An exploration of the influence of technology upon the composer's process

Presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy (Music) in Composition

Volume Number 2 of 2

Richard McReynolds

Contents

Table of Figures

Abstract

This thesis focuses upon how the use of aleatoricism can be used in electro-acoustic music to increase the perceived connection between the electronic and acoustic forces in performance. It also considers how the tools that a composer uses to create their work can enforce an influence upon their own creative process. These issues stem from research conducted early in the project investigating mapping strategies applied to composition for physical gesture capture devices. The thesis progresses by exploring performer freedom for both electronic and acoustic performers which includes examination of the use of different methods of scoring in order to transmit the composer's ideas. The approach is then considered in isolation from electronics with purely acoustic ensembles before exploring the use of recording as a compositional technique alongside indeterminate performance. All of these issues are explored within the context of my own practice, while simultaneously highlighting my overall compositional approach and how it is informed by this research.

The thesis consists of two volumes. The first presents a portfolio of compositions that explore varying approaches to composition for various ensembles. The second volume consists of a written commentary that explores the context, themes and motivations for the compositions in the first.

Introduction

The main aim in undertaking this project was to improve my practice as a composer. My research goal was to examine the effect that the electronic forces in electro-acoustic music produce in a performance situation. This is directly linked to personal frustrations that arose while experiencing compositions that did little to engage with the audience in the presentation of music on stage. Throughout my compositional journey, the electronic forces for which I have written have had a strong influence on my complete musical aesthetic. This has been much the case over the course of this project with my research taking quite a different approach to what I originally intended. In fact, the way that I thought about music has completely changed due to the influence of the enquiry.

I started this project with the intention of exploring the question of how can devices that capture physical gestures be used in order to generate the electronic components of electro-acoustic compositions in performance? I was interested in increasing the presence of the electronics in a performative sense, both visually and in the creation of the sounds, instead of pre-composing fixed media parts. Early on in the research, I considered the idea that it may be beneficial to allow the performer to have some freedom in the realisation. This led me to the questions: can the act of presenting the performer with freedom within a score create stronger interactions between electronic and acoustic instruments in performance?

While exploring this question, I started to notice ways in which my practice and approach were changing quite profoundly. This led me to consider ways in which working with technology impacts upon a composer's compositional approach? I had started to compose with Max/MSP, and this was incredibly influential ways in which I came to approach my music. The first of these effects was that some of the compositional processes that I had until that point explored in the studio started to be realised in performance. How

can I focus the compositional process in the live performance? This focus upon the live event as the main point of compositional realisation, especially in the creation of the electronic textures, became a main point of interest. The second effect was that I was able to cede some of the compositional decisions to the programs that I was making. The use of random process in the gestural instruments became an integral part in their design. This in turn led me towards performer in my music. These are concepts that I would not have explored if I had not been experimenting with gestural technology. Letting Max/MSP select samples using random process was a way to explore an infinite number of compositional combinations in the musical material that I generated.

After a number of experiments with pieces that can be realised in multiple ways, I started to consider the relationship is between the recordings of these pieces and the pieces as artworks. Each recording is a document of one realisation of that piece in time, but it is not necessarily what the piece will always sound like. With this in mind, I asked myself, how can recordings of different realisations of aleatoric works be used to create pieces? With this question, I tied in the acoustic works that I managed to neatly tie in the acoustic works that I had been exploring with the studio techniques that are situated in my electro-acoustic practice.

I have not structured the commentary in a way that follows the pieces in a directly chronological manner, but have grouped the different research areas together in order to explore them as separate units.

Chapter 1 explores my influences and the development of my compositional approach. I trace my compositional history from the beginning in order to illustrate the motivations behind my compositional decisions. I cover my introduction to electronic music and then follow on to my acoustic aesthetic. Throughout this chapter I discuss the effect that

the electronic experiments have had upon my acoustic compositional decisions and introduce why I have begun to use aleatoricism in my compositions.

Chapter 2 explores the use of devices to capture physical gesture and describes my experience with mapping techniques in the creation of digital instruments to perform alongside ensembles. The chapter describes and evaluates the compositional approach while mainly focusing upon three pieces *Circling Above, Circling Below* and *By Firelight*. Each of these pieces explores different ways in which composition and performance can be approached with gestural devices. I conclude the chapter by highlighting issues that arise when composing for such devices and possible ways that a composer could choose to address them.

Chapter 3 investigates my exploration of performer freedom without electronic forces. Over the course of this project I found opportunities to work with musicians where the use of electronics was unfeasible. In these cases, I chose to refine my craft in presenting indeterminate work to performers as the use of aleatoric approaches in my practice had become an influential factor in the creation of my works. This chapter explores my scoring methods for performers of solo and multiple forces. The documentation of these pieces inspired me to consider the relationship between a recording and an indeterminate composition as an artwork. This led me to write *Journey for x Blind Pianists* and *Recur* which focus on the overlapping of indeterminate recordings over the top of each other as a compositional technique. I finish the chapter by considering the electronic pieces that feature computerised generation of materials without the use of gestural devices.

I then finish the thesis by drawing conclusions from my experience and describe how I wish to apply the results of my research to my future practice.

Chapter 1

My compositional approach

Before working with notation and performers, I created electronic compositions in the studio. I was originally drawn to the medium by the opportunity to compose music for such a wide palette of sounds that were not bound by the physical restrictions of acoustic instruments; the freedom for experimentation excited me greatly. A year later, I started to compose notated works for performers. Not long after that, I began to combine these two practices in electro-acoustic music. Writing and rehearsing these pieces provided different perspectives on the creative process. Electronic music has an exactness and immediacy in realisation that is incredibly appealing for a composer who is determined to control every nuance of the sonic outcome of their work. Acoustic music on the other hand has the organic touch of the musician as well as the spectacle of performance. In my compositions, the rigidness of the fixed-media studio parts contrasted with the human and expressive nature of the instrumentalist. The qualities that attracted me to both mediums did not always sit together comfortably. Part of the problem was that I treated composition for acoustic and electronic forces as two separate approaches. Over the course of this project they have been converging towards a unified thought process.

The main reason for the change in my approach over the course of this project has been the technological means that I have used in order to realise it. The use of Max/MSP[1] has caused the processes that have been consistent within my electronic method to be created outside of the studio. This has provided me with a number of options in order to explore automated explorations of my process in order to address the rigidity of fixed media. This in

[1] A graphical programming language that was created in order to design musical and multimedia applications.

turn led me to provide freedom to the performers. In this chapter I will trace my main approaches to both my acoustic and electronic writing and how they have changed due to the research in this project.

(i) Electronic music style and approach

As I will begin by discussing my approach to electronic music, it seems pertinent to first define the main terms that will be used. My understanding is in accordance with Joel Chadabe's definitions from his book *Electronic Sound - The past and promise of electronic music*:

> Electronic music includes all music made with electronics, whether specifically with computer, synthesizer, or any other special equipment. I view the use of the term in much the same way that we'd use the term orchestral music, for example, to designate music played by an orchestra. Among other terms in current use, *computer music* too specifically connotes music made with general-purpose computers, *synthesizer music* is too specifically related to synthesizers, and *electroacoustic music* suggests, at least to me, systems that combine electronic and acoustic sound generators. Electronic music, in my way of thinking, is the generic term, even if in Germany it may cause confusion with *elektronische Musik*, which refers specifically to the philosophy of the Cologne studio in the early 1950s.[2]

At the start of my formal music studies I was introduced to the philosophies contained in writings such as Luigi Russolo's *The Art of Noises,*[3] Edgard Varèse's *The Liberation of Sound,*[4] and John Cage's *Silence.*[5] The idea that a composer should embrace all possible sounds as music excited me greatly. I saw the studio as a means to experiment with these theories in practice. Inspired by the compositional ideas of Pierre Schaeffer and the approach of musique concrète, my first formal compositions were acousmatic, which Michel Chion explains as, 'a rare word, derived from the Greek, and defined in the dictionary as: adjective,

[2] Joel Chadabe, *Electronic Sound: The Past and Promise of Electronic Music*, (New Jersey: Prentice Hall, 1997), p. X.
[3] Luigi Russolo, *The Art of Noise,* (New York: Something Else Press, 1967).
[4] Edgard Varèse and Chou Wen-chung, 'The Liberation of Sound', *Perspectives of New Music*, 5/1 (1966), p. 11 - 19.
[5] John Cage, *Silence*, (New England: Wesleyan University Press, 1961).

indicating a noise which is heard without the causes from which it originates being seen.'[6] He further describes the acousmatic listening situation:

> The acousmatic situation changes the way we hear. By isolating the sound from the 'audiovisual complex' to which it initially belonged, it creates favourable conditions for *reduced listening* which concentrates on the sound for its own sake, as *sound object,* independently of its causes or its meaning (although reduced listening can also take place, but with greater difficulty, in a direct learning situation).[7]

The idea of reduced listening appeals to me greatly. The aim of each piece is to create a situation where the sound in that present moment can be appreciated and scrutinised. This stems from my electronic approach and it is something that I consider in my acoustic practice also. This has similarities with the idea of letting the sounds be themselves which is echoed by both Morton Feldman and John Cage.[8]

An important aspect of my approach to electronics is the avoidance of sounds that could be easily replicated on a physical instrument. The wealth of possible timbres provided to the composer in the creation of electronics should be explored. I aim to use the electronic medium in a way that could not be replicated by other means, unless there is a conceptual intention behind its use. An example of an electronic means that could be replicated in another manner is unedited looping. In a number of cases the same effect could be achieved by another method, such as composing the piece for a larger ensemble. However, I do use straight looping in the indeterminate recorded pieces *Recur* and *Journey for x Blind Pianist* as an integral part of the concept of the piece. This idea is explored in detail in Chapter 3.

Generally, the collection of raw material has been my first undertaking when composing a piece featuring an electronic element. This involves recording a real-world

---

[6] Michel Chion, *Guide to Sound Objects. Pierre Schaeffer and Musical Research,* trans. John Dack and Christine North (Paris: Buchet/Castel, 1983), p. 11.
[7] ibid, p. 11.
[8] Michael Nyman, *Experimental Music: Cage and Beyond*, 2nd edn (Cambridge: Cambridge University Press, 1999), p. 50.

sound – specifically, the instrument(s) that will perform alongside the electronic part. The aim is to create a sense of unity in all of the elements. Usually, I begin by applying time-stretching processes to the samples. Exploring the nuance of the recorded sounds in the studio reveals interesting features that would otherwise be unnoticed. As the composer Jonathan Harvey states, 'Before the microscope, we never knew what the microworld looked like —and now, because of the tremendous precision in being able to look into sounds and work with them, the whole world of microsound has opened up and we can compose with it.'[9] Sonic exploration features strongly in my studio-based compositions and the same desire inspires my work with random process.

In my early compositions, I would select a particularly interesting sample and time-stretch it by an extreme amount. This created a drone that would generate the foundations of the piece's character. I viewed this as a similar technique to a painter using a background wash or texture on the canvas before painting the subject matter. From here I could start to arrange the sounds around the features of the time-stretched material. Some elements of that approach remain in my practice but as I developed my compositional methods I started to employ shorter cuts of material that I arranged to create the atmosphere. One recent example is in *The Oath* where I created a pulsing electronic drone from the layering of breath sounds. I would still employ large time-stretches to search out interesting details that may not be obvious when listening at normal speed, but I would be more discerning in my selection of the material. This exploring for different features of the music strongly appealed to me and has remained consistent in my approach, even though I now leave the exploration through time-stretching up to random process with Max/MSP. The drone works of Pauline Oliveros, Eliane Radigue and Phill Niblock are all models that I return to when considering the drone

[9] Joel, Chadabe, *Electric Sound: The Past and Promise of Electronic Music*, (Upper Saddle River: Prentice Hall, 1997), p. 42.

elements of my compositions. The aim is for the sound to remain in a consistent state with minimal movement and slow development in order to create a listening situation that focuses the ear on all of the minute nuances that go undetected without scrutiny.

The act of creating electronic material at the start of the compositional process can be considered a bottom-up approach. As Curtis Roads says, such a process 'constructs form as the final result of a process of internal development produced by interactions on low levels of structure — like a seed growing into a mature plant. In this approach, processes of attractive and repulsive pattern formation unfolding on lower levels of structure can lead to articulation of meso and macrostructure.'[10] After I discovered interesting nuances in the samples, I would then further manipulate them with the wealth of other effects available to me. All of this was intuitively decided by listening to and exploring the results of different effects in order to develop a palette of material. Curtis Roads sums up the process as follows,

> 'The philosophy of organised sound places great emphasis on the initial stage of composition — the construction and selection of the sound materials. Just as the molecular properties of mud, thatch, wood, stone, steel, glass, and concrete determine the architectural structures that one can construct with them, sonic morphology inevitably shapes the higher layers of musical structure.'[11]

The compositional process would begin by focusing on the intricate details of single samples. The appearance of similarities in the results of manipulations would then generate ideas of how they could be organised. I would start to think of the samples as a collection and ways in which their qualities relate to one another. Once I had collated a large amount of varied material, I would then begin to work with a sequencer and explore the interactions of the different samples. Interesting gestures were created which generated ideas of how to

[10] Curtis Roads, *Composing Electronic Music - A New Aesthetic,* (Oxford: Oxford University Press, 2015), p. 294.
[11] ibid, p. 17.

organise the structure and form of the piece. The procedure was always very organic with listening at the heart of the decision-making process.

(ii) Sample collection

To take an example of my process from the portfolio, I shall discuss my electro-acoustic flute piece *Circling Above.* As a pre-compositional act, a recording session was organised with a flautist to gather sounds that would later be manipulated by studio techniques in order to create the electronic material. Working with an instrumentalist in a relaxed setting promotes sonic experimentation while also providing practical insight into the instrument from the performer. Scored material is not generally brought into the studio as the focus is purely on the exploration of sounds. Usually I bring a list of extended techniques and sounds that I wish to capture. These ideas are verbally transmitted to the performer, and further direction is provided based on the sonic outcome. Using this modus operandi, a performer can suggest sounds that have not been considered or sounds that may be overlooked in the more formal environment of a workshop (where the focus is generally on the written score). In hindsight, I feel that experiences such as this have been part of the inspiration behind including the performer in the creation of works involving indeterminacy.

Having collected raw flute samples, I then started to manipulate them with studio effects. The aim during this stage was to create as wide a range of sounds as possible in order to provide a palette of sounds that could be later organised within the piece. It was here that an overall aesthetic feel for the piece started to emerge. This exploration of the mood of the piece, alongside the familiarity with the instrument that I have gained from the recording session, allowed me to generate ideas for acoustic material. I found that this ordering of the tasks is beneficial as it constrains the huge amount of electronic possibilities early in the process.

During a later workshop of *Circling Above* an audience member suggested that I should have created samples using the flute as a sound source, which I had already done. This implies that the use of a consistent sound source in the creation of my music is purely conceptual, a possible issue of reception that I am unsure how to address. Denis Smalley's description of the failure of electroacoustic works implies that the problem could lie in the process.

> 'A crucial reason for the failure of electroacoustic works may be the composer's inability to maintain control over the focal scanning of structural levels during the process of composition. Particularly in tape composition, because of the need for the constant repetition of sounds during the honing process, the composer is too easily tricked into perceiving microscopic details which will be missed by the listener. Furthermore, constant repetition quickly kills off a sound's freshness so that the composer's assessment of material becomes jaded. On the other hand, an over-concentration on the design of the higher levels of structure can all too easily lead to a work lacking in the lower-level detail so necessary for the rewards of repeated hearings.'[12]

It is potentially in the creation of the sounds that I become 'jaded' and perhaps lose the connection with what the audience will hear. In the electronic pieces that use a gestural device such as *Circling Below* and *By Firelight,* I experimented with the inclusion of samples with minimal manipulation in the interactive instrument, but found the sonic outcome to be unsatisfactory. For me, obviousness of the original material, especially if it is an instantly recognisable instrument, reveals too much of the process in the music. Further discussion of the interactive process can be found in Chapter 2.

The root of this problem may not be in the generation of electronic material but in the structure of the pieces that I create. The use of a procedural development that lays bare the creation of the electronic sounds over the course of the piece is one possible way that the problem can be addressed. If the connection between the sound source and the resultant

[12] Denis Smalley, 'Spectro-morphology and Structuring Processes', in *The Language of Electroacoustic Music*, ed. Simon Emmerson (London: The Macmillan Press, 1986), 61-97 (p. 81).

electronic outcome is revealed, it may be easier for the listener to comprehend. This way of working does, however, impose itself upon the structure of the piece which may not be to a composer's liking. In works such as *Pinhole Light, Recur* and *Circling Below*, I explored the use of live input to create a discernible connection between the acoustic source and electronic output.

