Augmenting an improvised practice on the viola da gamba

Mark A.C. Summers

Doctor of Philosophy in Music

Department of Music
University of Sheffield

June 2018

Abstract

This thesis examines my improvisatory practice on the viola da gamba and its augmentation with mixed-music computer systems.

It comprises creative work and an extended written commentary and discussion.

My creative work is presented in two albums of music – solo viola da gamba improvisation, and viola da gamba and mixed-music computer systems – and supplementary recorded material.

The written commentary looks in depth at the presented creative work. I use the first, solo album to examine my improvisatory practice. To explore augmenting this practice with systems, I look in detail at my performances with *gruntCount* by Martin Parker, *Laminate* by myself and *_derivations* by Ben Carey. Examples of these performances are presented in the second album.

Scrutiny of these three systems leads to extended discussion of the following topics:

1. Taxonomy: What are these systems? What are the characteristics they display? Do these systems fit into a standard classification scheme?

2. Ontology: Do performances with these systems instantiate musical works? What are the criteria that would help us to decide? How much of my practice is therefore underpinned by musical works?

3. Copyright: Who is responsible for the musical output with these systems? Who is a legal/musical author in such performances?

To conclude, I compare my improvisatory practice with and without systems and identify learnings arising from this research.

Contents

List of figures

List of tables

Chapter 1

Prologue, or why this work interests me

Contents

What follows below, after a brief account of the first time I played with an 'interactive music system', is an overview of how I got to this point both musically and academically. What is the point of that, one might ask – well, it is an overt acknowledgement of the various studies and experiences that have shaped my thinking. It will give some sense of why this work interests me. It provides a foundation for the highly personalised account of my practice that follows in subsequent chapters, and thereby forecloses any points of discussion that might lead to tangential departures from the central thesis.

1.1 First time

My first experience of improvising on the viol with an interactive music system was not a great success. It was to be an encounter between myself and "a modern-

day musical automaton"[1]. It is described by its designer as "not an instrument to be played but a non-human artificial musician that performs alongside its human counterparts". The problem for me (and by extension for my audience) was that it was in a bit of a strop.

Things had not gone well before the performance. We had a soundcheck for all the other pieces (most of which are to be found on the subsequent CD) and things were mostly fine. Towards the end, it became apparent that the "artificial musician" was having some issues, and that no rehearsal was going to be possible. I was unconcerned – after all, how bad could it be? I was an improviser so I would just make something up later on when the issues had been fixed.

Along came the performance. The other pieces passed largely without incident (though the point at which a speaker spat out part of its wadding was apparently quite dramatic). Finally, it was time to play with the non-human. The audience were expecting an improvised encounter of some sort, but I still had no idea what I was in for. I had been led to believe that the system would interact with me, via a physical assemblage that sat on stage next to me (some kind of pipework with a transducer).

I started to play. The system did not. I played again. The system made a small squawk and fell silent again. From that moment on it became increasingly clear that that was it, nothing more would issue forth from my improvising 'partner'. I did my best to keep going, despite feeling more and more uncomfortable. Having been used to playing with others, whether they had instruments or computers, I was sitting there, isolated, with an audience waiting for something to happen between me and it. Some minutes later, I gave up on the experience and stopped, having learned the valuable lesson that when playing with computers one should never, ever go on stage without a successful soundcheck. Never.

1.2   How did I get here?

The practice described in this thesis is rooted in my training and academic pursuits over my lifetime, and one of the ways that this thesis has been helpful to me is how it draws my seemingly disparate interests together to explore this area of performance.

---

[1]https://www.busterandfriends.com/io-001-beta/

1.2.1   Why the viol?

I started playing the cello when I was four years old, continuing with regular lessons until the age of seventeen. By that point I had sat numerous exams, ending with the ABRSM Advanced Certificate (later replaced by the current ARSM[1]). As such, I had been thoroughly schooled in the conventions of mainstream classical music.

At about the age of sixteen, I was introduced to the viol. It is an instrument that cellists take to relatively quickly and I was no exception. Over the next few years it would supplant the cello as my main instrument, though I have still to achieve the same degree of ingrained muscle memory for the viol as for the cello.

During my time as an undergraduate (Edinburgh, BMus(Hons)), my interest in new music expanded and I concentrated on performance of small scale works in this area and largely stopped orchestral playing. At the same time, I was increasingly pursuing historically-informed performance, on viols and gut-strung cellos. After my BMus, I spent a year at music college (Trinity College of Music, MMus), with the viol as my main study and, by the end of the year, I was one of five musicians from across the College to be invited to compete for the Gold Medal, the College's most prestigious prize.

Essentially, my interests moved increasingly from relatively mainstream to niche and esoteric.

1.2.2   Viol + computer

I returned to Edinburgh and started to work with the composer Martin Parker as he developed his musical practice with MaxMSP. I started playing the viol in this work, with Martin on self-made patches. The combination of viol and computer turned out to be ideal and, after a couple of years, a big project developed that culminated with a multi-premiere performance[2] and a CD of me playing with various composers' systems (Edwards et al., 2005).

1.2.3   Classification and copyright

Alongside playing, I had been doing a fair amount of research/music editing in various libraries and decided to train as a librarian. I moved to Oxford in 2004 to

---

[1]https://us.abrsm.org/en/our-exams/diplomas/music-performance/arsm-associate-of-the-royal-schools-of-music/

[2]Part of which is described in section 1.1 above.

spend a year as a trainee at Nuffield College library, and then to Loughborough to complete my qualification (MSc).

While in the Department of Information Science, I started to classify things. Library training covers classification and taxonomy, learning to put things in categories and work out the relationships between them. I became more and more interested in the research side, eventually completing my dissertation on citation analysis and research assessment in music (published later as Oppenheim and Summers (2008)).

After a brief stint as an actual librarian (cataloguing and classifying at Leicester University library), I got a job back at Loughborough as a Research Associate at LISU (Library and Information Statistics Unit). There I worked on a number of projects looking at various aspects of information science – scholarly communication, bibliometrics, library consultancy and the like.

As part of my job at Loughborough, I was the University's copyright officer. To enable me to give advice and training from a position of knowledge, I took a course in copyright law (King's College London, PGDip), during which I discovered that the most interesting cases in copyright law involve music, often concerning questions of musical contribution and the corresponding authorship.

1.2.4   And back to music

Information science was all well and good but I felt I did not have the depth of knowledge that would make me the best academic I could be. So, for my PhD studies, I naturally gravitated back to music to make use of my background knowledge and experience. I started out with the aim of becoming self-sufficient as a performer of instrument+computer music, building my own systems and performing with them, but over the course of my research I have increasingly concentrated on performing.

Thus I present here a thesis that sets the performance of music at its heart.

Chapter 2

Introduction

Contents

This thesis is about my practice as an improvising musician.

I improvise on a viola da gamba[1], both solo and augmented by the use of computer systems. I refer to the performance activity where I mix instrumental playing with computer systems, combining the two in (joint) musical performances, as 'mixed-music'. Importantly, there is just one human performer.

Because this thesis is a study of my personal practice as a performer, it is a necessarily personal thesis.

---

[1]N.B. Names for the instrument, 'viola da gamba', 'gamba', 'viol', and other variations, can be used interchangeably. I have a preference for using 'viol'.

2.1   A performer's account of action

Fundamentally, this is "a performer's account of action"[1], and it expands to include discussions about elements that can affect that action, or occur because of it. The purpose of this is to extract embodied knowledge and yield a fuller understanding of this practice.

In my emphasis on discussing the *performance* of mixed-music I offer this thesis as a contribution to balance out an overwhelming preoccupation with technology in the field thus far[2]. I have not aimed to make generalisations about improvising with or without computers, rather I am describe examples of this practice.

2.2   How I did my research

This project is an example of practice-as-research[3]. The musical activity described here and on the two albums is the beating heart of this research.

Gray (1996) cites the Hindu story of the blind men describing an elephant with each having a partial view of the animal and having to combine all their experiences together to describe the whole: "And so in the case of describing and developing practice-led research; the experiences of many researchers are required to define the parts in order to form the whole picture." I see my work sitting with other performer-focussed research in mixed-music, such as that described by Kimura (2003), Pestova (2008), Nicolls (2010), Berweck (2016), Lloyd (2016) and Furniss (2018).

The part of the elephant that I describe here is akin to that in Geeves and McIlwain (2009), having as a focus "the type of performance experience an individual musician views as worthy of striving toward (and avoiding) and the possible way(s) in which this can be accomplished". It also to some extent "sacrifices some generality of observation in order to contend with musical practice in local, socially entangled, contentious and noisy complexity" (Green, 2016).

---

[1] An idea suggested by Pete Furniss in a personal communication, August 31st 2017.

[2] Even a cursory glance over the leading conference covering this area, the *International Conference on New Interfaces for Musical Expression* (NIME), reveals a massive skew towards *New Interfaces*, with only a smattering of *Musical* and a tiny bit of *Expression*.

[3] Gurevich (2014) has 'practice-based research' while Green (2016) has 'practice-led', Schroeder (2015) proposes 'practice research', and Nowotny (2012) prefers 'artistic research' – there are different nuances that are appropriate for different purposes in different contexts and they may change for different people, so I have just chosen one that reflects my feeling that all my practice is research in some way.

I have allowed myself the time and space to explore my practice through the doing of my practice. This approach is in line with that of Vincs (2007) who writes of her dance research "I want to develop the idea that dancing and making dance forms a space or a substrate within which to think about dance. Rather than dances being the outcomes of thinking done previously, dances are the actual process of thinking, and this process is the core methodology of studio-based dance research".

My method has been a combination of *doing* and *writing*. The process has been messy, full of fits and starts, but it has been bound together with constant *thinking*. Indeed, regular self-examination, both musical and psychological, has been a fertile thinking ground as my practice is inextricably linked to who I am as a person.

I have been very insular in my *doing*. What outside influence there might be comes from the folk I have played with in the past, from the creators of the computer systems and from the occasional recording. I have come to see this as an active choice on my part, as I attempt to come to terms with who I am as an improviser.

The opposite is the case when it comes to the theoretical work, the *thinking* and the *writing*. You will see later on in this thesis that the work of other people is pivotal to my understanding of my practical situation when I discuss the theoretical aspects.

2.2.1 Doing

If the knowledge I am trying to uncover is hidden in my practice, then I had to do some *doing* before I could do *uncovering*: very obviously, it is essential to do the practice in order to find out what it is like to do it.

My two modes of improvisation, with and without computer systems, are represented in the two albums that make up the overtly musical component of this thesis[1]. My underlying style is 'non-idiomatic', like the free improvisation practiced by Bailey (1992). My relationship with this style is somewhat problematic. My conventional classical training runs very deep and as a result I have this nagging feeling that exploratory improvisation, where the audience joins the performer in experiencing found sounds at the same time, is somehow a charlatan's game. Rationally, I know that this is not the case, but I have to work hard for the self-acceptance that will allow me to play in public with the assurance that this is a worthwhile activity.

When improvising with other musicians, I have a better feeling about the activity because there is at least one more person to share the responsibility and to vali-

---

[1]Small (1998) would class my writing as musicking, and similarly your reading of my writing, hence describing the albums as overtly musical rather than 'the music'.

date my own efforts with their continuing presence. Substituting a computer for a human musician removes this sharing and validation, so I am in the same position as I would be alone, albeit with more sonic support. The big difference is that a computer cannot respond to my extra-musical communications, it cannot soothe me, question me or egg me on.

To ease the potentially paralysing position of playing solo, my *doing* has taken place in a studio environment and latterly in a private performance space. My usual set-up is a simple one. For input, I use a small, instrument-mounted microphone to input sound to the computer. This ensures that sound is captured from a uniform position from performance to performance and at any given time during a performance (i.e. the microphone moves with the instrument). It also allows a lower gain to be used which in turn minimises the inclusion of outside sound (including room reverberation), reduces the likelihood of direct feedback and prevents potential bow-microphone collisions. The main disadvantage of this on-instrument microphone positioning is that it cannot capture the optimal sound of the instrument, as this radiates from the entire instrument and can only be heard from further away (though still relatively close).

