the other? It is these questions which I believe the artists discussed above have made it their work to address. By delving into the processes, illusions and ambiguities of listening and vision, they search for points of stability and instability, for reasons why they exist, and why they exist in the form they do for individuals and collectively.

> What is that listening that occurs within my self-presence and that accompanies the presence of the things and of others in the perceived World? (Ihde, 2007: 118)

How do I perceive myself? How does the co-presence of the imagined and perceived manifest itself? How does it enable us to find points of stability? How do we construct meaning from fragments of sound? And what does it mean for our experience of space? Aaron Helgeson, writing on Sciarrino's *Infinito nero* (1998) makes the following observation:

> There is an incongruity between the sounds we expect to hear and those that we actually do hear. Within this circumstance of incongruity, our identification of these sounds as being made by woodwind instruments is momentarily suspended, allowing our lived experience to flood in, in order to complete the appearance of the sonic object. (Helgeson, 2013: 11)

When we listen, we follow a unique path through the multistable. Where there is ambiguity in the perceived our imagination fills the gaps. We navigate our way through an ever-present, omni-directional, constantly changing auditory field in the way that seems best to us. As Ingold puts it:

> Sound flows, as wind blows, along irregular, winding paths, and the places it describes are like eddies, formed by a circular movement *around* rather than a fixed location *within*. To follow sound, that is to *listen*, is to wander the same paths. (Ingold, 2011: 139)

The auditory field is not stable, not fixed, not absolute. It is ever present and co-created in dialogue with our self, our imagination. Thus spatial experience, informed by listening, is equally dynamic and equally dependent on a fluctuating balance between the 'real' and the 'imaginary'.

> The mental and the material, or the terrains of the imagination and the physical environment, run into one another to the extent of being barely distinguishable. (Ingold, 2011: 198)

It is a model of the world in which perceptual experience is *mediated through* bodily sensibility, not one in which perception perceives the fixed and already-rendered. We focus our listening attention — and our listening imagination — with conscious thought and unconscious drift. Our auditory field responds dynamically. In a real sense this journey through sound informs our experience of space; it is one aspect of the creation of spatial experience.

Over time, we build up categories of things and experiences. This enables us to give them names, names which are used not only for referential purposes, but which also serve to *guide us through* these things and experiences before they become such.

> Could it be that images do not stand for things but rather help you find them? (Ingold, 2011: 197)

It is an iterative process, then, and experience becomes a map for the multistable. It seems that, as at the end of Chapter 2, we must return to the issue of *metaphor*.

> In language each name, each metaphor allows us, if it is appropriate, to situate that which we experience in a certain way. But it is possible for this guidance, which is in some way essential to perceiving itself to be sedimented, fixed. It is possible that without the new metaphor, the "headless robot" might have been missed.[3] (Ihde, 2007: 188)

---

[3]The headless robot is an alternate, unusual point of visual stability for a particular multistable image described by Ihde.

Thus, it becomes critical to draw our own attention to our categorising — our metaphors — in order to discover where they are inadequate. *Through* listening, we may discover new ways *of* listening. It is listening to yourself listen. As we have seen in the second half of this chapter, it is a subject which has preoccupied many artists. Through their work, artists reveal for us, "reversals, and deconstruct our metaphors, and in so doing, construct new ones with new perspectives" (ibid.: 189). It is in this way that art does not simply represent the past or explore the present, but can give us a glimpse of the future.

To conclude this chapter, I will present some text from John Cage. In his engagement with unexpected sounds, with chance and silence, Cage foregrounds the multistability of listening. We must chose what to listen to in his music, we must find our own way through it. In Cage's *45' For a Speaker* (1954), he set down fleeting thoughts on sound, listening and composing, to be read aloud, some of which I have extracted below.

43'20"

There is no
such thing as silence. Something is al-
ways happening that makes a sound.
No one can have an idea
once he starts really listening.

28'00"

Keeping one's mind
on the emptiness,
on the space
one can see anything can be in it, is, as
a matter of fact, in it.

25'30"

So that listening one takes as a spring-
board the first sound that comes along;
the first something springs us into nothing and
out of that nothing arises the next something;

19'00"

Where is the best position for audition?
The corner where you are!

14'50"

When I wrote the *Imaginary Landscape*
for twelve radios, it was not for the purpose of
shock or as a joke but rather to increase the
unpredictability already inherent in the situation

04'30"

I begin to hear the old sounds, the ones
I had thought worn out

01'40"

Music is an oversimplification of the situation
we are actually in. **An ear alone
is not a being**;

00'50"

like an empty glass
into which
at any moment

anything

may be poured

00′10″

All you can

do   is

suddenly listen

John Cage, *45′ For a Speaker*, extracts (Cage, 2009: 146)

Chapter 4

Three terms to describe spatial experience in music for instruments and electronic sound

4.1   Introduction

> *It's not about, 'now the sound is over there, oh now it's behind here', and all of that. What I'm interested in are these <u>qualities</u>.*
>
> Jonty Harrison speaking on BBC Radio 3 *Hear & Now*, 26.12.15

So far in this thesis, we have examined evolving conceptualisations of space and listening, and proposed a model of spatial experience which is *embodied*, *dynamic* and *co-created*, mediated through bodily sensibility including auditory perception, and which can be explored through direct engagement with sound as a phenomenon.

In this chapter I present three terms for describing spatial experience in music, in particular music for acoustic instruments and electronic sound projected over loud-speakers and presented in a concert situation, although not strictly limited to this setting. This might be referred to as *mixed music* or *electro-instrumental music*. It does not readily include music for instrument and electronics where the electronic sound is essentially a partner in a duet (for example, George Lewis' improvisation

system *Voyager*), or sound installations without a live performer, although the ideas presented may still have relevance to certain works.

The three terms *focus*, *multiplicity* and *extension* are related to particular listening experiences. That is not to imply a one-to-one mapping of listening to spatial experience, but to group together related listening experiences and potential spatial outcomes. Each term is broken down into subdefinitions with musical examples used to illustrate the key points. A visual map of the three terms, subdefinitions and associated listening processes is shown in Figure 4.1. In most cases, a piece of music will not fall neatly into one term but will move between one or more of them in a continually rebalancing, shifting listening process. Emphasis will transfer from one term to another, inhabiting more than one at a time, or none at all.

In encapsulating my ideas into these three terms, I have started from the phenomenological context explored in Chapters 2 and 3. I have developed my definitions to be consistent with conceptualisations of spatial experience as embodied, dynamic and co-created, and listening as an complex, multistable and ongoing process, drawing on both the 'real' and the 'imaginary'. In doing so I have consciously tried to move away from language associated with fixity, stasis, and the geometric, and instead draw on vocabulary relating to emergence, becoming, flux, atmosphere, co-presence, and self-reflection. Although the words focus and extension of course have meaning in visual discussions too, in unpacking the terms I try to move away from these associations towards new meanings. It is hoped that by shifting the metaphorical basis in this way, existing conceptualisations of spatial experience in music will be developed and lead to a new and deeper understandings of it. My aim is that the terms presented below will be helpful in finding ways to talk about spatial experience in music, in both analytical and generative contexts.

The last section of this chapter presents an analysis of Alvin Lucier's *I am sitting in a room* (1969) with reference to the proposed terms.
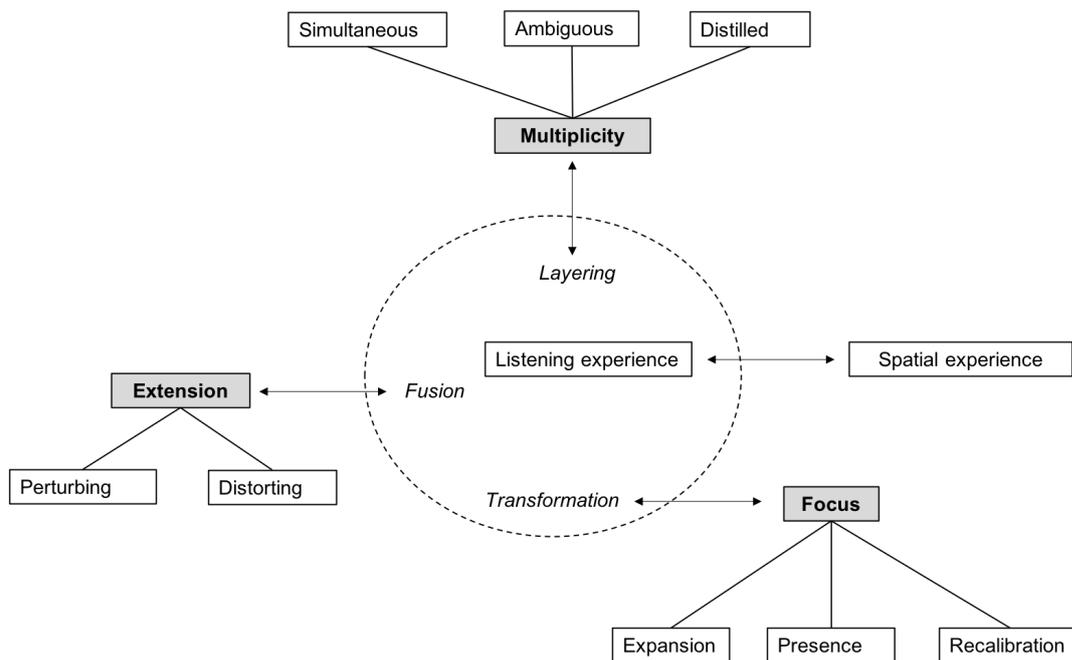
FIGURE 4.1: Map of the three proposed terms, subcategories and perceptual processes

4.2 The terms

4.2.1 Focus

Focus is the term that I use to describe the spatial changes which result from transformations of the listener's auditory field. The form and material of the music are used to enable sudden or gradual changes in the shape of the field, the horizonal boundary, and the ratio of fringe to focus phenomena. In this way focus draws listening attention through sound, enabling spatial experience as informed by auditory perception to become a compositional dimension.

Focus problematises spatial experience by shifting auditory scale and perspective. It calls into question the act of listening and what we learn from it by demonstrating its dynamic nature. The auditory field is foregrounded. Listening is not fixed or static, but in a state of constant flux, recalibration and relationality. The listener may start to question what is heard and the strategies of listening deployed. Most immediately, how does the spatiality of the instrumental sound compare to what I was expecting? Is it coming from the stage or somewhere else? Where is the sound located with

respect to my auditory horizon? Does it seem large and far away? Immense and close up? Tiny and expanded? To what extent does it expand and contract with respect to my auditory field? What effect do the concurrent sounds have on my perception of this scale? And what effect do later sounds have on my experience of the earlier sounds?

I have identified three subcategories of focus which are described in further detail below.

4.2.1.1 Expansion

Over a period of listening, sounds which initially seemed to be at the limit of hearing may begin to appear louder as they expand to fill the listener's auditory field. The auditory horizon is pushed outwards and yet quieter sounds are revealed. Conversely, the sudden occurrence of a very loud sound may precipitate a contraction of the auditory field, rendering quiet sounds inaudible for a time. The limits of listening are not hard borders, but malleable and omnidirectional.

If, for example, I reduce what is heard to a very limited range of sounds over an extended listening period, my auditory field settles in a particular form. What follows must then either perturb the field or cause further convergence, with consequent effects on my spatial experience. Salvatore Sciarrino describes his composition *La perfezione di uno spirito sottile* in such terms. He says of the opening section:

> In terms of psychological development, [the opening section] must be defined as a preparation of the horizonal boundary. This becomes important in narrowing our perception ... After almost ten minutes of listening exclusively to this process as the primary object of our perception, any notes that occur thereafter sound totally foreign. (Helgeson, 2013: 24)

Focus can act as a kind of *sonic microscope*, which zooms in on an instrumental sound to reveal fresh details. James Tenney's *Having never written a note for percussion* (1971)

makes use of extreme perceptual reduction in this way. In the piece a solo percussionist performs an extended crescendo and decrescendo on a tam-tam, which according to the score should be "very long", typically lasting for fifteen minutes or indeed much longer. Amplification is not used in *Having never written a note...* but by isolating this limited palette of sonic material, Tenney draws the listener's attention to a narrow portion of their auditory field which is entirely filled with the sound of the tam-tam. The sound grows from soft, distant and static to engulfing, immense and transient. The listener's auditory field expands with the sound. Consequently, rich, complex and ever changing layers of harmonics and beat frequencies are revealed within the tam-tam's sound as it surrounds the listener. It then decays, leaving the expanded auditory field to be filled with other sounds - a heightened auditory awareness which lasts for a period of time after the piece has finished.

Tony Conrad's influential *Four Violins* (1964) operates on a similar principle. The piece is comprised of shifting violin drones, with tiny variations in tuning, bow pressure and finger placement causing shifts in the internal texture of the sound. The auditory field is at first concentrated on one narrow selection of material. Sustained across thirty minutes, the auditory field is transformed so that this material entirely surrounds the listener, enabling microscopic detail to become audible and creating a close-up, dense feeling of space.

4.2.1.2 Recalibration

Focus is at play when instrumental sounds are presented from a peculiar angle, that is, when they are presented with spatial characteristics which are different to those typically expected acoustically. For example, if a very quiet instrumental sound is amplified to fill a room. Focus changes the apparent scale of the sound with respect to the listener. The listener is thus reoriented with respect to the instrument and must recalibrate their listening expectations. A common example is an acoustic instrument which is normally heard as a point source from the direction of the stage, amplified and diffused in such a way that its sound surrounds the listener.

Robin Hayward's *Plateau Square* (2014) for microtonal tuba and multi-channel electronics does just this. Microtonal tuba pitches are routed to one of four loudspeakers according to a specific system, creating harmonic "plateaus", with each loudspeaker representing a corner (Hayward, 2011). The listener is positioned in an engulfing and expansive field of tuba sound, as if somehow transported to the centre of a virtual tuba. In playing with scale in this way, Hayward uses focus to enable the listener to gain a new perspective on the sound of the instrument.

In Alvin Lucier's *Silver streetcar for the orchestra* (1988) the sound of a triangle is amplified and explored over a period of twenty minutes. The percussionist is asked "to isolate qualities of speed, loudness, striking location and amount of resonance and to explore each independently" (Schick, 2006: 181). The balance of amplification and live sound is key: it must be optimised for each space the piece is performed in so that the electronics blend with the live sound imperceptibly. When the correct balance is achieved, the superficially simple sound of the triangle is projected around the performance space, delving into the sonic potential of the instrument. As percussionist Steven Schick puts it, "*Silver streetcar* enables us to look inside the living material of percussion music and see the crosscurrents of rhythm and texture that comprise the inner workings of sound itself" (ibid.: 183).

A similar principle is at work in Stockhausen's *Mikrophonie I* (1964), in which six performers excite, amplify and diffuse the sound of a single tam-tam. The microphones are used somewhat like stethoscopes, roaming over the surface of the instrument and gathering sonic details. Amplification and spatialisation techniques are used to enlarge and reorient the instrumental sound relative to the listener, revealing normally unheard details and calling into question typical modes of listening.

4.2.1.3 Presence

Electronic techniques afford to instruments new possibilities. In Gernöt Bohme's terminology the *ecstasies* of the instruments (their ability to reach out beyond themselves) are transformed, thus the *atmosphere* or feeling of *instrumental presence* they

create is also transformed.

In focus, the atmospheric potential of an instrument plus electronics can be foregrounded. In expanding, contracting, shifting and recalibrating the auditory field, there is the opportunity to explore the vast and the infinitesimal, the real and the virtual, to create spaces of "intimate immensity" (Bachelard, 1994) or distant miniatures, and to juxtapose one against the other in a compositional discourse. As Smalley says, as a human listener "all I perceive is 'sized up', located, and put into perspective in relation to the human scale" (Smalley, 2007: 48). These shifts in presence offer to the listener liminal moments in the process of listening, a moment where listening, as the subject of the music, becomes aware of itself. In focus, the listener is listening to themselves listen.

In the electroacoustic work *Kits Beach Soundwalk* (1989), Hildegard Westerkamp uses edited field recordings and a narrative voice to emphasise aspects of the coastal sounds which surround her. By applying edits and equalisation, different components of the sonic environment are foregrounded or recede into the distance. The level of presence of different elements varies as Westerkamp's attention moves from one sound to the next. Westerkamp uses focus to reflect and emphasise a very human experience of listening, that is, the evolving experience of presence and the transformations of her auditory field which she experienced whilst she was on the beach.

Luigi Nono's late work *Das atmende Klarsein* (1983) for small choir, bass flute and live electronics, explores the ebb and flow of breathing (*Das atmende)* and in doing so presents the live flute sound with varying degrees of presence. The structure of the piece is a dialogue between choir and flute presented in eight alternating sections. Both choir and flute engage with electronic sound in a variety of different ways, but whilst the material and texture of the choir plus electronic sound "is very similar among its sections", the flute material "differs profoundly" (Edwards, 2008: 226).

The electronic sound associated with the choir is "spatialized amplification of varying degrees of loudness" in all choir sections. In the flute sections spatialisation,

delay and finally harmonisers are used. The harmonisers appear in flute section III, approximately "one quarter tone above and below the performed pitch" (ibid.: 226). Each section has a distinct spatial character which Nono uses "dynamically" over the course of the composition to articulate his compositional aims (ibid.: 239).

In flute section III, the flute is brought to a climax of presence using the techniques of spatialisation and electronic harmonisation. The bass flute plays very quiet, discontinuous whistle tones at specific pitches. A close microphone is used to amplify and project the live flute sound around the performance space whilst harmonisers create fluctuating repetitions. The listener is brought extremely close to the intimate breath and mouth sounds of the musician. At the same time, the harmonisers transform the flute sound into ghostly, ethereal winds which blow through the performance space, creating a pervading atmosphere of fragility.