(iii) Using live processing to generate electronic sounds

To perform *Pinhole Light* for accordion, clip on microphones are positioned on both sides of the instrument. In a change from my usual approach, recording is not used and all of the electronic sounds are generated from effects acting upon the live signal. The idea behind this is to preserve the aural fingerprint of the physical gesture within the electronic part in order to be more transparent in my creative process. Tighter cohesion in the sonic qualities of the electronic and acoustic material is created by generating all of the sounds live in the performance. In the case of this piece, all of the electronic material occurs shortly after its acoustic source is sounded and is guided by the gestures of the instrumentalist. The only way that the material is shifted temporally is with the use of delays. The composer is limited by the fact that sounds and gestures cannot be shaped with the same precise detail that studio editing provides. There are also limitations on the amount of simultaneous processes that can be applied to the sound at once.

In this piece the relationship between the electronics and the instrument is different than if they were created separately. I saw the instrument as a way of creating thick, dense, chordal material that would then have more of a subtlety in gesture applied to it by the electronic patch. Inspiration came from the accordion music of Pauline Oliveros, creating long durations to create a dense and aggressive sound-world. The connection between the acoustic and the electronics is more pronounced than with other pieces but in future

compositions I would like to have more separation in the parts. I prefer to approach electronics as another source of sound rather than a way to affect the acoustic sound.

I think of the piece as a composition for a very basic hyperinstrument, which Roger Dean describes as: 'In essence, the concept of a hyperinstrument is that sensors are used to detect aspects of the playing process that can then be converted into quantitative signals and used for aspects of sound productions. In addition to, or instead of the normal acoustic sound of the instrument.'[13] I regard *Pinhole Light* as a piece for a very basic hyper-instrument rather than one for an instrument and electronics. By this I mean that I composed for the accordion with the intention of creating gestures that drive the electronic effects more so than the instrument's natural sound. It would not technically be a hyperinstrument as the actions of the performer are not used in order to create a direct electronic output separate from the normal performance actions, but I find that my thought process is similar. In this way, the piece uses the electronics and the accordion as one instrument, not an accordion that is affected by electronics. In future, this type of approach could be used alongside pre-recorded media in order to bring the traditional instrumental sounds more in line the with manipulated recorded ones, which may be a way to address the disconnect between the acoustic and electronics while retaining some compositional individuality in the parts.

Circling Below illustrates a way in which I tried to retain the process of recording and partially manipulating the samples at the same time as clearly showing the evolution of material. Throughout the piece the performer records individual sections into a Max/MSP patch, which are then layered and looped at different speeds. As with *Pinhole Light,* it is a way of creating transparency in the development of the electronic materials over the course of the piece. The sounds of the recorded sections combine with the live performance to create interesting interactions of material.

[13] Roger Dean, *Hyperimprovisation: Computer-interactive Sound Improvisation,* (Middleton: A-R Editions, 2003), p.31.

(iv) The effect of the technology on compositional decisions

Trevor Wishart considers the effects of notation on the composer in his book, *On Sonic Art,* when he says, 'the priorities of notation do not merely reflect musical priorities – they actually create them.'[14] The five-line stave focuses the composer towards the use of pitch and rhythm as the main organisational parameters. It does not make other compositional focuses impossible but it does prioritise one approach over another. The priority is also reflected in instrument design, which aims to create instruments that most effectively can explore this system. In my electronic compositions the focus was on the organisation of sounds. There was not a score, so the way that I related to pitch and rhythm was very different than if I had begun to write notated pieces first. I did, however, consider the variety of frequencies in the samples I chose. I always aimed to have a palette of sounds that contained a large range of different frequencies, but no aspect of tonal organisation was part of my thinking. The combination of timbres and gestures that had become apparent in the created samples took more of a prominent role in my decision making. To truly break away from the focus upon pitch in acoustic composition is more difficult. Performers learn to play their instruments in this system and their instruments are designed for it meaning that there are so many different forces that direct the composer towards this pitch/duration paradigm that Trevor Wishart proposes. This is not to say that performers are not willing or are completely unfamiliar with non-standard notation, but due to traditional pedagogy and the wealth of standard instrumental scores, there is a tendency towards that approach.

The technology that is used to realise a piece of music strongly influences the decisions that are made, an idea that is reflected in both Trevor Wishart's ideas and Marshall McLuhan's *The Media is the Message.*[15] This is very much apparent in my research in both

[14] Trevor Wishart, *On Sonic Art (revised edition),* (Amsterdam: Overseas Publishers Association, 1996), p.11.
[15] Marshall McLuhan, *Understanding Media: The Extensions of Man,* (New York: McGraw-Hill, 1964).

my approach to scoring and the influence of technology. While working on purely acousmatic pieces my compositions featured tightly-controlled gestural events throughout. Each sound could be shifted by microseconds and auditioned to fastidiously prepare gestures from many interlocking components that could be individually edited to fit. When I came to compose live electronic music my approach had to change. Instead of meticulously crafting structures in the studio, the possible outcome of interactions of different processes had to be considered. I started to explore an approach that focused upon textures created from overlapping multiple sounds, instead of energetic successions resulting from the leading of one sound into the other. *Circling Above* marks the start of aleatoricism in my music which was inspired by the use of Max/MSP.[16]

The studio provides the possibility of creating thick textures comprised of multiple sounds that may not be practical for inexperienced composers working with acoustic ensembles. Another advantage is the ability to audition the music during composition, creating a situation in which experimentation is encouraged. This is especially the case in the digital studio as the option to undo an action or re-load a composition that was saved at an earlier stage is easy; multiple versions that explore different creative possibilities can be conserved.

The exploration of texture has been the strongest way in which the studio process has influenced my overall musical approach. Originally, I was very strongly influenced by the music of Edgard Varèse, and this came through as a very gestural approach to composition. This is very much apparent in my work *They Dwell in the Dark*[17]*,* that aimed to create tight gestures between the electronics and the instruments. As my research progressed during this

[16] The influence of this piece upon my compositional output is explored further in Chapter 3.
[17] Score is available in appendix (i).

project I started to think more texturally and the works György Ligeti and Iannis Xenakis started to influence me more heavily.

Ligeti is a composer who I find especially interesting. His experiments with electronics are few but seem to have quite a large impact on his output afterwards. *Glissandi*[18] and *Artikulation*[19] were written at the Studio for Electronic Music in Cologne and are incredibly influential compositions upon my music. *Glissandi* especially seems to highlight a style of composition that focuses on the sound mass rather than the individual events. The effects of these experiments can be seen in a number of the works that followed such as *Atmosphéres* (1961)[20] and *Volumina* (1961-62)[21], with *Volumina* interestingly being his only fully graphic score.

From my exploration of electronic music came the use of graphic scoring techniques. My first use of graphic scoring was via an electro-acoustic fixed media piece *The Rite*[22], composed during my undergraduate studies. The purpose was to present the performer with an image of the content of the electronics in order to provide them with cue points to enable synchronisation with the digital track. To achieve this the score consisted of images that represented the character and contour of the sonic structures in the recorded track. This approach to scoring started to change the way that I thought about the sounds in my acoustic pieces. Instead of starting with a staff line and placing pitch information, I began to sketch sound structures in a graphical format. As I have become more interested in experimenting with scoring methods, I have since incorporated more non-standard notational elements into my scores for performers. The influence is especially apparent in the indeterminate pieces such as *By Firelight* and *Journey for x Blind Pianists.*

[18] György Ligeti, 'Glissandi' in *Electronic Music Sources Volume 1* (Holland: Sinetone AMR, 2010)
[19] Ligeti, György, 'Artikulation' in *Ligeti: Project Vol.5 - Ballad & Dance, Cello sonata, Artikulation, Aventures, Nouvelles Aventures, Musica Ricercata, Big Turtle Fanfase & Régi magyar társas táncok* (Paris: Warner Classics International, 2006)
[20] Ligeti, György, *Atmosphères for orchestra* (Vienna: Universal Edition, 1961)
[21] Ligeti, György, *Volumina* (New York and London: Edition Peters, 1973)
[22] Score is available in appendix (ii).

The change to my process that has had the largest effect on my compositional approach is the inclusion of computer procedures in the realisation of the pieces. Working with Max/MSP is quite different to that of sequencers such as Pro Tools or Logic. A sequencer will present a timeline in which to organise sounds, and play them back to you in a chronological order. Max/MSP presents the composer with a much wider array of possibilities for the creation of music; with that there is a free range in which to consider what will constitute a piece. To refer back to the idea of tools influencing their users, once a composer changes from using a sequencer to Max/MSP, the linear chronology that the sequencer implies is removed. The composer is then free to think of their music in a different manner. One of the largest effects that Max/MSP has had on my work is the ability to include random process in the creation of my works.

Composing with Max/MSP was the first instance where I started to lessen my control over compositional decisions by letting the program manipulate some of the material. As I was allowing the computer to make decisions, I then started to explore how I could give the performer more agency to react to these decisions. This had both a creative and a practical application. Due to the fact that the electronics would not consistently produce the exact same sounds each realisation, the performer should have some element of flexibility in order to react to what they are playing alongside.

The use of computer processes did not immediately change the way that I approached my material but it did change the way that I realised my approach. In pieces such as *Circling Above, By Firelight*, I still used the pre-compositional process of preparing samples in the studio. The use of the studio as a process in the middle of composition is one that I find satisfactory. I have the ability to work with the sound source in the studio in the recording process. I design the overall character of the palette of the electronic sounds that I use which

will influence the overall character of the electronic part. Afterwards, there is further shaping and organisation of this material in the performance of the piece.

In pieces such as *Circling Below,* I started to explore the recording process in a live setting to try and be more transparent in the electronic processes that I was using. An important aspect of these pieces is the fact that a large part of the the work is created during the performance instead of before. This started the evolution of my music that focused on ways in which I could include more of the studio based process in the moment of performance. This caused quite a large change in the way my music was performed and organised which is explored in the following chapters.

The main appeal to me is that a composition is no longer a fixed object when aleatoricism features in the performance of the work. It should be noted that I do not use chance procedures to make a determined score such as John Cage's *Music of Changes*[23]. The aim of aleatoric approaches in my work is to create pieces that vary each time they are played. A piece that is varied from performance to performance reflects the natural world that is constantly in flux.

(v) Acoustic music style and approach

In previous pieces I used a narrative to ground the structure and character on. *The Wood Between the Worlds* is an example of this. This idea no longer appeals to me as a technique as I do not believe in music's ability to represent a narrative. If a person were to listen to a piece of music without being primed with extra-musical content, such as the title or programme note, I do not believe that the composer's intended narrative could be discerned, it will always be the listeners own interpretation. I am also apprehensive at writing vocal music

[23] John Cage, *Music of Changes* (New York and London: Edition Peters, 1951)

with a text as I am uncomfortable with the weight that the text has on the reception of the music. For this reason, if I am using a text I generally prefer to highlight by presenting it alongside the musical content as a spoken word part (for example *The Oath* and *Wet City Streets)*. My aim in presenting the text in this way is to keep it in some way separate from the musical materials.

Dismissing a narrative based approach led me to the idea of composing abstract pieces inspired by images, such as *Sunlit Smoke, Silicate Precipitation* and *By Firelight.* I started to approach my acoustic compositions in a manner closer to the way I approached my studio pieces. The focus became the exploration of sound as an object rather than a process. This fed into my work with aleatoricism and scoring indeterminate pieces for performers. I started to focus on intended sound structures rather than organisation of individual actions.[24] As previously mentioned, Trevor Wishart highlights the priorities of musical notation as pitch and rhythm. Over the course of this project I have experimented with different scoring methods, with varying success rates. For performers there is a tension between the familiarity of the staff notation and the novelty of newer forms of notation. When I have used alternate forms of scoring I have tried to take a middle path and not verge too far from staff notation means while focusing on the parameter that was important. This aims to lessen the amount of time required for a performer to spend familiarising themselves with the instructions.

The majority of the music in the portfolio does not aim to express or instil a particular emotion in the listener. In John Cage's words, I aim to 'let sounds be themselves rather than vehicles for man-made theories, or expression of human sentiments.'[25] My goal is to present structures that immerse the audience in sound. I do not wish to reveal obvious building

[24] Discussed further in Chapter 3.
[25] Michael Nyman, *Experimental Music: Cage and Beyond*, 2nd edn (Cambridge: Cambridge University Press, 1999), p. 51.

blocks in my music, or to allow the audience to hear the construction of the piece. This is reflected by Morton Feldman: 'his own view was that compositional systems were to be avoided, both because they encourage a preoccupation with compositional technique (what he termed the "craft" of composing) and because they involve handing over responsibility for the music to the system.'[26] This creates tension in the compositional approach to *Pinhole Light,* in which a sense of process is created in the development of electronics in order to create a deeper connection between the materials. As I stated in regards to *Pinhole Light* (section (iii) of this chapter), in the future I will aim for a connection between the electronic and acoustic forces but ideally blur the compositional process with the inclusion of electronics created in a manner similar to my usual approach.

My aim is to create an image that is fluctuating while at the same time retaining a consistency over the majority of the music. The piece that started to develop this idea was *Orbit,* which was composed for a small chamber ensemble of soprano saxophone, viola, piano and vibraphone. There are sections of repeating material that set a character which is then interjected with quick flourishes that stop and leave the resonance of the piano and vibraphone to ring out.

The theme of water consistently returns as subject matter for inspiration throughout my work. *Sunlit Smoke* is a focused example of this character. The piece draws upon a mental image of smoke illuminated by sunlight shining through a window blind. Patterns appear in an incredibly slow but constantly flowing motion that is occasionally interrupted similarly to a draft disturbing smoke then settling once more into a slow-flowing still form. This type of motion and mass was what I aimed to create in the work. I consider this as similar to Morton Feldman's idea of creating an 'unchanging image, where you have this image and there is movement and mobility but essentially it's just the energy of keeping up

[26] David Cline, *The Graph Music of Morton Feldman*, (Cambridge: Cambridge University Press, 2016), p. 126.

the same image...'[27] The music is slow with long durations, but includes flourishes, as if the air has been disturbed by the movement of a current flowing through it. There is no attempt to represent or instil this image in the listener. It is merely the nature of the material that I wish to imitate.

Sunlit Smoke highlights an approach that started to appear in my pieces which explore slow tempi and long durations in order to create a contemplative state in the listener. I had been listening to the music of Howard Skempton, Lawrence Crane, Salvatore Sciarrino and spectral composers such as Tristain Murail and Gérard Grisey; I took a great deal of inspiration from their individual aesthetics. Richard Glover states that: 'the sustained tone is a powerful tool for deployment in extended immersive environments. Sustained tones provide us with a unique landscape upon which expectancies, imaginations and temporalities can be flexible and entirely individual. These pitches are continuous, promoting an experience of extended presents.'[28] This aim at creating moments of stasis is common in a number of my works, but I may not use sustained tones to the point of drones. Instead, I choose to remain in a fluctuating but similar character. This is why the use of different forms of aleatoric processes appeals to me. There is the homogeneity in texture, at the same time that constant variation as explorations of material are repeated in different ways.

While researching post-minimal composers, I came across Bryn Harrison's piece *Repetitions in Extended Time*[29]. Instead of the use of sustained tones, he uses repetition to create a similar sense of stasis. I have not used repetition in the same way as Harrison, but I do find that I explore very similar material for long durations. In *Silicate Precipitation* the two violins glissando between two pitches for the entire opening. The harp and electronics

[27] Ibid, p. 173.
[28] Richard Glover and Harrison Bryn, *Overcoming Form: reflections on immersive listening* (University of Huddersfield Press, Huddersfield, 2013), p.7.
[29] Harrison, Bryn, *Repetitions in Extended Time* (unpublished music score: University of Huddersfield Repository, 2008)

do gradually change on top of this texture. The intention is similar to Harrison in that I wish to create a perceptual slowing of time.

As my doctoral studies continued, I became more interested in focusing on the communication of ideas and concepts in my music, as opposed to the abstract exploration of sound. A number of my pieces aim at a more concept-driven approach. These include *Journey for x Blind Pianists, The Oath* and *Wet City Streets.* In each of these pieces, I feel that there is a stronger conceptual message to translate to the audience.