For monitoring the output of the computer system, I started out using headphones as they give a clear perspective on the computer's output and minimise the chance of it leaking through to the microphone. Avoiding the room while listening to the output is not necessarily a disadvantage. Of course, it is very different to giving a live performance to an audience, but the live experience is characterised by compromised monitoring – in most performances I have sat behind the speakers, or outside the speaker ring if it is, say, a quadrophonic set-up – so it too is less than optimal. Latterly, however, in an attempt to mitigate this sometimes difficult situation, I have been performing to an empty room with out-loud monitoring and in the process I uncovered a number of issues which I address where appropriate in the text (mainly in chapter 4).

To record my playing for listening and analysis, viol input and computer output signals were recorded to separate channels (as many as appropriate), using in-system functionality. Additionally, I took 'field notes' in which I tried to capture as much of the experience as possible (see section 2.2.2).

Having a simple set-up is a conscious choice, as is having only a small concern for extraneous noise. I find that striving for 'ideal' conditions puts a significant obstacle in the way of me sitting down to play, and I have tried to minimise such barriers at every opportunity. Fortunately, this has the distinct advantage of being consistent, the sound and environment being very stable between sessions.

2.2.2 Writing

The written component of this thesis is made up of a number of different elements, each with a distinct approach to the writing. It comprises:

- Descriptions of the experience of improvisation, and of recorded music

- Drawing out elements of commonality/difference in those descriptions

- Descriptions and results of musical analysis

- Extended philosophical discussion of matters of interest

First, the field notes I made whilst in the studio are a link between my practice and the written component of this project. When writing them I am aiming for the honesty and frankness that de Montaigne sets out in the introduction to his *Essays* of 1580 (de Montaigne, 1877): "twas my wish to be seen in my simple, natural, and ordinary garb, without study or artifice, for twas myself I had to paint. My defects will appear to the life, in all their native form". This has been an important touchstone when making notes, a reminder that what I am aiming for is a description of the experience of playing, how it feels to play this music, in as raw a form as possible with a minimum of analysis (a process that comes later). These notes are a way to extract the embodied knowledge from my playing experience, and they are something of a half-way house between the freedom and lightness of performance and what can feel like the crushingly overwhelming weight of writing this thesis.

I am attempting to grasp the 'elusive obvious', an idea put forward by Igweonu et al. (2011), the "ethereal aspect of creative arts practice that is often palpable to the practitioner but equally hard to pin down within the creative process". They suggest that "expressive writing" is a way to reveal this, and can be used as "a vehicle for grasping and articulating process in order to provide critical insight on the subject or object of enquiry" (Igweonu et al., 2011).

Another example I have followed is that of *Ways of the hand* (Sudnow, 2001), in which Sudnow presents a detailed examination of the process of learning to play jazz on the piano. In his foreword to the second edition, Dreyfus characterises the book as a "production account", with Sudnow keeping to the "concreteness of situated relevant detail" without leading to generalisation (Sudnow, 2001). This approach fits well with my attempts at a performer's account of action.

Second, I have analysed my field notes to find common themes so that I can give a concise experiential description, to make comparisons of my playing with and without computer systems, and then to draw conclusions about my practice. My

underlying motive is to "attempt to take you as the reader into the intimacies of my world" (Sparkes, 1996).

In this process, I have settled on my own particular version of autoethnography, though this has been a recognition of what I have done rather than a premeditated choice of method. It has been a useful tool, with benefits in common with Vasconcelos (2011) who states "I came to autoethnography because I realized that if I expected to answer the questions that compelled me (What makes me the teacher I am? What has made me into the teacher I am?) with any chance of success, I had no other, nor better or more promising place to go".

As suggested above, I do not mean to present my experience as being typical of others, so it follows that I do not make generalisations beyond those that apply directly to my practice. This position is supported by Lloyd (2016) who points to advice given by Rice (1994) on bias in ethnographic research – one should be careful not to substitute a 'fictitious author' (e.g. 'the Bulgarians') for the actual person(s) who are representing the group being studied. Lloyd states that "it was important for [her] to develop a discourse that did not rely on making generalisations... but that was nevertheless analytical of [her] own approach". And so it is for me.

Of course, an improvisatory practice that uses the systems of others is necessarily a commingled one and, as such, I have examined what is essentially an extension of the system creators' agency into my performances, particularly its manifestation in the systems themselves and the overlaps of creativity/authorship/responsibility between performer and system creator. Questions that arise from this are largely dealt with in the discussion chapters (chapters 5, 7 and 9), each of which takes its kernel from the examination of the preceding system. I use these ideas to probe my practice with systems, but I do not make the discussion *about* the concepts themselves. Rather, I use these ideas as lenses through which to examine my practice with systems and to gain a better understanding thereof.

2.2.3 Selecting the systems

I concentrate on three systems in this account: one made by me (*Laminate*), one made for me (*gruntCount*) and one that was freely available for me to download (*_derivations*).

The main prerequisite for each system was that it should be a standalone system that I could operate with minimum fuss on stage, with no need for involvement from a second person in performance. To me that means simple setup/system priming, a minimum of key presses to get things in motion (ideally just one) and no additional controls to manage during performance. Essentially, I want to start

the thing running and then play music with it, rather than play the dual role of performer and computer operator.

Martin Parker and I have worked together on and off for almost two decades. Because of this, I was in mind when he was building new versions of *gruntCount*, personalised modifications of the system he developed with and for Anne La Berge[1]. It is a musically rewarding system to play with and my studio recording is included on the *gruntCount* album[2]. *gruntCount* is discussed in depth in chapter 4.

My own system, *Laminate*, was built around the idea of the loop being the easiest way to set up an improvising duo partner, designed to be a live version of *Treading*, a fixed piece I made previously[3]. It was a simple idea that I could more or less program myself with my rudimentary MaxMSP skills. The fact that it is a very satisfying system to perform with is a happy accident, simple but not simplistic. *Laminate* is discussed in depth in chapter 6.

The third system, *_derivations*[4], was made by Ben Carey. He responded to a message about looking for systems to play that I put out on various email lists in 2013. The system's open availability was appealing, and the improvisational premise of the system appeared to offer an experience close to having a duo partner. *_derivations* is discussed in depth in chapter 8.

2.3   Research questions

Following Gray (1996), Haseman and Mafe (2009) suggest that "the practice-led researcher may find problem definition is unstable for as long as practice is ongoing and it is only when the practice is done... that the final research problem will be decided". It has been like this for me, the questions to be answered only emerging gradually along the way, including when looking back at my practice at the point of writing about it.

I have found that my interests (outlined above in chapter 1) have been very influential, and also that directions have come about because they have presented themselves as appropriate avenues to pursue.

Potential questions have come from an easily delineated practice – the instrument, the type of systems, the improvisation – and this gives a solid centre to its examination and a coherence to my account of it. I raise many questions along the

---

[1]http://annelaberge.com/
[2]https://sumtone.bandcamp.com/track/frau-mausi
[3]https://soundcloud.com/maxhummus/treading
[4]Freely available to download at http://derivations.net/

way, many of which I leave unanswered, something that Scrivener (2000) views positively as a problem-posing rather than a problem-solving approach: I cannot answer all the questions that come up and indeed I do not aim to.

Throughout all this self-examination, the over-arching question I have kept in mind is "what is it like to engage in my practice, what is it like to be me doing this activity?" I address this question in the chapter about my solo practice (chapter 3) and the chapters about improvising with systems (chapters 4, 6 and 8).

Following on from this is "what is it that I am doing, where the music can be so different between performances yet feel so similar?". This had to be answered by asking subsidiary questions which I address in the three substantial departures from direct discussion of my practice:

- Chapter 5 – What are these systems that help make the music (taxonomy)? Do they fit within existing musical instrument schema?

- Chapter 7 – How much, if any, of my practice is underpinned by the presence of musical works (philosophy)? How can I tell?

- Chapter 9 – Who is responsible for the music that comes out (copyright)? Where is the authorship?

2.3.1 Determining factors

My practice, and with it these particular research questions, sits within a wider context, so here I have taken a moment to sketch out some of the many determining factors in the immediate ecosystem of performance. What follows is a list of what could be seen as 'nodes' in a network of determining factors, outlining many of the concerns that I as a performer might have, both practical and theoretical. It is not meant to be comprehensive, rather it is designed to give a flavour of the situation of my practice.

Improviser How am I feeling? Excited, nervous, clueless, ill?

Have I been practicing enough?

Composer Is the creator of system a composer, sound designer, environment creator? What do these mean, do labels matter?

What relationship do they have to the performer?

Musical work Is there a musical work associated with the system?

Time scale Does it have a time line, fixed/unlimited duration or progression through scena?

Can it play at different speeds?

Type of system Different paradigms, like player/instrument.

Set-up of system Is it generic or instrument specific?

Nature of system generation Where does the system sound come from?

Is it (re)synthesised? With/without reference to instrumental input?

Is it processed? How far removed is it from the instrumental input?

'Intelligence' of system How are choices made by system? According to fixed/random composer design ('dumb') or using some kind of model ('intelligent')?

Generosity of system Is it effortful to get a response?

Thick/thinness of system How much of it is shaped by the instrumental input? Relative number of choices for system-maker and improviser.

Microphone placement Physical – do I need to avoid hitting a fixed position mic or yanking the cable of an instrument-mounted microphone?

Aural/aesthetic – what does it sound like?

Improvisation Does it require a specific style of improvisation?

Does improvisation style make a difference?

Sound world Is there a pre-defined aesthetic to follow?

Does the aesthetic come from the 'expectations' of the system/maker?

Personal preference/habit.

Familiarity with system Exploration or re-treading paths?

Instrument Does it feel alive? Is it effortful to play?

Is it comfortable or precarious holding the instrument – am I wearing the right trousers?

Presence of audience Physical, virtual or imagined.

Expectations From audience, from self.

Audience perception Do they see the interaction? Do they care about seeing it?

Performance place Time, feeling of physical environment.

Output Room effect, monitoring, speakers, speaker set-up.

There is a whole host of factors at play here. Given the number of different areas, it will be obvious that to cover all of them would be impossible within a finite PhD time period, so this could be seen as a checklist of things noted but ultimately set to one side to keep my project within a manageable scope. Instead, I have gravitated towards a small number of areas/ideas, and I have looked in some detail at how these relate to my performance.

2.4 Form of the submission

This thesis comprises two components, one performed and one written.

2.4.1 The performed

Presenting an experience as ephemeral as improvised performance in a thesis is problematic (this and other issues are discussed in chapter 3.2 below). It is especially difficult to present the playing from the player's point of view, rather than simply the listeners'[1].

I include two albums as examples of my practice:

- Album 1: *The unquickening pace*, solo improvisations

- Album 2: performances of *Laminate*, *gruntCount* and *_derivations*.

In addition, an appendix includes additional, related audio material.

2.4.2 The written

The written component that you are reading now is more straightforward. It verbalises the experience of the performed component. This can be read in chapters 3, 4, 6 and 8, where I focus on the doing of my practice. Chapters 5, 7 and 9 each contain a discussion of the related theoretical work. They are interspersed like this

---

[1]Though Colton (2017) says of my solo album that "we hear every gritty detail, squeaky string, and scraping glissando as if we were making the music ourselves."

so that the questions raised by a particular musical case are then immediately addressed in the following chapter. For example, chapter 6 finds that the *Laminate* system feels very like a musical work, and then chapter 7 asks if it is possible to conclude whether it is indeed a work in ontological terms. A final chapter draws together the themes uncovered and comes to some conclusions about me and my practice.