To summarise, focus foregrounds transformations of the listener's auditory field, drawing attention to the dynamic and relational nature of this field, and the ways in which it shifts and recalibrates over time. In this way, focus enables a heightened awareness of the contribution of sound — through bodily sensibility — to the totality of embodied spatial experience.

4.2.2   Multiplicity

4.2.2.1   Being in two or more places at once

Multiplicity is the experience of multiple spaces at the same time. Through electronic or other means, the sound of one or more other spaces is rendered within the performance space concurrent with the instrumental ensemble. It could be the same space at another time, or somewhere different, but it is a recognisable 'elsewhere'.

Smalley has written on this particular topic in relation to acousmatic music. The concept of multiplicity calls to mind his description of a particular type of space-form process, as proposed in his 2007 essay, "Space-form and the acousmatic image". The third of three space-form processes is, he says, "occupied with multiple

spaces, mixed materials, possibly intercuttings, dislocations, and impressions of simultaneous spaces" (Smalley, 2007: 54). The element of simultaneity is key, as the spaces must overlap in the temporal sense. Smalley's definition of *mediatic space* is also relevant, as it "suggests and transmits to us spaces from beyond our own immediate enacted space" (ibid: 39).[1] This therefore introduces the supporting element of otherness, the idea that the layered spaces must be located elsewhere, somewhere distinct from the current performance space.

Joanna Bailie's *Artificial Environments Nos. 1–5* (2011) for amplified ensemble and tape is a good example of multiplicity. Field recordings from various urban locations are played in the performance space alongside an instrumental ensemble on stage. Additionally, the recorded voice of the composer explains to the audience the various processes which are at work. In employing these distinctive recordings, Bailie introduces two explicit and recognisable other spaces into the ensemble space: the busy urban environment and the intimate speaking voice. The instrumental parts are derived from the field recordings, picking out strong pitches such as the descending glissando of a passing aeroplane. This dislocated harmony and accompanying narrative create uncanny bridges between the three spaces which are, in isolation, very different. As Stephanie Power puts it, "the 'strange parallel music' (the instrumental sound) sits in powerful juxtaposition to the 'real' (the field recordings), thereby strangely enhancing the sense of displaced reality" (Power, 2014: 28). It is this uncomfortable, displaced reality which constitutes the total spatial experience of the music.

Luigi Nono's *La fabbrica illuminata* (1964) for solo soprano and electronics makes use of multiplicity to create dramatic tension. The deafening mechanical sounds of a factory are projected in to the performance space using multiple loudspeakers. The live solo soprano is pitted against this, sometimes struggling to be heard above the din, at other moments of quiet, she is a contrasting, soft, local sound. The listener is at once within the factory and witness to the personal, close-up voice of the singer.

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[1]Enacted space being defined as a "space produced by human activity — a space within which humans 'act'" (Smalley, 2007: 55).

This creates a striking contrast between the human scale and the vastness of the factory, in what is an overtly political piece.

Multiplicity can also be achieved without electronics. Nicolaus A. Huber's *Bed and Brackets* (1990) for solo piano with 'doors and windows to be opened or tape', makes use of external environmental sounds to disrupt the performed space. The sound of the piano, full of dense, staccato clusters of chords and delicate chromatic scales, is interrupted after thirteen minutes by external environmental sounds which infiltrate the performance space through doors and windows which are thrown open (a recording from outside may be used if no suitable openings are available). A new sense of space is created, one which includes local sounds, characteristic of the area where the performance is happening. The piano is silenced for a minute, and then re-enters softly, as if trying to find its way in this curious space. During the final four minutes of the piece the piano gradually regains its direction, located now in a mixed space of internal and external sound.

4.2.2.2 Ambiguity

Ambiguity can arise when different spaces overlap. The spaces bleed into one other, intertwining and entangling perhaps through chance visual and auditory alignments or corresponding frequency spectra. Sometimes it may be difficult to identify the origin of a particular sound: which space does it belong to? Is it electronic, environmental or instrumental? Is it 'real' or 'virtual'? The mechanisms of auditory scene analysis may be fooled and become confused. Consequently, the resultant spatial experience is hybrid and idiosyncratic. Layers upon layers which do not lie neatly, moving past, through and around one another — a compound space where belonging and identity are fluid and subjective. Consequently, perceptual awareness may be heightened during and after listening to the music, as the listener tries to reconcile the various channels of information received.

This individualised ambiguity can be adopted as a compositional tool. Janet Cardiff, in reference to her composed audio walks, states the aim of confusing her listener

in order to heighten perceptual awareness across all the sense modalities (Cardiff, 2005). Compositions such as, *A Large Slow River* (2000) are designed to be listened to over headphones whilst following a predetermined walking route. *A Large Slow River* was commissioned by Oakville Galleries in Canada, to be located in their Gairloch Gardens. It features binaural recordings made by Cardiff along the route of the walk and other locations, as well as the voices of Cardiff and another unnamed man. This description of the experience of the piece is taken from Marnie Fleming's catalog essay which accompanied the exhibition:

> We hear her thoughts as we are led out of the creaking gallery doors into the garden, and they become intermingled with a man's tape-recorded voice. Disconnected thoughts, sounds, conversations, and events are strung together in a sequence that suggests mystery. Gairloch Gardens oscillates from being a gentle park to being a place that has the potential for tragedy. Janet, in effect, has created a virtual space anchored in reality. (Fleming, 2000)

Whispered words appear to originate inside the listener's head, sounds from the same place but a previous time seem to cross temporal borders, and contradict what is seen. It becomes difficult to tell whether what is heard comes from the headphones, external environment, or perhaps from the listener's own memory. The experience is an intensely personal one; at times intimate, joyful, menacing or uncanny. The listener must attempt to reconcile the various channels of information received but ultimately is left searching for the source of the sound. "Visual senses are amplified, trying to equilibrate the acoustic experience with what you see" (Cardiff, 2005).

4.2.2.3   Mixing, distilling

Multiplicity can also be used to convey a sense of the hyper-real. Rather than a single auditory 'window' onto a space, multiple 'views' can be opened up at once. This multiplicity can in fact enable the creation of a sense of a particular space much more effectively, being closer to the continual flux of lived experience. In some ways

it is analogous to Hockney's technique of using multiple points of perspective in painting or collage — akin to perception's spheroid field of vision.

Paul Lansky's *Night traffic* (1992) renders the experience of listening to road traffic in electroacoustic form. The piece uses a stereo recording of heavy traffic, layered with comb-filtered versions of itself which extract and emphasise specific musical pitches present in the original. The piece progresses through a number of filters and associated harmonic content. "Musical processes and real-world sounds are fused" (Norman, 2004: Ch.3, 13) to create a *distilled, experiential* multiplicity, a layering of listening which is much more effective at evoking a sense of space than the original recording. As Norman says, "an epic field-recording of untouched traffic sounds would be too literally a 'picture' of sound" (ibid.: Ch3, 13), but a multiplicity immediately evokes the feeling of space.

In a similar vein, anthropologist Steven Feld's electroacoustic *Rainforest Soundwalks* (2001), do not intend to represent the sound *of* a space, but to convey the experience of being *in* a particular space. Rather than a single extended field recording, the four soundwalks relate to different periods in the diurnal cycle, and are "carefully crafted from Feld's recordings of the rainforest environment in the foothills of Mount Bosavi, Papua New Guinea" (Norman, 2012: 259). The stereo tracks are created by mixing together recordings taken at different times, depths and heights within the rainforest. In the same way as Lansky, Feld creates a multiplicity of sound which is more than the sum of its parts. It is a distilled, experiential multiplicity, layers of co-related listening composed to evoke a specific feeling of space. As Feld says:

> These are composites, not just of the height and depth, time and space of the forest, but also of a history of listening, my history of listening and being taught to listen. It is a way of knowing a place, a way of absorbing. The 'soundwalk' is a densely layered image of this experience. (Palombini, 2001)

Neither the Lansky nor Feld pieces are about description, but rather experience. The subject is not a fixed soundscape of objects, but rather the flux of listening through

which a particular feeling of space is created. Both pieces consciously foreground spatial experience through the layering techniques of *distilled multiplicity*. Listening merges with listening to create a mutual more-than, each requiring all the others to create the whole. Rather than seeking to strip away the cause of the sound, the distilled multiplicity enables us to understand through listening that, "of *course* those are trucks and cars" (or trees and wildlife), and to go further, to attend to the "*feeling* of listening itself" (Norman, 2004: Ch.3, 13).

4.2.3 Extension

4.2.3.1 A unified instrument

Extension refers to the perception that the combined electro-instrumental forces have fused to form a unified instrument with a single set of spatial characteristics. This composite instrument can therefore be understood as an extension of the acoustic instrument.

The resultant spatial characteristics may be fairly similar to that of the acoustic instrument alone. Subtle extension can be achieved with a single, small loudspeaker positioned close to the instrument, for example, underneath or inside a piano. On the other hand, the resultant spatial characteristics may be totally different to that of the acoustic instrument alone. Extreme extension can be achieved with an array of large loudspeakers located throughout a performance space. In both cases the key is the perceptual fusion of acoustic and electronic sound to create a single, coherent spatial experience.

A perceptual link must be created between the spectral content of the instrumental sound and the electronic sound, and between gestural cues embedded within the instrumental performance and the temporal response of the electronic sound, in order to preserve the coherence of the resulting feeling of space.

4.2.3.2 Distortion

Extension is related to John Croft's *instrumental paradigm*, one of several possible forms of relationship between performer, instrument and electronic sound which he proposes in his 'Theses on liveness' (Croft, 2007). Croft describes the instrumental paradigm as follows:

> The performer plays the instrument-plus-electronics in a way somehow analogous to the way in which she would normally play the instrument alone. (ibid.: 62)

Croft highlights the importance of gestural and spectral alignment in this conception of extension. The energetic profile of the instrumental performance should therefore be closely related to the energetic profile of the electronic sound, in order to fuse the two together in the listener's perception. The combined forces of instrument and electronics create a *distortion* of the expected spatial character of the instrumental sound, as though the instrumental sound has been pushed, stretched or otherwise deformed.

Paul Doornbusch's *Continuity 3* (2002) for percussion and electronic sound presents the acoustic sound of, "a china cymbal, a metal plate and a tam tam" alongside electronic sounds which are, "transformations" of the percussion sound (Hannan, 2005: 77). A range of modification techniques are used, including pitch shifting and ring modulation. In the opening two minutes, the electronic sound follows the percussion part exactly, distorting and stretching the decay of the metallic sound, creating an extreme extension of spatial experience but never appearing to operate independently. It is as if the strikes of the percussionist have excited a huge, "virtual resonating body" (Barrett, 2006: 85) which extends and warps the spectral and transient content of the cymbal sound, but crucially, is perceived to be part of the same, unified instrument.

In the 2002 recording, percussionist Timothy Phillips engages with the live electronics with such subtlety that Richard Barrett characterises the relationship as akin to

the "almost subliminal interactions of chamber music", with the successfully fused electro-instrumental forces appearing as a single "extension of the idea of resonance" (ibid.: 85). This effect is fundamental to the success of the piece and is consciously and carefully composed. Towards the end of *Continuity 3* the percussion and electronic parts separate, emerging as independent voices and casting the initial fusion in a new light.

Kaija Saariaho's *Lichtbogen* (1985) for nine musicians and live electronics also uses electronic techniques to distort the spatial qualities of the instruments, but in this case it is an alteration of the ensemble rather than a single instrument, and the effects are generally fairly subtle, and often not recognisable as 'electronic effects', as such. Indeed substantial sections of the piece do not have any electronic treatment at all. Saariaho uses amplification, spatialisation, harmoniser and reverberation to subtly foreground a soloist or sub-group within the ensemble for a particular section. This has the effect of, "distorting the perspective" across the stage space (Emmerson, 1998a: 159). Simon Emmerson sums up the overall effect of the instrumental plus electronic sound on the listener's spatial experience:

> All these contribute to an idea of a 'space' or perspective (a combination of timbral and real) with highlighted or heightened features; in Lichtbogen their functioning is subtle and only dominant in the final section of the work. (Emmerson, 1998a: 160)

It is the subtlety of the electronic techniques which allows perceptual fusion to take place, and thus the combined spatial experience is an extension of the ensemble.

Another technique to achieve extension, often used alongside gestural cues, is a dialogue between the spectra of the instrumental and electronic sounds. Often samples of the instruments are used as a basis for the electronic part, undergoing manipulations of one sort or another, or analysis to extract spectral information to be used in a resynthesis process. Newton Armstrong's *Making one leaf transparent and then another* (2012) achieves a very subtle distortion of the spatial character of the piano, in part by positioning a single loudspeaker inside it. This means that the piano strings

and sound board act as a resonator and complex filter for the electronic sound, resulting in strong perceptual fusion for the listener. The electronic part is comprised of layered sine tones derived from a spectral model of one of the piano strings: a sort of additive synthesis. The precise temporal alignment of piano key depression and electronic sound file triggering, plus the close spectral relationship between the sounds, allows the sine tones to emerge from the resonance of the piano in such a way that the listener is at first not certain if there is any electronic sound at all. There is extremely strong but subtle fusion of piano and electronic sound, which results in a very slight stretching of the listener's spatial experience of the instrument. Rather than an entirely new or recalibrated sense of space, the piano field is subtly distorted, pushed outwards towards the listener through the emerging electronic sound. As the piece progresses the electronic sounds are extended temporally, becoming gradually more distinct, although still very much centred on the piano due to the location of the loudspeaker. At this point, the spatial experience tips over towards *focus*, the electronic sound enabling a more conscious reorientation of the auditory field.

4.2.3.3 Perturbing

There is a more unusual form of extension which is more or less the other way around than the examples described above. In this conception the effect is inverted — it is not the electronic sound which stretches and distorts the listener's spatial experience of the instrument, but rather the instrument which perturbs the sense of space created by the electronic sound.

In Alvin Lucier's *Small Waves* (1997) for string quartet, trombone, piano and two water pourers, just such a scenario is set up by the composer. Six glass vessels of various sizes and shapes are positioned around the performance space, each with a microphone positioned immediately above it. The microphones are connected to amplifiers and then to loudspeakers. Over the course of the piece (which is around an hour long) the gain of each amplifier is increased and decreased according to the

score, resulting in fluctuating feedback tones at pitches related to the size of the vessels and their proximity to the loudspeakers. At certain points in the piece, the 'water pourers' (two additional performers) move around the performance space adding or removing water from the vessels, which changes the pitch of the feedback.[2] Lucier thus sets up the electronic sound as a complex network of very narrow band tones, which results in a particularly close feeling of space. The nature of the vessels, the feedback tones and their relation to one other gives the electronic sound as a whole distinct and dynamic spatial characteristics. The spatial experience is different in each performance because the frequencies of the feedback tones are dependent on the vessels used, loudspeaker positions and interaction with the performance space.

Into this scenario comes the instrumental sound. Following a sequence notated in the score, the musicians play slow, sustained tones which they tune closely with the individual strands of feedback (or as closely as they can, in the case of the piano particularly). As the instrumental sound meets the electronic sound, oscillating audible interference patterns are created in the air around the listener, almost viscerally. The gestural and spectral alignment of instruments and electronics is not exact, the slow, sustained tones weave their way amongst each other; but somehow we are left with the impression of a pre-existing electronic sound which the instruments then proceeds to disturb. Subtly, but unmistakably, the spatial experience of the electronic sound changes. In *Small Waves*, it is the instruments which are heard to perturb the spatial experience of the electronic sound — to alter *its* spatial qualities, to make *it* fluctuate — and not the other way around.

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[2]As an aside, when I heard this piece performed by the Quatuor Bozzini at the *Sala Rossa* in Montréal in 2015, I was fortunate enough to be present at a rehearsal with Lucier. During rehearsals, Lucier was very concerned with the theatrical qualities brought by the 'water pourers', and directed their movements around the stage precisely. The dramatic qualities of this work are not discussed in further detail here.

4.2.4 An analysis of Alvin Lucier's *I am sitting in a room*

In this section I will set out an analysis of a piece of music in terms of *focus*, *multiplicity* and *extension*, as a demonstration of the utility of the terms and of their experiential fluidity.

Alvin Lucier's influential work *I am sitting in a room* (1969) for voice and tape uses a repeating process of recording and reproducing sound to inscribe a space upon itself again and again. The length of the piece depends on the number of times the process is repeated, but will often be fairly long at 30–45 minutes.

In the piece, the performer reads a short text aloud which is recorded by a microphone positioned somewhere in the performance space. Originally this would have been accomplished with electromagnetic tape but can also be carried out digitally. Once the reading is finished, the recorded speech is played back into the performance space over loudspeakers. This reproduced sound is in turn recorded and played back into the room once again. The same process continues for multiple cycles, in each of which the reproduced sound is recorded and replayed again.

In the initial cycles, the spatial experience is one of *focus*. The speaking voice is projected into the space of performance, far outwards and separate from the performer. The voice fills the space and the listener must *recalibrate* their listening as compared to the unamplified speech. There is a *narrowing* of the auditory field as our perception is filled with the sound of the repeating voice, focusing on its internal rhythm and melody. In Lucier's premier of the piece, the rhythms of his stuttering became foregrounded on repeated listening.

As the cycles of recording and playback continue, there is a transition towards *multiplicity*. The performance space acts as a complex filter, attenuating some frequencies and amplifying others depending on its dimensions and materials. Those frequencies which are amplified are the characteristic modes of the room, its resonant frequencies. This 'acoustic fingerprint' becomes increasingly audible with each cycle. Soon we hear not 'just' the voice, but the voice and the room. Not the voice *in* the

room, which is the typical situation, but the voice *alongside* the room represented by a distinct set of frequencies.