The Oath is the simplest version of this. The piece was born from an opportunity to compose for a concert of music (for soprano and harp) based on texts and images relating to terminal coma states. Composers were provided with a number of possible texts but I found the Hippocratic Oath to be the most relevant. I had been aware of it, but not the specifics of its content[30]. I found it an incredibly interesting document, and felt sure others were likely to be as ignorant of its content as I was. The text became the main point of the piece. This area of interest also featured in my undergraduate piece *Hemlock,* an electro-acoustic spoken word setting of a speech from Socrates in Plato's *Apology*[31].

The acoustic writing of *The Oath* focuses upon small detailed sounds, the vocal part taking strong inspiration from Luciano Berio's *Sequenza III*[32]. I did not want to set the text to be sung or to have a dramatic presentation in any way. In between sections of non-verbal development, the text is presented over repeating material. The composition of the electronics was also inspired by the subject matter. Instead of composing an electronic part to the piece, I originally decided that I wanted to use breath as the sound source. My first idea was to record the sound of a number of different people breathing and without processing the sounds in any obvious manner. The layering would be a similar process to the

[30] See the text included in the score to *The Oath*
[31] Plato, *The Last Days of Socrates* (London: Penguin Classics, 2003)
[32] Luciano Berio, *Sequenza III* (London: Universal Edition, 1966)

one that I used in *Journey for x Blind Pianists*[33]. The idea was to convey a sense of strong connection between life and the body. Due to time constraints and difficulty getting studio time, I then decided to use one track to create an eerie atmosphere with two strong reverberations with the sound of the performers. Even though the original idea was not realised, a natural rhythm of the breath is present in the drone like electronic part. This serves as an example of a similar electronic approach to *Pinhole Light,* where the physicality of the sound's sources remains recognisable within the electronics in order to keep a point of reference.

Wet City Streets is an electro-acoustic piece scored for oboe, string quartet and spoken word performers. The oboe quintet element of this piece was originally written as a score to accompany a film. The video depicted a girl walking the streets of London, and the form of the piece was strongly dictated by the onscreen events. I had recently seen a spoken word piece written by composer Daniel-Wyn Jones called *Pigeon Talk*[34] and wished to collaborate with him on a further development of the piece. The text of the piece was created by writing down snippets of conversation overheard from passers-by on the street. This part was performed by spoken-word performers positioned in the four corners of a space with the audience in the middle. I chose to add some new spoken word material from my own walk around Cardiff. To further bring the thematic content of the piece together, I added an environmental track, – a sound-walk in the rain, un-edited. The piece relates to the soundscape work of Joanna Baillie, who says of environmental sounds, 'The other less direct, but aesthetically pertinent factor was a gradual conversation to a kind of Cageian/Duchampian belief in the power of 'framing', the act of transforming real-life non-art into art through placing it in an artistic context or by just seeing or hearing it in a different

[33] See Chapter 4, section (ii)
[34] Daniel-Wyn Jones, 'Pigeon Talk', *Daniel-Wyn Jones soundcloud page* <https://soundcloud.com/daniel-wyn_jones/pigeon-talk> [accessed 7 August 2018]

way.'[35] This idea of framing is at the heart of *Wet City Streets,* placing the day-to-day experience and atmosphere of the street into the concert hall.

More concept-driven explorations could point to a way for my electronic and acoustic compositions to come together. In *The Oath* I feel that there is still a strong sense of abstraction in the music, but the text provides the piece with its purpose. I have not cut up the recorded source material in order to arrange it with the acoustic writing; I have merely presented it as a representation of the human body alongside the other material. In *Journey for x Blind Pianists* the technology and the acoustic writing are intentionally combined to explore live performance and the disconnection of time in the recording of music. *Wet City Streets* provides a meditation on day to day sounds and the interactions of people within a city. Each of these I feel has enough of an extra-musical concept in order to make a statement outside of the abstract quality of sound.

(v) Aleatoricism

The urban soundscape is a complex mixture of multiple sources interacting and overlapping with no perceived order, yet containing a strong cohesion. The majority of my life has been spent in cities, which has meant that traffic noise has always been the predominant sound of my daily life. I find this incredibly pleasing to experience, so much so that I cannot stand listening to music through headphones while walking due to the sense of aural isolation that they create. On the other hand, when seeking for a respite from traffic noise during a stroll in the calm of a park, the complex sound of leaves rustling in the wind always mesmerises me. As I came to embrace pieces that could be realised in multiple ways, my compositional aim was to design separate processes that were then organised to observe

[35] James Saunders Interview with Joanna Bailie <www.james-saunders.com/2012/04/06/interview-with-joanna-bailie> [accessed 29 November 2017].

the interactions of material. In this way, I can create my own reflection of the nature of the world around me. As I started to use random processes with the Max/MSP patches, I then started to consider what the implications were for my music and how I could incorporate them into my acoustic compositions.

Grove Music Online defines aleatory as, 'A term applied to music whose composition and/or performance is, to a greater or lesser extent, undetermined by the composer.'[36] From this definition, we can see that aleatoricism is an umbrella term that refers to music that uses either chance and/or indeterminacy. Chance and indeterminacy are methods in which the composer can cede control of the compositional process. James Pritchett states:

> 'In Cage's terminology, "chance" refers to the use of some sort of random procedure in the act of composition. *Music of Changes* is a perfect example of this, with the *I Ching* being used to order and coordinate elements from the charts in the score. "Indeterminacy," on the other hand, refers to the ability of a piece to be performed in substantially different ways –that is, the work exists in such a form that the performer is given a variety of unique ways to play it. Brown's *25 Pages* is a good example: it exists as twenty-five independent pages of music, the order or superimposition of those pages being left to the players to choose, thus varying from one performance to another.'[37]

This quotation highlights two methods which I explore throughout my portfolio of compositions. First there is indeterminacy. This takes some of the compositional decisions away from the composer by sharing them with the performers. The second aleatoric method involves chance caused by a random procedure. The decision making process is shared with whatever random procedure is used. To use chance means that there are decisions dependent on an outside factor, which is in no way considering its action a musical choice.

Through the use of Max/MSP, my pieces started to feature chance elements as I ceded control over parts of the music to the computer process. Referring back to James Pritchett's quotation: '"chance" refers to the use of some sort of random procedure in the act of

[36] Paul Griffiths, 'Aleatory', *Grove Music Online* <www.oxfordmusiconline.com> [accessed 2 July 2018]
[37] James Pritchett, *The Music of John Cage*, (Cambridge: Cambridge University Press, 1993), p. 108.

composition.'[38] Chance can happen at any point in the process of creating a musical work. In the case of John Cage's *Music of Changes*[39], the chance elements take place pre-compositionally meaning that the piece will not change from performance to performance. The coins were tossed and the tables were organised so that when he came to scoring the musical material they were there to be referenced. However, in *Imaginary Landscape No. 4*[40], the use of radios adds a chance procedure that occurs in the performance of the piece meaning that it will change each time it is realised. It is this approach to aleatoric music that interests me and my use of computer generated material.

I believe there are parallels between the use of radios and the use of computer programs to generate random data in performance. In the case of *Imaginary Landscape No. 4,* the radios are used as generators of material and the performers must manipulate the parameters in order to create the piece. This is very similar to the use of computer-programmed random generators of sound materials in laptop performances over which performers then have limited aspects of control.

All pieces of music lie on a continuum between the extremes of determinacy and indeterminacy. Starting at the determined side of the spectrum and moving towards indeterminacy, we see pieces that require strict demands of uniformity from repeat realisations. This could take the form of a scored electro-acoustic piece involving a fixed-media part that requires a performer to precisely synchronise their actions with the electronics, e.g., Karlheinz Stockhausen's *Kontakte*[41]. This piece sits very close to the determined end of the spectrum, but will have more variations in repeat performances due to the nature of human performers. In this area of the continuum, composers demand strict control over many parameters of the work.

---

[38] Ibid., p.108.
[39] John Cage, *Music of Changes* (New York and London: Edition Peters, 1951)
[40] Cage, John, *Imaginary Landscape No.4* (New York and London: Edition Peters, 1951)
[41] Karlheinz Stockhausen, *Kontakte, Nr 12 ½.* (Germany: Stockhausen-Verlag, 1958)

Moving towards the indeterminate end of the spectrum are pieces that have consistency in performance through the use of fixed segments that may be performed in different orders. An example of such a work is *Tierkreis*[42] by Stockhausen, where the starting point is determined by the calendar month but the music is relatively fixed. Morton Feldman's *Last Pieces*[43] are examples of consistency in certain parameters but variation in others. In *Last Pieces,* the pitch material is fixed and a tempo is given (although not an exact metronome marking), but the durations are free, meaning the performer has a lot of influence over the rhythms. This creates consistency within a range. Moving towards the extreme end of indeterminacy are graphic scores, such as Cornelius Cardew's *Treatise*[44]*,* which provides graphical stimuli that are designed to influence the performer, however, the manner in which the performers should exactly realise these symbols is unclear.

A piece that is varied from performance to performance reflects the natural world that is constantly in flux. Christian Wolff writes, 'There is rather an inevitable natural complexity in things (cf. the structure of a tree); and it cannot finally be precisely indicated or controlled or isolated. To insist on determining it totally is to make a dead object.'[45] This aim to reflect the 'natural complexity' of things informs much of my compositional output. John Cage's use of chance also takes the natural world as inspiration, but for different reasons. As Benjamin Piekut says, 'For Cage, nature provided a ground for aesthetic principles that was unassailable: there was one nature, the nature of chance, and thus the correctness of his views was given and absolute.'[46] In this reflection of nature by means of chance organisation, Cage aims to remove the composer and, in consequence, the influence of social traditions from his music. I do not wish to remove myself completely from the creation of my music but over

[42] Karlheinz Stockhausen, *Tierkreis Nr 41* ½.(Vienna: Universal Edition, 1974)
[43] Morton Feldman, *Last Pieces* (New York and London: Edition Peters, 1959)
[44] Cardew, Cornelius, *Treatise* (New York and London: Edition Peters, 1967)
[45] Michael Nyman, *Experimental Music Cage and Beyond, Experimental Music: Cage and Beyond*, 2nd edn (Cambridge: Cambridge University Press, 1999), p. 38.
[46] Benjamin Piekut, 'Chance and Certainty: John Cage's Politics of Nature', *Cultural Critique*, 84 (2013), 134–63 (p. 147).

the process of exploring aleatory techniques in my music, I have been willing to cede decisions to the performer or to the electronics.

This questioning of tradition opens up new possibilities in organising the materials of composition. Leonard B. Meyer argues, 'that the tendency to group pitch and time, rather than dynamics, timbre, and touch, into patterned relationships is a culturally conditioned kind of behaviour and that it therefore might be possible to learn to perceive the secondary parameters as stable organised relationships.'[47] Using chance as the organisational factor of material, the effect of cultural conditioning on the composer is weakened by minimising the influence of their decisions on relations between the musical materials.

Morton Feldman's aim of setting sounds free is another idea of the New York school that strongly influences my own compositional ethos. While experimenting with graph scores, Feldman discovered a drawback that subsequently led to him abandoning this approach for a period: 'After several years of writing graph music I began to discover its most important flaw. I was not only allowing the sounds to be free – I was also liberating the performer.'[48] This freedom creates a tension between the composer's ideal of what the sound of the piece should be, and what the performer feels that they are able to do within the boundaries that have been set. Phillip Thomas makes the point that, 'it could be said that, unlike Feldman, Cage *was* interested in the liberation of the performer from the control of the composer.'[49] This issue is one of the central sources of friction between composer and performer in indeterminate music.

The approach of the performer towards the music is a further factor that can influence the level of indeterminacy. Musicians who are to perform a score that requires them to

[47] Leonard B. Meyer, *Music, the Arts, and Ideas: Patterns and Predictions in Twentieth-Century Culture* (Chicago: University of Chicago Press, 1967), p. 248.
[48] Morton Feldman, liner notes to Feldman/Brown, Time Records 58007/S8007 (1963), reproduced in *Give My Regards to Eighth Street: Collected Writings of Morton Feldman*, ed. B.H. Friedman (Boston: Exact Change, 2000), p.6.
[49] Philip Thomas, 'Determining the Indeterminate', *Contemporary Music Review*, 26/2 (2007), 129-40 (p. 133).

choose certain notes or gestures in sections may want to make the decisions in rehearsal and create their own performance score. Here we have a determinate score that is used for the performance of an indeterminate work. A famous example of this practice is David Tudor's preparations of John Cage's scores. Mark Iddon describes David Tudor's approach to *Winter Music*[50] below:

> 'Once in this combined state, Tudor's performance materials exhibited almost precisely the same structural characteristics as Cage's own scores for *Music for Piano* had: the individual part books of *Winter Music* could be performed from in any order, but the notation for an individual sheet, or group of sheets, was now fixed. In this sense, one might argue that Tudor had retrospectively recreated versions of that earlier sequence of pieces. Yet it was obviously fundamental to the finished product that it was Tudor, and not Cage, who had undertaken the work. Equally, it was significant that, though Tudor had prepared fixed realizations, the determinations he came to were only single versions of very many conceivable realizations.'[51]

It is important to note, however, that in order to preserve the intended indeterminacy of the piece in a repeat performance a new performance score would need to be created. I discuss my experience with a performer who wished to create a performance score of *Journey for x Blind Pianists* in Chapter 3, section(iii).

Composers must be willing to have the limits of their set parameters probed by the performer and evaluate results that are not to their taste. An unsatisfactory result could be due to their failure to set the correct boundaries in which the performer can work. This is the argument that I would agree with; however, Christian Wolff believes that 'a measure of goodwill is assumed.'[52] It is also interesting to note that despite Cage's desire to set the performers free, he wrote many of his indeterminate pieces for David Tudor. In Tudor he had a performer who was extremely dedicated to his ideas, one who meticulously prepared realisations before performance.[53] These meticulous preparations can cast doubt onto how

[50] John Cage, *Winter Music* (New York and London: Edition Peters, 1957)
[51] Mark Iddon, *John Cage and David Tudor: Correspondence on Interpretation and Performance* (Cambridge: Cambridge University Press, 2013), p. 78.
[52] Christian Wolff, *Cues: Writings and Conversations* (Cologne: Musik-Texte, 1998) quoted in Philip Thomas, 'Determining the indeterminate', *Contemporary Music Review,* 26/2 (2007), 129-40 (p. 131).
[53] Rob Casey, 'Cage and Tudor as Process', *Contemporary Music Review*, 36/6 (2016), 670 – 685.

free the performer actually was in these performances due to the determined nature of the performance score.

An audience member will experience indeterminacy by listening to different performances of the same work. An audience member who sees only one performance will not experience that element of the work at all. In an example of a performer creating different scores for repeat performances the indeterminacy could be said to occur in the change of score.

Another potential factor on performance is the effect of subconscious influence from the performers. Years of training are spent trying to play music that follows a certain number of rules. Numerous hours spent practising scales will ingrain in a performer a natural tendency towards a certain approach. When trying to write a piece that aims to disregard these rules while giving the performer elements of freedom, the composer needs to acknowledge this as an issue, and if need be, provide instruction on minimising this effect. This is especially relevant in scores that use improvisatory passages in order to break from tradition; conscious resistance will be needed to suppress conditioned habits.

Morton Feldman later abandoned graph scores and returned to fully determined notation, a move which prompted John Cage's remark that 'Feldman's conventionally notated music is himself playing his graph music.'[54] This opens the question of why composers should use indeterminate notation when there is an ideal version of the piece that could be performed. From the perspective of the audience, why should they have to run the risk of sitting through a less successful realisation of a piece that may be performed exceptionally another time? Why not notate the exceptional performance and present that? I have been interested in using an opposite technique, starting with the determined work and then examining what the key features of the piece are and how they can be blurred in order to

[54] Michael Nyman, *Experimental Music: Cage and Beyond*, 2nd edn (Cambridge: Cambridge University Press, 1999), p. 53.

find a way that the piece can have the same qualities but with opportunity for variation. One of the effects of including indeterminacy in my process was the realisation that the piece creates a focus upon the live event. Multiple realisations of an aleatoric piece can show what other variations are possible, meaning that a deeper understanding of the work may be apparent.