I hope that the combination of reading these chapters and listening to the two albums will give you, the reader-listener, an extended insight into my practice, and will hopefully lead you to raise questions of your own.

Chapter 3

Solo without a computer

Contents

The improvised music I create in my practice centres on sound, with a particular emphasis on timbral qualities. My personal sound is the result of combining my playing technique with a particular instrument, sometimes with and sometimes without without a computer companion.

The viol is a fairly unusual instrument in most musical genres, whether it be conventional Western art music (WAM), contemporary music, experimental music, free improvisation or mixed-music. Because of this, in this chapter I discuss the sound of the instrument, both as it is played conventionally and how I play it within the practice described in this thesis.

Laying out my playing of the instrument without a computer system allows me, later in this thesis, to make direct comparisons of experience when the computer is present. Here, I highlight matters of interest and issues that arise in the act of improvising, especially an overview of my sound and aesthetic tendencies and the aspects of the instrument that particularly attract my attention.

It is a difficult thing to describe sound in words, but I attempt this below with regard to the viol using historical sources and recent commentary. After that, in the latter half of the chapter I dwell on my own sound as part of a wider discussion of my improvisatory practice on the instrument, solo without computer, as exemplified by my solo album *The unquickening pace* (Album 1).

3.1 The sound of the viol

The viol is "a bowed string instrument with frets ... [that] appeared in Europe towards the end of the 15th century and ... continued to flourish until the middle of the 18th century" (Woodfield and Robinson, 2001). It is not a straight-forward task to give an overview of the conventional sound of the viol, as Rutledge (1979) notes: "It simply is quite difficult to describe in words the refined sound of an instrument such as the gamba. A great deal of subjectivity is involved and there has never been much in the way of standard vocabulary". Further, it is noteworthy that there is no single 'standard' viol to describe. Rather, each instrument is a historical snapshot (or modern copy thereof) of a certain place and time (sometimes with elements that do not survive the intervening years and have to be reconstructed, such as bridges), in which one can see development achieved up to that point. For example, there is a great difference between a tenor renaissance viol by Linarol (c.1540, plain gut strings, no soundpost) and, say, an early eigthteenth century seven-string bass by Bertrand (the model I use, with three silver-covered strings and a soundpost).

3.1.1 Historical descriptions

In contrast to the violin and other standard instruments, there is no continuous tradition of viol-playing because it went out of fashion and, practically speaking, died out by the start of the nineteenth century (Summers, 2001). The resurrection of an obsolete, historical instrument has led to a constant consideration of what performance practice is appropriate, notably in terms of playing a particular piece of music with the right kind of instrument and technique. In recent years, researchers have gathered evidence from old written sources and extant instruments in order to make decisions about performance practice. Thus, the history of the viol is a living part of its present, and it has the weight of history and the weight of modern historicism intertwined with every sound made on it.

Thus the historically-informed playing of today is based on a number of treatises and other sources from (mainly) the sixteenth to eighteenth centuries. Such works tell us much about how to play the instrument as it was being practiced at a certain place and time. As with other aspects of musical convention that are not apparent in the notated music (for example, the French *notes inegales*[1]), knowledge of the sound of the viol appears to have been assumed by most writers of methods for playing the viol. Thus, useful information about the sound is not to be found in what we might think would be obvious places. Instead one needs to look for "unlikely sources such as diaries, novels or 18th-century periodical and satirical literature, one has to rely on serendipity, and the task may take a lifetime" (Rutledge, 1979).

Mace (1676) provides a few words in his *Musick's monument* (a book mostly concerned with the lute), illustrating the sort of language that was used in describing the sound:

> "Now being Thus far ready for exercise, attempt the Striking of your Strings; but before you do That, Arm your self with Preparative Resolutions to gain a Handsom-Smooth-Sweet-Smart-Clear-Stroak; or else Play not at all: For if your Viol be never so Good, if you have an Unhandsom-Harsh-Rugged-Scratching, Scraping-Stroak, (as too many have) your Viol will seem Bad, and your Play Worse" (Mace, 1676).

Historically, imitation of the voice was a common standard by which many instruments were described (Schubert and Wolfe, 2016), and the viol is no exception. For

---

[1]The convention of playing notes of evenly notated time values in an unequal manner.

example, both Mersenne and de Machy suggest that the viol is the closest match to the voice (Rutledge, 1979). Descriptions by these and other writers use words such as sweet, lusty, tender, ruffness, brilliant, lovely, velvety softness, clarity, sweetly touching, nasal, humming, snarls, twangs (though these last two were used to describe an organ stop modelled on the viol) (Rutledge, 1979). Most of these words are not particularly useful on their own as they could be used for many different things. Some of this list seem rather pejorative - ruffness, nasal, humming - but they do relate something of the distinct sound of the gut-strung viol.

Henry Purcell gives us a contemporaneous evocation of the sounds of the instrument, perhaps tongue-in-cheek and/or affectionate:

> Of all the Instruments that are,
> None with the Viol can compare.
> Mark how the strings their order keep
> With whet whet whet and a sweep sweep sweep.
> But above all, this still abounds,
> With a zingle zingle zing, and a zit zan zounds
> (Purcell, 1693)

One notable writer who offers extensive descriptions of the viol's sound is Hubert le Blanc. He was writing in 1741, a time when the violin family was in the ascendant in France and the viols were already less popular and becoming more so. His *Defence de la basse de viole* is a somewhat polemical work, defending the viol against the rise of the violin which was "full of evil intentions against the viol" (Jackson, 1974). Le Blanc goes to some lengths to describe the sound, employing classical metaphors, gender characteristics and class distinctions amongst others. He variously describes the sound as partly gold, partly silver, feminine, tender and resonant like a bell, and that "the viol has a partly rounded sound, sharp, yet not sour, which nips in comparison with the instruments of Cremona..." (i.e. violins), "...drawing on the tone of an ambassador's voice, which is not loud (and even a little nasal)" (Jackson, 1974). The viol is able to "greatly diminish" sounds (i.e., play very quietly), is not very effective from a distance, but very good close-to (unlike the violin, which is the opposite), whilst "the evenness of the viol['s tone] is more suitable for a gentleman's use [than the violin]".

3.1.2 More recent comment

Writers in more modern times have also attempted to describe the viol's sound, including Galpin (1932) "soft and slightly reedy or nasal, but very penetrating",

and Campbell and Greated (1988): "The tone on the viols is generally quieter but more edgy than on violins".

Otterstedt (2002) describes it as "bright and a little rough" and states that:

> "From the sound of preserved old instruments we can infer that the ideal was not at all an evenly flowing, immaculate sound without accidental noise, but a mixture containing a high degree of reedy components, plenty of accidental noise, and an overtone structure so complex that modern recording technology has occasionally been known to be overtaxed by it"[1].

One of the significant problems with describing sound is the existence (or not) and use (or not) of a standardised vocabulary that links directly to physical attributes. Recently there have been studies that have attempted to accurately link specific words with specific sound qualities for specific instruments (e.g. Fritz et al. (2012) whose work links semantic concepts with the violin's timbre space), but it appears that such a study has not yet been attempted for the viol.

3.1.3 Effect of stringing on its sound.

The viol typically uses strings made out of treated sheep-gut. This gut stringing is especially prone to making noise, a propensity that was noted by Rognoni in 1620 (though he was writing specifically about gut-strung violins), saying that the sound is "crude and harsh if not tempered and sweetened by dulcet bowing" (Webber, 2002).

An innovation of the mid-seventeenth century was the addition of metal winding around the string. A wire, often made of silver, is wound tightly around a gut core so that none of the gut shows through ('close-wound'). This winding gives a heavier string weight with a significantly smaller increase in diameter compared to plain gut strings of similar pitch/tension, allowing more manageable thicknesses for lower pitched strings (reducing problems that thick strings would otherwise pose in tightly confined pegboxes). The introduction of this technology to France saw an extra, seventh string being added to bass viols from the later seventeenth century on.

---

[1]I disagree with this latter point, referring the reader to my album that features complex overtone structures in abundance with no technical problems (see section 3.2 below). Otterstedt provides no evidence for this 'overtaxation' and I assume that it derives from issues encountered in her personal experience of recording.

Another associated string type is the 'open-wound', where a metal wire is wound round a gut core in a wide spiral, leaving a surface which is mostly gut. This is designed to bridge the gap between plain gut and close wound strings, theoretically giving a sound that is halfway between, though it has more in common with the plain gut than the close wound.

The particular instrument I use is a seven-string bass viol, based on an extant early-eighteenth century instrument by Nicolas Bertrand. I have two different string types to play on, plain gut and close-wound gut, with different sound qualities and bow response.

The top four strings are plain gut. They are thicker, have a rougher surface and are more flexible than corresponding synthetic strings used on 'modern' instruments. There is a definite edge to the sound, and the pure-tone to noisy range available with normal bowing is quite large, even without using extended techniques.

The fifth, sixth and seventh strings are close wound. As these strings vibrate easily in sympathy with other sound, they give the instrument a resonant halo, and produce most of the vibrational energy for the instrument's long natural resonance. The wire is round in cross-section, meaning that the strings have small ridges running perpendicular to their length. As a result, when a fingernail is run down the length of the string, it acts as a succession of tiny pizzicati, and differing pitches can be produced by increasing/decreasing the speed with which this is done. Another aspect of this surface type is its predisposition to making sweep noises, exactly like those heard from guitars but which do not feature on violins and cellos (since modern strings are flat wound).

3.1.4 The 'scourge' of cello technique?

Many viol players have previously been cellists, myself included. Such a start can aid a quick progression from beginner to competent player, with the basic hold, left hand fingering and right/left hand coordination being familiar. Other aspects of viol technique are alien – keeping the left elbow down, pulling the fingers down close behind the frets, the lack of continuous vibrato and the bowing/bowhold.

To take this last aspect as an example, one can start to question where viol technique boundaries might lie, if indeed there are boundaries. Tension is usually maintained by the action of the right-hand fingers on the hair, and the bow is kept on the string with (generally) three points of contact – first finger knuckle, second fingertip, string(s). In theory, without any one of these three the bow will slip off, though in practice the thumb and forefinger often grip the stick. Higher tension and thus putting more force into the string is achieved by rotating the hand so that the middle finger is turned more towards the floor. It is very difficult to achieve

high-tension bowing for long periods of time without great fatigue, hand pain and a greater risk of damage to the bow. This type of bowing, the bow/string contact that it forces and the limitations it places on the player are all part of the essence of the instrument in extended practice.

It would be easy to change the bowhold from underhand (viols) to overhand (cellos), but I see this as undesirable. On a cello or any other modern instrument, there is an endless scope for anything that is physically possible, with no qualms about using other instruments' techniques. This is perhaps because continuously played instruments have a tradition which engenders self-confidence in extended areas. As mentioned above, the viol was effectively dead for near enough a century (c.1780-1880) and so does not have this continuous tradition of playing, teaching and construction in the same way as other instruments. When the viol was revived at the end of the nineteenth century, it was largely as an antique curiosity, a historical rather than current instrument. Technique had to be reconstructed using historical written sources.

I resist the temptation to use cello techniques on the viol for three main reasons. First, the viol's identity comes from a delimited period of time and its technique is clearly set out in the historical documents that describe it (and which underpin learning and practice on the instrument). Second, it feels wrong to 'play the viol like a cello' as the physical experience is so different – the underhand hold sits in constant contact with the string, with a strong pull to floor, and the bow acts as a continuous connection between right hand and instrument, whilst the overhand hold is more airborne/flying, is placed on the string from above, and the bow feels like an extension of the arm. Third, I have found that overcoming any limitations and coping with difficulties that may occur is an important spur to creativity.