At first the spatial experience is an *ambiguous* multiplicity, as listeners we are not quite sure what is voice and what is room. As the cycles continue it becomes a *distilled* multiplicity, listening written on listening. The space of performance is extracted, repeatedly stamped onto the voice with each cycle.

Towards the end of the piece the voice starts to disintegrate under this modal pressure. The words loose their shape and become unintelligible. Eventually all that is left are the whistling shared resonances of the voice and the room — those frequencies which they have in common and which have not been lost. The layered spaces which were first ambiguous, then distilled, have bled into each other to such an extent that they are no longer multiple, they are inseparable. The cycles of sound merge into and shape each other, unified by their common spectral characteristics. This is *extension*, the initialising qualities of the voice disturbing the space of the room, or the space of the room perturbing the voice — it's difficult to tell which.

The piece demonstrates the profoundly physical nature of sound and the dynamic, co-related nature of listening and space. The piece foregrounds the geometry of the performance space, the behaviour of sound within it and the effect of our repeated listening. Layer upon layer, inscribing space on sound powerfully affects our listening and spatial experience. Focus becomes multiplicity, and eventually multiplicity becomes extension, a unification of sound and space. Through sound, space becomes inseparable from listening. Lucier asks us to consider the nature of sound and in doing so, the nature of listening and of space.

4.3 Conclusion

In this chapter I have discussed three terms for describing spatial experience in music: *focus*, foregrounding transformations of the auditory field; *multiplicity*, involving two or more spaces at once; and *extension*, a fusion of instrumental and electronic.

The terms were introduced following a contextualising discussion on the nature of conceptualisations of space and phenomenological descriptions of listening. The terms were developed using a model of the world whereby sensory perception is mediated by bodily sensibility, to create a constantly changing, never-finished, dynamic and embodied space. Therefore, sound, through listening, is a critical and constitutive element of spatial experience.

The three terms proposed are not limiting; spatial experience may be understood in other ways; a piece of music may develop through one or more or the aspects described, or none at all. However, by defining these terms from a conceptualisation of spatial experience as embodied, dynamic, and co-created through sound, they may be useful in developing new theoretical frameworks relating to spatial experience in music.

This is a practical research project, involving both theoretical and compositional elements. Whilst chapters 2, 3 and 4 have been focused on theoretical work, the next two chapters present my portfolio of music, demonstrating how I have put some of these ideas into practice in my compositional work.

Chapter 5

Portfolio Part I: Two pieces for solo instrument and multi-channel electronic sound

5.1   Introduction

Chapters 5 and 6 (Portfolio Parts I and II) present a discussion of the portfolio of original compositions submitted alongside this thesis. In these chapters I give an account of the compositions, their development, the compositional techniques used and the form and material of the music. I relate the music back to the broader discussion of listening and spatial experience, and how it might fit into the categories of spatial experience proposed in Chapter 4.

In this chapter, Portfolio Part I, I will discuss two pieces for solo instrument and quadraphonic electronic sound. In both of these pieces a solo instrument is located on stage and a microphone is positioned close to it. The audience is at the centre of four (or more) loudspeakers, which received live-processed sound from the instrument via a laptop and interface. The first piece, *Late lines* (2013) is for cello and electronics and the second piece, *Partial filter* (2014) is for tuba and electronics.

Both of these compositions explore the sound of the solo instrument, manipulating

live samples of the instrumental sound using various processing techniques. Central to the music is a dialogue or tension between the solo instrument's typical spatial qualities (a point source, located on stage) and the expanded spatial possibilities afforded by the particular electronic processing techniques used. In both pieces the solo instrument is reimagined using close-amplification and multi-channel granular synthesis techniques to redistribute the sound of the instrument across the performance space. These amplification spatialisation techniques tend to lead to instances of *focus* within the composition, as the electronic sound re-orients the listener with respect to the instrument multiple times over the course of the piece. Both pieces feature subtle and gradual changes in amplification, spatialisation and balance between instrumental and electronic sound. This creates moments of ambiguity and change which then recede into the linear flow.

Both of these pieces were composed towards the start of this project and represent the beginnings of my formal explorations of spatial experience in electro-instrumental music. The compositional techniques used build on projects undertaken during my Masters in computer music at the University of Edinburgh in 2009–10, in particular *A to B* for solo percussion and electronics. This is where the questions which have preoccupied me since first began to present themselves.

My compositions have developed over the course of the project in tandem with my theoretical research. In general all of my compositions are characterised by a concern for composing *situations* — moments of self-reflective listening which give rise to a changing experience of space. It is a series of these moments which constitute the experience of the piece. In this chapter, both pieces discussed follow a general linear dynamic form, that is, the listener follows a singular line of sound energy over time, a constantly evolving texture created by the overall sound field in which the balance between electronic and acoustic layers is always shifting. These shifts lead to liminal moments, points at which the listener must question what they hear and where it is coming from, and in doing so, may understand a change in the feeling of space created.

5.2 *Late lines* for cello and electronics

5.2.1 Overview

Late lines is an eighteen minute piece for solo cello and quadraphonic electronic sound. The piece makes use of a combination of live, amplified and sampled instrumental sound to foreground spatial experience and reorient the listener with respect to the cello. As such, the piece is primarily concerned with ideas of *focus*. It comprises multiple points where gradual shifts in spatialisation create instances of *expansion*, and other moments where sudden drops in perceived loudness, or the masking of one sound by another force a *recalibration* of the listener's auditory field. Towards the end of the piece, changes in the balance between electronic and instrumental sound create variation in the level of *presence* of the instrumental sound, from the close-up and intimate to the immense and engulfing.

The piece was composed in 2012–13 in a collaborative process with the brilliant cellist Séverine Ballon. I was lucky enough to work with Ballon over the course of a number of workshops in London, Huddersfield and Paris, and it was during these sessions that we developed the instrumental material together, drawing on Ballon's great skill, her exploration of extended techniques (especially multiphonics) and her generosity in sharing her personal experience with the instrument. I recorded our sessions and used the sampled material to develop the electronic part.

In performance, the cello is located on stage, sufficiently close to the audience that it can be heard unamplified when there is no electronic sound. The audience is located in front of the stage surrounded by four loudspeakers (additional loudspeakers can be used if required for a larger space). A suitable microphone (such as an omni-directional DPA) is located very close to the bridge of the cello mounted on a clip. The microphone signal is sent to a computer at a suitable front of house position via an interface. The computer runs a bespoke SuperCollider patch which performs a number of manipulation and mixing processes on the incoming mono audio, before sending four channels of audio back out to the loudspeakers via a mixing desk. A
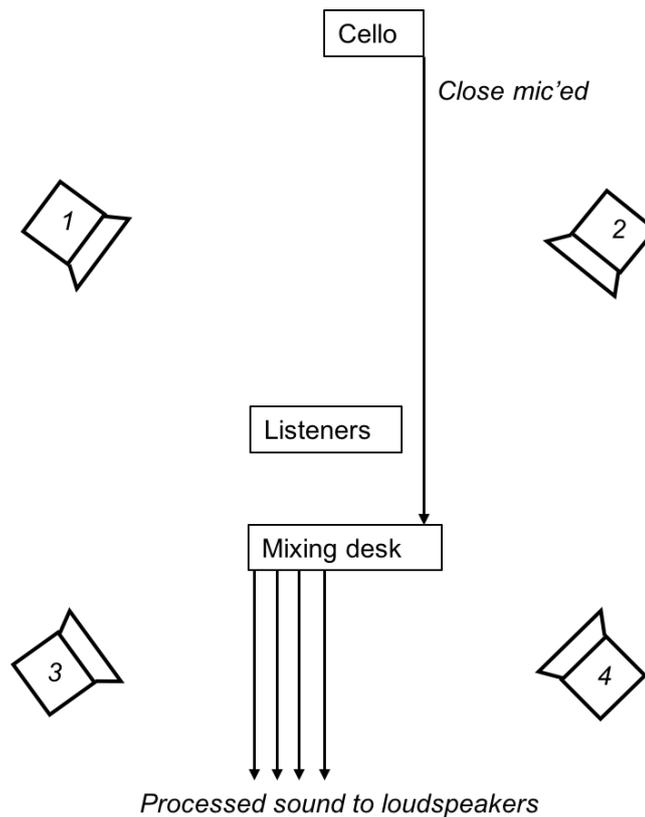
FIGURE 5.1: Technical diagram of the performance set-up for *Late lines*

technical diagram of the performance set-up is shown in Figure 5.1, and an image of the first performance of the piece by Séverine Ballon at City, University of London in June 2013 is shown in Figure 5.2.

5.2.2 Instrumental techniques

The three main instrumental techniques which Ballon and I focused on and explored in the workshops are set out and discussed below. These families of sound and transitions between them constitute the instrumental material of the piece, and centre around an investigation of the complex relationship between left hand contact pressure, bowing pressure and bowing position.

1. *Air noise:* Air noise is the term Ballon uses for the sound which arises from bowing the cello strings with low pressure whilst fully muting the strings with the flat palm of the left hand. The resulting sound is something akin to filtered

FIGURE 5.2: Image of the first performance of *Late lines* by Séverine Ballon in June 2013 at City University (still from video).

white noise, having no exact pitch but filling a specific frequency band. The spectral content of the air noise can be controlled by altering the string which is bowed, the bowing position — from bowing on the bridge itself to *sul tasto* — and bowing speed.

2. *Light harmonic pressure:* A light harmonic finger pressure is used in the left hand and soft bowing in the right. The bowing position is slowly transitioned from right on top of the bridge, to *sul tasto*, via *ordinario*. This creates a high frequency harmonic with a somewhat 'thin' quality, which seems to rise out of the previous air noise.

3. *Hard multiphonic pressure:* This results from a hard contact pressure in the left hand and high pressure bowing in the right. The bowing position varies between *ordinario* and *molto sul tasto*. This creates variable multiphonics with a scratchy, grainy quality, which at its extreme manifests as single, stuttering 'click' sounds.

5.2.3   Electronic techniques

Electronic sound manipulation and projection was realised in the SuperCollider environment using bespoke patches which I wrote for the piece. The key electronic techniques I developed and used in the piece are outlined below, and are centred on granular synthesis as decribed in Roads, 2001. An illustrative diagram showing the electronic sound-processing techniques used can be found in Figure 5.3.

1. *Amplification and spatialisation:* Amplification and spatialisation was used across four channels. It is controllable in terms of gain and the speed of circular movement - the sound moves around the listener in swirls. This is in order to create a dynamic, surrounding sound from the point source of the cello.

2. *Granular synthesis — thickening:* The granular synthesis operates with long grains of sound (5–7s) which overlap two or three at a time. The playback

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                          ┌──────────────────────┐
                          │ Live cello via close mic │
                          └──────────────────────┘
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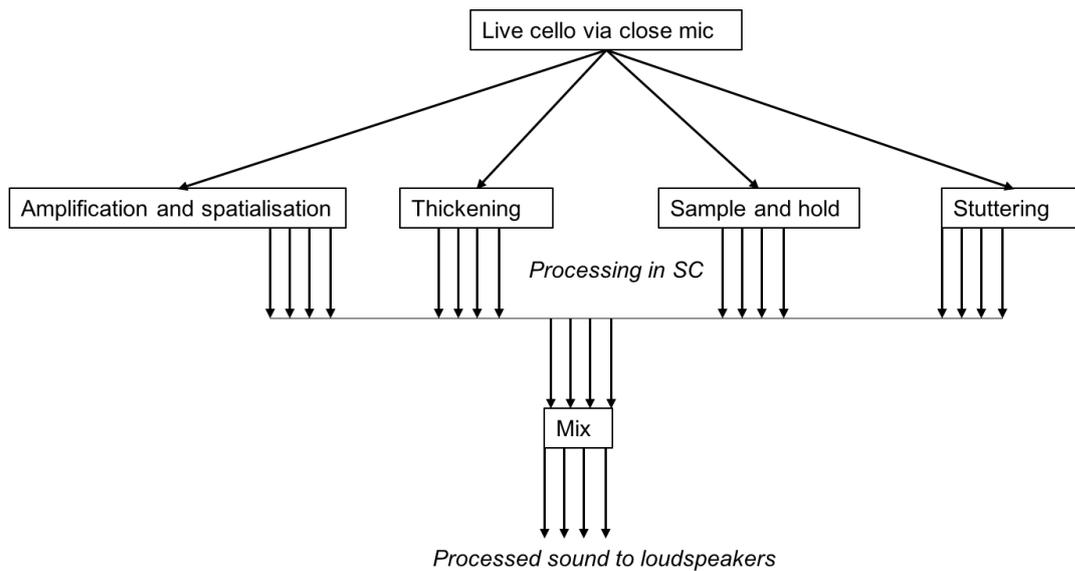
FIGURE 5.3: Diagram of electronic sound processing in *Late lines*

rate of each grain varies between 0.98–1.02. This has the effect of slightly increasing the spectral density of the cello sound without creating an overtly manipulated sound.

3. *Granular synthesis — sample and hold:* Tiny grains (10–20ms) are used with thousands of grains played per second. The grains are spatialised at random across the four channels. This creates a dense, loud, surrounding texture from a short cello sound.

4. *Granular synthesis — stuttering:* Medium length grains (1–2s) are used, overlapping five to ten at a time. They are panned to create movement of the grain line. This creates a perceptible, reoriented, chunky repeat of cello sound.

5.2.4 Spatial experience

In the first five minutes of *Late lines* the cellist plays a limited palette of sonic material, constantly bowing on different strings and in different locations to produce air noise of varying spectral content. In addition, the cellist gradually changes the pressure in the left hand which results in the slow introduction of more specifically pitched harmonic content. At the same time, the signal from the microphone is

passed to the laptop which begins to subtly amplify the cello across four loudspeakers surrounding the audience. There is a liminal moment (between 2'00" – 3'00"), which varies by listening position, where the listener suddenly becomes aware of the surrounding amplified cello as it grows louder than the live instrumental sound. This perceptual shift is a sudden reorientation of the listener's auditory field, and as such is an example of *focus*.

As the electronic sound becomes dominant, the artifice is increased as the cello sound starts to be dynamically spatialised and moves around the audience. The swirling, engulfing cello sound is then joined by a layer of granular sound — thousands of tiny grains of sampled cello which grow to to a loud and dynamic cloud of sound. The gain of the amplified cello is gradually reduced to leave only the grains of sampled cello. The live cello cannot be heard above this very loud layer. Eventually the cellist on stage stops playing but no change is heard in the resultant sound. The listener's spatial experience shifts again, as they become aware that what they are listening to is not related to the live cello at all, but is an entirely synthesised dense and nebulous electronic sound field.

Some seconds later the cellist on stage begins to play again, short, staccato bows on successive strings. This is a very visible action which creates short bursts of cello sound with a visual cue. However, the listener still cannot hear the live cello above the granular synthesis. The desire to hear what we can plainly see is confounded. The listener actively searches for the sound of the live cello but cannot find it. The grains of sampled cello are perceptually too short to be identified as cello, so again listening is foregrounded and questioned.

Gradually the cloud of cello grains becomes quieter and the live cello amplification is increased. The live cello becomes audible again, but not as the expected point source from the direction of the stage. Instead the live cello becomes a moving, stuttering spiral of loud cello 'clicks', the listener questions what they hear against what they expected to hear. The sampled cello grains cease suddenly, creating a significant drop in amplitude and another perceptual shift for the listener, who must once again

recalibrate their auditory field.

The spiral of live cello 'clicks' winds its way around the listener, recalling the sampled grains just gone, and gradually diminishing in loudness. The spatial experience contracts, eventually settling back to the point source of the cello once amplification is removed entirely. The space of the unamplified cello seems smaller by comparison to the electronic sound, but also much more personal and present in the performance space, emphasising the human scale of the cello and its player.

The piece thus comprises a succession of moments where the listener must question what they are hearing and how they are hearing it. Is it direct or amplified? Sampled or live? Static or dynamic? The auditory field is expanded, contracted and reoriented multiple times, demonstrating *focus* being deployed as a compositional method, and setting up situations which foreground listening. The development of the auditory field over the eighteen minutes of the piece enables a broad arc of scale to be created: from acoustic cello as a point source on the stage, to an engulfing, oppressive and dense cloud of sound, and back again to a human scale. It is this transformation which leads to a significant change in the *feeling* of space over the course of the piece.

A diagram of auditory field development in *Late lines* is shown in Figure 5.4.

Time

0'

Acoustic cello

00:00-02:00 Unamplified solo cello. A point source from the direction of the stage. Plays unpitched 'air sounds'.

Acoustic cello

Amplified cello

02:00-03:00 Increase of amplification until the point where the electronic sound is louder than acoustic sound. Liminal moment as localisation point switches.

Acoustic cello

4'

Delayed cello

Amplified cello

03:00-05:00 Oscillating delays start in the electronic sound, gradually causing the amplified cello to move around the listeners. This disconnects the electronic sound from the live performer.

05:00-06:00 Oscillating delays disconnect the electronic sound from the live performer.

Acoustic cello

Delayed cello

Amplified cello

06:00-10:00 Granular synthesis in the electronics is combined with harmonics in the cello part to layer the harmonic content and spread it across the quadraphonic image. The resulting sound is ambiguous in direction and origin.

Acoustic cello (harmonics)
Layered cello

Amplified cello

9'

FIGURE 5.4: Diagram of auditory field development in *Late lines*. The auditory field is shown with a dotted circle, and points of focus with solid squares. Developed with reference to diagrams in Ihde, 2007 and Helgeson, 2013.