Realising a composition on stage focuses upon the live performance as an event. The strong contrast with the nature of recorded music is another reason that I wish to incorporate aleatoric processes into the live performance of my music. Walter Benjamin's essay, *The Work of Art in the Age of Mechanical Reproduction,* mention's the effect of recording, 'Even the most perfect reproduction of a work of art is lacking in one element: its presence in time and space, its unique existence at the place where it happens to be.'[55] He continues to describe elements of the artwork that is removed by the recording as the 'aura' of the work. This presence at the time of the event is something that I like to explore in my work with indeterminacy. The musician has more control over the realisation of the music at the same time as the audience is hearing it. The advent of recording completely changed the way that music was and is consumed, and this has been further changed by the fact that a wealth of recorded material is now available with a few simple mouse clicks on the internet. Recording freezes moments in time. I would like to create pieces that resist this stasis. They could still be recorded, but a recording of them would be a documentation of an event that is in no way an accurate representation of the piece. The variance that comes with indeterminacy is one factor along with the fact that the piece is realised on stage. Another avenue of exploration involves how the effect of recording be utilised as a parameter in the composition of my music which is explored in Chapter 3, section (iii).

[55] Walter Benjamin, 'The Work of Art in the Age of Mechanical Reproduction', *Illuminations*, 214 - 18.

(vii) Spatialisation

In my early acousmatic compositions, I considered the presentation of sound throughout the stereo field as an integral part of the compositional process. Due to the conventions of the concert hall, I never gave much thought to the possibilities of placing instrumental performers in places other than the stage. The placement of speakers was something that I generally planned in advance, even if only to determine the best way to diffuse a stereo field into the concert space. Realising that I was considering this element for the electronics led me to start to consider the possibilities for my acoustic works.

This use of spatialisation is a technique that can focus the ideal experience of a piece on the live event since the spatial relations between the performers and the audience is key to the reception. In relation to a recorded piece, it is still common to record in stereo, which means that the spatial features of the sound will not be as strongly presented as if you were in the space. There are methods of recording such as binaural sound, but this is not commonly used at this moment in time.

In projects such as installations, there can also be a need for longer explorations of textures. The audience members may not listen to the piece from beginning to end which means that the music should be able to be experienced in sections. The way that I would like to approach these works is to create music using flexible scoring so there is consistency but with variation by allowing the musicians to explore the material in different ways. Considering the environmental sounds, the presence of the listeners may also effect the sounds of the space, and with adequate fore-thought, this can be incorporated into the piece.

It also seemed logical to progress to music that immersed the listeners in sound. James Tenney's consideration of the performance area for the piece *In a Large Open Space*[56] provides a fantastic example of the immersive effect that can be created. By placing the

[56] James Tenney, *In a Large, Open Space* (Lebanon: Frog Peak Music, 1994)

performers around the audience, smaller actions can demand more attention as the direction that they come from may be unexpected. For my electro-acoustic compositions *Wet City Streets* and *Silicate Precipitation,* I started to position performers in different areas of the performance space.

Ancient Mariner: Not an Opera[57] was an opportunity to explore this idea further. The project was a collaboration with a number of composers based in Cardiff: Julia Howell, Joseph Hillyard, Leona Jones and the Welsh artist Ivor Davies. Each of us composed individual sections of a long-form piece to be presented in the foyer of the National Museum Cardiff. My part positioned vocalists on the balcony while electronic sounds were projected from four speakers on the ground floor of the space. The piece was more of an installation work than a concert piece. The audience was free to explore the piece. As Richard Glover states, 'the listening environment in which individuals are able to traverse the space in order to experience different listening locations promotes the notion of individuals taking charge of their own narrative throughout the duration of their stay.'[58] The projection of sound combined with the hard marble surfaces of the museum created a texture that immersed the audience, who were free to move around and listen from different positions. Chairs were situated in the centre of the projection space but the piece was designed without a focal point in mind.

[57] See appendices (vi) for the performance materials.
[58] Richard Glover and Harrison Bryn, *Overcoming Form: reflections on immersive listening* (University of Huddersfield Press, Huddersfield, 2013), p.30.

Chapter 2

Composing for gestural devices

(i) Compositional aims for gestural devices

In the live presentation of electronic music, it is common for a performer to be seen on stage staring into their laptop screen for the duration of the music. This leaves the audience with a focal point on stage but barely any visual signification of performance. On the other hand, to abstain from an onstage performer does not create this issue. Acousmatic music presents no visual information in order to focus the listening experience upon sound removed from causal association. However, performances that feature an individual onstage forgo this practice. In her article *Grain, Sequence System: Three Levels of Reception in the Performance of Laptop Music,* Kim Cascone states,

> 'Today, most live electronic music is performed on laptop computers in the traditional proscenium setting of concert halls, theatres and galleries. This context invokes the standard performer-audience polarity, which places the performer in the role of a cultural authority. During laptop performances, the standard visual codes disappear into the micro-movements of the performer's hand and wrist motions, leaving the mainstream audience's expectations unfulfilled.'[59]

Combining the altered conventions of electronic music presentation with the fact that the form and individual sounds constituting the compositions can lack recognisable reference points for the listener, the concert experience may be extremely difficult for someone unaccustomed to this type of music. Alistair MacDonald describes the possible difficulty of understanding electro-acoustic music in his article *Performance Practice in the Presentation of Electro-Acoustic Musi*': 'In something as rich and diverse as electro-acoustic music, the basic carriers of musical meaning may be ambiguous and difficult to identify, leading to a

[59] Kim Cascone, 'Grain, Sequence System: Three Levels of Reception in the Performance of Laptop Music', *Contemporary Music Review*, 22/4 (2003), 101-104 (p.101).

lack of comprehension on the listeners' part.'[60] Inspired by my dissatisfaction with electronic performances that do not consider the visual aspects of performance, I decided to write a piece that attempts to explore a possible solution.

At the same time as providing a visual element to the electronics, I equally wished to address the rigid structure that pre-composed fixed-media tracks can impose upon the acoustic performer. In my previous electro-acoustic pieces, the electronic part was realised in the studio prior to performance. This meant that when realising the piece, the musician had to rigidly stick to the written tempi dictated by the fixed recording. Any deviation meant that the current gesture would be incorrectly timed, and following that, it would be difficult to re-achieve synchronicity for the remainder of the piece. Part of this problem could be attributed to my approach to the acoustic material as a direct extension of my studio activity. I was creating gestures that were strongly linked with the electronic structures which meant that the focus was upon the sound organisation and not on the actions of the performer.

The ability to realise intricate, tightly-woven gestural sound structures is one of the principle strengths of studio work. Take the intricacy in the gestures from 4'39" - 5'39" in Morton Subotnick's *The Wild Bull*[61], for example. The gesture is tightly composed with a level of accuracy that would be incredibly difficult to replicate as an interaction of instruments and electronic sounds. In *Circling Above,* the aim was to create similar ideas of musical gesture in the performance of electronics in order to create a tighter cohesion between the acoustic and electronic parts.

Musical devices that track the movements of performers on stage are not a new phenomenon. The most widely recognised electronic instrument that relies on physical gesture, the Theremin, was invented in 1919. In more contemporary practice, Michel

[60] Alistair MacDonald, 'Performance Practice in the Presentation of Electroacoustic Music', *Computer Music Journal*, 19/4 (1995), 88-92, (p.88).
[61] Morton Subotnick, 'The Wild Bull' in *Subotnick: Silver Apples of the Moon/ The Wild Bull* (Mainz: WERGO, 2016)

Waisvisz used a device known as Hands. "Waisvisz' *Hands,* built first at STEIM by John den Biggelaar in 1984, then further developed by Wim Rijnsburger, are two aluminium plates, formed to be comfortably strapped under the hands. The plates contain keys that respond to finger touch and sensors that respond to thumb pressure, tilt, and the relative distance between the Hands.'[62] Another composer working in this field is Laetitia Sonami, who I saw perform first hand during her key-note presentation at NIME[63] 2014. As Tara Rodgers explains, 'Her main instrument is the Lady's Glove , a glove modified with sensors, which allows her to use subtle movements of each finger to control sounds, mechanical devices, and lights in real time.'[64] I have focused upon devices that utilise the motion of the performer's hands to present electronic music on-stage, but many other approaches have been explored by others.

By connecting the generation of sound to physical movement, a level of engagement is achieved that is not found when one performs with a laptop computer. The sound of the Theremin does not use incredibly complicated synthesis techniques, but as Todd Winkler suggests, 'The results produced by moving the hands in space were more subtle and varied than a simple oscillator would suggest because the sound reflected the expressive quality of human movement.'[65] Performances with gestural devices differ from acoustic performances due to the fact that the procedures that create the sounds are not always apparent. The way that the physical movement is mapped to the musical outcome is of critical importance. Fernando Iazzetta describes three parameters of mapping devised by Rovan, Wanderley, Dubnov and Depalle[66] below:

---

[62] Joel Chadabe, Electronic Sound: The Past and Promise of Electronic Music, (New Jersey: Prentice-Hall, 1997), p. 238.
[63] New Interfaces for Musical Expression
[64] Tara Rodgers, Pink Noises: Women on Electronic Music and Sound, (Durham: Duke University Press, 2010), p. 239.
[65] Todd Winkler 'Making Motion Musical: Gesture Mapping Strategies for Interactive Computer Music', Proceedings of the International Computer Music Conference, (1997)
[66] Rovan, J.B., Wanderley, M.M., Dubnov, S. and Depalle, P, October. Instrumental gestural mapping strategies as expressivity determinants in computer music performance. In *Kansei, The Technology of Emotion. Proceedings of the AIMI International Workshop,* (1997) p. 68-73.

> 'The simplest mapping scheme, one-to-one, maps each independent gesture to one musical parameter. In the divergent strategy each gesture is mapped to more than one musical parameter, while in the convergent mapping many gestures can be mapped to one musical parameter. As the authors have observed, expressivity increases from the one-to-one to the convergent strategy and we may also note that the difficulties to implement these strategies increase in the same proportion. Thus, in the design of a new instrument or musical environment there may be a compromise between the expressivity allowed by the system and the obstacles imposed by its implementation.'[67]

This PhD project was my first exploration of the use of gestural devices, so the idea of optimising expressivity was not in the forefront of my thoughts at this early stage. I did quickly realise the limitations of one-to-one mapping and had to explore further ways in which I could create my own instrument that satisfactorily presented electronic sounds.

(ii) *Circling Above*

Circling Above is an electro-acoustic piece composed for flute and live electronics. It is the first of my explorations in performing electronic sounds using physical gestures. Using an Xbox Kinect, the electronic performer's movements are tracked in order to control parameters that are mapped using Max/MSP. The challenges of composing for such a device and the subsequent rehearsals with performers have had a strong impact on the way that I have since approached the composition of my music.

Having created the samples[68] the next stage was to design the gestural instrument in Max/MSP. The first task was to decide what sounds would be mapped to the actions of the electronic performer. The samples were arranged into six different banks in order of duration. To trigger playback of the samples, the performer sweeps their right hand through six columns mapped to the Kinect's field of vision. For each column, a sample is chosen at random and will loop for as long as the hand remains in that column. There is the added functionality of the height of the hand controlling the speed at which the sample plays back.

---

[67] Fernando Iazzetta, Meaning in musical gesture. *Trends in gestural control of music*, (2000) p.265.
[68] Discussed in Chapter 2, (ii) Sample collection

Moving lower than the middle point reverses the samples, whereas higher than that plays the samples forward. The left hand controls the output amplitude, creating an envelope for each gesture.

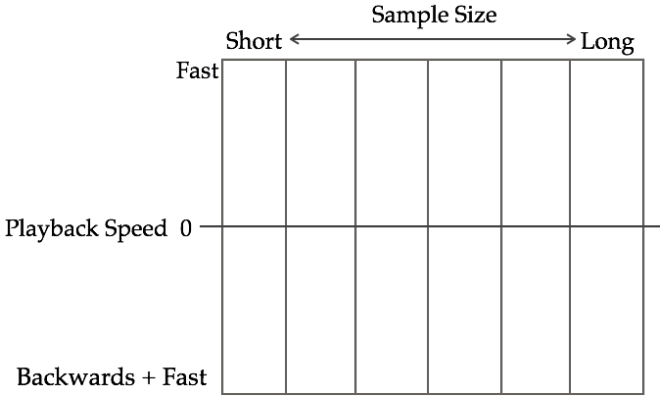


Figure 1. Mapping of the right hand for *Circling Above*.

These mappings were chosen to maximise the variation in the sonic output of the piece. By keeping the right hand close to the zero point of the playback speed, a sample can be played much slower than its original speed, creating droning textures. In contrast to this, quick repetitions of short samples can be created by holding the hand in the top left area of the grid. The ability to control the speed of sample playback then provides a means by which to transition between these two contrasts. Finally, the left hand can alter the amplitude of the sounds in order to shape the sonic output into separate phrases.

When using a direct one-to-one relationship to connect a physical action to a program's parameter, the interaction can have a very simplistic and unsatisfactory feel to it. I chose to include a random element of functionality to the program in order to incorporate an element of unpredictability that the performer would need to react to. For example, if the height of the right hand just relates to the speed of a sample, the visual transparency of the performance will be easy to discern; however, the interaction may be too simplistic to be appealing to the performer or the audience either sonically or visually. Choosing to

incorporate controlled unpredictability in the program provides the opportunity for a wider range of complex sounds without requiring a complex system of control. However, there is a period of learning the instrument and how the gestures interact with the computer. This effect is explored by Andy Hunt, Marcelo Wanderley and Matthew Paradis in their article, *The importance of parameter mapping in electronic instrument design*.[69] In the article they experimented with different mapping systems and found that users quickly become bored with a one-to-one mapping system. When more complexity is used in the mapping of the physical gestures the instrument has a more satisfactory feel to perform.

In the case of *Circling Above*, the correlation between the height of the right hand and the sample playback speed is a simple relationship. On its own this is an unsatisfactory mapping to present. However, the simplicity is blurred by random selection of samples and further complexity is added by the fact that samples from the different columns can be played simultaneously in order to create complex textures from combinations of the sounds. This method provides a variation in sonic output with a much greater interest than would be the case if the samples were fixed for each column. The visual translation of the exact relationship between the actions of the performer and the output was less important to me at this stage than the sounds that were available for composition. This contradicts the focus upon the visual performance of the electronics, but I felt that the use of physical gesture provided an adequate sense of performativity and I did not want this focus to be detrimental to the musical outcome.

The process is similar to Joel Chadabe's definition of interactive composing: 'Interactive composing is a two-stage process that consists of [1] creating an interactive composing system and [2] simultaneously composing and performing by interacting with that

[69] Andy Hunt, Marcelo M. Wanderley and Matthew Paradis, 'The importance of parameter mapping in electronic instrument design', Proceedings of the 2002 Conference on New Instrument for Musical Expression, (2002).

system as it functions.'[70] This means that the performer of the electronics must react to the outcome of each new sample, creating an improvisatory dialogue between themselves and the computer. The performer can predict the character of the musical gesture that they will create but not the exact sound and as soon as a new sonic event is triggered the performer has to quickly react in order to change the character of it. It is interesting to note that in the same journal, Chadabe writes that, 'The primary goal of interactive composing is to place a performer in an unusually challenging performing environment.'[71] This was not the intention of my piece, but it did have that effect for the electronic performer. By aiming to create a freer performance environment for the acoustic musician, a more challenging one was imposed on the electronic performer. For this reason, the positions of the electronic performer's hands were prescribed at certain points but not the exact motions. This provided a flexible framework in which they could follow the flute part while reacting to the outcome of the computer.

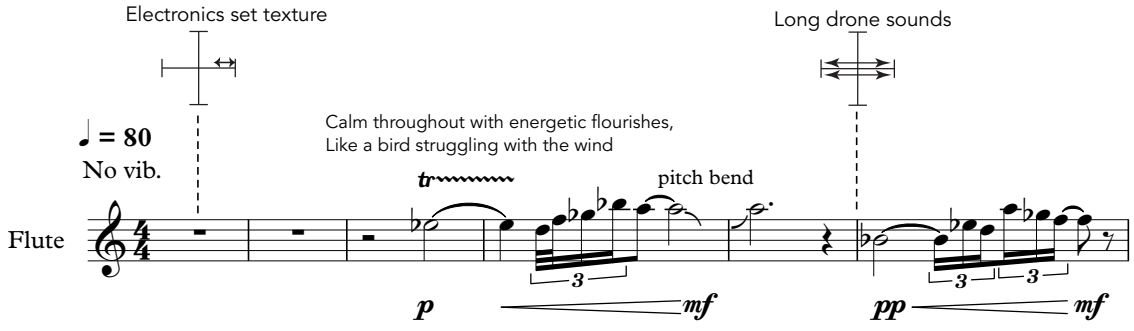


Figure 2. Example of the determinate score with electronic indications.