3.1.5   The viol in contemporary practice

Contemporary music has a small but established place on the viol. I state it this way, rather than the other way around, because what new music that is written tends to happen in a viol context, rather than the instrument being brought into a contemporary music context, say as part of an ensemble. On the few occasions this does occur, it is usually because of a personal relationship that compels a composer to write for the instrument.

The earliest new music for viol after its revival appears to be Balthazar Bettingen's Concerto for viola da gamba and orchestra (1931)[1] and since then there have been an increasing number of pieces for the instrument on its own or in combination

---

[1]https://vdgsa.org/cgi-bin/nm/work_details.cgi?id=1024

with other instruments. The viol consort, groups of three or more viols playing together, is typical of historical English viol music and much of the instrument's repertoire is devoted to this chamber music. The current consort Fretwork has done much to extend that repertoire to include modern day composers, having worked with over twenty thus far.

3.1.6   Overview of my practice

My practice differs from this modern tradition, however, as its focus in not on conventionally notated music. Rather, I am interested in improvised viol, with and without 'electronics', and there are few other exponents in the world with a similar approach to me[1].

My 'contemporary' playing has largely used extended techniques and typically avoids the conventional techniques used when playing 'historical' music. My improvisation has tended to dwell on noisy aspects of the instrument. I first explored the noise-making potential of the viol whilst performing Martin Parker's *Environment for stone violin* (Parker, 2005). Here, the viol was taking the place of a stone sculpture of a violin that is played using a stone bow, creating a gritty, scraping noise.

The viol is rewarding for me in a new music context because of its noise, scratch, glitch, also the physicality of the instrument - the way it is constructed, held, played, hugged - and how its limitations can provoke artistic decisions. For example, the bow excites the string in a sawtooth stick/slip motion, friction/tension enabling the string to be pulled a fraction sideways by the bow hair until it goes too far and is released. A similar tension/release pattern can be seen in much of the way that I play the instrument. Exploring this concept in physical movement against the instrument in various ways can at times be a primary aspect of my playing, certainly in the louder, more frenetic and noisy parts of my improvisation.

In section 3.2 below, I present a commentary on my solo album *The unquickening pace* which serves as a (necessarily selective) overview of the part of my improvisatory practice that does not use computers. As well as being a substantial part of the overall portfolio included in this thesis, it enables direct comparison of the two distinct experiences of improvising with and without a computer.

---

[1]Two players I have had contact with are Nicoleta Chatzopoulou (Greece) and PY Martel (Canada).

3.2 *The unquickening pace*

In 2015 I made a solo album[1]. Comprising ten tracks, this album gives some idea of the sound world that I inhabit when improvising on the viol without any computer system or live processing.

The title is a play on the phrase 'the quickening pace', often used to refer to technological change. Making it 'unquickening' was intended to be a loose reference to the fact that this is an album with no computer equipment on it, simply using the eighteenth century technology that is embodied in the viol itself (of course, this ignores the part that computers played in the recording and subsequent mixing/editing/mastering/distribution of the album). The manner of use of the instrument's technology is also much changed from its historical roots, the techniques used in producing the sound being as much extended as conventional. So perhaps the loose nature of the play on words is appropriate – just because the rate of change is not increasing does not mean that change is not there.

The form of the commentary in this section takes inspiration from Geoff Dyer's book about Tarkovsky's film *Stalker* (Dyer, 2013), where he writes about the film and the resonances it has for him as a viewer, such that it contains many things the action (or lack thereof) reminds him of. Likewise here, my commentary/analysis is a mixture of several different viewpoints:

- Remembered – intentions and/or actions that are still clear memories or written in contemporary notes.

- Vaguely remembered – shadows of intentions/actions.

- Reconstructed – actions that can be deduced from careful listening.

- Listening afresh – more from a listener's perspective, aspects that were not part of the conscious creation process but which are apparent after the fact.

In the next sections, I will address the album's individual tracks in turn, except the *Tongue and groove* tracks which I take together as they have a particular interconnection.

---

[1]Co-produced with Owen Green who also engineered, mixed and mastered the recording. It is publicly available at https://fearful-owl.bandcamp.com

3.2.1 Curious mice never squeal[1]

This started with the idea of a 'French overture'[2]. The initial motive is a strong, fanfare-like opening statement on a unison D which owes much to Handel's Concerto grosso in D, op.6 no.5, something I listened to a lot 20 years ago. With reiterations, this widens out from the unison, becoming a major second, a minor 3rd (with a glimpse of a B below, making a diminished triad) moving to a major 3rd. Then it drops down a 7th, from being centred around the top (D) string down to the 3rd (E). The closely pitched double stopping continues to develop, widening to encompass more strings (up to five at 1m05s). There is a restatement of the opening (1m14s) which is extended to include a gradual drop down from the top string to the third, from where it builds up a quasi-pedal on E.

The bowing here is generally strong but even more forceful at times, which leads to a gritty sound that contains more noise than pitch. The quick crescendo shape < is common, especially at the end of short declamatory phrases. Overall, the pace is slow, until faster movement is foreshadowed at 2m12s, where the now familiar diadic material around the quasi-pedal is played with faster repeated strokes. This comes to a rest on a long held note with increased tension in the bow, then a release to an almost-slither down the instrument, a falling away that leads to a single line of rapid notes, the start of the 'fast' section.

The fast section starts a little under half way through (at 2m26s) with some grumbling around, double-bowed notes. There are lots of arcs where the pitch goes up and down with small steps between. Runs only going up also feature. All of them are pretty short gestures with short breaks between. More extended runs of ups, and up&downs going from/to the bottom string but instead of silence there are successions of repeated low notes. These give the same space as silence for figuring out what to play next, much as the ahs, ums and ers do in conversation, but they keep the sound going, arguably leading to a more forward moving feel – certainly the playing has more impetus that pushes along.

Much of the pitch changes sound like hand position changes, with approximate purpose, i.e. that the left hand is sent to an approximate place rather than to a specific note. The left hand goes to various points around the instrument, often

---

[1]From Ulysses by James Joyce. I chose that book because it was recently out of copyright, freeing it from a particularly protective literary estate.

[2]"A festive musical introduction for an opera, ballet or suite. The form combines a slow opening... with a lively fugal second section. ... [usually] the second section ends with a brief echo of the first, recalling its style, pace and sometimes even its melodic content" (Waterman and Anthony, 2001).

reverting to 'home' positions (places to which the left hand naturally gravitates out of familiarity).

The fast section of a French overture is often fugal in nature, and my idea before beginning the take had been to follow that pattern. However, I had forgotten about this plan having settled into playing. The route from slow to fast took me in a direction that had nothing in it to remind me, up until an arc after a low anchor point (2m57s) jogged my memory. Some fugato[1] comes at 3m09s, manifesting as arcs again, a bit like dozen-a-day piano exercises (Burnham, 1961), but slurred (both in terms of the right hand's bowing and also the slightly drunken-sounding manner in which the fingers 'act' at stopping notes as the left hand is moved up and down the neck), roughly following the example of a Bach one-part fugue[2] (in spirit, at least, and with a very short subject). On re-listening it reminds me of the airy harmonic bit in the second movement of Shostakovich's cello sonata, it has a similar shape and airiness to the sound, thus making one unintentional and two intentional allusions to existing music.

Figure 3.1: D. Shostakovich, *Cello sonata*, Op.40, 2nd movement, bars 76-87.

This arc motive is repeated a number of times, gradually degenerating, shortening with rhythmic inconsistencies, ending up at a hiatus point, a swoop up that leaves the listener hanging (3m49s).

Continuing the upward trajectories, the material becomes more fragmented, the preceding quickness being carried through in the bow movement, settling on ricochets for a short while, before returning to the double-note bowing. This moves up and down the instrument, never quite settling in one place until it ends up on the 2nd (A) string with what could be described as a bowed trill on the augmented

---

[1]Fugue-sounding without being a fully worked out fugue.

[2]The French overture prelude in Bach's 5th cello suite (BWV 1011) has a one-part fugue as its fast section, something I play regularly.

4th/perfect 5th above, leading to a final truncated and modified statement of the initial idea to close the track with an upward whoosh.

In this opening track, we can see a number of elements or themes that permeate my improvisation. I begin a list of these themes here, and will add to it when discussing subsequent tracks:

- Tension and release.

- Starting point that then finds its centre of gravity (the shift from D to E).

- The instrument's tuning influencing the music.

- Conventional musical material but which has more grit in the bowing than you would get in conventional playing.

- Forms or ideas from existing music.

3.2.2 And then this

Although there is minimal thematic connection, this and the previous track sit well together and to me they form a pair. I started to play this straight after finishing the first track, as if a continuation of the first track, and my immediate carrying-on took my producer by surprise such that a small part of the opening did not get recorded. However, I suspect that it was only a very small amount missed because the opening is very typical of my starts[1].

Across all the takes of the two recording sessions, there is a pattern to my starts that shows searching or, at least, warming to the task – I play a note, repeat it, maybe with or without a variation, then repeat again until a direction becomes apparent. In between may be small possibilities that are audible to all, or perhaps just to me. Listening closely from the start, we can hear some almost inaudible testing of the waters, possible directions in non-bowed left hand stopping the strings.

This track continues to search for its purpose for some time. From about 0m50s on, the pitched material has set itself up for quite a traditional cadential bass line (0m59s) that could end up as a perfect cadence onto the 6th (D) string a couple of seconds later. I suspect that settling there would have brought a premature ending to this take, but instead a bow change at 1m05s that almost imperceptibly clips the string above (4th, C) sets up another sequence, where it morphs from being an

---

[1]From the raw audio files it sounds like only the excitation of the first note heard was missed (we made a very small edit so that it sounded like a more natural start)

incidental noise to the inspiration for a possible change in direction (other strategies in this instance would have been to ignore it or to turn a 'mistake' into an intentional thing by repeating it, taking charge of the error – 'yes, I meant to do that, see?'). This leads into the beating heart of the track...

At 1m42s, the restatement of the major 2nd double stop starts to beat as the bow pressure increases, finally the spark that becomes the basis for the rest of the track. Because there is no resolution of the dissonance, for example by moving to the open 3rd of the middle (3rd and 4th, E and C) strings, it suggests that my recognition of potential for interest in the beating was pretty immediate and could be accommodated into the existing bow stroke instead of needing a repetition to establish it as an idea. This is the point where the track finds its purpose, and I find more and more places to get the instrument to beat.

Listening back, the track seems to stop prematurely, but while I was playing it felt like I had explored the idea much more thoroughly. I find that the experience of time is different for player/listener if I am not careful – for me, time goes faster when I am playing, so everything feels like I have played for much longer.

There are tiny bottom D string noises throughout the track, audible really only on headphones. This was almost certainly made by pressing the 6th (D) string with a finger and then removing it without plucking, the excitation coming only from the displacement of the string and possibly some slight adhesion to the finger. I have no idea now whether they were intentional. I have no recollection of doing it, sometimes they sound as if they would be difficult to have played on purpose, but now that I have heard them, they add some soft depth to the track.

How the ending turned out – the reaching for the wider major 3rd, almost impossibly wide, and the tiny 'bong' from the bottom string making it into a sharp 4/2 (3rd inversion 7th) chord – has made me reflect on the importance of serendipity in my improvisation. There are many points where something I have later found to be magical has come about without direct intention.

Themes:

- Searching for a purpose.

- Time perception.

- Dissonance/resolution.

- Physical acoustic phenomena.

- Unintentional elements

3.2.3 The *Tongue and groove* tracks

For the *Tongue and groove* tracks I took a different approach in an effort to inspire my creativity. These tracks were recorded in sequence whilst I listened to a playback of the preceding take (excepting the first take, *Tongue and groove I*, for which I had nothing to listen to). The numbering corresponds to their order of creation and they are presented on the album slightly out of order.