Time

9'

Acoustic cello

Dense grains

11:00-12:00 Dense grains of high frequency sound fill the performance space, making the spatial experience feel synthesised and close.

12:00-12:30 The cellist stops playing.

Dense grains

12:30-13:30 The cello becomes audible again. The grains stop suddenly. Attention shifts back to the cello.

13'

Acoustic cello
Amplified cello

14:00-17:00 New cello material – clicks and pops from high pressure bow action. The oscillating delay returns, the cello clicks move around the listener, encircling.

17:00-18:00 Sense of contraction as the oscillating delay and amplification reduce. The combined sound gradually returns to the solo cello, unamplified. The smaller, human, acoustic scale returns.

Acoustic cello

Delayed cello

Acoustic cello

18'

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5.3   *Partial filter* for tuba and electronics

5.3.1   Overview

Partial filter is an eleven minute piece for solo tuba and quadraphonic electronic sound, and again uses a combination of live, amplified and sampled instrumental sound to enable spatial experience to become a key compositional dimension. The piece makes use of the huge dynamic range of the tuba, which enables the instrumental sound to emerge unamplified through the loud and dense electronic sound. In this way, the performance space, as articulated by the tuba, is overlaid with the dense and engulfing electronic sound, forming a *multiplicity*. Other key moments in the piece can be understood in terms of *focus*, as the electronic sound spreads the instrumental sound out across the performance space, allowing it to linger and layer in ways which would not be possible acoustically. A tension is created between the live and electronic sound, and moments arise which require a recalibration of the listener's auditory field. In contrast to *Late lines*, in *Partial filter* I allowed the acoustic (unamplified) sound of the tuba to play a bigger role in creating different spatial experiences throughout the piece, in part due to the nature of the instrument itself (its dynamic range in particular), and also because I wanted to move away from any sense of electronic sound 'dominating' an acoustic sound.

Partial filter was composed in 2014 as part of Sound & Music's *Next Wave* programme for emerging composers, in conjunction with the London Sinfonietta. Twelve young composers were selected from different U.K university music departments. Each composer had the opportunity to select their preferred instrumentation from a group of Sinfonietta musicians, and then had a workshop with them during a three day residential course. The finished pieces were premiered at a concert at the 2014 Huddersfield Contemporary Music Festival.

I chose to work with tuba player Oren Marshall specifically because I was aware of his fantastic improvisational skills. I thought we could potentially have a fruitful collaboration during the workshop. This indeed proved to be the case as Marshall

demonstrated many extended tuba techniques, which again I recorded and sampled to develop the electronic part.

The technical set-up for *Partial filter* is very similar to that of *Late lines* in terms of instrument, microphone, laptop, loudspeaker and listener positions (refer to Figure 5.1). The tuba is again close-mic'ed with a suitable omnidirection microphone positioned just above the instrument's bell to capture quiet breath sounds. I again wrote bespoke SuperCollider patches to process the captured live sound and distribute it across the loudspeaker array, along with pre-processed electronic sound files.

5.3.2   Instrumental techniques

The three key instrumental techniques used in the piece are described below. Marshall and I explored these techniques and the parameters within which they can be performed live (for example, maximum duration, amplitude and pitch range) during our workshop.

Breath sounds and long sustained tones constitute the main performed live instrumental techniques used in the piece. *Tuba flute* is an extended technique suggested by Marshall which is not performed live due to practical constraints (all the tuba valves must be removed). However, I made several recordings of the sound produced by this technique and samples of it are integral to the electronic sound in the latter stages of the piece.

1. *Breath sounds:* The player articulates various phonemes such as *shh*, *sss*, *mm*, *tsk* into the mouthpiece. The spoken phonemes are filtered using the physical space of the instrument, which creates an intimate amplified sound, bringing the listener close to the gestural space of the performer through a process of expansion.

2. *Sustained tones:* The player creates long, held tones at a specific pitches. The instrumental tones emerge with a very gradual crescendo through the electronic
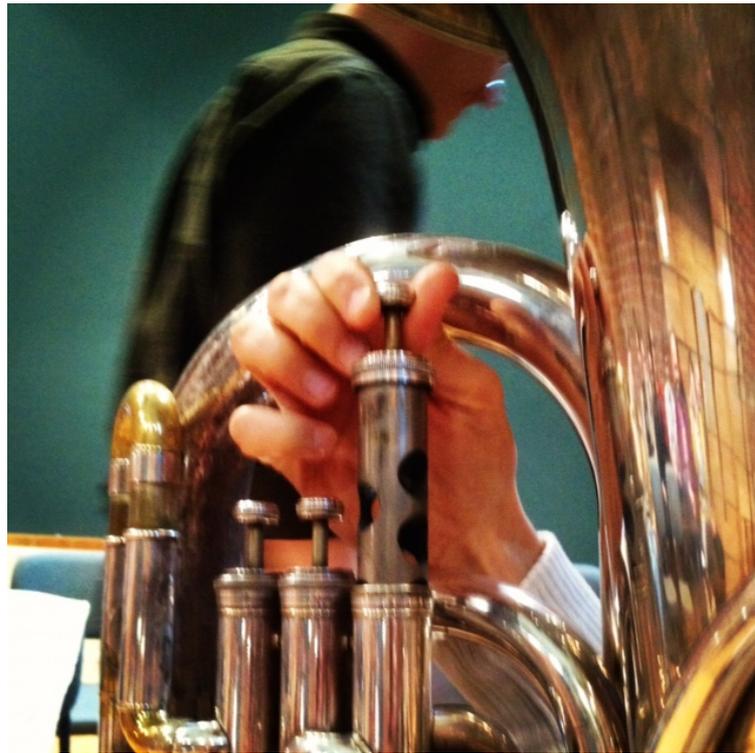
FIGURE 5.5: Photograph of the tuba valves being removed during the workshop in order to create the 'tuba flute' sound. Photograph by the author (2014).

sound and then disappear into it with a symmetrical decrescendo. This creates a loud, live, pitched instrumental sound which can be heard through the electronic sound.

3. *'Tuba flute':* All the tuba valves are removed. The player then blows across the valve tubes as if playing a flute or pan pipes. A photograph of this is shown in Figure 5.5. This creates a flute-like sound from the tuba. The technique is not used live in performance due to the practical constraints but samples are used in the electronic sound to create a fixed electronic cloud of delicate, breath-like sound which is related to the tuba but slightly removed, not being distinctly 'tuba-ish'.

5.3.3 Electronic techniques

Electronic sound manipulation and projection was realised in the SuperCollider environment using bespoke patches which I wrote for the piece. The key electronic techniques used in the piece are described below, again making use of the vast possibilities of granular synthesis. An illustrative diagram showing the electronic sound-processing techniques used is presented in Figure 5.6.

1. *Amplification and spatialisation:* Amplification and spatialisation across four channels to create a dynamic, engulfing sound from the point source of the tuba.

2. *Granular synthesis — stuttering:* Medium length (2–4s) grains each located at a different position in the quadraphonic space. Two or three overlap at a time in order to create a perceptible, reoriented, intimate repeat of the tuba breath sounds

3. *Granular synthesis — noise cloud:* Thousands of tiny (10–20ms), individual grains are used at a playback rate of 0.9–1.1. They are spread evenly across the quadraphonic space to create a dense, loud, surrounding and noisy texture from the tuba breath sounds

4. *Granular synthesis — harmonising:* Hundreds of medium length (2–4s) grains are played in multiple layers at a set of different playback speeds, and are spatialised to create a 'canopy' of high frequency sound. This creates a thick 'tuba flute' cloud with specific harmonic content (discussed in further detail in 5.3.4) arching across the performance space.

5.3.4 Spatial experience

The beginning of *Partial Filter* is concerned with *focus*. The tuba player articulates phonemes such as *shh*, *mm*, *tsk* quietly into the tuba mouthpiece, where they are filtered by the instrument. These sounds are typically just audible to the listener, and are easily localisable to the tuba. These modified breath sounds are amplified via a microphone located close to the tuba bell, and spatialised over four loudspeakers

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                        ┌─────────────────────┐
                        │ Live tuba via close mic │
                        └─────────────────────┘

┌──────────────────────────┐  ┌──────────┐  ┌─────────────┐  ┌──────────────┐
│ Amplification and spatialisation │  │ Stuttering │  │ Noise cloud │  │ Harmonising │
└──────────────────────────┘  └──────────┘  └─────────────┘  └──────────────┘

                              Processing in SC

                              ┌──────┐
                              │ Mix  │
                              └──────┘