The piece was workshopped with Carla Rees of the Rarescale ensemble. The outcome was as I intended, however, it was felt that there was a disconnection sonically between the electronic and acoustic elements, as well as in the way that the performers realised their parts. The flute player had a determined score, while the electronic performer

[70] Joel Chadabe, 'Interactive Composing: An Overview', *Computer Music Journal*, 8/1 (1984), 22-27, (p.23).
[71] Ibid.

had a large amount of freedom to explore their material. I have already talked about the sonic disconnect in my approach to electronic composition in Chapter 1, section (ii). On a second play-through we changed the approach in order to address the performative disconnect.

The nature of the written material was such that the score could be easily divided into individual phrases. The performer then could play the phrases in any order that she liked, adding her own dynamics. The outcome was a piece that had a more natural dialogue between the performers, which in turn created a stronger sense of fluidity. This was the first time that I had considered using some form of indeterminacy in my music. In a second workshop with a student performer, we played the determinate score followed by an updated indeterminate version. Again, the same vibrancy was achieved in the indeterminate performance. Both of us felt a greater feeling of connectivity when the acoustic performer had more freedom to react to the electronics.

After the workshop with Carla Rees, I revised the score in order to create a finalised indeterminate version. Morton Feldman's *Intermission VI*[72] proved to be a useful model. Elena Dubinets describes the piece as such:

> 'All fifteen chords in Feldman's score are written separately on small sections of the note staves, distributed freely over the white sheet. There are no bar lines. This composition represents Feldman's concept of projecting sounds into time in the clearest way, because time here loses its linearity; on the other hand, the sounds are very precisely designated, making the piece a perfect example of the aleatory principle in the performing process.'[73]

Cutting individual phrases from the score, I arranged them freely around the page. A main concern in the placement of the phrases was not to imply any order of performance

The next consideration was the structure of the piece and how to present each of the pages to the performer. The score consists of four pages, each with predominantly different

[72] Morton Feldman, 'Intermission VI' in *Solo Piano Works 1950-1964* (New York and London: Edition Peters, 2002)
[73] Elena Dubinets, 'Between Mobility and Stability: Earle Brown's Compositional Process', *Contemporary Music Review*, 26/3-4 (2007),409-426, (p.413).

material but some with shared phrases. All of the material is taken from the original score. The choice of shared phrases was informed by their repetition in the determinate score. In this way I thought it would be interesting to see if a stronger continuity was created between the different sections. Over the course of the piece the complexity of phrases increases. In order to provide a way for the performers to work through the score, stopwatches are used. The timings that are provided in the performance note are as follows:

The electronic performer will start the piece and the flute player will join in at their discretion.
*Play **page 1** for approximately **2 minutes** then continue onto **page 2**.*
*Play **page 2** for approximately **1 minute** then play material **from page 2 and 3 collectively.***
*Play **page 2 and 3 collectively** for **2 minutes** then play the material from **page 3.***
*Play **page 3** for **1 minute** then play the material from **page 4.***
*Play **page 4** for approximately **1 minute** then play material **from page 4 and 1 collectively.***
*Play **page 4 and 1 collectively** for **2 minutes** then play the material from **page 1.***
*Play **page 1** for approximately **1 minute** until an end point is agreed upon.*
The electronic performer will end the piece on their own.

Figure 3. Performance notes for the indeterminate version of *Circling Above.*

Originally the score called for one minute durations in all of the pages, but in performance I found that the pace was too quick (particularly at the start). Increasing the timespan to two minutes for the first page, as well as the sections that shared material over two pages, created more space in which to explore the interactions of the material.

The two aims of this piece were to provide a visual performance of the electronic material and to provide a more accommodating performance environment for the flautist. In hindsight, I believe the strongest influence is on the performers rather than on the audience. The addition of the chance element in the output of the samples creates an interesting change to the traditional performer-instrument interaction. There is a dialogue between the electronic performer and the computer that creates an element of improvisation before the other performer is included. Comparing performances of the two different scores has been useful in reflection as I have found that the indeterminate version of the score has provided the most successful outcomes, both sonically and in satisfaction for the performers.

However, when thinking of this in terms of visual communication of sound to the audience, the hands do not directly correlate with obvious musical action. Despite this fact, I feel that it is a step toward a more extroverted approach to presenting electronic music.

(iii) *Circling Below*

After the completion of *Circling Above,* I aimed to continue this line of research further with a piece for piano and electronics called *Circling Below.* Instead of using the Xbox Kinect, a LEAP motion controller[74] was intended to be used to manipulate the electronic sounds. This was chosen due to my desire to explore a composition where one performer realises both the acoustic and electronic elements of the piece, creating a single focus for the audience. The LEAP motion controller is small enough to fit on the side of the piano and doesn't require the performer to synchronise for each use. This means that transition from instrument to device is simple.[75] Additionally, *Circling Below* uses live input instead of pre-recorded samples with the aim of also addressing the sonic disconnect that originally featured in *Circling Above.* While composing *Circling Below*, I found that I was constantly dissatisfied with the gestural elements that I was using with the piece. I came to a solution that provided a sense of transparency in the development of material using recording of individual sections. This caused me to re-consider the need for a gestural instrument in this piece. Due to this fact, I decided to jettison the use of the LEAP Motion device. Despite not continuing with the original plan for the piece, I found the process a worthwhile learning experience and I wish to return to the LEAP Motion controller in the future.

[74] A device that was designed to accurately track hand motions.
[75] This is in contrast to the Xbox Kinect which requires the performer to hold a strongman-like pose with raised arms in order to get the device to detect them. If the performer moves out of the field of the device's vision, they will be required to repeat the action in order to re-connect.

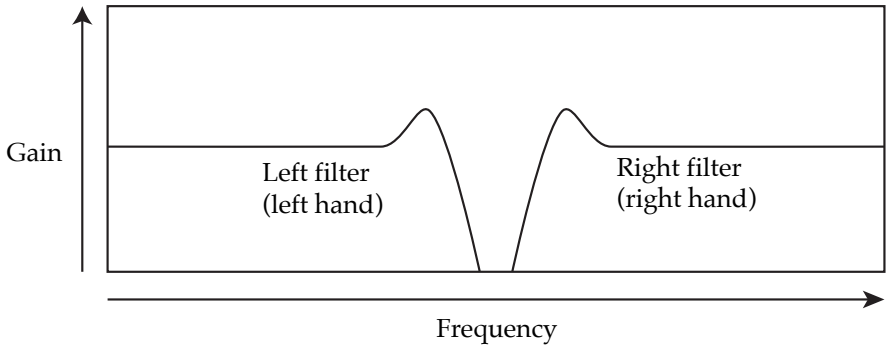


Figure 4. Mapping of Parameters in *Circling Below*.

In the LEAP Motion version of the piece, the mapping of the physical gestures uses two hands to control a resonant filter applied to live input of the piano. The left and right hands control two filters acting upon the lower and upper frequencies respectively. Moving the hands through the x axis controls the frequency values, while moving through the y axis controls the gains of the two filters. The z axis controls the Q factors[76] of the filters. For each LEAP Motion gesture, I have used a black box to denote the device itself, above which I have used arrows to depict the motion of the hands. When the hands are required to move in the z plane the thickness of the arrow is changed (a thinner line represents motion that is further away, and a thicker line represents motion that is closer). For this piece I have arrived at a simple way to notate the gestures that I require. However, there are few complex gestures that require very accurate positioning of the hands.

Continuing with an indeterminate approach that began in *Circling Above*, *Circling Below* is graphically notated with freedom granted to the performer in timing the gestures. There is also an element of controlled improvisation in one section, where a selection of gestures is depicted on the score that the pianist can select in any order.

[76] The Q factor represents the bandwidth that filters act upon.

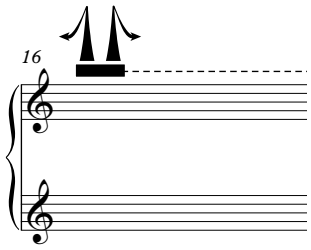


Figure 5. Example of breast stroke swimming motion on the LEAP controller.

The music in *Circling Below* focuses upon texture in order to contrast with the gestural approach of *Circling Above*. This is also informed by a water theme in which swimming strokes were the inspiration for the physical actions. This is depicted in the acoustic movements, with sweeping motions across the strings of the piano. I started to consider the physical gestures in a much more conceptual manner than in *Circling Above* with an aim of creating a tighter connection between the acoustic and electronic elements. *Circling Below* takes its inspiration from movement in water, and with detailed consideration of the motions of the performer and the shape of the musical gestures.

The electronic element originally utilised filtered delay lines of controlled feedback taken from live input from the piano. These were combined with synthesised bubble sounds to fit the theme of water that inspires the material of the piece. This is another way to explore different material from the pre-composed studio samples approach of *Circling Above*. The motions required from the performer are modelled upon swimming strokes, with this action controlling two bandpass filters acting upon the output.

After creating the patch and rehearsing the piece, I found that the interaction of the device with the material was not satisfactory. This was again down to the one-to-one mapping of the hands to the filter-control. I decided to record segments of the piece, which were overlapped at different speeds and presented in combination with the acoustic part. I then explored the use of the device with this altered version of the patch but again found that

I was not satisfied with the result. The mapping with the filters created an obvious connection but like with the early versions of *Circling Above,* I found the mapping too simplistic. I also felt that the filtering alone as a sonic procedure could potentially be more complex, possibly using more advanced filtering techniques. At this time in the project, I was unsure of how much time it would take to solve these problems in a technical manner. In the end, I decided to jettison the idea of using the LEAP Motion controller as the interaction that it was creating did not have enough musical merit to warrant its inclusion in the piece.

Despite not using the gestural device, *Circling Below* still addressed the issues that I intended to focus upon. The procedural manner in which the electronics affect each of the sections creates an obvious connection between the material. The use of different overlapping speeds of recordings creates new timbres while at the same time being quite recognisable from the source. The recordings themselves also add a transition to the form. The score itself does not have transitions between each of the sections; there are merely sections where the performer explores a set of gestures and then moves on. However, the fact that the recording is still playing the previous section while the next is recording provides an overlap of material that creates a gradual transition.

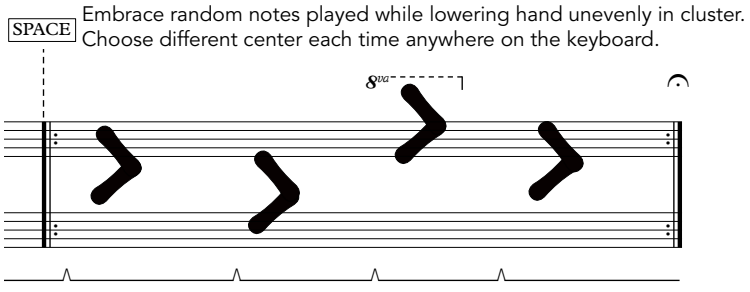


Figure 6. Bar 8 of *Circling Below.*

The use of the random process that had started with *Circling Above* also started to create interesting effects in the material that I had created. *Circling Above* featured the same collection methods as if I was creating a fixed media piece. In *Circling Below,* the samples are recorded live. This means that realisation of the different parts of the piece by the

performer directly affects the electronic material. In bar 8, the gesture requires the performer to roll their hand upon the piano of the keyboard in order to create a cluster that forms out of the individual notes. This in itself was an interesting variant of the chromatic block cluster, but when it came to rehearsing the electronics, I found that the different speeds of the playback, especially when slowed down, highlighted the different timings of the notes to create interesting rhythmic figures.

(iv) *By Firelight*

The final composition in the portfolio to use a gestural device is *By Firelight,* for flute, viola and harp with electronics performed using the Xbox Kinect. The score provides a large amount of freedom in the realisation of the parts. In this piece, I ask the electronics performer to improvise alongside the score but did not provide scoring for them. In this way, there is an improvisation similar to the indeterminate version of *Circling Above*. Using this method, I saw a conceptual unity in the acoustic and electronic materials. This is the most freedom that I have used in the pieces where I compose for gestural devices and it definitely stems from the use of the technology. The random elements within the instrument call for an exploratory method of performing which led me in the direction that I took.

It has to be noted that for the majority of the realisations of the gestural pieces that have been performed, it has been easier for me to perform the electronics myself. In order to explore the scored aspects of my compositions, it would be beneficial to have other performers perform the instrument. The experience of performing the works myself has been useful, as I have been able to feel the interaction with the performers first hand, giving me a very practical means of developing pieces and collaborating with performers. However, it would be interesting to see how other electronic performers shape the music, and to see if I need to stipulate more instruction in the scores.

In contemporary work, I see the composer as a performer becoming more of a trend. I find the works of Johannes Kreidler and Jennifer Walshe incredibly inspiring, and both have a number of pieces in which they perform. In Jennifer Walshe's performances of her pieces, she so powerfully expresses her own material that it provides such a strong character to her work. I like being in a position of control over the performance of my electronic pieces, and I also to strengthen a sense of ownership over them; on the other hand, there is a lot to be learned from presenting scores to other people and seeing their interpretation.

(v) Issues with composing for gestural devices and possible solutions

> 'There is certainly a continuity between indeterminacy and live electronics: you can make machines whose effects on the sound are unpredictable (as Mumma does), or you can exploit the characteristics of electricity itself, using feedback or the kinds of fault that develop when you multiply your circuits (which interests Tudor very much).'[77]

As Christian Wolff alludes in the above quotation, there is an element of unpredictability to using new technologies. The use of indeterminacy for my gestural device pieces created a structure that was more suited to performance with the new technology. At times, there are slight glitches with the accuracy of the tracking, which if a piece demands strictly notated events, would create errors that may derail the performance if the piece depended on the timings of specific exactions occurring at specific moments in time. Composing with indeterminacy in mind (and with these fluctuations considered in advance), it is possible to compose for the technology in a way that creates a satisfactory piece. *Circling Above* creates a situation where it is feasible to incorporate unexpected glitches into the piece. This is due to the extra freedom that is granted to the performer alongside the constant awareness of unpredictable sonic output of the device.

The technology created satisfactory sonic output, but I realised that there were certain

[77] Christian Wolff, *Occasional Pieces: Writings and Interviews, 1952 - 2013*, (Oxford: Oxford University Press, 2017), p. 41.

inaccuracies that added an element of uncertainty to the instrument. One example was the responsiveness of the device, which could change due to variances in the brightness of the performance space. In some locations, the device would be slow to connect and more prone to losing synchronisation with the performer. This would be a problem for a composer who wishes to control precisely every detail. But for composers working with indeterminacy, this was a new source of live chance operations. 'Tudor, working with Cage, recognized the profound potential of electronics to create fundamentally new, endlessly adaptable and (equally important) eternally unpredictable performance instruments.'[78] This unpredictability is still a feature of new devices and will remain for as long as composers choose to compose music for new technologies.

Composing new music for brand new or developing device involves an element of aleatoricism that is built into the instrument. It is not a choice between using chance or not using chance; there is only the choice between composing for that instrument or not composing for that instrument. If composers choose the latter option and wait for technology to arrive at a point where they feel it will accurately perform their envisioned task, composers will have less influence on the future of music technology and developers of technology will shape the progression of electro-acoustic music. If composers choose to engage and examine possibilities, they can work towards shaping the future of technology in alignment with their musical ambitions. 'The music of any age depends upon the kind of musical instruments which that age possesses. *Composers can go no further than the possibilities of the instruments for which they write.*'[79]

With both of the devices that I have used, every movement that a performer makes in front of them will be tracked once they are detected by the instrument. This can cause

[78] Nicolas Collins, 'Composers inside Electronics: Music after David Tudor', *Leonardo Music Journal*, 14 (2004),1-3, p.1.
[79] Thomas Patteson, *Instruments for New Music: Sound, Technology and Modernism*, (California: University of California Press, 2016), p.1.

problems with page turning or when you want to use it alongside other controls such as a computer. The performer's actions will always be detected, which may cause a change in the output. The ability to change the functioning of the device during a performance can be difficult to incorporate. For *Circling Above*, I originally incorporated an external for Max/MSP, allowing me to use an iPhone as a device to change volume from the stage. Unfortunately, the device was later discontinued. Instead of re-programming the patch for another device, I decided that the piece could work with the settings prescribed before the performance. In the cases of the *Circling Above* and *By Firelight*, I believe that this is an adequate solution; however, in the future I shall look for some method to vary the functionality of the instrument in performance. This could be controlled by something other than the performer. This could be pre-composed, and it is another element that the performer would have to react to over the course of the piece.