Tongue and groove I starts with some musical 'treading water' as it gets going, a little like letting an engine idle to warm up. Hints of a played observation of pitch discrepancies can be heard, though perhaps to start with this is a result of the playing method (later on the differences are plainly deliberate). It sounds like a succession of push bows[1], a somewhat labour-intensive method of playing repeated notes, out of which subtly emerges push/pull at 0m40s.

The single but undulating pitch gives way to a succession of quickly meandering notes (1m09s) that travel around the higher register, with bow 'chiff' being more important/constant than actual pitches, reminiscent of the fast section of the first track. Hints of additional voices start at 1m48s, becoming almost a chorus providing some counterpoint, before going back to the meandering single line. This builds up to 2m48s where the bow stutters slightly, leading to what to me is a very satisfying, unrepeatable change in direction – the open top strings starts to sound on a different pulse, effectively putting the brakes on, slowing proceeding to an accelerating variation of the opening which quickly becomes an exploration of low pressure sliding over the string surfaces, the bow moving both perpendicular to the string and also parallel. It slows to some big circular movements by the end, covering a large part of the string length, big enough that it slips over the bridge and falls off, ending the track with a thunk.

Tongue and groove II was recorded whilst *Tongue and groove I* was played back to me over headphones. It feels like a gentler version of *Tongue and groove I*'s pattern, much more of a joining in, with more space between phrases, like half echoes, sometimes more like forceful interjections. There are a number of audible breaths which sound like the type that I would take when playing in animated dialogue with another player. Overall a varied and embellished version of the first.

Tongue and groove III, recorded alongside playback of *Tongue and groove II*, starts off fast, moving from the lowest register up one of the bottom strings. It is mostly

---

[1]The viol is bowed underhand and as a result the pressures are different. Instead of, say, a violinist's strong bow being on the down where the bow moves frogwards with the help of gravity, the viol has its strong bow moving tipwards. The difference between that and the opposite movement is that tipwards is a push and frogwards a pull, hence the terms 'push' and 'pull' bows.

quiet, tremolo, with crescendo/decrescendo bulges and strong overtones. The fast left hand movement along the string can be heard in the guitar-like slide sounds, a consequence of the wound string construction (mentioned above in section 3.1.3), indicating that I was exploring the string and the length of the instrument at that point. The musical material is fairly consistent until about 1m30s when we can hear the bow skitting over the surface of the string as my right hand not only pushes/pulls perpendicularly but also curls up on itself, forcing the bow to make small circle movements. A significant change comes after a peak at 1m57s, overtone rich notes, not fully voiced, cracking between a fundamental and a harmonic, much slower bows, then back to more scrubbing movements which dwindle over the last 45s of the track.

Recorded against *Tongue and groove III*, *Tongue and groove IV* starts with double-stopped scrubbed harmonics, sliding around in small steps, with frequent accents. Leading into 0m45s, I am changing how I bow so that there is less and less chance for the string to vibrate, until the bow is essentially stuck to the string, directly moving it around without any slip. At 0m54s we can hear sympathetic resonance from the other strings as the viol is asserting itself by adding extraneous sound. A few seconds later, I am in 'computer input' territory, making similar sounds to the creaks that feature heavily at the start of my performances of *Laminate* (see chapter 6), straining against the instrument. By 1m30s I am echoing the quick repeated notes of *Tongue and groove III* in short phrases before a softer passage of slow-bowed higher pitches with space in between, sounding like one side of a musical conversation until 2m54s when it becomes more independently animated again for a short coda, ending with a 'thwock' not unlike the end of *Tongue and groove I*.

I have found it much more difficult to write the commentary for these tracks. I think this is because having used playback as stimulus means that, as a group, the motivations for each track are distinctly different from the other, unconnected tracks on the album. However, keeping this in mind, it becomes easier to get to grips with the material.

The main difference is that these are not stand-alone tracks, each one having a direct relationship with two other tracks, with the exception of the *Tongue and groove IV* (I would argue that *Tongue and groove I* still has two relationships, one with the next track and one with the anticipation of a next track). The effect of this is tangible as the music has noticeably different characteristics, with the feeling that the material is much more stretched out, often given longer to make subtle variations, and with more space into which the ideas from the other (unheard) tracks can fit.

These are 'virtual' relationships but ones that clearly have an effect on the manner of improvising. This introduction of an outside influence has resulted in musical material that is much more akin to the input that I might give to a system and so it hints at the music discussed in chapters to come. Maybe a listener could feel that there is something latent in the extra space, with the relative lightness of material acting as aural palette cleansers amongst the other tracks.

Layered versions of the *Tongue and Groove* tracks, i.e. aligned pairs of tracks, are presented in Appendix A.1.

Themes:

- Introduction of aural stimulus;

- Quasi computer-input

3.2.4   Ro and unrest

I start with something very like a typical tuning pattern. There is a gradual change to being specifically 'not tuning' after 0m35s but without a clear point to pinpoint where it starts to be different. Over the top of this simple diadic material is a strange acoustic artefact – a kind of high-pitched 'squiggle' or oscillation, maybe an extended wah-wah, certainly difficult to pin down in words.

At 1m26s there is an abrupt change to loud, more extreme material. Both hands are used in a comparatively uncontrolled manner, gradually coming back under control for the diads after half a minute. This time they are very definitely harmonic and hinting at a melody rather than being 'functional' (tuning). The 'squiggles' are very strong here. At 2m53, the musical material changes but timbrally it moves towards noisy, close to the bridge, becoming more and more like the appearing/disappearing sounds of Dr Who's TARDIS. The bowing gets faster and the pressure gradually eases, the bow slips over the bridge and back again, ending up on the open bottom string. I could have ended there and, had I been concentrating on this aspect in particular, I may well have done. However, on I went, probably out of a habit of laying into the bottom string, dwelling on it too frequently/for too long. I seem to be trying to get it to play a 'sub-harmonic', where a pitch is produced below the fundamental of the string (see Kimura (2010)), but for whatever reason the instrument is not responding and so eventually I give up and play out quietly, ending with a slide off the string and resulting tap.

Themes:

- Missed ending

● Instrumental resistance

3.2.5 Plucked out of the box

This track exploits the de-tuning that happens during breaks between recording sessions. This happens especially when the instrument changes temperature, for instance when being transported from one place to another. As the strings go out of tune with each other, so frequency conflicts arise, leading to interference that appears to increase the resonance of the instrument. The out-of-tune-ness gives a richness that is not present with normal tuning – strong resonances are present throughout, not just when a sympathetic pitch is sounded (eg. D string ringing when D or A is played). The result is a rich new sound-world which, on this particular occasion, responded well to being plucked, and where the instrument has a strong influence in pushing a particular musical direction.

This is the only track on the album that breaks the 'single-take improvisation' pattern, in that it combines selected portions from two takes of similar musical material. Though the sound-world was desirable, each take on its own was lacking in 'something'. Each take had moments that were worth keeping, but only by combining the best bits from each take did I get something cohesive that expressed itself well. This is in direct contrast with all the other tracks which were entirely played end to end. That feeling of needing to play something 'good' right the way through was very strong throughout the recording sessions, probably a hangover from my training to give 'good' performances. Perhaps I was putting too much pressure on myself by expecting both a good improvisation and a good performance of it, with a beginning and an end with no editing.

There are some nice moments of me playing around with the small pitch discrepancies that are inevitable on a fretted, gut-strung instrument[1], a notable one being from 1m32s. There is a 'moment of magic' at 0m59s that combines clear intention with clean execution, in this case a quick upwards scalic passage. Compare that to a similar gesture later on (1m22s) in which I trip myself up towards the end.

As a result of the splicing, the start of this track is very unlike my others. It is more 'motive dense' than usual and has none of the warming up that I often do. It sounds like I am enjoying the new sound-world, pottering around in quite a relaxed manner, just seeing what happens (*free* improv at last!). I have the impression that

---

[1]This is inevitable because strings go out of tune easily, and with a fixed fret there is little you can do about accommodating that during performance. Also, as strings age over the months they go 'sharp on the fret', where a note stopped at a fret will sound higher on an old but in-tune string compared to an in-tune new string

I ended up playing a lot of pitched material because the de-tuned sound world was far enough away from usual that normal harmonic pulls did not apply, and I was free from any anxiety about spoiling a harmonic moment by playing out of tune.

Themes:

- Influence of instrument.

- Resonance.

- Virtuosity.

- Relaxation.

3.2.6   Arriving at concord

This is the most traditionally harmonic track of the album and is consistently so. The germ of an idea that propagates the whole track is that of overlapping pivots, physically from one string onto another and harmonically from one diad (mostly) to another. This can be heard 'coming to life' in the first phrase – after the moment of hesitation where the long, low note is played without the same sense of time as the rest of the track, then rising a tone to the F# (a note from which it is usual to cross strings when ascending), across to the A with the overlap that makes the diad, then releasing the F#. The idea of the overlap which gives way to a subsequent note is then cemented with the descending fifth at the end of the phrase, where the narrowness of the interval makes it too far from perfect to want to sustain it (contrast this with the much purer fifth at 1m03s).

From there the idea is elaborated in two long arching phrases, the second of which chances upon the group of diads based on the notes of C, E and G which turns out to be pivotal for the rest of the track. Similarly pivotal is the diad at 1m41s, where one note changes by a step (itself prefigured by the quasi-mordent just before), enough of a suspension to implant it as an idea, such that the stepwise motion returns a few seconds later (1m58s) as what could be described as a 4-3 suspension without root.

This is the start of a harmonic sequence that can be heard five times (see figure 3.2 below). It is not uncommon for me to get caught in a harmonic loop like this, but it is most often a fairly conscious thing, whereas here each iteration is varied just enough for it to be hidden when recording[1]. Certainly I remember deciding to finish when the repetition became clear. The impetus came very much from

---

[1]This puts me in mind of Harrison Birtwistle's *Tragoedia*, where apparently he wrote the repeated refrain from memory each time to give himself some subconsciously derived variation.

exploring familiar finger positions and progressions, different to what I normally find myself playing absent-mindedly (quasi French baroque), more reminiscent of a wispy lyra style[1].

I do not know what the twang is at 2m42s, and I wonder whether the quiet upper partials squiggling heard sporadically above the 'main' notes are down to my strings being a little on the slack side, and my bow moving up and down in relation to the bridge.

Figure 3.2: Pitches in *Arriving at concord*, showing a series of similar harmonic progressions (marked below the stave with horizontal bars).

The playing on this track is not a traditionally 'beautiful' or 'pure' sound. Given that my mind was on pitch and harmony it is perhaps unsurprising that I gave less attention to the timbral quality in relation to the material. This is a salient lesson in the limitations of my awareness when in unfamiliar territory (unfamiliar with using pitched material in an improvisational context, at least). Were I or someone else to play the music in this track from notation, the tendency would be towards pristine bowing, where the expression is driven by the bow. That said though, for listeners not expecting the dulcet tones normally associated with the instrument, there may be some parallels with the cracked vocal style of certain singers.

Themes:

- Germ of an idea becomes a whole track.

- Harmony

---

[1]A seventeenth-century English chordal style of playing that is very like bowed lute music, usually notated in tablature.

3.2.7   White out

We can hear shushing white noise, the bow on the bridge, bow changes, accidental pluck, squeak of bow hair, pitchy harmonics from bowing on string, friction of LH fingers up and down strings, bow ticks of wood on wood, surprising difference from changes in bowing position on the bridge, seagull harmonics, squiggly high pitches, maybe some trouser friction on the instrument's ribs...

More of the instrument is being used to make these sounds than on any other track. The sound world was inspired by and echoes elements of *Skin* by Michael Edwards (Edwards et al., 2005), using the basic technique of bowing (literally) up and down on the bridge at 90° to normal, i.e. in a direction parallel to the strings. This produced the shushing 'white' noise that underpins the entire track. As it progresses, the bow comes into contact with the extreme ends of the strings on both sides of the bridge, gradually building independent parts in the sound, a kind of polyphony. The exact sounding surface and excitation technique are sometimes identifiable, at other times not, leading to a pleasing air of mystery throughout the track.