                        Processed sound to loudspeakers
```
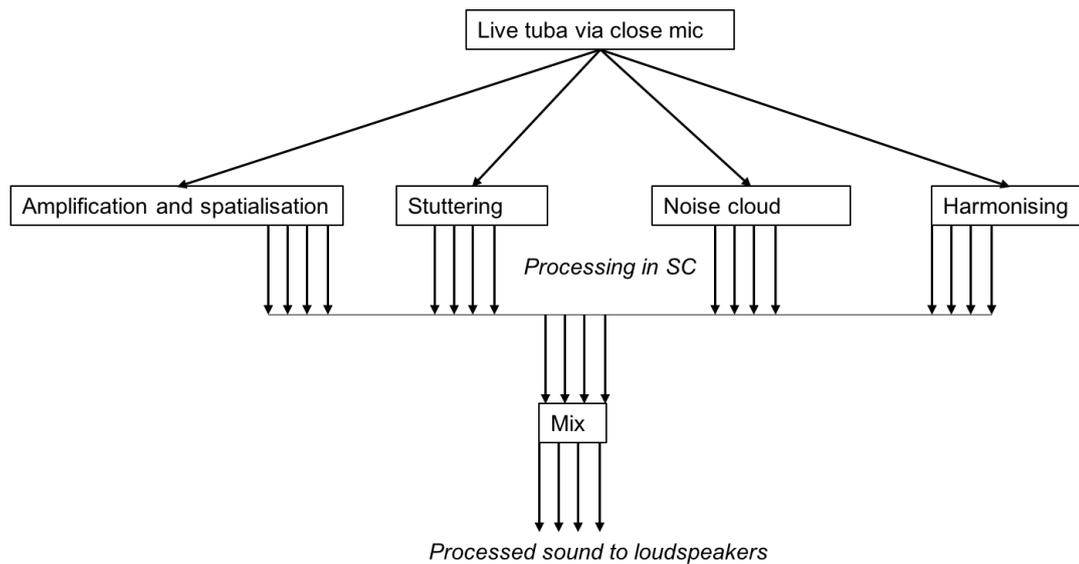
FIGURE 5.6: Diagram of electronic sound-processing in *Partial filter*

in short, sampled chunks. Gradually the gain is increased until the listener is surrounded by the, by now fairly loud, breath sounds. The listener is brought inside a sound which should be distant, close-up to an intimate, personal utterance space (in Smalley's terminology) modified by the spectral filtering characteristics of the tuba. Phonemes appear at different points across quadraphonic space, creating a series of changing point sources. The acoustic instrument has been superseded by electronic sound with very different spatialisation, and the listener must recalibrate their auditory field in response.

The electronic sound begins to disintegrate into shorter and shorter chunks, until it has the quality of grains. Finally the sound cannot be perceived as gestalt phonemes emanating from a particular location, but instead has become a cloud of dense, filtered noise which surrounds the listener. At this point, live or recognisably sampled tuba sound is no longer audible. The listener is in an oppressive space, unable to hear the instrument or performance space due to the intensity of filtered noise around them. Again, the listener must recalibrate their listening, as the sound now engulfs them in a dense and homogeneous fashion.

The live tuba player then moves on to a very different sort of material: loud, sustained tones at specific pitches, individually shaped with a long crescendo and decrescendo. These tones gradually emerge through the dense cloud of noise, and become sufficiently loud that they reimpose into the listener's auditory field the instrumental sound as a point source in the performance space. It is a moment of *multiplicity*, as the performance space, as articulated by the tuba, co-exists with the oppressive and engulfing feeling of space created by the electronic sound. Then the electronic sound stops suddenly, leaving the sustained instrumental tones alone, emphasising a changed auditory field filled with the articulation of the performance space by the instrument. This sudden change creates another moment of *focus*, as the listener's auditory field collapses abruptly from multiplicity to a singular, real space.

When electronic sound is reintroduced, it is of a very different character to the first half of the piece. It is a fixed, quadraphonic sound file, composed by processing and layering the *tuba flute* extended technique samples which were recorded during the workshop. The processing techniques used in SuperCollider were developed specifically to emphasise the harmonic content of these samples, which is related to the size of the tuba valves. In turn this harmonic content was used to set the pitches of the tones played by the live tuba, enabling a relationship between the live tuba and electronic sound, upon the electronic sound's re-entry.

The processing techniques were quadraphonic, and used to create a 'canopy' of high frequency 'chirrups' in the electronic sound which create a vast, imaginary space into which the tuba plays sympathetic tones. *Multiplicity* is at work again, though more ambiguously than before, creating layered and interconnected spaces: the space of performance as articulated by the instrument, and the imaginary space of the electronic sound.

A diagram of auditory field development in *Partial filter* is shown in Figure 5.7.

Time

0'

Acoustic tuba

*00:00-00:45
Unamplified solo
tuba. A point source
from the direction of
the stage. Plays
unpitched breath
sounds, directional
and intimate.*

Amplified tuba
Acoustic tuba

*00:45-02:00
Sampling of breath
sounds across four
channels. The
sound field has
become
impossible, virtual.*

3'

Amplified tuba
Sampled tuba

Acoustic tuba

*02:00-03:30 Sampled tuba
increasing, pushing
acoustic tuba to periphery.*

*03:30-05:00 Granular synthesis
creates a dense an noisy cloud of
sound. Reduced sense of space –
claustrophobic. Acoustic tuba is lost.*

Acoustic tuba

Dense grains

*05:00-07:25 Acoustic tuba returns playing long, swelling notes
which become just audible over the noise. Claustrophobic sense
reduces as the point source of the musician filters through the
noise. At 05:45 the grains stop and only the acoustic tuba
remains.*

Acoustic tuba

6'

FIGURE 5.7: Diagram of auditory field development in *Partial filter*. The auditory field is shown with a dotted circle, and points of focus with solid squares. Developed with reference to diagrams in Ihde, 2007 and Helgeson, 2013.

Time

6'

07:25-09:00 Processed 'tuba-flute' sounds.. The sound is diffuse across four channels, soft but dense. Sense of expanded space.

Acoustic tuba

Processed 'tuba flute'

9'

09:00-10:00 Very high frequency clicks located in specific positions across four-channels create a 'canopy' which further extends the sense of vast space. The solo tuba is a times audible, rooting the imagined space to the human.

Processed 'tuba flute'

High frequency clicks

Acoustic tuba

10:00-11:00 Sense of contraction as the electronic sound reduces. Return to the solo tuba, unamplified. At 10:18 the electronic sound drops in amplitude. The smaller, human, acoustic scale returns.

Processed 'tuba flute'

Acoustic tuba

11'

Acoustic tuba

5.4   Conclusion

The two pieces presented in this chapter are representative of a particular compositional method which occupied me at the start of this project. I was interested in working intensively with a solo musician in order to be able to engage with that person over the course of a series of workshops. I hoped to learn directly about their unique relationship with their instrument and the ways of playing it which intrigued them. I wanted to use this collaborative process to inform the development of the music, specifically the instrumental material and the electronic sound-processing techniques, to enable a reimagining of the instrument and the ways in which it is presented to an audience. In addition to the pieces for cello and tuba presented in the thesis and portfolio, I have also written pieces for piano and quadraphonic electronic sound (*Cut it out*, 2014) and percussion and quadraphonic electronic sound (*A to B*, 2010). I would consider these pieces to fall into the same category as *Late lines* and *Partial filter*, and whilst they are not presented as part of the portfolio, they nevertheless demonstrate similar concerns.

The form of these pieces can be described as linear dynamic, a singular line which the listener follows. Electronic sound-processing techniques, particularly granular synthesis, are used extensively to spread the instrumental sound around the performance space, allowing it to linger and layer in ways which are not possible acoustically. The electronic sound thus re-orients the listener with respect to the instrument, leading to the potential for self-reflective listening experiences and a heightened awareness of sound and space.

The compositional techniques used — the gradual increase in amplification, the sudden turning off of dense sounds, the quadraphonic spatialisation of granular synthesis, the continually changing texture, the linear dynamic flow — act together to transform the listener's auditory field, and by doing so shift the *feeling* of space from the human scale towards the *vast* and *imaginary*, and back again.

Chapter 6

Portfolio Part II: Emergent form and spatial experience

6.1   Introduction

In this chapter, the second of two which discuss my portfolio of compositions, I present five pieces composed towards the end of the project. I consider how my compositional strategies have evolved from a strong use of live-processed multi-channel electronic sound, to instrumental pieces which contain limited or no electronic sound at all, whilst still retaining spatial experience as a central compositional concern.

The five pieces described in this chapter do not follow the linear dynamic form typified by the long and gradual sonic transformation of the solo pieces discussed in Chapter 5. Instead, these five pieces demonstrate in various ways a more emergent conception of form; one which is characterised by sonic material presented in subtly different contexts. The effect of listening to these pieces, though, is more than simply a contrast between materials. The procession of sound becomes more than the sum of its parts, both local and global contexts are critical to the form. Thus, the formal experience of these pieces emerges through active listening, rather than by following a linear dynamic flow of sound energy.

Herman Sabbe, writing on the music of Morton Feldman, said that Feldman's music is composed of:

> shifting, ongoing dis-placements, de-centerings, unfixings: a chain of differences, not a system of (reciprocally related) oppositions of fixed, constituted, essentialised meanings. (Sabbe, 1996: 11)

These 'shiftings' — which Sabbe refers to as "differences which are *not oppositions*" — mean that "similar information is presented in dissimilar/similar contexts" (ibid.: 11). This in turn leads to a sonic experience which is "constantly modifying or altogether defeating continuation hypotheses on the part of the listener" (ibid.: 11). The sonic material — or more accurately, the relationships between sonic materials over time — result in different perceptual outcomes, thus enabling the listener to question their listening, or to put it another way, to listen to themselves listen. There is also an analogy with the simultaneous contrast effect in colour theory, identified by Chevreul (Chevreul, 1839) and explored in paintings by Sonia Delaunay (see 3). In this effect, a blue, for example is perceived differently when set against a red as opposed to a green. Our perception of colour is not fixed and stable but is rather influenced by adjacent colours — by the context. The artist, in their particular use of the material of colour, can create situations in which this perceptual effect becomes a central focus of the work.

In the compositions discussed in this chapter I pursue these ever shifting differences, to create situations of active listening in which the question of spatial experience is foregrounded. Space is key in all the pieces, either through an exploration of physical and instrumental acoustic behaviour, or poetic imagery of spatial scales and atmospheres, or in the case of the last three works, in an abstracted sense using the extracted resonant frequencies of particular spaces as the basis for the music's harmony. The musical material, presented in changing contexts, leads to listening situations in which spatial experience is central. Agostino Di Scipio's conception of sonological emergence is also relevant here, as we consider the music in terms of, "the systemic conditions (internal and external constraints, resources available in the

environment)" (Di Scipio, 2008: 221). Spatial understanding emerges as a by-product of the system interactions: the sonic, acoustic, atmospheric and social constraints of the environment of performance. The pieces reflect, "less a fixed temporal constellation, and more a shared, lived experience of time and space" (Di Scipio, 2011: 97).

The first piece I will discuss is *Three pieces*, a string quartet written in 2015 for the Quatuor Bozzini and developed as part of their Composer's Kitchen programme of workshops and compositional mentoring. The piece does not include any electronic sound but rather highlights three aspects of the acoustic behaviour of stringed instruments, presented in three distinct sections.

The second piece, *Near and far*, is for vocal ensemble (soprano, alto, tenor, bass) and stereo electronic sound. The electronic sound consists of simple layered sine tones and narrow-band filtered white noise. It is based on a poem, *Stars* by Emily Brontë, and aims to evoke the contrasting scales of space created in the text by presenting the sung material over an ever expanding range of sine tones. It was written for EXAUDI in early 2017.

The last three works form a series which I have called the *Real Spaces* series, and which I began in the summer of 2017. Each piece in the *Real Spaces* series is based on a set of resonant frequencies extracted from a particular building by a process of spectral analysis of the building's acoustic impulse response. These sets of frequencies are then used as the basis for the harmony of the instrumental pieces. Two of the pieces are acoustic only, and one contains layered sine tones. The spaces chosen for the series so far are Maeshowe in Orkney, St. Andrew's church in Lyddington, Rutland, and York Minster in York. In this series, the pieces draw on a thoroughly abstracted spatial fingerprint — the resonant frequencies — and reinsert this aspect of space into a present spatial experience. Whilst this is a more metaphorical foundation than other works presented, these pieces are none the less concerned with the different ways in which space is conceptualised and experienced in music.

The pieces discussed in this chapter demonstrate the development of my compositional techniques over the course of this project, as I sought new ways to explore

spatial experience in music and absorbed the lessons learned in previous experimentations with electronic sound. The strategies used in each piece are discussed in detail in the following sections.

6.2 *Three pieces* for string quartet

6.2.1 Development

This piece is the first I wrote without electronic sound. This was a conscious decision in order to challenge myself to achieve my compositional aims of foregrounding spatial experience but without using the same electronic processing techniques which I had used twice before. Instead, I decided to examine ways in which the formal structure of the piece could be used to these ends. I wanted to explore the potential of monolithic blocks or textures of sound, and the properties which might emerge when they were placed next to each other.

This piece was created with the Quatuor Bozzini as part of their Composers' Kitchen programme, which I was selected for in March 2015 and took part in with the support of Sound & Music. Four composers were in the group, two based in the U.K and two from Canada, plus composition mentors Christopher Butterfield and Christopher Fox. In June 2015 the quartet held a week long residency in Montréal, Canada. As a group we workshopped the sketches each composer had brought and discussed compositional ideas and strategies over the course of seven intense days, in what was an invaluable period of support and development. In February 2016 the group met again, this time in Banchory, Scotland, for further rehearsals and the premieres of the four finished pieces at a concert supported by Sound Scotland.

6.2.2 Form and material

The piece is approximately twelve minutes long. It is divided into three sections of around four minutes in length. In each section all four instruments explore a single aspect of the sound of a stringed instrument, moving onto a different aspect with each section. Between each section is a ten second silence.

Each section is comprised of a single block of sonic material with an abrupt start and end. Each block has a simple development over the course of the four minute period

(for example, in section one, a gradual increase in bow pressure). The development is staggered slightly within the block and across the quartet, leading to a slowly fluctuating texture.

Each section is thus very different in texture and sound, but exactly the same in form. This self-similarity enables the three sections to integrate together as a whole, whilst retaining their distinct and individual character, in a form similar to a triptych painting. This allows the listener to focus on the specific sound of each section, the contrasts between them, and also to develop an understanding of the correspondences of the whole. Perceptually, then, the form allows the successive sections to become more than the sum of their parts.

The sonic material and development of each section is discussed below.

1. *Section one — noise to pitch:* Soft bowing on the strings, with bowing position moving from bridge to fingerboard. All strings are muted with the palm of the hand. This creates an unpitched 'air sound' similar to filtered white noise. The spectral content varies by the size of the instrument, the specific string bowed and bowing position. There is a gradual increase in bow pressure to allow harmonic content to come through as fragile, high frequency pitches.

2. *Section two — resonance:* Long, slow swells of single pitches with some double stops. The swells are played with long crescendos and decrescendos, and overlap to create a constant, oscillating wave of sound. The pitches are specified to be played on opened or stopped strings, in order to foreground the varying body and air resonances of the different sized instruments in relation to the standard tuning of their open strings. A limited group of pitches is used altogether, and the selection of sub-groups of pitches changes through the section.

3. *Section three — friction:* Twisting movement of the bow next to the bridge with high pressure in the right hand (see Figure 6.1 for image of the technique). This creates loud, dry 'clicks' and 'pops'. By varying the speed of the bow twists each player changes the density of the clicks (i.e. the number of clicks per