The question of sustainability is one that is prominent in the field of composition that uses new devices. Fernando Iazzetta states, 'The life of an electronic instrument can be as short as the duration of a composition.'[80] Due to the rapidity of technological progression, pieces written for new devices can quickly become outdated. There is no simple solution to this problem, but it is an issue that is being discussed.[81] In his article *Preserving Performances of Electronic Music*, Joel Chadabe proposes that 'electronic performance can be preserved by describing the sounds themselves so that they can be performed on any appropriate instrument, by using current technology, or by updating the composition itself, and that such approaches can be artistically viable if the performer understands the composer's intentions.'[82] Here we see a move towards a more indeterminate approach to

[80] Fernando Iazzetta, Meaning in musical gesture *Trends in gestural control of music* (2000) p. 264.
[81] Nicola Bernardini, 'Sustainable live electro-acoustic music, Proceedings of the International Sound and Music Computing Conference, (2005).
[82] Joel Chadabe, 'Preserving Performances of Electronic Music, Journal of New Music Research, 30/4 (2001), 303-305, p. 303.

performance. By allowing elements of flexibility in the performance of material while retaining the intention of the composer, the sonic focus of the piece can be maintained while the means to realise the exact sonic outcome may change.

In the case of *Circling Above,* it is essential that a gestural device be used. It would be possible to perform the piece using different technology, for example, using Nintendo Wii controllers or a webcam. Both would require a change to the programming of the input of the patch, but the control of the sound manipulation should be able to remain the same. Interestingly, while taking part in Big Ears 2015[83] at the Sonic Arts Research Centre at Queen's University Belfast, I met artist Helena Hamilton, who has previously experimented with gesture-following realised with Max/MSP using webcam technology in her piece *Untitled (WHEN)*[84]. While working together on a project to enable people with physical disabilities to perform music, it was interesting to discover that the means used to realise her work was a grid very similar to the one used in *Circling Above*. The mapping of interaction (fig.1) is central to the functioning of the piece and is what I believe needs to be consistent if different realisations were to be performed. The input device can be changed, but for this piece the visual element comes from the motion within that grid. As long as that mapping remains the same, the scoring of the piece will also remain the same.

The wide variance in available, similar types of technology that are available is another element that a composer for new devices must consider. There is no standard in design for a lot of technological equipment, and to compose a piece for a specific device can mean that performance is impossible without it. A further complication arises when using devices that have been 'hacked' in order to make them function in a way that they were not

[83] Big Ears was a collaboration with the Drake Foundation NI where different sonic arts practitioners came together to design interfaces for people with physical disabilities in order to enable them to perform music. http://www.socasites.qub.ac.uk/bigears/BigEars2015.html

[84] Helena Hamilton 'Untitled (WHEN)', *Helena Hamilton* < https://www.helenahamilton.com/untitled-when> [accessed 7 August 2018]

originally intended to, as is the case with the Xbox Kinect. Even within relatively common musical programs such as Max/MSP there are multiple ways to present the same manipulation of a single parameter. We can see from David Tudor's experience that similar issues occurred in his collaborations with John Cage:

> 'Now involved in my decisions was the fact that John Cage always makes his electronic notations according to numbers. For instance, with the gain control, he looked at how many gradations there were on the dial. Well, gain controls can be made in different ways: you can turn the control almost all the way up and there is no change in gain or it can happen very immediately halfway through the control and there is no further effect. I had to find some relevant means of using this amplification as part of the instrument. It's not just amplifying the instrument, but the whole thing taken together is an instrument of its own.'[85]

This is a problem that is skilfully addressed by Karlheinz Stockhausen in *Mikrophonie I*[86]. 'Rather than notate the way in which the sounds must be produced, the composer attempts to describe the sounds and their temporal placement within the piece using a variety of means: graphic notation, verbal descriptions, time lines, and regular notation. Thus, while the score is not precise in the sense that a traditional one can be, it is nonetheless extremely detailed.'[87] This detail without exact precision in the score of *Mikrophonie I* is an effective way to provide different methods of realisation of the same sounds. It is clearly scored with a large number of different possible outcomes, providing an example of what an ideal electro-acoustic score should be. A good deal of interpretation can be left up to the performers while still creating musical structures that will remain consistent each time the piece is realised.

Even though my focus moved away from the use of gestural devices, they are central to the research concepts within this project. The main reason I chose to use them was to explore how the performative aspects of my electro-acoustic could be improved. The design of the instruments and the aleatorical nature of the mapping required me to concentrate on

[85] Ron Kuivila, 'Open Sources: Words, Circuits and the Notation-Realization Relation in the Music of David Tudor', *Leonardo Music Journal*, 14 (2004), 17-23, p. 19.
[86] Karlheinz Stockhausen, *Mikrophonie I, Nr 15*. (Vienna: Universal Edition, 1964)
[87] James Harley, 'Reviews: Karlheinz Stockhausen: Mikrophonie I', *Computer Music Journal,* 23/4 (1999), p. 74.

how performers interact with them which in turn caused me to reflect on how I scored the music. This is a direct example of how the technological means that are used to create a piece impose themselves upon the composer. My solution to this was to include performer freedom which provided a platform for the performer to listen and react to the electronics. In the case of *Circling Above,* I have found on multiple occasions that the indeterminate scored version provides a more successful outcome due to the ability to listen and react. This is both in the sonic outcome as well as the feeling of connectivity between the performers. All of these issues I have considered in the music that I have since composed.

Chapter 3

Combining indeterminacy and recording

Reflecting on the experiences of rehearsing my pieces for gestural devices, I realised that aleatoricism could play an important role in the creation of my electro-acoustic music. This seemed to me a practical solution to the problems that I encountered while using the devices. As I further explored this manner of working further my thoughts gradually transformed about music as an art form. One of my key areas of interest was the New York school of composers surrounding John Cage, such as Earle Brown, Morton Feldman and Christian Wolff. Their scoring methods and thoughts provided a wealth of different ideas that became a basis for my own. The dialogue between the composers and artists of that time also influenced my exploration of the art scene in Cardiff and Bristol, which has in turn offered new perspectives and also opportunities for presenting my music in different settings other than the concert hall. Later in my research, experimental music figures such as Gavin Bryars, Cornelius Cardew and Howard Skempton provided musical ideas to consider from a British perspective.

My original research plan involved examining the performance practice and organisation of materials in electro-acoustic composition. However, due to the opportunities to collaborate with performers, it appeared to me that the most useful avenue of enquiry was in acoustic applications which could later be applied to electro-acoustic music. The exploration of different approaches to scoring and the presentation of clear instructions for indeterminate realisation to performers became the focus of a number of my works. In this chapter I describe how I have loosened my direct control over certain parameters of my music and how the result of this act has affected my approach.

(i) Exploring performer freedom for solo piano

Two piano pieces, *Clockwork Devils* and *Henry Stauf,* were my first studies of an indeterminate approach to purely acoustic composition. *Clockwork Devils* was a commission to write a piano work for a combined concert and visual art exhibition at the Abacus Art Gallery in Cardiff. Upon receiving the scores of a number of composers, visual artists were provided with the first and last pages, from which they created artworks that were to be displayed in the gallery.

George Crumb's *Makrokosmos*[88] and the piano works of Henry Cowell were at the forefront of my thoughts at this time, due to my fascination with their innovative techniques used to create alternative piano timbres. My own approach focused upon manipulating the strings more than the keys as I tried to assimilate their approaches into my own. In the case of this commission, string-based techniques were not practical due to an upright piano being used. It required me to consider a more conventional manner of playing the instrument. I became aware of György Kurtág's *Játékok*[89] at this time. His ideas in regards to scoring had a significant impact on not only these piano pieces, but my scoring methods throughout this project.

Clockwork Devils explores limited pitch materials with variation coming from ascending and descending runs of notes chosen at the performer's discretion. This places the focus upon the rhythm and energy.

[88] George Crumb, *Makrokosmos I* (New York and London: Edition Peters, 2002)
[89] György Kurtag, *Játékok Volume I* (Budapest: Edition Musica Budapest, 2004)

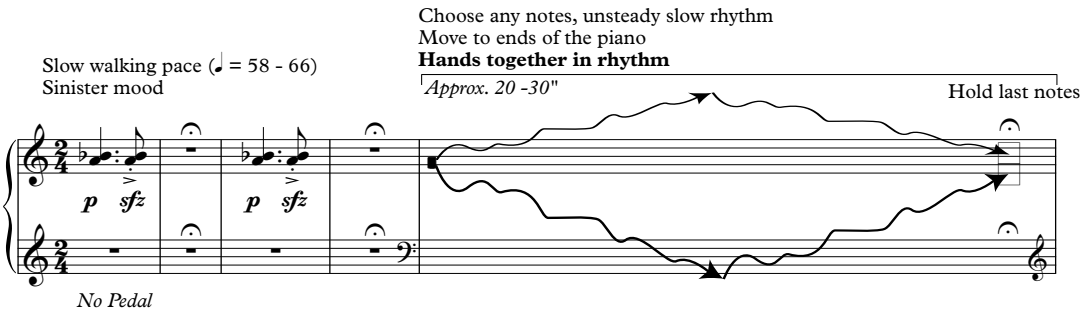


Figure 7. Score Example of *Clockwork Devils.*

This was the first of my pieces to be performed outside of a formal concert hall environment. The audience members were allowed to walk freely around the space during the performance, and silence was encouraged but not required. This performance situation strongly informed my compositional decisions. I was also aware that the score would be displayed as part of an exhibition, which caused me to reflect upon the visual presentation much more. It encouraged the use of alternate scoring methods in order to provide something different visually, but my focus remained on the functional aspects of the music. At this time. I was uncomfortable giving a similar amount of freedom to a performer of my music the amount of freedom as is often provided to a performer of graphic scores, such as Cornelius Cardew's *Treatise*[90]. The graphic notations that I used were simply arrows that instructed the player to choose pitches in a chromatic run in the indicated direction.

Henry Stauf was a commission from the performer of *Clockwork Devils,* Mark Smith. He requested a similar work to *Clockwork Devils* to be performed as part of his final undergraduate recital. George Crumb's *Makrokosmos* was still prominent in my musical thought at this time, and I used it as a guide to develop familiarity with composing and scoring extended techniques for grand piano. I originally set out to explore performer freedom, as I had with *Clockwork Devils,* but the actions in *Henry Stauf* are defined specifically, and the only parameter that the player has more freedom over is the overall

[90] Cornelius Cardew, *Treatise* (New York and London: Edition Peters, 1967)

tempo and phrasing of the piece. This is to encourage the performer to focus upon the resonances and let them ring for as long as they feel is necessary.

This loosening of time was also part of an aim to write a piece that could be a pedagogical tool for a pianist who is not experienced with extended techniques, taking inspiration from *Játékok*. A successful performance of this piece is one which takes into consideration the resonances that are created from the harmonics and the swiping of the strings. The timing of the individual gestures is important in shaping the piece but between which there is time to prepare each action. The fact that the piece allows resonances to stay for a long duration means that the performer can take as much time as they feel they need in order to prepare themselves for the next action. Due to this fact, this is a piece that uses techniques that are not standard, but are also not entwined with other intricate and difficult sections, making it more accessible to performers not acquainted with these techniques. The idea of making my works available to as many performer skill levels as possible is something that strongly appeals to me. A number of my pieces, such as *Circling Below* and also *Clockwork Devils,* are composed in a manner that would create the desired outcome without requiring an extremely high level of skill on the required instrument.

(ii) Exploring performer freedom for ensemble

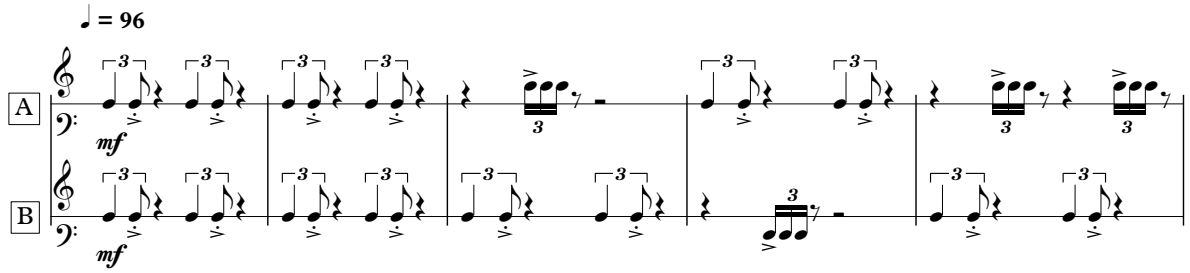


Figure 8. Score excerpt from *Little Fish.*

Moving on from solo piano, I explored an indeterminate work for a large ensemble when I took part in a workshop that celebrated the music of Louis Andriessen. Based very closely on the scoring of *Workers Union*[91], I composed *Little Fish* for a variable ensemble of winds, strings, piano and vibraphone. There are two parts for performers which are dispersed alternately around the ensemble in order to to avoid creating a spatialisation of the material by splitting the ensemble into two halves. Like *Workers Union,* a single-line stave represents the middle of an instrument's register, while the notes depict pitches in relation to that line but not exact values. This creates a melodic contour for the ensemble to follow at the same time as providing an exact rhythm to create a pulse. This was a useful investigation as my previous uses of indeterminacy had explored more freedom in rhythm.

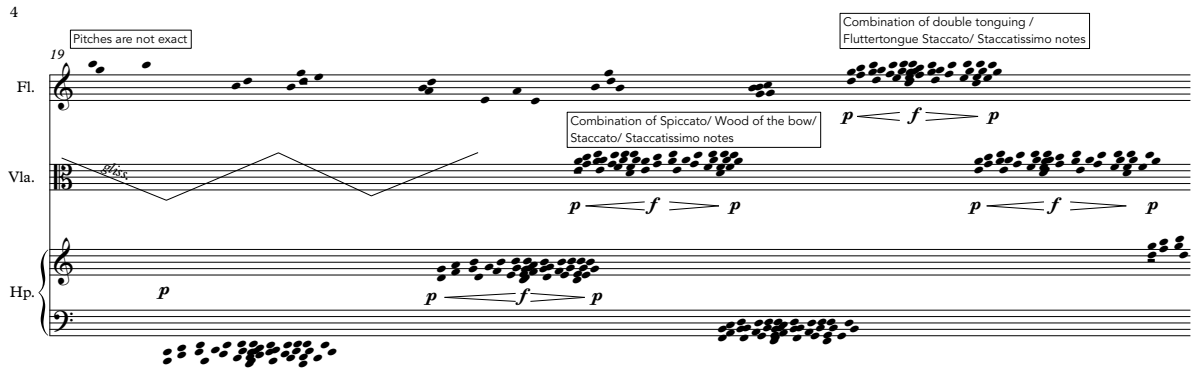


Figure 9. Score excerpt from *By Firelight.*

By Firelight features a number of sections that require the performer to choose notes in a frantic, arrhythmic, cloud-like textures. A large inspiration for this sound is *Concrete Ph*[92] by Iannis Xenakis; the control of density over a large amount of very small musical events is key. I return to the cloud-like structure again in *Silicate Precipitation,* as well as exploring similar approaches to the electronics as an homage to *Concrete Ph*. The idea in the

[91] Louis Andriessen, *Workers Union, symphonic movement for any loud sounding of instruments,* (Amsterdam: Donemus, 2002)
[92] Iannis Xenakis, 'Concrete Ph' in *Adventures in Sound* (London: Él Records, 2009)

indeterminate gestures is to repeat a similar structure that is varied each time it appears. This means that there is repetition and variation at the same time. One consideration that I may experiment with in the future is the use of more repetition in tightly structured sections, similar to the music of Bryn Harrison, in order to create a feeling of stasis with slight change. This is also another method to try and circumvent the prescription of pitches to the performers.

Another technique that I used was to allow the performer to choose from a constrained number of pitches. In this way I impose my own choice upon the pitches and bind them within a scale that I have devised while still allowing variance. I have found that when I have used techniques such as this, the effect of calm overlapping tones is created quite easily. It is difficult, however, not to conjure up the idea of Morton Feldman's music. This is, of course, the inspiration for a lot of my work, but I aim to construct my own distinct compositional voice.