There is an arched form to this track. The development of material from the initial sound is very satisfying as there is less of a sense that you can hear an idea being seized on in a predictable manner. Instead, the bowed white noise gives a coherence that allows time for the various possibilities to be explored, connecting them in a way that would not necessarily be the case if those 'other' ideas were played on their own. That underpinning is almost certainly the reason that the track is noticeably longer than any other, 50% longer than the next longest (*Arriving at concord*), as the security of the continuous noise freed me to concentrate on the higher layers of sound.

3.3   More general thoughts

This section discusses a number of elements that relate to the album and its recording as a whole.

3.3.1   (Surprising) aesthetic directions

The only intention going in to the recording sessions was to make something that could be released to the public. I did not have a set style that I was aiming for, only that it would be my improvisation specifically without a computer. I am conscious that I was playing less 'noisily', because timbrally-focused playing, the embracing of imperfection often to the exclusion of pitch, is something that it is unsatisfying in long stretches on its own.

Having said that, there is a fair bit of noise on the *Tongue and groove* tracks, though as discussed above those tracks come close to sounding like input for a system. Also, in *Ro and unrest* there is a movement between pitch and noise – pitch making way for glitch then returning to pitch, with that pattern repeating. Pitch, then, is obviously something that became an important element here, and something that I had to make a concerted effort to come to terms with. Pitch needs to be treated carefully, especially if the improvisation practice has no set language or conventions. With pitched/harmonic material, (subjectively) wrong, bad, boring or inappropriate material is all very much more noticeable, glaring even.

Another thing I was thinking about going in to the recordings was that I was sure that I did not want to have a drone on the album. I felt uncomfortable with the idea because an intentional drone felt a bit lazy, and it was not obvious how I might sustain one without losing anyone's interest. However, the last track, *White out*, turns out to be underpinned by one, albeit one made of noise. This happened without being intended and was sustained by the polyphony that developed, and it is not an explicit drone (i.e. it is unpitched).

3.3.2 (Lack of) imagination

Throughout the sessions I had the feeling of having a distinct lack of imagination. Many times it was difficult to start off because I had no idea or no confidence in finding material. This was an obvious conflict with my compulsion to make single take tracks that were up to scratch from start to finish, as mentioned in section 3.2.5 above. There may be several factors that underpinned this, but a key issue for me was a lack of practice – my 'improvisation muscles' felt flabby and out of shape, so perhaps it was obvious that summoning material would be difficult.

This is especially so if I harbour ideas of 'perfection'. Trying to play 'good improv' straight out is likely to have been a big hindrance/inhibition. A different approach could have been to start off with a warm up, with a bit of a break when things are going smoothly to allow a cut in the editing. Of course, I did try the alternative tack of sending back previously recorded material as stimulus (see section 3.2.3) which produced some substantial material, though of a distinctly different kind.

3.3.3 Virtuosity

I want my playing to be rooted in strong technique, just as I want it to be distinctively of the viol (see 3.1.4). This inevitably leads to a conflict of approach or, at the very least, a conflict between the satisfaction of playing/listening in the moment and subsequent judgemental listening at a time removed from the creation.

Playing 'well' on the viol is a very precise thing. Being deliberate with intention is much more critical a lot of the time, so a surety of technique is important. This is a reason to have a thriving practice in conventional viol music happening in tandem with the improvisation. The nature of viol technique is, of course, very particular to that instrument and to its music, both past and present.

To get a note to sound properly requires careful timing of both hands, and unless a scrappy, skatey sound is acceptable, there is a limit to how fast and for how long rapidly leaping passages can be maintained. For example, long stretches of quick notes bouncing around an instrument's range, something employed by, say, saxophonists, is unavailable to players of larger string instruments owing to the physical distances that need to be covered. Bowing can jolt the instrument, the bow can bounce, and the very deliberate technique of 'jump then play' (Crum and Jackson, 1992) doesn't easily work for unrehearsed randomness.

Also, there is the question of what is 'virtuosic' improvisation. Just scratching around making noises isn't fulfilling for me, mainly because it does not feel very skilful to me as a player, perhaps to a listener as well, certainly not the product of applied intention. Making 'nasty noises' may provide suitable material when working with computers, but a whole album of it on its own would not likely be aesthetically satisfying. Some balance with 'good' sounds is necessary, maybe even conventionally 'beautiful' material.

3.3.4   The instrument often dominates

The instrument can be very dominant. Its resonances and the ease with which 'extraneous' sounds creep in both make a big impression on the overall sound. Even lifting the bow or hand *off* the strings will often make them sound, audibly if other sounds are equally quiet. This is at its most off-putting when I am trying to improvise with pitched material, then a string pops out and clashes/muddies the harmonic thing I am working on. It supports the practice of tuning the instrument properly, even before playing glitchy noise, as the resonance of a well-tuned instrument is very particular and, for me, necessary.

The instrument dominates too in my struggles with and against it. These are often at the edge of what is physically possible, where the physical nature of the instrument's construction can only go so far, or that friction becomes too much to allow vibrations to occur. There is some echo here (certainly when I am going 'all in') of the sheer physicality of Phil Minton's vocal performances (Cassidy and Einbond, 2013), though I assume that I will not look anywhere near as contorted or tortured as the points of friction are largely situated (and hidden) in my hands. I do things

to my instrument that many people would not, but I consider the instrument to be a willing (!) participant and am aware too that most damage can be fixed[1].

3.3.5   Improvisation as/is expression

For me, improvisation is very much a technique of *direct expression*. I can put into my playing things that are inexpressible in other form, especially in words. I engage an active creativity, one that involves a lot of thinking, about direction, material, rhetoric. However, there are often times when I wish my inner monologue (sometimes a great hindrance) would simply switch off.

This could be characterised as a difference between 'imaginative' and more exploratory/experimental improvisation. Given that this characterisation immediately feels almost pejorative, perhaps a better way to differentiate the activities would be thought-led and experience-led improvisation, where the former sees the improviser deciding to do something and doing it, the latter has the improviser letting the sound and/or physical experience of playing guide their choices.

Of course, the reality of any given improvisation almost certainly sees both. An improviser is always making decisions, but how conscious they are and where they are directed will change, and will be appropriate to their instrument. A sax player, as in the example given above, might play lots of quick notes all over the place where the precise sequence of notes is not consciously chosen moment by moment. Similarly, a string player might let the feeling of bow on string be their focus, perhaps with a physical movement that is repeated but following and emphasising the inevitable differences (which are normally corrected when attempting to maintain a consistent sound, fundamental to 'classical' training).

An idea I have been cultivating is what I have come to call 'effort at one remove'. This applies to the times when my focus is not directly on producing a specific sound, but rather on an action that has sound as its by-product – sonifying combinations of bodily movements, as opposed to realising a pre-chosen sound. For example, I might be concentrating on the feeling of the bow hair's tension as I pivot it on the string, or I might be performing a 'balletic' movement with my right hand where the bow comes in contact with the instrument unpredictably. In both these cases, the emphasis is on physical movements rather than resulting sound. Sometimes, of course, this will sound scrappy and unskillful to me because I have had too much conventional training to be able to hear it differently without consciously correcting for a deeply-rooted bias towards consistent tone and the like.

---

[1]I have not yet sustained any damage needing to be remedied, though both instrument and bow have numerous 'battle scars'.

Chapter 4

gruntCount

Contents

I augment my solo improvisation by playing with computer systems that contribute to the sounds heard in performance. The first of the systems I will look at in depth is *gruntCount*. It was devised by Martin Parker, initially for flute and subsequently reiterated in several different versions for different instruments, including viol. I gave the first performance of the viol 'edition' at the INTER/actions symposium at

Bangor University in April 2012[1], and subsequently recorded a performance for a gruntCount album[2].

4.1 What is *gruntCount*?

gruntCount has been described variously as an improvisation, a piece, a system and an instrument (Parker, 2011; Furniss and Parker, 2014). It is manifested in software that receives improvised input from an improviser and outputs a mixture of synthesised and processed live sound.

Each of the several versions made by Parker uses the same underlying system architecture. Its behaviour is dictated by "a range of interconnected parameter changes that are nested within one another" (Parker, 2011). Parker tailors each version for a specific performer by way of "a period of system 'training', in which he acts as composer and responds in real time to [the performer's] free improvisations and creates a set of interrelated digital sound processing (DSP) parameter presets unique to the player" (Furniss and Parker, 2014). This sets Parker's direct response to an improviser's musical personality and musical language at the very heart of the software, and this can be heard within all subsequent performances.

A performance of *gruntCount* is navigated by way of a performance curve (figure 4.1). Preset numbers are on the vertical axis, and the horizontal axis nominally measures time (as number of grunts). A curve is drawn within this space to map out the route between presets. A horizontal portion of the curve represents a period of time in a preset without change, while a vertical portion will change preset abruptly. A sloped section will gradually change from one preset to another by interpolating between settings. A playhead moves along the curve as grunts are counted, ensuring that the player can keep track of their progress during performance (if desired).

The grunt in *gruntCount*'s name is the performer's sound as heard by the system[3]. When the performer 'grunts', they have made a sound that has an amplitude higher

---

[1]See   http://www.tinpark.com/2012/04/gruntcount-examples-viola-da-gamba-mark-summers/ for a recording of this performance.

[2]See   https://sumtone.bandcamp.com/album/gruntcount-improvised-pieces-for-player-and-computer

[3]Parker (2011) also notes: "At the time of writing... war is everywhere. Grunt is a colloquial term used in computer games (such as Microsoft's Halo) and in the American military to identify expendable infantry. Whilst writing this piece, there has been an almost weekly increase in the number of young men and women killed across various fronts around the world. The opportunity to express outrage, sympathy or disgust at this is available to any player who wishes to project this onto the piece".

than a threshold that is set prior to performance. As long as the sound is above this threshold, grunts are counted, which in turn pushes the system's playhead along the curve just described. As soon as the system is primed, it will react to sound at the microphone and start along the curve at the first grunt.

4.1.1 Variables

Beyond setting the microphone and loudspeaker levels, there are two main variables that a player needs to set according to preference: input amplitude threshold and number of grunts.

A higher amplitude threshold level will let a performer play quieter sounds without progressing the playhead, while a lower level will allow more constant movement along the performance curve with quieter sounds. The threshold level can also account for the main external factor of the system's output from speakers in the room, a higher level reducing the likelihood of the sound folding back and causing the system to 'play itself'.

The number of grunts dictates how much sound is needed to get through a performance. Too many and it may feel like wading through treacle, too few and there is no space for nuanced performance.

4.2 Performing *gruntCount*

Within the viol edition of *gruntCount* I have two versions that I play with, gC-2014 and gC-2018. This section introduces both versions and gives a performer's account of playing with them. When I am performing with the system, the thoughts going through my head are generally feeling-led rather than a more cerebral working out of material. In this way, performances are liberating experiences. Describing such an intangible experience is difficult as so much depends on the moment, how the system is making me feel.

4.2.1 gC-2014

I load the gruntCount standalone and go through a set initiation procedure: I select version gC-2014, check the ins and outs – interface and microphone channel. I prime the system by pressing 'p' to perform and then get in a playing position.

Nothing happens.

Figure 4.1: The performance curve as presented in the system display for gC-2014. The 'false ending' is marked [FE].

> An initial gesture jolts the system into life.
> Time to savour the atmosphere.
> Play into the space and have it take the gesture and bounce it around.
> The system accepts my sounds, holding or letting them bounce off.
> Then it morphs into something different, more rhythmic.
> Moving along the curve, still holding onto pitches as I move away.
> Bloops and bleeps, following, supporting.
> Building up. Something else nattering in the distance.
> Suspensions fading in, fading out,
> Sliding up, sliding down to reveal some chuntering
> All the while I am soloing above, with, not really ever against.
> Letting it surround me, support me.
> Bloops and bleeps, then me coming back at me, rhythmically.
> The space expands.
> And then distorts me, I play into it, carefully, not too much.
> Make a bold ending and melt away.