second). Each instrument follows an individual density profile over time, to create a single, rippling texture.

6.2.3 Instrumental acoustics and spatial experience

Electronic sound is not used in this piece — it was one of the first pieces I composed for acoustic instruments alone. My starting point for the piece was investigating the physical sound-generating properties of each instrument, building on my explorations of the cello with Séverine Ballon during the composition of *Late lines*. I wanted to reduce the instrumental materials to the roots of sound production on a stringed instrument, and thus arrived at the three aspects used: *bow pressure*, *resonance* and *friction*.

By focussing so closely on a single aspect of sound production, the sonic material of each section becomes very distinct. Each section of *Three pieces* is thus able to articulate the space of performance in contrasting ways, due to the interaction between the particular qualities of the sound produced and the specific acoustic character of the performance space. In some ways listening to the three sections of *Three pieces* is like walking into three different rooms.

Thus, despite approaching the composition of this piece from a purely instrumental acoustic perspective, the material — when so arranged in this particular formal structure — results in a foregrounding of spatial experience. So whilst in some ways *Three pieces* is a departure from earlier multi-channel electronic works, the central role of listening and space nevertheless locate it within the same, continuing exploration of spatial experience through sound.

There follows a more detailed description of instrumental acoustics and spatial experience in each section.

Ten seconds of silence

FIGURE 6.1: Image of Clemens Merkel demonstrating the technique used to produce granular 'click' sounds on the violin, during a workshop with the Quatuor Bozzini in Montréal (still from video taken by the author).

— Section one:

The first section starts off extremely quietly. The bow pressure used is not sufficient to create Helmholtz motion — setting the string into harmonic oscillation — so the typical sound radiation of the instrument is not achieved. The 'air sound' produced by the instruments is often masked by background noise within or external to the performance space.

Slowly the 'air sound' becomes louder and more audible, but remains a diffuse and wavering sound field. This is the first interaction between the sound of the instruments and the performance space, as the instrumental sound and background noise seem to merge, before the background noise gradually recedes as bow pressure is slowly increased and some harmonic content starts to be produced by the instruments. These pitches are much more directional and easily heard than the unpitched content, and thus the listener's auditory field starts to morph and change shape as the sound of individual instruments become more easily distinguishable. Once the harmonic content is fully established, the section stops abruptly.

Ten seconds of silence

— Section two:

The second section maintains a fairly constant *forte* dynamic throughout, and only a limited number of pitches are used over the course of the section. The listener's auditory field therefore does not change shape over time in the same way as in section one, but sets itself up from the start. Double stops are used frequently, as is an instruction to play the note on an open string.

The characteristic resonances and radiation patterns of each stringed instrument are slightly different. Figure 6.2 shows a graph of the wood and air resonances of a violin in relation to the tuning of its open strings. It can be seen that the tuning of the open D and A strings coincides almost exactly with the typical air and wood resonances for the instrument. A similar graph can be drawn for cello and viola. In each case there is a slightly different relationship between the frequency of the wood

and air resonance and the tunings of the open string. This causes a difference in the response of the instruments to open strings being played. In the case of the viola, the tunings of the strings do not coincide well with the resonances of the body, giving the viola its slightly different timbral quality.

Additionally, each stringed instrument radiates sound in a slightly different directional pattern according to frequency. Figure 6.3 shows an illustration of this in the horizontal plane for violin and cello. The violin, for example, radiates sound omni-directionally at A4 = 440 Hz, whereas the cello only radiates sound in a forward direction.

Since a limited number of pitches are used, the pitches are often repeated and passed from one instrument to the next. The slight differences in resonance and patterns of radiation between the instruments become intensified and heightened in our listening experience. The instrumental material is thus highly resonant in quality and self-reinforcing, in a cycle of feedback and repetition. The instrumental sounds and acoustic characteristics interact with the resonant frequencies of the performance space, placing the listener within an engulfing, surrounding sound field which gently fluctuates as the instruments play their staggered, swelling notes. At the height of this resonant field, the section again abruptly stops.

Ten seconds of silence

— Section three:

The material of the last section is dry clicks and pops created by friction between the bow hair, string and bridge. Each musician controls the density of clicks and pops produced per second by varying the speed of their twisting bow action. This creates a unison rippling, granular texture.

The short, dry sounds do not carry much of the resonant characteristics of the instrument itself, although the violin and viola do tend to produce clicks of a higher frequency than the cello. In addition, the transient content of these types of sounds
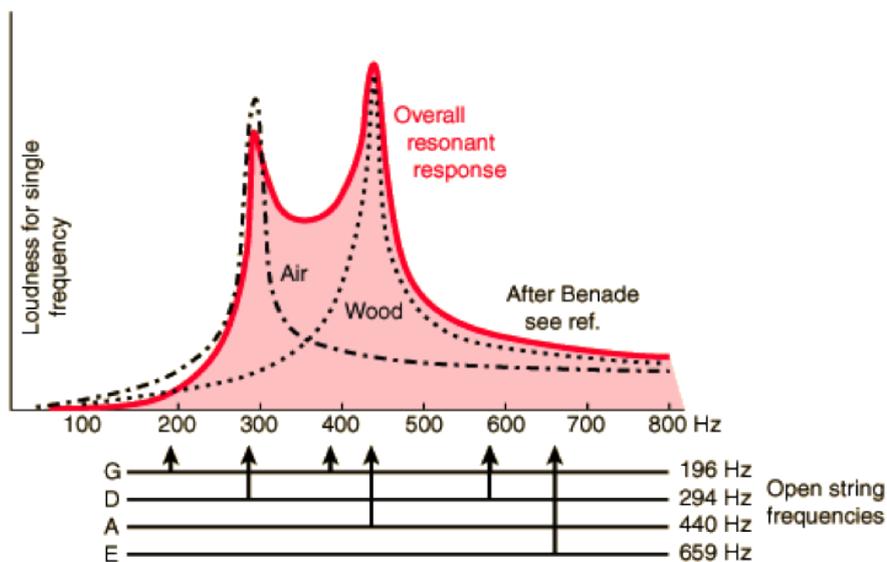
FIGURE 6.2: Graph of the wood and air resonances of a violin in relation to the tuning of the open strings (Benade, 1976).

activates the acoustic characteristics of the performance space in a different way to long, sustained pitches. It is therefore the temporal profile of the sound which is emphasised here, repeated with each click in varying density, rather than spectral characteristics. This gives a very different spatial characteristic to section three in comparison to section two, where the steady level of sound sets up a constant and surrounding sound field. The texture created, though dense, is not surrounding or engulfing, but centred on the quartet. Overall then, the feeling of space is very different for the listener, especially when juxtaposed so starkly with the previous section.

6.2.4 Summary

Overall *Three pieces* can be characterised in terms of *multiplicity*. Each section creates a different listening experience due to the distinct nature of the instrumental material and its interaction with the room. However, the similarity between sections — in length, shape and development — allows the three to be perceived together as a whole. The primary form is a sort of triptych, in which all sections exist together, enabling them to become more than the sum of their parts.
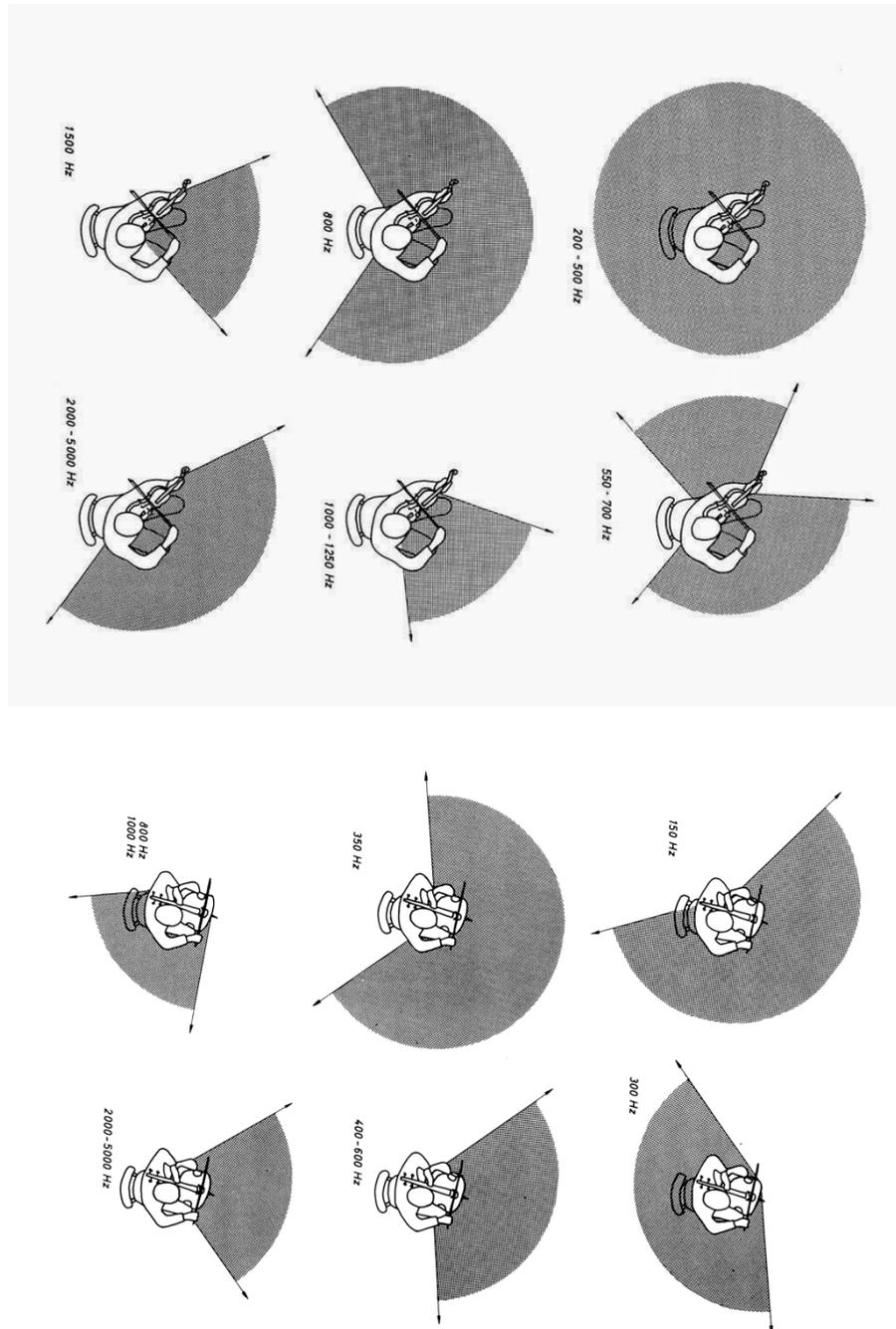
FIGURE 6.3: Illustration of the radiation of sound in the horizontal plane from a violin (left) and cello (right). Radiation patterns vary with frequency and according to the type of instrument (Meyer, 2009).

Each section ends abruptly, which leaves the impression of a never ending sound within each section, one that might continue on though we don't hear it anymore. By the end of the piece, although we experienced each section consecutively, it is as if all three are continuous and present together, layered on top of each other in a multiplicity of listening. We listen to the same space at different times, or different spaces at the same time, listening on listening.

A diagram of auditory field development in *Three pieces* is shown in Figure 6.4.
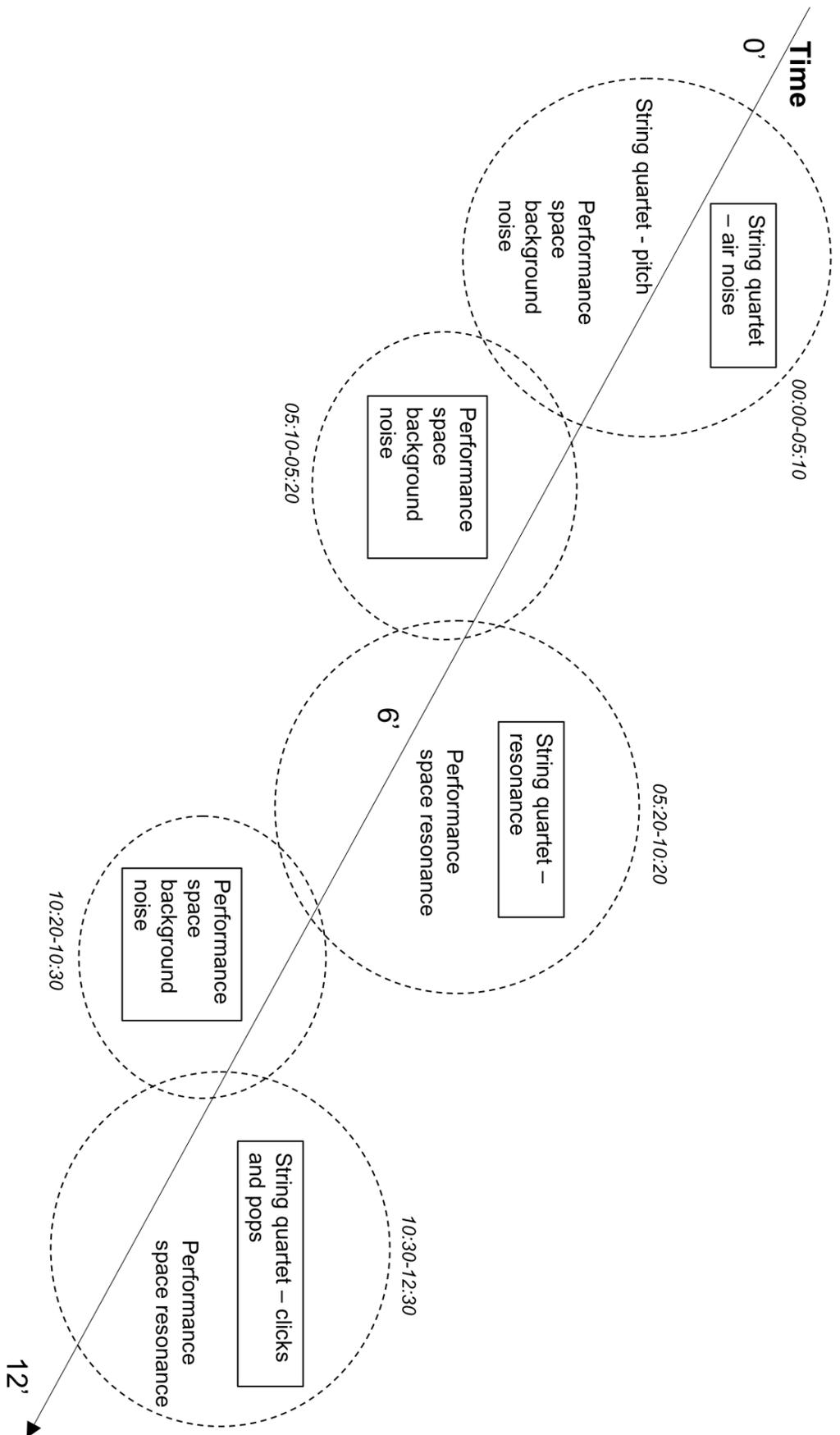
FIGURE 6.4: Diagram of auditory field development in *Three pieces*. The auditory field is shown with a dotted circle, and points of focus with solid squares. Developed with reference to diagrams in Ihde, 2007 and Helgeson, 2013.

6.3 *Near and far* for vocal ensemble and electronics

6.3.1 Development

This seven and a half minute piece for vocal ensemble (SATB) features continuous, simple electronic sounds which permeate through the singers whilst expanding in pitch range and density. It was written for EXAUDI vocal ensemble who visited City University in March 2017 for a workshop and, later that spring, a concert.

The piece is concerned with an evolving relationship between the singers as individual voices, the singers as ensemble, and the singers with the electronic sound. In composing the piece I was interested in exploring how to use this varying relationship to create a dynamic sense of space throughout the piece. The text is taken from the poem *Stars* (1846) by Emily Brontë, which is discussed in further detail below.

6.3.2 Form and material

When I started thinking about how to approach this piece, I was keen for the singers to sing a text with meaning, and to use this meaning to access spatial imagery. I had read Bachelard's *The Poetics of Space* (Bachelard, 1994), and was curious about how the various poems and texts quoted in that book evoke powerful imagery related to spatial experience. I wanted to see if I could incorporate this into my music.

I chose to use extracts from Emily Brontë's poem *Stars*. The poem deals with issues of spatiality, both physical and imaginary. Brontë achieves a great sense of drama in the poem by contrasting the relative magnitudes of stars — referencing infinity, the universe, the sun, God — with a personal scale, studying the body, a room, a fly, bedroom curtains, pillows (the poem is reproduced on page 137 for reference). I wanted the music to achieve something similar to the poem by creating an intimate, personal and human scale of space at the start of the piece, which would develop into something much bigger — an enormous, vast, impossible idea of space.

Pitch is often intuitively understood as geometrically spatial, if a low pitch and a high pitch are heard simultaneously the listener may imagine this as an opening up, and describe a gap or a distance between the pitches. This is not just a way of describing what is heard but can be felt as a particular sense of space, as described by Smalley in his 'spectral space' (Smalley, 2007). I wanted to explore harmony and spatial experience in this piece, and to use the combination of voices plus electronic sound to create a distinct transition in the feeling of space from the beginning to the end of the piece.

The piece is divided into eight sections, each of which makes use of a different set of pitches but which otherwise use fairly similar material. Overall this creates a transition, initially the sine tones are played at the same pitch as the individual singers, creating a blended and constrained sound, but by the end the sine tones are played at wide intervals, increasing the sense of imagined scale. The pitches are shown by section in Figure 6.5.

The changes between sections are generally marked by a pause in the vocal part, while the continuous electronic sound is simply switched to the next set of pitches. This enables the returning vocal part to be set against a 'new' background, a new context in which the vocal material is perceived. These moments of change or recalibration create the potential for self-reflective listening, where the listener may notice an altered sense of space created by the developing harmony, and a tension as the returning vocal sound makes its way in the new setting.

On reading the poem closely I noticed a number of two syllable words containing a 'zed' sound — *dazzling, gazing, blazing* — and chose to use these for the start of the piece, as well as other two syllable words with complementary sounding phonemes — *changeful, blinding, gentle, revelled*.

At the start of the piece the singers pass these single sounds around between themselves, singing one syllable at a time and finishing each others' words in close harmony. As the piece progresses the ensemble sings longer fragments in alternating pairs and, towards the end, whole phrases are sung by the ensemble together in

expansive chords.

I selected increasingly longer phrases to build up these later sections of the piece, each of which I found to be particularly evocative — *To call back night*, *Dreams and gentle*, *As they were life to me*, *Ah! why because*, *Your worlds of solemn light again*. Each of these phrases is repeated multiple times.

The electronic sounds used are fairly simple: sine tones from C2 to F7 (ca.60–2800Hz) and white noise filtered with a narrow bandwidth. The electronics are presented in wide stereo. A loudspeaker is located on either side of the ensemble, ideally behind and slightly below the singers as this helps the sounds to blend. (When the loudspeakers are placed above the singers, as with a standard PA above the stage, the electronic sound is perceived as being too separate from the singers.)

The sounds are triggered live using a specially written, automated SuperCollider patch with 17 trigger points which are controlled by the conductor or an alternative person. This live element again helps the electronic sounds to retain a perceptual relationship with the singing, as the timing of the attacks can be closely controlled.

6.3.3 Harmony and spatial experience

In the first two sections of the piece the vocal part consists of very narrow intervals of a whole, semi- or quarter-tones, which the electronic part follows closely. The vocal part consists of single, held syllables which are passed around between singers. This creates a shifting sound field which moves from individual to individual, and which is constrained and bounded closely by the electronic sound.

Each sine tone is panned to a specific location in stereo space, giving the impression of a point source which corresponds with the point sources of the individual voices. High frequencies are used, which the human ear can locate well on the horizontal plane.

There is a gradual opening up of the harmony as the sections progress, until we reach the wide, full chords sung in section eight. These chords, sung to long phrases, feel

enormous in comparison to the constrained tones, semi-tones and single syllables of earlier sections. The electronic sound also thickens, with up to nine sine tones layered together, spanning and filling an increasingly broader frequency range.

In these long phrases, the sense of the individual voices is reduced, and the ensemble comes to the fore. As a whole, the vocal plus electronic parts come together to create a sense of vastness. In contrast to the narrow, individualised sounds of the start, the performance space is filled-up, and the electronic sound surrounds the listener, engaging the spatial imagination in a totally different way.

A diagram of auditory field development in *Near and far* is shown in Figure 6.6.

6.3.4 Summary

In *Near and far*, for the first time, I used a set of electronic sounds which were not derived from processed recordings of the vocal sound. Instead I chose to return to what could be considered a fundamental of electronic sound synthesis, the sine tone. In reducing the electronic sound production to this basic level, I challenged myself to find ways of creating a powerful sense of shifting space using limited means, and to form a deeper understanding of the role of harmony in this process.

The piece as a whole can be characterised as a *multiplicity*, as the distinct electronic and vocal parts play out against one another, generating an overall sense of space which is related to their juxtaposition. Towards the end of the piece, there is a shift towards *focus* as the electronic and vocal parts become more unified, creating a feeling of space which is almost a magnification of what has gone before.

FIGURE 6.5: Harmony used in *Near and far* sections with associated
bar numbers above and text below.
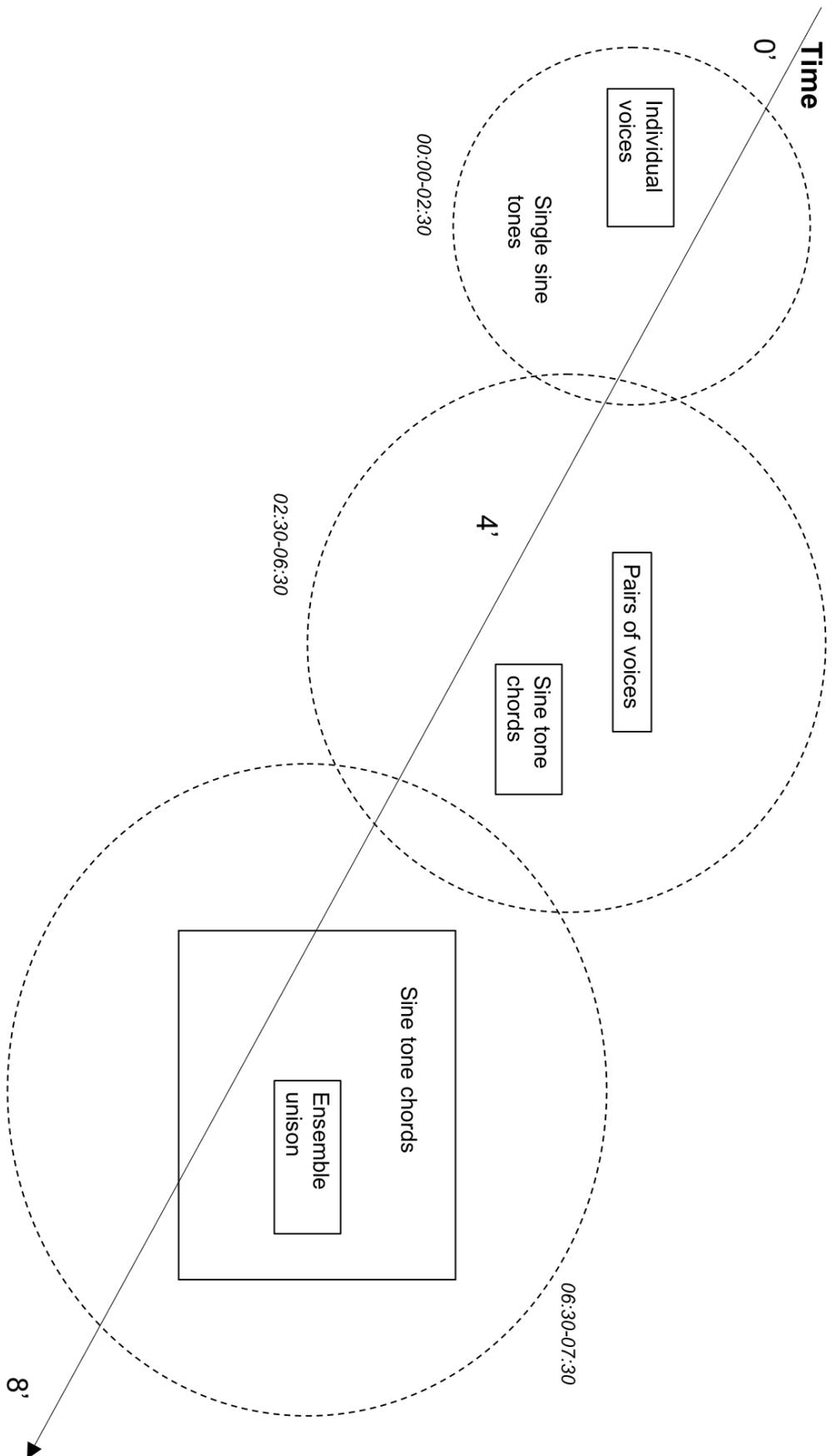
FIGURE 6.6: Diagram of auditory field development in *Near and far*. The auditory field is shown with a dotted circle, and points of focus with solid squares. Developed with reference to diagrams in Ihde, 2007 and Helgeson, 2013.

Stars

Ah! why, because the dazzling sun
  Restored my earth to joy
Have you departed, every one,
  And left a desert sky?

All through the night, your glorious eyes
  Were gazing down in mine,
And with a full heart's thankful sighs
  I blessed that watch divine!

I was at peace, and drank your beams
  As they were life to me
And revelled in my changeful dreams
  Like petrel on the sea.

Thought followed thought — star followed star
  Through boundless regions on,
While one sweet influence, near and far,
  Thrilled through and proved us one.

Why did the morning rise to break
  So great, so pure a spell,
And scorch with fire the tranquil cheek