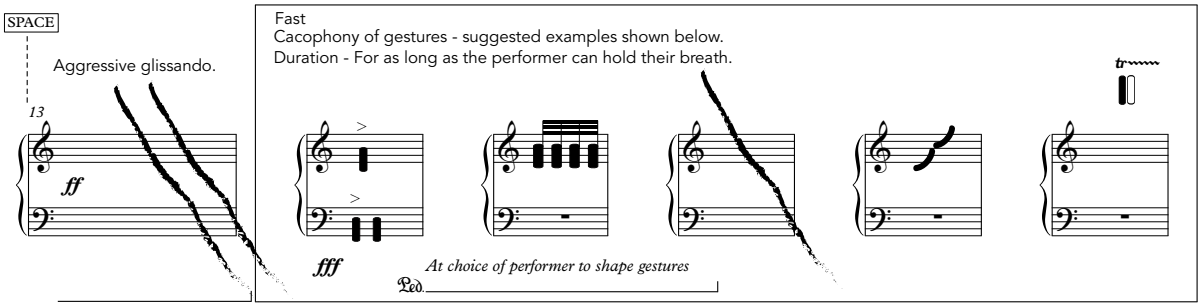


Figure 10. Score excerpt from *Circling Below.*

In *Circling Below* and *Journey for x Blind Pianists,* there are sections that instruct the performer to choose from a selection of gestures in order to create loud aggressive textures. These in some ways are my most free instructions, and I have found from working with performers that the outcome of these sections are some of the most pleasing results to me as a composer. A number of performers have played these sections, and the individual

personality of these performers really comes to the fore. If the performer has a background in performing jazz, one hears a different realisation than if the performer mostly plays classical repertoire, and yet a different interpretation if the performers regularly plays pop music. This is a feature of interpretation that came through in *Journey for x Blind Pianists*. I really enjoy providing a platform to hear the strong individual voice of the performers that play my music.

In the future I hope to expand on this. As I mentioned when discussing *Clockwork Devils,* I have been anxious about providing too much freedom to the performers as I still wanted to ensure that I could claim a strong ownership over the work. Looking at the freedom of pieces like John Cage's *0'00"*[93]*,* there is a much larger scope to give performers further freedoms than I have allowed. One way that I wish to address this further is to work with improvisers. I have not, over the course of this project, had the opportunity to fully explore my music with musicians who are experienced with free improvisation and I feel that it would be incredibly beneficial to my craft.

The works of Cornelius Cardew and the Scratch Orchestra have become more prominent in my thinking over the course of this project. Recently in the university, a group of composers and performers have come together in order to explore experimental music scores. On the first meeting we decided to perform John White's *Hooting and Whistling Machine*[94] which asks for a variable number of performers to blow into bottles to generate the sounds of the piece. They then drink from the bottles over the duration which lowers the pitch of the material. When I first discovered the composition, I was blown away by the fact that anyone is able to play this piece, but the outcome of it is incredibly interesting and nuanced. Pauline Oliveros' *Rock Piece*[95] is another score which is incredibly simple in realisation but highlights the act of listening in an interesting way. For the future, these are

[93] John Cage, *0'00"* (New York and London: Edition Peters, 1962)
[94] John White, *Drinking and Hooting Machine* (unpublished music score: Experimental Music Catalogue)
[95] Pauline Oliveros, ' Rock Piece' in *Anthology of Text Scores* (Kingston: Deep Listening Publications, 2013)

models that I wish to aspire to in terms of accessibility of performers, while at the same time maintaining depth of concept.

(iii) Recording indeterminate realisations as a compositional technique

While reviewing the performances of these aleatoric pieces, I started to consider the relationship between pieces that can be realised in different ways and the recording process. Indeterminacy places emphasis on the live event. Recording opposes this emphasis as an act of storing the sonic outcome of the present with a view towards future access. Live music features unexpected events and outcomes and must react to them while recording is the same each time it is presented. As mentioned in Chapter 1, section (v), indeterminacy requires experience of multiple realisations for the audience to experience it. A recording in a traditional sense cannot do this. As David Grubb says,

> 'Most genres in experimental and avant-garde music in the 1960s were ill-suited to be represented in the form of a recording. These various activities — including indeterminate music, long-duration minimalism, text scores, happenings, live electronic music, free jazz, and free improvisation — were not only predicated on being experienced in live performance, but they can also be said to have actively undermined the form of the sound recording.'[96]

I started to realise that a recording of a live event is only a documentation of one performance and does not represent the piece as an artwork, particularly for recordings of my pieces at this time. It is only from experiencing multiple realisations of the piece that the variable elements become apparent. This led to contemplation on possible means through which recording could become an integral part of the work.

Journey for x Blind Pianists is a recorded piece that explores the differences in separate realisations of an indeterminate score. It is composed for a variable number of pianists (with a minimum of four), who each play off the score in separate, closed recording sessions. Each of the performers has influence over the rhythmic and pitch material

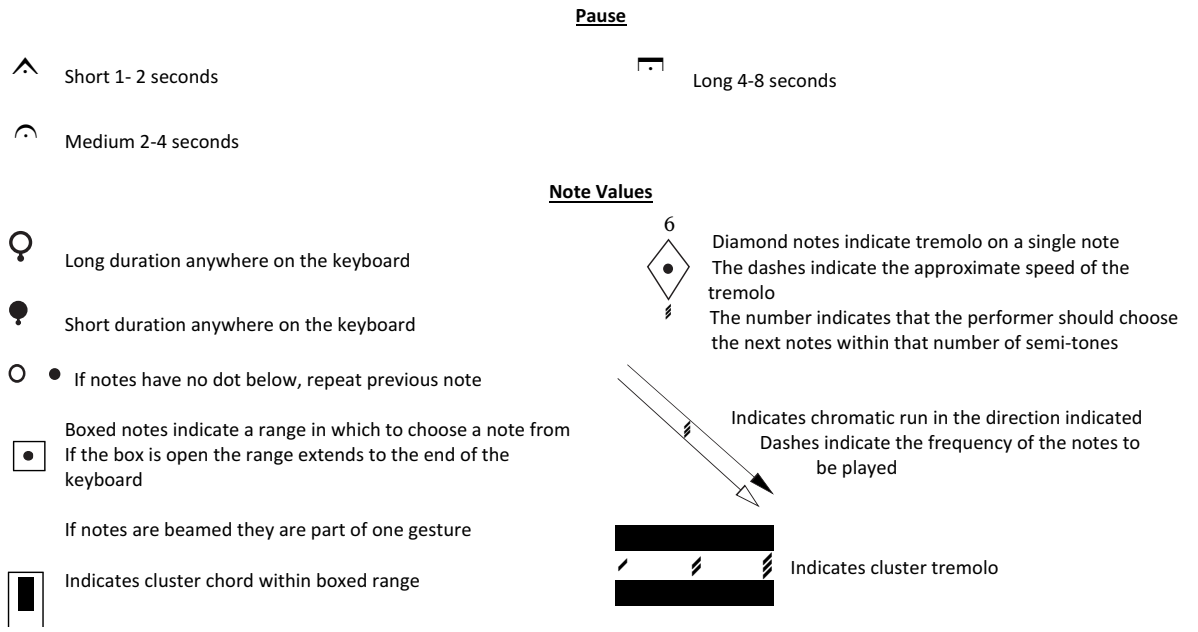
[96] David Grubbs, *Records Ruin the Landscape: John Cage, the Sixties, and Sound Recording* (Durham: Duke University Press, 2004), p. 28.

throughout the piece. The complete work is not the individual performances, but a recording of the combination of all of the interpretations that has been assembled in the studio with minimal intervention. This means that that the differences become key components of the music.

Once again, I chose a new scoring method in order to present the performance instruction to the players. In this case, the early graph paper compositions of Morton Feldman were the model. Thomas DeLio states, 'graphic notation enabled Feldman to shape sound through broad compositional gestures in which silence, density, register and timbre were used to create striking and original sonic structures.'[97] 'Broad compositional gestures' are the intended functions of the different scoring methods of *Journey for x Blind Pianists.* The material is intended to evolve in the same direction while creating a blurred texture. The difference from *Little Fish* was that exact rhythm was not desired, meaning that a new notation was required.

The notation requires the pianist to perform either short or long variations with long, medium or short pauses in between. Pause marks were chosen instead of rests, as they fit the slow tempo of the piece with less variation in length of pauses than for rests. I allowed variation in the tempo over the course of the piece but always within the tempo indication of very slow and meditative. The first note of each of the performances starts at the same time. After that, the timings are up to the performers. This allowed for a shaping of recognisable structures without depicting unnecessary detail.

[97] Thomas DeLio, *The Music of Morton Feldman*, (New York: Excelsior Music Publishing Company, 1996), p. 21.



On page two the boxed gestures indicate a section where the performer chooses the gestures creating a loud aggressive texture. The duration should be around 20-30 seconds.

Figure 11. Performance instructions for *Journey for x Blind Pianists.*

There are a number of notes which include dotted stems below them to indicate a choice of a pitch anywhere on the keyboard. The notes without these stems indicate a repetition of the previous pitch. In this way, a large amount of freedom in the selection of pitches is created, as well as a great deal of chance between each realisation. I then chose to use boxed notes to restrain the amount of variation from one realisation to the next. In this way, I shaped the possible range of material which could be expanded or contracted to create the form and evolution of the piece.

At certain points I chose to re-align the synchronisation of the parts in order to keep certain sections tightly interacting before gradually separating. This had been my plan from conception of the piece, but after recording a set of performances, I listened to a version of the piece that allowed each realisation to run from the start. I found that the sense of form tended to be lost without re-synchronisation. In a realisation that is not re-aligned at certain points, the sections with a louder dynamic, as well as the sections with glissandi, tend to overpower the quieter material. Interesting interactions are created, but for this version of the

piece, it is important that variation is allowed while retaining the intended form. As a recorded work, there was the option of creating both versions, but I felt that it would be best to decide upon one. In the future I may come back to the idea of single take, but with a score that is designed with that fact in mind.

The synchronising of the separate sections added a new dynamic to the piece which I had not considered. In some of the sections, I decided to have the performers start together and then let the differences in their interpretations gradually diverge. I then had the idea that some of the sections could start differently and then converge towards a final point. This creates a slightly different but interesting contrast in the movement of each of the sections.

One notable interpretation of the score was made by a performer who was uncomfortable making pitch decisions during performance. This was an element that I considered important to the concept of the piece and I wanted the performer making decisions in the moment in order to highlight the distortion of liveness that comes from the recording process. He suggested that he create a performance score beforehand and use that during his recording session. Even though this was contrary to my intention for the piece, I decided that I would allow it in the spirit of research. The parallel with the approach that David Tudor took towards indeterminate music was something that I was interested in exploring.

The performer's discomfort in being asked to choose the notes in the moment led to an interesting performance situation. He was worried his realisation would not sound right if he did not choose notes and practice them beforehand. This idea was strange to me, as one performance does not make the piece, it is the combination of multiple realisations. Therefore, in this piece, even if a performer may be concerned with the relations of their own notes, they will have no control over another performer's realisation, meaning that the harmony of the piece is created by chance. My notation provides a structure and

relationships between the actions that pianists must adhere to in order to perform a successful rendition of the piece, but choosing 'correct' notes is not one of them. The realisation that they performed had a successful outcome, and it was interesting to see the score that they have created (appendix (v)). In the future, however, I shall require performers to make their decisions at the moment of performance, as it is truer to the intention of the piece.

One of the key explorations of this piece is the organisation of material created by the combination of performer indeterminacy and the recording process. An important idea behind the piece was that the performers were isolated from each other and therefore were not able to react to each other's realisations. I also took care not to discuss the results of other outcomes, in order to avoid them influencing other player's realisations. When discussing the piece before the pianists practiced their realisation, I simply took them through the notation so that they understood the instruction. I tried not to influence the performer or indicate my own desires for the realisation of the piece. By concealing the exact intention of the desired character, I hoped that the notation alone would be clear enough to create a realisation and that any possible oversights on my part would appear in the final performance.

Isolating performers in the creation of a single work and combining them with technological means is an idea that I have lot of interest in and would like to further explore in the future. I see the disconnection of performers using recording as comparable to a number of modern technologies, such as the Internet or the telephone. In the future, I would like to explore the work as an installation. The work would use the same principles as *Journey for x Blind Pianists,* but be scored for an ensemble. Instead of being a recorded piece, it would be a number of individual performances that take place in separate spaces in one building. Each performance would be streamed into one central space. The audience would then be able to experience the performance in its separate state as well as in its entirety. In this way the isolation of performers would be caused by separation of their

position in space, rather than their position in time which is the case with *Journey for x Blind Pianists.*

Interestingly, using documentation as a central component in the creation of *Journey for x Blind Pianists* turned the piece towards the effect of recording as a phenomenon. The interaction between the live focus of indeterminate music and the stasis created from the recording process made me consider the semantic aspects of the materials that I was using, instead of solely focusing upon the creation of abstract works.

(iv) Live recording of indeterminate realisations as a compositional technique

Shortly after composing *Journey for x Blind Pianists,* I had the opportunity to write for Dov Goldberg, the clarinettist of the Manchester-based Psappha ensemble. *Recur* is a piece for bass clarinet that furthers my exploration of indeterminacy-based organisation with recording, but this time with a solo performer using live looping. In the score, there are a number of sections with indeterminate rhythm that the performer repeats, while a Max/MSP patch loops each of the previous realisations on top of the other. In this way the same organisational principles that are apparent in *Journey for x Blind Pianists* occur, but in a more procedural manner.

The audience can hear the process build over the duration of each of the sections. The loops are gradually replaced in turn, causing a slow progression between each section. *Recur* differs from *Journey for x Blind Pianists* due to the variance in the realisation, which requires conscious effort from the performer. An integral part of *Journey for x Blind Pianists* was that the performers were completely unaware of the other realisations, creating a real disconnection between each play-through. It is the same performer realising the score in *Recur,* and so the disconnection is harder to achieve. The desired effect is for the performer to realise each indeterminate section as though they are coming to it for the first time.

As discussed in Chapter 2, *Circling Below* is another piece in which live recording is a means to create all of the material during the performance. The difference between *Circling Below's* use of recording and *Recur's* is that *Recur* aims to keep the material recognisable from the original recording, while *Circling Below* aims to transform the material more drastically. The aim of *Recur* is to be transparent with the process that I am using, while *Circling Below* aims to create a texture that is recognisable from the piano material, but is noticeably different.

(v) Computer-generated chance

The majority of electronic material that features in this portfolio uses Max/MSP in order to control the randomised selection and playback of samples. A feature of my earlier electro-acoustic works is the use of time-stretching to explore the nuances of recorded sounds. Random procedures created in Max/MSP allow me to remove my own decision-making from that process. The different speeds and the length of the samples became something that I could observe. I found the results of the patches pleasing and was then able to run multiple versions of these processes on top of one another. This mimicked the act of imposing an organisational structure upon the sounds. Rather than auditioning samples and organising the interaction directly, I was able to create an automatic never-ending version of my compositional method. I see this an evolution of my use of fixed media tracks but the focus is no longer on a fixed recording but constantly changing material that is realised at the time of performance. The use of the electronics is similar but there is a focus on the live event as the electronic parts will generate, creating different interactions with the material each time that the piece is played.

Most of the patches that I used in this project work in very similar ways; I simply change the way that they are used. In *Circling Above,* I started with the same two steps that I

would use if I were to compose an acousmatic piece. I recorded the source, cut it into many samples and then manipulated the samples in order to generate new timbres. These manipulated timbres were inputted into the Max/MSP patch, which would select and play them back using random procedure.

Silicate Precipitation was an experiment in controlling the density of a randomly generated texture. In this piece, I experimented with the use of Ableton Live and the ability to incorporate a Max/MSP patch into a sequencer's effects chain. I designed a Max/MSP patch that randomly chose from a bank of harp samples randomly when triggered by the MIDI messages from Ableton. I was then able to use the MIDI sequencer in Ableton to program their attacks and the effects that were used upon them. The density of the texture was controlled by the amount of samples that I chose to play at once. The effects were also controlled in the sequencer meaning that there was less variance in the different overall aesthetic. With this method I ceded some of the process to the computer but the overall effect was relatively consistent due to the heavily effected nature of the samples. The use of the sequencer in Ableton Live also aligned my process with earlier fixed media pieces, as there is a timeline of events that will occur at the same times in the piece but the actual material will differ each time it is realised.