The feeling of playing with gruntCount is difficult to pin down. I know roughly how the system's sounds will manifest along the curve, but each time will be different. I am very much 'in the moment' while I am performing and my playing into the system and my response to its output will be different each time. I like to

latch on to pitches (the bloops and bleeps), often to move them when I know that the system will take my lead, but otherwise I feel very free to express myself.

gC-2014 has come to have a particular feel that I like to set up, both with the way that I play over its duration and with the way that the music sounds in the room. The idea of a 'slow movement' came to me relatively recently, but it has made my understanding of this version click in a way that I was missing before. Less strident output through the speakers into the room means the system becomes supportive rather than demanding attention. With that I have been able to play in a more 'reflective' manner, sometimes almost wistful, leading to the idea of the slow movement of a concerto, where the soloist is allowed to be more introspective without the need to push along a strong musical agenda. (In this case, of course, it is a standalone movement.)

Having said all that, there is still a need to be mindful of the overall trajectory. I have found that there is a 'false' ending hidden in the latter part of the curve, a little flat line three quarters of the way through (marked [FE] on figure 4.1). It has the effect of making the remainder of the performance into a quasi coda. Approaching this spot needs to be done carefully, pacing the energy and keeping momentum so that it does not sound as if an ending was missed. The actual end can be played very gently. The steep slope in the final moments passes through quite a few presets and requires care, what Furniss (2018) characterises as "negotiating the ending".

4.2.2 gC-2018

Figure 4.2: The performance curve as presented in the system display for gC-2018.

The system hears its first grunt, leaps into life.
Lots of noise, distortion.
Soon after, the scalic trope comes for the first time.
Distorted, rhythmic.
Slides down, up.
Some viol-computer hocket.
Percussive rattling around, biding our time.
Getting quieter, little gestures.
Woodpecker tapping.
Distorted bang to quiet.
Every sound from me is big and distorted, quiet between.
Don't use up the moment too quickly because...
Big slide, disjointed distorted, back to percussive.
Big slide down into a sequence, computer following me.
Slides both ways, interrupted.
Percussive.
Contrary motion slides into an ending.

gC-2018 has a completely different feeling. As with gC-2014, I am playing in the moment. It is much more of a blast and was designed to let me have some fun with more unconstrained improvising. The journey through the settings is seems more overtly 'composed' (as indeed it was, see section 4.3.3 below).

The settings change quickly into fairly discrete and recognisable 'scenes'. I can follow a recording of this version and know where it comes on the curve. The system is dominant aurally, but without the feeling of being dominating – I am the one driving it along, though the system gives me a lot of impetus to help me to achieve that degree of momentum.

4.3 Themes that emerged

4.3.1 Interpretation

Parker (2011) suggests that "a player who has rehearsed the piece several times will develop an understanding of how the improvisatory tension develops and will give the player confidence to find musical solutions to some of the unexpected events the computer may throw up as the piece runs".

This is indeed true in my experience. However, I would suggest that 'several times' will not be enough. While gC-2018 has been straightforward to learn to navigate,

gC-2014 has been much harder. It is all too easy to give an unconvincing performance if insufficient preparation is put into it. Without being careful about what is put in and how, a performance will feel lacklustre and can necessitate finding a way out of the doldrums. A performer needs to know the curve and how to pace their performance.

It may be tempting to change the curve to account for difficulties, to make interpretation easier, but being able to negotiate difficulties presented in the curve is part of being expert in the performance of this music. Maintaining inherent challenges is part of the art.

4.3.2   Monitoring

The particular calm feeling I have settled on for gC-2014 comes partly from using less strident output levels. This highlights how important the signal strength of the system output is to me as the performer. I will typically sit behind the speakers to minimise feedback, so I will hear less of the detail at a lower volume. With no routing of the viol's audio through the speakers, the audience will hear more of the system and less of me compared to what I will hear – slightly muffled system and a lot more viol.

Olmos et al. (2011) note that in this situation "the choice of audio perspective makes a significant difference in some musicians' performance". I too have tried alternative methods to vary my listening position.

For example, listening on headphones during a performance is a possibility. However, this cuts out one of my major points of focus, the close sound of the viol. Moreover, the sound of the system via speakers in a space is different to the same level of sound direct from system on headphones, and it can also change the way that the system output might otherwise push a performance forward by folding back into the input microphone.

Another alternative I have tried is to set a pair of omnidirectional microphones on a Jecklin disc (Jecklin and Josephson Engineering, 2016) placed in the audience space, and then route this back to headphones for me to listen through. This is the only way for me to get close to experiencing my own playing from the audience perspective.

While a new perspective on my performance was refreshing, it was too divorced from my own sound at the viol. I experimented with routing my audio through the speakers or directly to the headphones, but nothing was close enough to the subtleties of sound that are so important for my playing process.

4.3.3 Artistic agency

While it is possible to edit *gruntCount*'s parameters, I have been reluctant to do so because of the feeling that this would be stepping over a boundary between the performer and the system-maker. I have, however, made two significant exceptions.

Coming back to gC-2014 afresh after some time without playing with it, the settings seemed 'wrong' compared to my memories of the system's 'tone'. What I remembered was a feeling of gentleness and calm, of it being a soft version. However, there was a large amount of distortion and what felt like feedback, so I assumed that the settings had become corrupted.

Once I had checked that the signal was not distorted or feeding back owing to the system being corrupted in some way, I asked Martin to soften it by removing the distortion. I felt that it wasn't letting me play in the way that I wanted to, or in the way that the underlying musical journey wanted to be travelled. I had the feeling that it is a relatively gentle version and needs to be treated with care.

Martin largely removed the distortion and I have been happy with the system since. Was I interfering with his agency, with his musical personality embedded in the system? I am not entirely sure. *gruntCount* has been a collaborative affair from its beginning so there is less likelihood of there being fixed boundaries in this way.

In contrast, gC-2018 was set-up with the purpose of allowing me to 'let rip'. In this instance, Martin set the tone without any interference from me, except in the sense that I was playing into the system whilst he chose the settings. So the tone is all his.

The curve he left me with was more or less a straight line and was constructed in a couple of seconds, with the invitation to make my own. Playing the first curve was utterly unsatisfactory because the musical flow was all wrong. The settings are big and energetic in the low numbered settings, and reduce in 'size' and energy as you progress up the hill (so to speak). The upward slope went from big to small and fizzled out quickly.

I have subsequently made my own perfromance curve to progress through the presets in a more satisfactory manner. I see my re-drawing of the curve as bringing out the version's potential. Was this robbing Martin of agency? Perhaps.

But this may only be a problem of looking at the parts too closely – Green (2013) suggests zooming out to see a clearer picture of a mixed-musical situation, and this sees Martin's agency left much more intact, as his architecture is still there with its overall influence on the sound made, even if more adjustments have been done by a performer.

Also, it is part of my role as performer and injector of creative sounds to strive for the best performance possible. An aspect of this can be to ask for or unilaterally make changes in the music. Reducing the distortion in this case has allowed me to play with greater nuance, and the re-drawn curve shows the settings off to better effect, and gives performances a more musically satisfying feeling.

4.4 Variable timing in performance

As I have set out above, *gruntCount* has a timeline along which the performance/performer travels, but with flexible timing. When performing with the system it is obvious that time can be taken or hurried along, but I initially found it difficult to form an accurate picture of exactly how much this is happening.

I asked Martin for a data file that records information about about progress through the performance curve alongside the audio recording. He added this facility, automatically providing a data file that contains:

- the event time (in milliseconds and hh:mm:ss);

- the percentage of the way through the performance curve as a decimal from 0.0 to 1.0;

- the grunt number at which the event starts, n of N total; and

- the preset number and name.

The data file does not record every single grunt, but rather a series of 'events'. An event is defined as the point at which the input amplitude rises from below to above the threshold. As soon as the input amplitude falls below the threshold, the system is ready for the next event. This information is not as fine-grained as it could be (i.e., every grunt recorded with a timestamp) and, as such, may not yield rich data in every performance (e.g., when the input is above threshold for long periods of time). However, it has provided sufficient data to be useful in my analysis here.

As discussed above, the reason for requesting the data was to account for the flexibility of timing that the system allows in performance. This means that, unlike a fixed duration piece, a given point on the curve could potentially come at a radically different proportion of the way through the duration of one performance compared to another performance.

From these data files I have been able to chart the proportional progress of performances. By using a proportional approach, performances of different lengths can

be viewed together with ease and the concertina effect of the flexible performance time shown.

Figure 4.3: The performance curve adjusted to reflect the relative timing of three performances of different lengths of gC-2014. The raw performance curve is in red.

Figure 4.3 shows three performances of gC-2014 (black lines) against the raw performance curve (red line). The variance of timing between performances is most clearly visible at the sharp upward slope two thirds of the way through. Each one of the performances plays through this point ahead of the performance curve as proportionally less time has been spent in the first half of the performance curve.

Figure 4.4 shows similar temporal flexibility across three performances of gC-2018. Certain trends of timing can be seen. For example, all the performances take extra time on the gentle slope before hitting the highest peak. Further, all performances also descend from there and rise up to the end in roughly similar proportions.

Figure 4.4: The performance curve adjusted to reflect the relative timing of three performances of different lengths of gC-2018. The raw performance curve is in red.

4.5 What *is gruntCount*?

In their paper on *gruntCount*, Furniss and Parker (2014) look at the system from their respective roles as researcher-performer and composer. They articulate a tension in the duality/multilarity of the nature of the system.

As mentioned above, *gruntCount* has been described variously as an improvisation, piece, system and instrument (Parker, 2011; Furniss and Parker, 2014). However, these categorisations appear to have been rooted in their experience, rather than as the result of interrogating matters with explicit assessment criteria.

Furniss and Parker write about the features of musical works, but it does not appear that they are taking a particular view about what actually constitutes a work, except perhaps on the basis of their experience as (classically trained) musicians. Thus, structure, predictability, hierarchy and notation play a part, as does the traditional separation of roles between composer (imagination) and performer (interpretation): "the *gruntCount* software is, at least in some sense, a score... The curve... constitut[es] a framework around which the improviser *negotiates* a path through the piece".

However, Furniss and Parker (2014) also advocate a non-traditional approach to composing/performing. They state that *gruntCount* "allows both composer and performer to be heard through the music" and has "a more even distribution of authorial agency". Further, "the manner in which the piece is individuated is entirely defined by the live performer".

They state, too, that "by inviting a co-created and improvisational quality to each performance of the same curve, some aspects of *gruntCount*'s pieceness begin to blur". What is a 'co-created quality' in respect to a work? What is being created, a co-authored musical work, or a performance, or something else? I will explore this discussion further in the following chapters.

For now, we can conclude that *gruntCount* is an ambiguous entity. Furniss and Parker highlight this, not only by discussing it, but also in the changing way they refer to *gruntCount* over the course of their paper (piece, system, composition, etc.). That is, it takes on a different form depending on the angle from which you view it.

This is an example of the difficulty in defining what a system is. In the next chapter, I will explore this by way of a discussion of the classification of systems.

Chapter 5

What are these systems?

Contents

In the preceding chapter I introduced an augmentation to my improvised practice; namely a computer system that allows me to make music that would otherwise be impossible with just an acoustic instrument. In this chapter I will present the first of three more abstract explorations of this mode of augmentation, a conceptual discussion to contrast with the experiential nature of the work presented thus far.