  Where your cool radiance fell?

Blood-red he rose, and arrow-straight,
  His fierce beams struck my brow;
The soul of Nature sprang elate,
  But mine sank sad and low!

My lids closed down — yet through their veil
  I saw him blazing still;
And bathe in gold the misty dale,
  And flash upon the hill.

I turned me to the pillow then
  To call back Night, and see
Your worlds of solemn light, again
  Throb with my heart and me!

It would not do — the pillow glowed
  And glowed both roof and floor,
And birds sang loudly in the wood,
  And fresh winds shook the door.

The curtains waved, the wakened flies
  Were murmuring round my room,
Imprisoned there, till I should rise
  And give them leave to roam

O Stars and Dreams and Gentle Night;
  O Night and Stars return!
And hide me from the hostile light
  That does not warm, but burn —

That drains the blood of suffering men;
  Drinks tears, instead of dew:
Let me sleep through his blinding reign,
  And only wake with you!

       Emily Brontë (1818–1848)

6.4 The *Real Spaces* series

6.4.1 Development

During the course of this project I came across various examples of site-specific works in which the acoustic characteristics of a room or building are used to create music or sound installations, for example, Maryanne Amacher's *Sound-joined Rooms* series (1980), Bill Fontana's *Harmonic Bridge* (2006), and David Byrne's *Playing the Building* (2005). The *Real Spaces* series stems from the reciprocal question which occurred to me whilst researching my term *multiplicity*, namely, how could the characteristics of a space be used to inform a piece of music which would not be performed in that space. A non-site-specific site-specific piece, as it were.

If it is possible to layer distinct spaces using electronic means to create a multiplicity, then is it possible to extract something from a space and recreate some aspect of it aurally somewhere else? The question boiled down to this: what are the acoustic characteristics which can be extracted from a particular space and how can they be used in music? And, apart from a literal recording made in the space, are there any acoustic features which are sufficiently cohesive to survive this extraction and transcription process in some coherent form?

My idea was to extract the *resonant frequencies* or 'room modes' of a real space by analysing the space's acoustic impulse response. These resonant frequencies are then used as the harmonic basis for a piece of music. It is important that each piece in the series is named after the space in question, in order to bring that space into the 'atmosphere' or perhaps 'collective imagination' of the performance. The following sections give a brief overview of the spaces and instrumentation used in the series so far, followed by an explanation of the analysis and extraction process, and finally a discussion of spatial experience and the compositions.

6.4.2 Pieces and instrumentation

There are currently three pieces in the series, which I began in the summer of 2017. The pieces are set out below in the order in which the composition was started, but not necessarily finished.

1. *Maeshowe* (2018): A twelve minutes long piece for sextet and sine tones composed for *The Riot Ensemble* following their 2017 call for scores. The piece is named after a neolithic tomb on the Scottish island of Orkney, probably built around 2800 BC. The instrumental ensemble comprises clarinet, trombone, percussion, harp, piano and cello. The electronic sound is comprised of overlapping sine tones at the frequencies of the strongest nine resonant frequencies of Maeshowe, which is a fairly small room with a rough stone wall finish.

2. *St. Andrew's Lyddington* (2017): A seven minute duet for violin and piano composed for the *840* concert series. The harmonic content is derived from the strongest nine resonant frequencies of St Andrew's church in Lyddington, Rutland. St. Andrew's is a small parish church known for its 'acoustic jars' dating from the 15th century, which are set into the chancel walls. These features were supposedly meant to help amplify the voice of the priest, but there is some doubt as to whether they would have worked or not. There are no electronics in this piece.

3. *York Minster* (2018): A five minute long trio for flute, piano and cello composed for *The Marsyas Trio*. The harmonic content is derived from the strongest nine resonant frequencies of York Minster, the impressive cathedral in York. There are no electronics in this piece.

6.4.3 Acoustic impulse response

An impulse response is the reaction of a dynamic system to a short burst of energy input. In acoustics, the dynamic system is an enclosed or semi-enclosed body of air

and the energy input is a short burst of noise such as a bursting balloon, a hand clap, or the firing of a starting pistol. The impulse of noise excites the body of air which then responds in a characteristic way. The response is measured by a microphone.

The acoustic response takes the form of a series of reflections of sound arriving back at the microphone, which can be heard as reverberation or echoes. Each sound reflection arrives at the microphone having bounced off one or more of the surfaces in the room. The type of surface affects the character of the reflection. Porous surfaces, such as curtains or carpets, absorb a large proportion of the sound energy whilst hard surfaces, such as glass or concrete, reflect nearly all of it. The *coefficient of absorption*, as it is referred to, is also frequency dependent, that is, the proportion of sound energy which is absorbed by the surface varies according to the frequency of the sound (Meyer, 2009).

Sound reflections arriving at the microphone within 50ms of the initial impulse are categorised as *early reflections* and are perceptually fused to the initial impulse. Those reflections which arrive later are referred to as the *reverberant tail*. The reverberant tail generally has less energy than the early reflections, as later reflections have travelled a longer distance and bounced off more surfaces.

The complete series of reflections is called the *impulse response* and is characteristic of the space. It is complex and depends strongly on architectural design: the geometry, proportions and surface finishes of the room (Beranek, 2003, Blesser and Salter, 2007).

The impulse response contains a great deal of information about the way sound behaves in a space and for this reason it is often called an *acoustic finger print*. Impulse responses are used widely in a variety of audio applications, most commonly perhaps in reverberation plugins, where the acoustic character of a particular space can be mixed into a sound through a process called convolution.

For this project I used the open source impulse response database made available by the *Spatial Audio Creative Engineering Network.*[1]

6.4.4 Spectral analysis and process

The process which links the pieces in this series is the spectral analysis by which the harmonic content is obtained. The resultant collection of pitches is deployed in different ways in each piece depending on the instrumentation and other factors, but the underlying analytical process is the same each time.

The first step in the process is to perform a Fourier transformation on the complete impulse response. This transposes the sound from the temporal domain to the frequency domain, which means that instead of seeing how the acoustic energy changes over time, we can see how it is distributed across the frequency spectrum. A complex impulse response contains many frequency components at various different amplitudes. Figure 6.7 shows an image of the impulse response for Maeshowe in the time-domain (top) and the frequency-domain spectrum (bottom). Similar graphs were produced for St. Andrew's Lyddington and York Minster.

It is clear from the prominent peaks of the frequency graph in Figure 6.7 that more sound energy is present at certain frequencies than at others. The highest amplitude components tend to be *resonant frequencies* or *room modes* — those frequencies which are supported most strongly in the room due to its geometrical and architectural properties.

For the *Real Spaces* series I extracted the strongest nine or ten resonant frequencies for each space, and collected them as a list of frequencies in cycles per second (Hz). I then calculated the closest twelve-tone equally tempered pitch to each frequency, based on A4 = 440 Hz. The final step was to calculate the difference between the

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[1]The SPACE database is available at http://www.space-net.hosted.york.ac.uk/index-22592.html accessed 24/06/2020.

resonant frequency in Hz and the exact twelve-tone equally tempered pitch in Hz. I expressed the deviation from the pitch as a value in cents.[2]

At the end of the analysis process, we arrive at a set of frequencies, pitches and cent deviations which are characteristic of the particular space. Tables 6.1, 6.2 and 6.3 show the sets of frequencies, pitches and deviations extracted from Maeshowe, St. Andrews Lyddington and York Minster respectively. A comparison of the resonant frequencies of the three spaces is presented in Figure 6.8. The graph demonstrates how the sets of resonant frequencies are quite distinct for each space, it is their unique acoustic 'fingerprint'.

I went through the analysis process for a number of different spaces, selecting those which were most spectrally interesting to me to take forward for use in composition. Generally, the spectrally interesting spaces have tended to be architecturally complex, such as the two churches I have used. The intricate nature of the carved stone leads to a complicated series of acoustic reflections. Other, simpler spaces I tried, such as a stairwell and a cupboard, for example, have many parallel surfaces. This leads to what are known as *flutter echoes*, as the sound bounces back and forth between the flat surfaces. The impulse response in these spaces tends to be more temporally interesting than spectrally. I did not consider these to be suitable for use in my composition.[3]

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[2]A semitone can be divided into one hundred cents. Fifty cents is a quarter tone and twenty five cents is an eighth tone. For consecutive sounds, the smallest difference in pitch we can perceive is around fifteen cents depending on the listener. When sounds are played concurrently, a much smaller difference of around five cents is audible as beating (Campbell and Greated, 2001).

[3]See Davide Tidone's excellent video project *A balloon for Linz* (2011) for compelling examples of temporally engaging impulse responses https://vimeo.com/28686368.
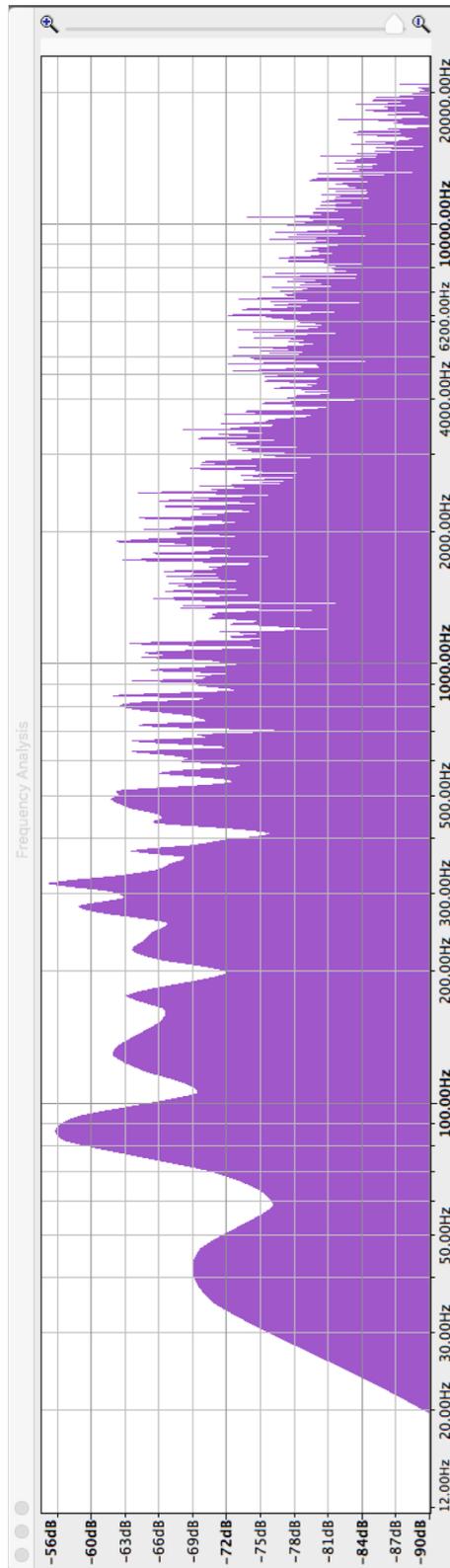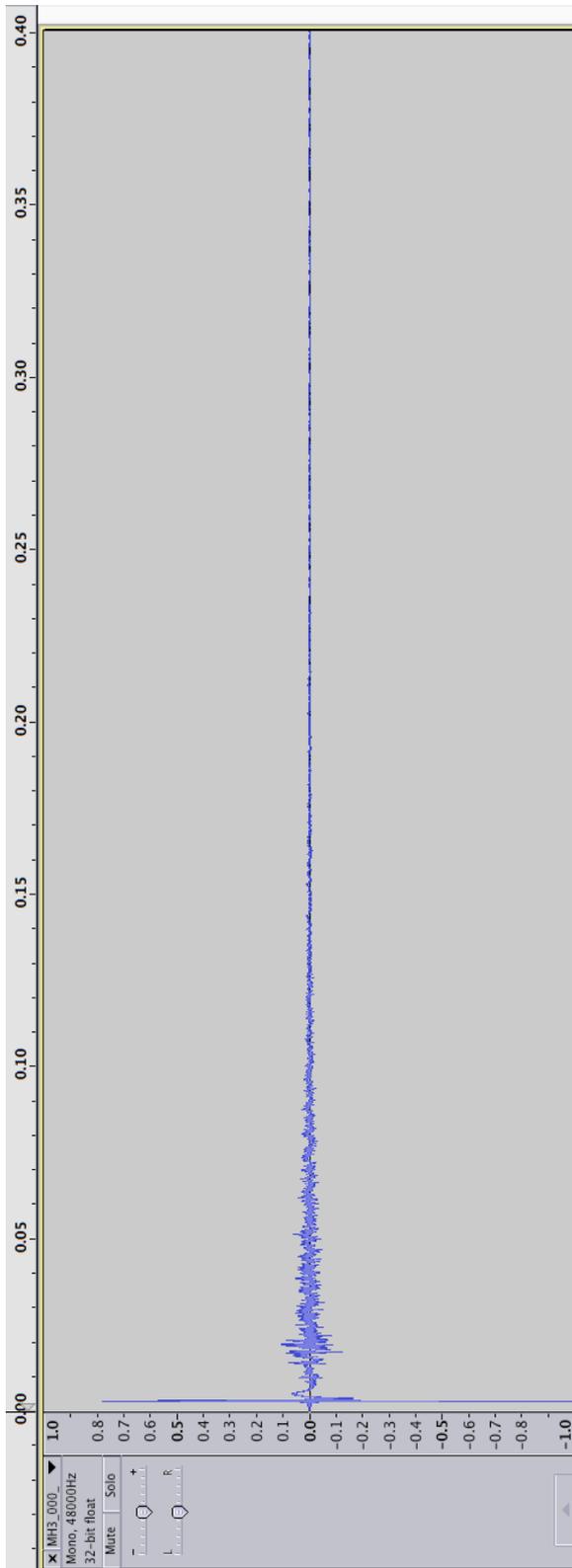
FIGURE 6.7: Spectral analysis of Maeshowe main chamber. The top image shows the impulse response in the time-domain, the bottom image shows it in the frequency-domain. The peaks in the frequency domain correspond to resonant frequencies in the space.
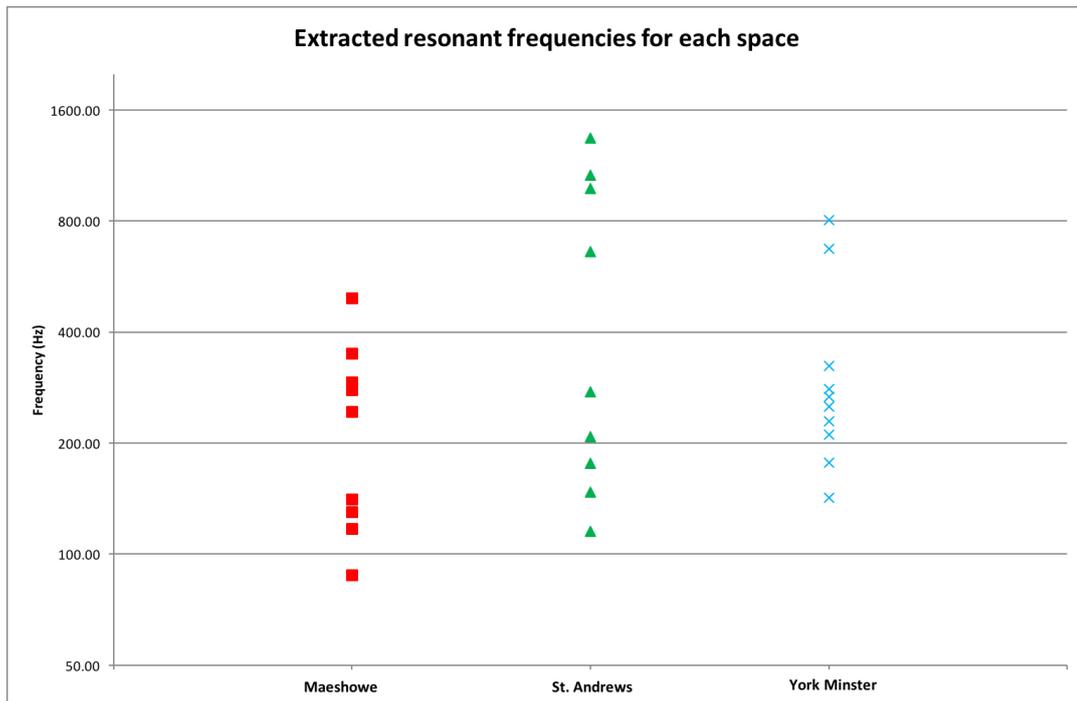
FIGURE 6.8: Graph to compare the resonant frequencies extracted from each space

Frequency (Hz)	12T ET pitch	Deviation in cents
87.89	F2	+12
117.19	A#2	+10
130.37	C3	-6
140.63	C#3	+25
243.16	B3	-27
278.32	C#4	+7
292.97	D4	-4
350.10	F4	+4
495.12	B4	+4

TABLE 6.1: Resonant frequencies extracted from the impulse response of Maeshowe, and associated twelve-tone equally tempered pitches and cent deviations

Frequency (Hz)	12T ET pitch	Deviation in cents
114.99	A#2	-23
147.22	D3	+5
176.51	F3	+19
207.29	G#3	-3
275.39	C#4	-11
661.38	E5	+6
979.98	B5	-14
1062.74	C6	+27
1338.87	E6	+27

TABLE 6.2: Resonant frequencies extracted from the impulse response of St. Andrew's Lyddington

Frequency (Hz)	12T ET pitch	Deviation in cents
142.09	C#3	+43
177.25	F3	+26
210.94	G#3	+27
229.25	A#3	-29
251.22	B3	+30
266.60	C4	+33
279.79	C#4	+16
323.73	E4	-31
670.90	E5	+30
802.73	G5	+41

TABLE 6.3: Resonant frequencies extracted from the impulse response of York Minster

6.4.5 Extracted spectra and spatial experience

Each of the pieces in the *Real spaces* series is based on the characteristic set of frequencies extracted from the space after which it is named. In composing the pieces, I wanted to ensure that these frequencies were always foregrounded in the music, since they were the key connection between the space and the piece. Of course, a particular set of frequencies will never be identified by listeners as belonging to *York Minster*, for instance, or even necessarily be understood as belonging to a particular space at all. Nevertheless, I wanted to convey a coherent sense of space through these extracted frequencies, and hoped that the experience of listening to the piece would retain some sense of spatial identity, carrying some characteristic quality with it. I wanted the form of the pieces to facilitate a mode of listening which would support this, and used the title of the work to bring the specific *real space* into the consciousness of the listener.

With only the sets of frequencies as a starting point, in some ways the compositional methods boil down to a matter of personal engagement with the extracted material. I set down the pitches in an order which I felt allowed the set of frequencies to remain coherent across the particular duration and instrumentation of the piece (the instrumentation and approximate duration of each piece having been set by others, not chosen by me). Having said that, the idea of form emerging through active listening remained crucial for these pieces. All three contain a limited palette of sonic material, so that similar sounds are presented at different times, in different contexts, to create a shifting listening experience. My intention is that this leads to moments of self-reflective listening, situations where we become aware of our listening, and may notice the way in which our auditory field is changing, that it is dynamic, not static in time. The question of space is thus foregrounded, and the listener may wonder how the space of this listening relates to the space of extraction.

Further discussion of the compositional strategies used in the individual pieces is presented below.

6.4.5.1 Maeshowe

In *Maeshowe*, gradually overlapping sine tones are played into the performance space at the exact frequencies of the extracted room modes. This sets up a slowly oscillating but defined set of pitches which fills the performance space and dominates over any particular acoustic characteristics of that room (background noises, resonances etc). Each tone is panned to a different position across the stereo field, thus the listener is able to hear the sound energy gently move, and can feel surrounded by the fluctuating electronic sound despite it being in stereo only.

The form of the piece is sectional, there are three long sections with smooth transitions from one to the next. The first section (0–5') focuses on the higher of the extracted frequencies, before the lower frequencies are introduced in section two (5–10'). In the last section (10–12') the sine tones are removed altogether and the instruments play alone. These changes enable a developing sense of space to be created, where the listener may notice the changing quality of the harmony and associated spatial experience. For instance at section two where the low sine tones are introduced. These very low frequencies are not so easily localised by the listener as the previous high frequency sounds. This creates an increased sense of being surrounded or encircled by the electronic sound.

The trombone, clarinet and cello play long, sustained tones. The piano, harp and percussion play chords or single notes which have minimal attack and are left to ring as long as possible. The pitched instruments approximate the frequencies of the sine tones in various ways according to the particular instrument: playing the frequency exactly if possible by lipping the note up or down, playing the note as a harmonic, or simply playing the equally tempered note (for example, the crotales).

Each instrumental sound is thus anywhere from 0–30 cents out of tune with the sine tones. However, the instrumental notes have the same swelling and receding shape as the sine tones. Furthermore, at least one pair of loudspeakers is positioned at the same height as the ensemble and just behind them, to help the instrumental

and electronic sounds blend together. In this way the electronic and instrumental sounds, though not in the same tuning, are brought together as a whole.

Once sufficient blend is achieved, the slightly detuned instrumental sounds appear to disturb the harmony set up by the electronic sound. This causes significant beating patterns which seem to flutter in the air around the audience, as they interact with the sine tones. The particular instrumental distortion of the surrounding electronic sound serves to emphasise the feeling of space created through listening. Spatial experience in *Maeshowe* can be characterised as *inverted extension*, similar to Alvin Lucier's *Small Waves* (as described in Chapter 4), as the instrumental sounds perturb the pervasive electronic sound field.