(vi) Automated electronic process - *The Wood Between the Worlds*

The first piece to explore a fully automated process alongside an ensemble was *The Wood Within the Worlds.* The electronics generated different textures, which were then changed over the course of the piece to create slightly different characters for each section. The electronic part generated the mood but there were no points of synchronicity of the two. Instead of sonically exploring the material solely in the studio, the exploration process became an intricate part of the performance. In *The Wood Between the Worlds* flute and harp

samples are used without processing in order to create a more natural feel to the sounds. I also use the samples in separate sections, never together, providing another way in which to create variation of character.

This meant that a score could not describe definite structures, and the acoustic organisation became partially removed from the electronics. I started to compose with a textural focus where I created two different components and then observed the resulting interactions between the two. An indeterminate approach in my scores was a way to try and reconnect the two elements. Much like the work of John Cage in *Imaginary Landscape No.4*[98], the material is chance driven. The organisational focus of the sound output then becomes the density and the rate of change of these devices instead of the exact sound.

I started to see the different elements of my composition as overlapping processes. They were designed to interact together but realised independently. The combination of autonomous material created a consistency with my approach to both the acoustic and electronic elements in my electro-acoustic pieces. I organised materials for the electronics and then observed the interactions of the simultaneous processes. The use of determinate scoring for *The Wood Between the Worlds* did not use this method and I am not as pleased with as with other pieces. The lack of freedom that the performers have is something that I am not satisfied with. The indeterminate scoring of *Silicate Precipitation* is a preferred method for me as there is ability for the performers to listen and react. When working with generative electronics the ability for the performer to tailor their realisation to the current generation of electronic material is a sense of dialogue between the two parts that I feel creates a stronger cohesion between the material. The overlapping process in *Recur* is more successful as ignoring the electronic track and not reacting to it is a central part of the piece's organisation.

[98] Cage, John, *Imaginary Landscape No.4* (New York and London: Edition Peters, 1951)

The exploration of indeterminacy within my work has caused quite marked changes in the way that I construct my music. David Bernstein says, 'A composition is no longer an object, but a process through which the performer creates a piece.'[99] I no longer wish to write completely determined scores, that tell the performers exactly what to do in order to realise the work. The focus of indeterminacy is upon the live realisation of the score, and this has also led me to consider what ramifications that has for the meaning of recording. This in turn has led me to my work on recorded pieces with indeterminate realisations at the heart of the organisation of material and a reflection on the nature of recording. The use of indeterminacy has completely changed the way that I think about my music and the way that I wish to develop in the future.

[99] David W. Bernstein, 'John Cage's Cartridge Music (1960) 'A Galaxy Reconfigured', *Contemporary Music Review,* 33/5-6 (2014), 556-569 (p. 557).

Conclusion

The starting focus of the project, composition for gestural devices, was not a complete success in practice; however, it was the catalyst for the work that came afterwards. The use of the Xbox Kinect provided me with a means to create an improvisatory instrument that presented the electronics in a visually appealing manner. From the experience of working with this device alongside musicians I started to consider more performer freedom in my music. This created quite a large change in the approach of my music and I found a wealth of interesting avenues to explore. It is from this use of aleatoricism in the instrument and the performance approach that I came closer to finding a universal approach for both the electronic and the acoustic writing in my project.

To review the questions that I posed in the introduction: How can devices that capture physical gestures be used to perform the electronic sounds of compositions in a live setting? They can be used as instruments in order to perform the electronics, but a strong focus needs to be on the design of the mapping of the parameters to the physical actions. This sits at the heart of how the electronic performer will interact with the technology. I have found that my approach to the musical material that I used within the gestural device pieces didn't change drastically, but the way that the material was organised did change notably. The use of Max/MSP did change when the electronic processes occur within the creative process of the work. With Max/MSP I was able to include a large part of the manipulation of the material that had previously been complete prior to performance in the live realisation of the piece. Due to this ability, I was able to explore the performative aspects of electro-acoustic music in a number of different ways.

Can the act of presenting the performer with freedom within a score create stronger interactions between the electronic and acoustic instruments in electro-acoustic performance? Through my work, I have formed the opinion that giving flexibility to the performer is

paramount to creating a sense of connection between two parts of the music. This means that the performer has a platform in which to express their own reactions to the sounds that are created. For me personally, this creates a very rewarding experience of musical creation. I find that the more freedom that a performer has within the music, the more interesting the process is for me. At the start of the project, I was very wary of giving a performer too much freedom with each piece, but as I explored the notion of indeterminacy further I became more willing to allow them greater freedom. The idea of collaboration with performers has grown over the course of the project and is something that I wish to feature centrally in my compositional work in the future.

What impact does working with technology have on a composer's compositional approach? In my compositional approach, I mentioned Trevor Wishart's and Marshall McLuhan's ideas that the tools we use end up using us. This has definitely been the case for me, at least somewhat. As soon as I used Max/MSP in the creation of my music, my process changed, meaning that the music changed. The use of gestural controllers was where aleatoricism first appeared in my music and I allowed this to affect my entire musical thinking. The idea that the tools that we use should be considered is one of the strongest ideas that I would like to present in this project. The use of gestural devices that required complex mappings to create an instrument that had a satisfactory feeling of performativity meant that I had to work in a much freer way than I ever have before. Working in this fashion opened up a wealth of different options to explore in the creation of my music. If there is one takeaway from this project I would like to highlight, it would be to promote the creation of music with unhabitual tools. This provides a completely different perspective on decisions that are made from natural processes and what is actually the true intention.

In relation to the question: how can I focus the compositional process in the live performance? The use of aleatoric techniques in this project was first born out of necessity

but I came to love the conceptual ideas that it created in my music. If parts of the score are to be realised during live performance, aleatoricism focuses that moment in time as a moment of creation. This focus upon the present moment is one that I love to have in my pieces. I am also greatly enthused by the idea of creating pieces that will have a consistency to them but will change each time they are played. This leads on to how can recordings of different realisations of aleatoric works be used to create pieces? This line of enquiry is one that I find incredibly interesting, and I enjoy the contrast of the aleatoric method that focuses so hard on the present and the recording process (that focuses chiefly upon the past). It also highlights the concepts of recorded music as a concept; in an age when we are bombarded with recorded music, I find it to be a very relevant line of enquiry.

Edgard Varèse famously stated that 'I do not write experimental music. My experimenting is done before I make the music. Afterwards, it is the listener who must experiment.'[100] I always admired this quote, but have found that in this project, I have come to the view the music that I write as experimental. That is not to say that the works are not considered in their outcome and form but I do see each piece as a discovery in the workings of the sounds that they focus upon. I have abandoned choosing the safer options of writing pieces that I was certain would definitely work or had been done before, and instead I chose ideas that I am slightly unsure of, such as my indeterminate works. This freedom to experiment is the main aspect of the PhD that I am incredibly grateful; I hope it will be at the heart of all of my future musical endeavours.

[100] Thom Holmes, *Electronic and Experimental Music*, 2nd edn (London: Routledge, 2002), p. 126.

Bibliography

(i) Books and articles

Anderson, Virginia, '"Well, It's a Vertebrate…": Performer Choice in Cardew's Treatise', *Journal of Musicological Research*, 25/3-4 (2006) 291-137

Behrman, David, 'What Indeterminate Notation Determines', *Perspectives of New Music,* 3/2 (1965) 58-73

Walter Benjamin, 'The Work of Art in the Age of Mechanical Reproduction', *Illuminations*, 214 - 18.

Bernardini, Nicola, 'Sustainable live electro-acoustic music, Proceedings of the International Sound and Music Computing Conference, (2005)

David W. Bernstein, 'John Cage's Cartridge Music (1960) 'A Galaxy Reconfigured', *Contemporary Music Review,* 33/5-6 (2014), 556-569

Cascone, Kim, 'Grain, Sequence System: Three Levels of Reception in the Performance of Laptop Music', *Contemporary Music Review*, 22/4 (2003) 101-104

Cardew, Cornelius, 'Notation, Interpretation, etc.', *Tempo*, 58 (1961), 21-33

Casey, Rob, 'Cage and Tudor as Process', *Contemporary Music Review*, 36/6 (2016), 670 – 685

Chadabe, Joel, *Electronic Sound: The Past and Promise of Electronic Music,* (New Jersey: Prentice-Hall, 1997)

Chadabe, Joel, 'Interactive Composing: An Overview', *Computer Music Journal*, 8/1 (1984), 22-27

Chadabe, Joel, 'Preserving Performances of Electronic Music, *Journal of New Music Research*, 30/4 (2001) 303-305

Collins, Nicolas, ‘Composers inside Electronics: Music after David Tudor’, *Leonardo Music Journal*, 14 (2004), 1-3

Dean, Roger, *Hyperimprovisation: Computer-interactive Sound Improvisation,* (Middleton: A-R Editions, 2003), p.31

DeLio, Thomas, *The music of Morton Feldman*, (New York: Excelsior Music Publishing Company, 1996)

Dubinets, Elena, 'Between Mobility and Stability: Earle Brown's Compositional Process', *Contemporary Music Review*, 26/3-4 (2007), 409-426

Feldman, Morton, liner notes to Feldman/Brown, Time Records 58007/S8007 (1963), reproduced in *Give My Regards to Eighth Street: Collected Writings of Morton Feldman*, ed. B.H. Friedman (Boston: Exact Change, 2000)

Griffiths, Paul ‘Aleatory’, *Grove Music Online* <www.oxfordmusiconline.com> [accessed 2 July 2018]

Grubbs, David, *Records Ruin the Landscape: John Cage, the Sixties, and Sound Recording* (Durham: Duke University Press, 2004)

Harley, James, ‘Reviews: Karlheinz Stockhausen: Mikrophonie I’, *Computer Music Journal,* 23/4 (1999)

Holmes, Thom, *Electronic and Experimental Music*, 2nd edn (London: Routledge, 2002)

Hunt, Andy, Wanderley, Marcelo M. and Paradis, Matthew, 'The importance of parameter mapping in electronic instrument design', Proceedings of the 2002 Conference on New Instrument for Musical Expression, (2002).

Iazzetta, Fernando, 'Meaning in musical gesture', *Trends in gestural control of music* (2000) 259-268

Iddon, Mark, *John Cage and David Tudor: Correspondence on Interpretation and Performance* (Cambridge: Cambridge University Press, 2013)

Kahn, Douglas, 'James Tenney at Bell Labs', *Leonardo Electronic Almanac,* 8/11 (1999) quoted in David Grubbs, *Records ruin the landscape: John Cage, the sixties, and sound recording* (Durham: Duke University Press, 2014)

Kostelanetz, Richard, *Conversing with Cage* (New York: Limelight Editions, 1987)

Kuivila, Ron, 'Open Sources: Words, Circuits and the Notation-Realization Relation in the Music of David Tudor', *Leonardo Music Journal*, 14 (2004) 17-23

LaBelle, Brandon, *Background Noise: Perspectives on Sound Art*, (London: Bloomsbury, 2015)

MacDonald, Alistair, 'Performance Practice in the Presentation of Electroacoustic Music', *Computer Music Journal*, 19/4 (1995), 88-92

Meyer, Leonard B., *Music, the Arts, and Ideas: Patterns and Predictions in Twentieth-Century Culture* (Chicago: University of Chicago Press, 1967)

Nyman, Michael*, Experimental Music Cage and Beyond, Experimental Music: Cage and Beyond*, 2nd edn (Cambridge: Cambridge University Press, 1999)

Patteson, Thomas, *Instruments for New Music: Sound, Technology and Modernism*, (California: University of California Press, 2016)

Piekut, Benjamin, 'Chance and Certainty: John Cage's Politics of Nature', *Cultural Critique*, 84 (2013), 134–63

Plato, *The Last Days of Socrates* (London: Penguin Classics, 2003)

Pritchett, James, *The Music of John Cage*, (Cambridge: Cambridge University Press, 1993)

Rodgers, Tara, *Pink Noises: Women on Electronic Music and Sound,* (Durham: Duke University Press, 2010)

Rovan, J.B., Wanderley, M.M., Dubnov, S. and Depalle, P, October. Instrumental gestural mapping strategies as expressivity determinants in computer music performance.

In *Kansei, The Technology of Emotion. Proceedings of the AIMI International Workshop,* (1997) p. 68-73.

Thomas, Philip, 'Determining the Indeterminate', *Contemporary Music Review*, 26/2 (2007), 129-40

Winkler, Todd, 'Making Motion Musical: Gesture Mapping Strategies for Interactive Computer Music', Proceedings of the International Computer Music Conference, (1997)

Wolff, Christian, *Cues: Writings and Conversations* (Cologne: Musik-Texte, 1998) quoted in Thomas, Philip 'Determining the indeterminate', *Contemporary Music Review,* 26/2 (2007), 129-40

Christian Wolff, *Occasional Pieces: Writings and Interviews, 1952 - 2013*, (Oxford: Oxford University Press, 2017), p. 41

(ii) Scores

Andriessen, Louis, *Workers Union, symphonic movement for any loud sounding of instruments,* (Amsterdam: Donemus, 2002)

Berio, Luciano, *Sequenza III* (London: Universal Edition, 1966)

Cage, John, *4'33"* (New York and London: Edition Peters, 1952)

Cage, John, *0'00"* (New York and London: Edition Peters, 1962)

Cage, John, *Imaginary Landscape No.4* (New York and London: Edition Peters, 1951)

Cage, John, *Music of Changes* (New York and London: Edition Peters, 1951)

Cage, John, *Winter Music* (New York and London: Edition Peters, 1957)

Cardew, Cornelius, *Treatise* (New York and London: Edition Peters, 1967)

Cowell, Henry, *Piano music. Vol.1* (New York: Associated Music Publishers)

Crumb, George, *Makrokosmos I* (New York and London: Edition Peters, 2002)

Feldman, Morton, *Last Pieces* (New York and London: Edition Peters, 1959)

Feldman, Morton, 'Intermission VI' in *Solo Piano Works 1950-1964* (New York and London: Edition Peters, 2002)

Harrison, Bryn, *Repetitions in Extended Time* (unpublished music score: University of Huddersfield Repository, 2008)

Kurtag, György, *Játékok Volume I* (Budapest: Editio Musica Budapest, 2004)

Ligeti, György, *Atmosphères for orchestra* (Vienna: Universal Edition, 1961)

Ligeti, György, *Volumina* (New York and London: Edition Peters, 1973)

Oliveros, Pauline, ' Rock Piece' in *Anthology of Text Scores* (Kingston: Deep Listening Publications, 2013)

Stockhausen, Karlheinz, *Kontakte, Nr 12* $\frac{1}{2}$. (Germany: Stockhausen-Verlag, 1958)

Stockhausen, Karlheinz, *Mikrophonie I, Nr 15.* (Vienna: Universal Edition, 1964)

Stockhausen, Karlheinz, *Tierkreis Nr 41* $\frac{1}{2}$.(Vienna: Universal Edition, 1974)

Tenney, James, *In a Large, Open Space* (Lebanon: Frog Peak Music, 1994)

White, John, *Drinking and Hooting Machine* (unpublished music score: Experimental Music Catalogue)

(ii) Acousmatic Pieces

Ligeti, György, 'Artikulation' in *Ligeti: Project Vol.5 - Ballad & Dance, Cello sonata, Artikulation, Aventures, Nouvelles Aventures, Musica Ricercata, Big Turtle Fanfase & Régi magyar társas táncok* (Paris: Warner Classics International, 2006)

Ligeti, György, 'Glissandi' in *Electronic Music Sources Volume 1* (Holland: Sinetone AMR, 2010)

Subotnick, Morton, 'The Wild Bull' in *Subotnick: Silver Apples of the Moon/ The Wild Bull* (Mainz: WERGO, 2016)

Xenakis, Iannis, 'Concrete Ph' in *Adventures in Sound* (London: Él Records, 2009)

(ii) Performance art Pieces

Hamilton, Helena, ‘Untitled (WHEN)’, *Helena Hamilton* <https://www.helenahamilton.com/untitled-when> [accessed 7 August 2018]

Jones, Daniel-Wyn, 'Pigeon Talk', *Daniel-Wyn Jones soundcloud page* <https://soundcloud.com/daniel-wyn_jones/pigeon-talk> [accessed 7 August 2018]

Appendices