Towards the end of the piece, the electronic sound fades away, but the instruments continue to play the same set of pitches. There is a trace of the collection of pitches extracted from the space is left behind, now contrasted against the space of performance, which has once again become prominent, re-imposing itself upon the listener's auditory field and contributing to a sense of changing, dynamic space.

6.4.5.2 St. Andrew's Lyddington

This piece does not contain electronic sound. It takes the form of a simple violin melody with piano accompaniment. It is again divided into sections of related musical material, which are repeated a number of times and which recur throughout the piece. Each material type uses a fixed sub-group of the total set of pitches.

The piano part comprises the extracted frequencies played normally on the keys i.e. the closest equally tempered notes *without* the cent deviations. The violin plays a number of harmonics which approximate the cent deviations, and is thus slightly out of tune with respect to the piano.

The violin melody traces out the extracted frequencies of St. Andrew's in a linear fashion, using repetition to emphasise and reiterate the pitches. The piano provides an accompaniment which complements the violin rhythmically, but which is not

in tune with it. This creates a tension in the listening experience, which is especially stark at the changes between sections, when a new sub-group of pitches is introduced. This continuing strain between the two instruments, as they both compliment and contradict one other, creates a heightened awareness of the sound of the instruments, and the idiosyncrasies of the set of pitches used. In this way the set of extracted frequencies is made central, creating a unified and unique harmony. By calling attention to the specific tuning of the instrumental sound in this way, it could be described as an example of *focus*, requiring a constant recalibration of the listener's auditory field.

6.4.5.3   York Minster

York Minster is comprised of a simple one page 'tune' which is repeated seven times. The instruments play the pitches extracted from York Minster. The flute and cello tune as required to achieve the specified cent deviations, and the piano plays the pitches in equal temperament on the keys.

At the beginning of the piece the instruments create a contrapuntal sound in which each instrument is distinct. There is a tension between the trio due to the unusual harmony presented, but, through the interwoven melody the set of pitches retains an overall unity. On each repeat of the initial tune, one pitch is removed from each part, a different pitch for each. By the end of the piece each instrument is playing a single pitch repeatedly, each pitch different from both others. The single pitches are played extremely legato and with as much resonance as possible. The three remaining pitches, played in this manner, strongly blend together through their resonance. The result is that by the end of the piece we tend not to hear the individual instruments any more, but rather a single instrument which is tuned to the extracted pitches. It is a metaphorical *York Minster* instrument, unique to that space. The added resonance also allows the instrumental sound to radiate around the room, creating a more immersive sound field for the listeners, heightening their awareness

FIGURE 6.9: Rehearsing *York Minster* with *The Marsyas Trio*: Valerie Welbanks (cello), Helen Vidovich (flute) and Zubin Kanga (piano).

of the spatial qualities of the sound in distinct contrast to the contrapuntal sound of the start of the piece.

In some ways the process of this piece is analogous to Alvin Lucier's *I am sitting in a room*, although of course the Lucier involves the consequences of material interactions whereas my piece is a composed representation. The original tune is played back into itself repeatedly in the same way as the spoken text in the Lucier. On each repeat the tune catches onto some frequencies and loses others. The tune disintegrates and evolves as does our understanding of Lucier's words. Eventually all that is left is shimmering resonance. In the Lucier it is the revealed resonance of the performance space. In my trio it is the extracted resonance of York Minster.

Spatial experience in *I am sitting in a room* and *York Minster* can be characterised as *multiplicity*. The repeated cycles of sound are layered one on top of another through listening, creating a distillation of the initial words or tune, which is influence by the behaviour of sound itself.
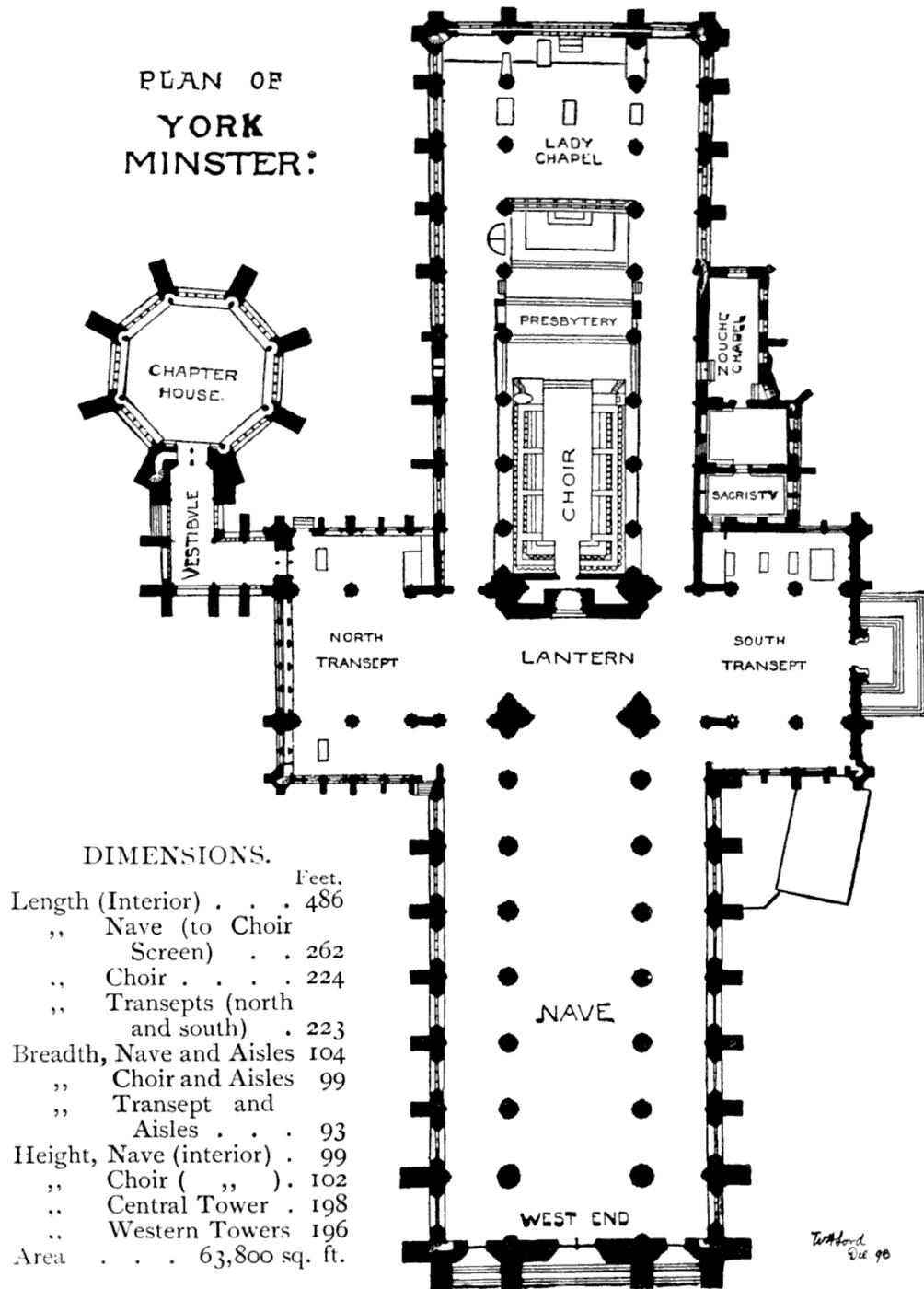
FIGURE 6.10: Architectural plan of York Minster

6.5 Conclusion

This chapter has presented five pieces characterised by an emergent form in which context is critical. The material of each piece relates to spatial experience in different ways, but aims to foreground space by setting up a particular mode of listening in which the listener questions what is heard as sounds or groups of sounds in different contexts over time. This leads towards moments of self-reflective listening and a heightened awareness of spatial experience as it is transformed.

Moving away from my earlier use of live-processed, multi-channel electronic techniques which gradually transform instrumental sound into enveloping textures, these later pieces find novel ways to use instruments, acoustics, harmony and form to foreground spatial experience, often through large or small scale contrasts, juxtapositions and tensions.

Chapter 7

Conclusion

7.1 Summary

7.1.1 Overview

The old chain of meaning — space-representation-stasis — continues to wield its power. (Massey, 2008: 24)

In this thesis I have asserted that the influence of a representational model of space — space as fixed, external, isotropic and geometric — pervades our ways of thinking to such an extent that its influence on critical frameworks surrounding spatial experience in music is extremely significant, but not always immediately evident. It is therefore necessary to question the apparent transparency of space in order to open up new possibilities for reimagining it.

I have proposed a conceptualisation of spatial experience in music as fundamentally *embodied*, *dynamic* and *co-created*, rooted in a phenomenological understanding of listening as bodily sensibility: interconnected, open-ended and constantly changing. In this way we move away from the space of representation and stasis towards a new chain of meaning, which could be summarised thus:

— space-relationality-flux —

It is a model whereby sound, through listening, is actively involved in creating our evolving experience of space; moving beyond a geometrical understanding centred on distance and direction, towards a dynamic interplay of listening, environment and imagination. Within this model we can no longer rely on a simple boundary between internal thought and external matter. As Ingold writes:

> Questions about the meaning of light, as of sound, are surely wrongly posed if they force us to chose between regarding light and sound as either physical or mental phenomena. They are wrongly posed because they continue to regard the organs of sense as gateways between an external, physical world and an internal world of mind. (Ingold, 2002: 257)

The ears are no threshold, no simple boundary. Instead, it is through the complex process of listening that we find our own way in sound, in a "never-ending, two-way process of engagement between the perceiver and his or her environment" (ibid.: 257).

The division between mind and matter is not so rigid as we would like to think; as humans we use image and metaphor not just to describe things but to understand them in the first instance. In our experience there is a continuing dialogue between the perceived and the imagined. Therefore, we must recognise in listening, "the power of the imagination" and the "creative impulse of life itself in continually bringing forth the forms we encounter" (Ingold, 2011: 208). It is in this dialectical relationship between perception and imagination that the barrier between 'internal' and 'external' breaks down, becoming porous; a complex network full of feedback and idiosyncrasy.

Space is not just something to be 'added' to music to create another layer of depth or interest, but, as a dynamic and relational dimension, spatial experience can be regarded as a critical and central compositional concern. Music for instruments and electronic sounds affords composers new opportunities to mix acoustic and synthesised, live and recorded, 'real' and 'virtual', and through these means explore the ever-shifting balance between physical and imaginary; the complex, ever-changing

network of human perception; the "simultaneity of stories-so-far" (Massey, 2008: 9).

7.1.2 Project review

The descriptive terms which I have proposed — *focus*, *multiplicity* and *extension* — aim to provide a point of access into this conceptualisation of space which can be useful to practitioners in the field. These are terms which I have developed during this project in the course of composing music where spatial experience is a central concern. The project has been a combination of theoretical and practical research. The music was written from my own engagement with spatial experience which both informed, and was informed by, the theoretical research in an iterative process of experimentation, research and reflection.

During the six years of this project spatial experience has remained central to what I do and what I think about when writing and listening to music. Since first working with multi-channel electronic sound during my Masters degree in 2010, I have considered spatial experience in music to be far more important than is often thought. *Spatial experience*, to me, is so much more than the *spatialisation* label to which it is often ascribed. Initially I questioned the concept of the *sound object*, and tried to understand its limitations. I then came to the phenomenologists, in particular Merleau-Ponty, and the critical concept of embodiment. The embodied and relational nature of listening became central to my thinking.

I have learnt about precedents in phenomenological approaches to making art, including visual art as well as music. I discovered visual art which was *about* light and looking, and music which was *about* sound and listening, and the history of these various practices. What could I learn from these artists' direct engagement with human perception as the material of their work? I made music in which I tried to re-imagine solo instruments by spreading the instrumental sound out around a performance space, using electronic techniques to change the way the instrumental sound behaved, to allow it to layer and linger in ways which are not possible acoustically.

Engaging with sound and listening as compositional materials led me back to spatial experience. Phenomenological descriptions of listening could not, it seemed, really be totally separated from spatial experience. I reviewed existing critical frameworks surrounding space in music, and I was left unsatisfied in this respect. Informed by my reading on phenomenology, I missed the central role of the *dynamic*, *embodied* and *co-created* in existing descriptions of spatial experience in music. I discovered (via Tim Ingold), Doreen Massey's edifying book *For Space*, which argued for exactly this consideration of space; a space which seems so transparent, we have forgotten how it informs our thinking. This apparent transparency raised the question of *finding new metaphors*.

I started to review my research and consider how I could propose useful developments in the field. My conceptualisation of spatial experience and listening had, by this point, developed significantly. I wanted to find new ways of describing spatial experience in music which would be rooted in ideas of the *dynamic*, *embodied*, and *co-created*. I gradually distilled this into to three new terms: *focus*, *multiplicity* and *extension*. It is hoped that these terms may be of use to practitioners in both analytical and generative discussions.

My musical output has changed significantly over the course of this project. I tried to find new ways to explore spatial experience through listening, without using spatialised electronic sound. I made music which set up listening situations, rather than following a single, linear progression; music which sets up moments of change and reflection, leaving it to the listener to create the final form through their listening. In this way, the later pieces in this project demonstrate my developing engagement with spatial experience and listening as an embodied phenomenon. I hope that this engagement will not finish with this project, but continue to evolve into the future.

7.2 Future directions

> *The dialectic of perception and place (and of both with meaning) is as intricate*
> *as it is profound, as it is never-ending.* (Casey, 1996: 19)

Coming to the end of this project, it is interesting to consider future directions which my work could take. As this project has progressed, my understanding of spatial experience has become more and more intertwined with the *environment*. The environment of course includes the anthropogenic, but also encompasses non-human realities. Although I have developed this thesis from a phenomenological perspective, it is interesting to consider how these models could be expanded to embrace non-human and trans-species experience. Would this take us towards an 'objective', shared reality of environment, which precedes our perception of it? After all, "our very perceptual apparatus, our sensing body, reflects the kinds of places we inhabit" (Casey, 1996: 35). Just think of the many and various adaptations of ears, eyes and other sensory organs displayed by animals inhabiting the different places of the world. Could this approach yield new possibilities for music making and listening? And is this potentially especially important in the time we live in, given what we know about climate crisis and the fragile interdependence of ecosystems?

Edward Casey argues that, even before perception is solidified into conception, place (or environment) is fundamentally connected to it (or 'infused' with it):

> To be not yet articulated in concept or word is not to be non-culturally
> constituted, much less free from social constraints. Hence, the primacy
> of perception does not entail the priority of perception to the givens of
> culture or society, as if the latter were separable contents of our being
> and experience: these givens become infusions into the infrastructures of
> perception itself. (ibid.: 19).

Philosopher Quentin Meillassoux has also written of this entanglement, of what may be missed through a 'purely' phenomenological approach.

> Whether it be affective or perceptual, the sensible only exists as a *relation*:
> a relation between the world and the living creature I am. In actuality, the
> sensible is neither simply 'in me' in the manner of a dream, nor simply
> 'in the thing' in the manner of an intrinsic property: it is the very relation
> between the thing and I. (Meillassoux, 2009: 2)

What is the nature of this 'relation', which is both intrinsic and 'other'? For Casey
there exists a fundamental *wildness* in our experience which cannot be resolved. He
describes wildness as, "the radically amorphous and unaccounted for" (Casey, 1996:
35). Does wildness lie between perceptual apparatus and the 'properties' of 'things'?
Does wildness manifest itself in the multiplicity of collective experience?

> In the very heart of the most sophisticated circumstance is a wildness
> that no culture can contain or explain, much less reduce. (ibid.: 19)

Exploring this wildness, this 'relation' between environment and individual, through
a focus on spatial experience in music may be possible. This would require delving
into the disjunct between individual perception and collective experience, relying
at once on embodied sensibility and social *atmosphere*. There is certainly work to be
done in disentangling the individual experience of space from the collective, or *social*
experience. As Massey says, it is through the relationality of space that, "the social is
constructed" (Massey, 2008: 13). Massey goes further, proposing a relationship be-
tween, "the imagination of the spatial and the imagination of the *political*" (ibid.: 10,
my italics), adding a further thread which could be pursued, of space and political
theory.

There are many potential future directions for my work which interest me. But, at
the end of this project, it seems important to restate that sound is different from any
object. Sound is a medium in which we are immersed: a medium which connects
people, environments, and events through listening. The nature of this relationality
might be wildness, or something else, but it is through listening that we can learn.
We must recognise the effort of listening; the social, political and environmental un-
dercurrents which permeate listening. We must understand the ebb and flow of our

own, individual listening, and through this perhaps increase our own connections to the world around us.

> *Light, sound and feeling tear at our moorings, just like the wind tears at the limbs of trees.*
>
> (Ingold, 2011: 134)

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