This chapter, then, asks 'what are these systems that help make the music?' and 'do they fit within existing musical instrument schema?'. To do this, I provide a brief review of systems to establish the purview of the chapter. After that, I look at the main classification scheme for musical instruments and a number of other approaches to see whether there is anything to be gained from looking at systems in this way.

5.1 Systems review

As mentioned above, I use systems to augment my improvisatory practice. They could be termed 'interactive music systems', 'improvisation environments' or something else, but such terms are difficult to use with any precision as they raise as many questions as they answer, if not more. It is extremely difficult to generalise about such practice because each particular system will either carry its own, often bespoke, stylistic conventions, or will place decisions about such conventions in the hands of performers who, as a consequence, make highly personalised choices prior to, and during, the act of performance. Accordingly, statements about systems may communicate something meaningful about the use of technology and, perhaps, the performative context that such systems presuppose. However, these terms do not necessarily communicate anything about the musical language or performance style that is likely to be heard in concert. This point is reminiscent of Harrison's view on 'computer music', a term that "[...] tells us very little too, because it describes the tool, not the music - it is hardly any more helpful than a term such as 'piano music'" (Harrison, 1999).

To take 'interactive music system' as an example, it becomes clear that this phrase may not tell someone without prior knowledge much about what these things are. I remember 'music system' being used years ago to denote the all-in-one tape/radio/CD machines – does adding 'interactive' move the concept enough to reach the subject of this current writing? I had such a system that included a karaoke function that would mute the vocal line of a track, perhaps that could be considered interactive enough to count. Likewise the term 'digital musical instrument'. This easily brings to mind the unsophisticated Casiotone keyboards of school music lessons, with their programmed drum beats and distinct lack of musical finesse.

The context in which a term is used, however, lends more meaning to it. Being mindful of the sometimes quasi-/sometimes actual computer science environment, the label gains some implied meaning: the use of a (computer) system, the interactive label standing for undirected interplay between system and musician.

Not having a ready, commonly understandable term has meant that I have found it difficult to state what 'systems' are, as they could be almost anything and are pretty much ungeneraliseable. Certainly, the systems described in this thesis are but three of many such systems that exist in the world. There are relatively few 'off-the-shelf' systems, and these do not appear to get widespread use. The majority of systems are made individually either for the maker themselves or for a particular musician. But they have all sprung from more or less the same wellhead.

5.1.1   How we got to here

The development of technology over my lifetime has seen computers move from being unusual, limited and often large devices to become small, ubiquitous and massively powerful. This has allowed computers to become extremely portable, capable of processing high quality audio in real-time and cheap enough to be available to many. In turn, innovations in both soft- and hardware born in well-funded and well-equipped institutions have come into mainstream creative use. An example of this is the MaxMSP platform that grew out of developments by Miller Puckette at IRCAM, Paris in the 1980s[1], the software in which *Laminate, gruntCount* and *_derivations* have been made.

Powerful audio processing software, like MaxMSP and numerous others, has allowed users to create sounds that they are unable to create with acoustic instruments. As a result, there are many examples of developments in musical technology that have produced new systems – instruments and performance software for which there are no 'standard models'.

Using electronic sensors, it is possible to make more or less any given thing into a sound controller. Computer processing allows the sound that is controlled to be almost anything imaginable and the acoustic means of producing the sound (most often a louspeaker) is physically and conceptually uncoupled from the impulse to make the sound (the pressing of a key, or passing through a light beam, or whatever). Jordà (2004) refers to this as splitting the chain. This contrasts with the observation that "prior to electronic and the digital instruments, the interface was inherently an integral and inseparable part of the instrument – part of the excitation-sonification system" (Paine, 2009), like a viol string which is both control interface and sound producer.

A few groupings have coalesced within the field, however, bringing together new musical conglomerations which share certain similarities. Notably, these include digital musical instruments, augmented instruments and interactive music systems.

Digital musical instruments

Miranda and Wanderley (2006) define a digital musical instrument (DMI) as "an instrument that contains a control surface (also referred to as a gestural or performance controller, an input device, or a hardware interface) and a sound generation unit."

---

[1]https://web.archive.org/web/20090609205550/http://www.cycling74.com/twiki/bin/view/FAQs/MaxMSPHistory

Important concerns when building digital musical instruments (DMI) relate to the capturing of gestural information from the human performer and associated ways of mapping performative gestures to the sound generation by way of "liaison strategies" (Miranda and Wanderley, 2006).

Examples include:

- The hands (Waisvisz, 1985).

- Tooka (Fels and Vogt, 2002).

- Reactable (Puig, 2005).

- Wubbles (Berthaut and Knibbe, 2014).

Whilst DMIs could include augmented instruments (and is often used loosely as a term for them), a distinction can be made such that DMIs are those with controllers that are not traditional musical devices.

Augmented instruments

Augmented instruments build on a pre-existing acoustic musical instrument which is "extended by the addition of several sensors, providing performers the ability to control extra sound or musical parameters" (Miranda and Wanderley, 2006).

Examples include:

- Hyper-instruments, including violin, viola, cello (Machover, 1992) and flute (Palacio-Quintin and Zadel, 2008).

- Meta-trumpet (Impett, 1994).

- Disklavier, notably used in Risset's *Duet for one pianist* (Risset and Van Duyne, 1996).

- Magnetic resonator piano (McPherson, 2010).

Interactive music systems

Interactive music systems (IMS) are systems "whose behavior changes in response to musical input. Such responsiveness allows these systems to participate in live performances, of both notated and improvised music" (Rowe, 1993).

IMS is the broad grouping of systems that brings something 'other' to a performance and is where most of my interest lies. The term, as with DMI, has been

used loosely in the past to mean any kind of responsive system, even those which require a computer operator or a notated score for the performer. However, as system sophistication has increased rapidly the term has more recently begun to coalesce around systems that have some kind of so-called 'intelligence', such that the making of IMS has become more about innovations in using software agents (Whalley, 2009), especially those that will 'improvise' with human performers in ways powered by novel means.

- Cypher (Rowe, 1993).

- Voyager (Lewis, 2000)

- Milieu (Sayer, 2006)

- Deeply Listening Machines (Van Nort et al., 2013)

- OMax (Bonnasse-Gahot, 2014)

- piano prosthesis (Young, 2009)

- Free improvisation simulation (Collins, 2007).

- CAIRA (Braasch et al., 2012).

- Odessa (Linson, 2014).

One of the key questions about IMSs is what the output should be. Rowe (1993) identifies three different types of processes that lead to output sound: transformative, sequenced and generative. The first two of these will take input and return it changed in some way. The last makes output without using input. At the time when Rowe was writing, the use of MIDI data meant that much of the transformative responses would be manipulating sound as MIDI data, rather than working with the performer's raw audio.

Bown et al. (2009) propose a different term whose conceptual basis attempts "to characterise emerging aspects of music software", namely a 'behavioural object'. They define this as "an entity that can act as a medium for interaction between people through its dissemination and evolution, [and that] can develop interactively with individuals in processes of creative musical development with other behavioural objects to produce musical output". Their discussion makes it clear that 'interactive' as mutual interdependence is not vital. Rather, they see behaviour as anything from interdependence to a 'musical' behaviour exhibited by a software synth.

5.1.2   The systems context of my augmented practice

The key things about all the systems I am discussing in this thesis are that 1) they produce sound of some kind to support and inspire me and 2) they do not have an active operator. As such, I take the approach of interfacing solely by sonic means (i.e. without physical controllers of any sort) which is something I share with Einarsson (2017).

In contextualising my work within the broader field of computer music systems, I have found that there is a mismatch between what I am trying to achieve in these pages and how systems are generally presented to the world. I am putting forth a performer's account of action (see section 2.1) which concentrates to a large extent on the experience of playing, both with and without systems, and includes some technical details to explain my expectations of how a system will behave. In existing literature, systems are largely written about in a manner that focusses on technical details, almost entirely excluding any indication of what it is like to play with the systems and often lacking discussion of the music that results. Previous reviews of the field have also focussed on the technical aspects (for example, see the recent account by Carey (2016)), though to be fair these reviews are generally aimed at supporting further technical developments.

With the above in mind, any sensible study concerning performance practice would surely need to focus upon individual systems, or the actions of individual performers. This should allow for subsequent comparisons to be made once a broad set of assumptions or findings have been collated, ultimately enabling one to pass judgement on the field at large. Even so, there are still numerous barriers to progress; systems are not widely circulated, making direct interrogation and comparison difficult and, unsurprisingly, the same may be said of performances which are not only rare, but frequently undocumented. Even when performances *are* documented, it is typically in the form of recorded audio and, although recordings offer the possibility of endless listenings, one needs to find some meaningful way of identifying and codifying the choices made by performers. In this context, transcription seems unlikely to offer more than a partially workable solution – improvisers frequently operate beyond the pitch/duration paradigm as enshrined in the traditional score (Wishart, 2002), and a formalised system to encode an ever-expanding palette of musical materials and languages is notably lacking (Klien et al., 2012). A technical focus is useful, however, as systems could be classified according to their technical make-up.

A comprehensive review is prevented by systems being generally unavailable for trying, testing and performing with. Most are personal to the system-maker and will not be released for reasons no doubt individual to each case. Perhaps the biggest barrier to release is the degree to which a system becomes part of a per-

sonal voice of the maker, especially where they are a 'performer-developer', a label coined by Carey (2016). Another compelling reason might be the degree of extra work that may be involved in making a system releasable. I have had experience of that with *Laminate*, passing on a version to a few players I know, whilst painfully aware that it is not necessarily completely stable, nor is the documentation complete (see Berweck (2016) for more on these difficulties). But in my case this is only a practical problem rather than one of identity, given that the voice that is layered is that of the performer, not of me as system-maker.

A certain amount of information can be drawn from audio recordings if they are available. Occasionally, these have been brought together as a curated collection (for example, Van Nort (2014)). Otherwise, it is necessary to go searching for individual examples. Some are available, some are not, and this has influenced the choice of what can be included in any review.

Last, from written descriptions of behaviour it is possible to glean some idea of what it might be to play with a given system – not with absolute certainty or in great detail, but it is *something* to go on rather than nothing.

The systems I use

Whilst *_derivations* (Carey, 2016) and *gruntCount* (Parker, 2011) sit comfortably within the IMS grouping, *Laminate* does not sit so easily.

Laminate is the only one of my three selected systems that is not interactive as such (see chapter 6), and has the least in common with the systems cited above, at least behaviourally. It perhaps shares more in common with loop-based music.

Alvin Lucier's *I am sitting in a room* takes the form of a progression from distinct speech sounds into "sustained and slowly changing pitches" (Broening, 2005). It has a written 'score' that details the material that could be spoken by the performer, and the technical method for performing the work: recording the speech, playing it back into a room and recording the playback, playing that back and recording, and so on. As a simple system that collects and replays audio, modifying the timescales according to a pre-decided pattern, *Laminate* cannot be said to be interactive in any meaningful way but, if viewed as a behavioural object (Bown et al., 2009), it sits alongside other systems, albeit at the other end of the interactive continuum.

Simon Emmerson's *Spirit of '76* is an "accelerating tape delay system" for flute that forms "one steady rising process", first implemented with a physical tape loop mechanism adjusted to make the delay 64 seconds long, but more recently adapted into a MaxMSP patch (Rodgers, 2018). Carey (2016) notes that "contemporary musicians such as Zoe Keating, Camille Dalmais and Imogen Heap make use of

live looping technology to build traditional song structures from sampled and re-
peated materials."

5.2 Classification

In my practice, I can easily say what I am (a human), more or less what I do
(improvise music) and what I use (a viol). I am playing on an identifiable and
understandable musical instrument of a certain type (see section 3.1) and it can
be placed into a standard instrument classification scheme. But can I be similarly
specific about a system with which I have augmented my practice?

Clearly it is not human, rather it is a processor performing functions by running
calculations (a computer), that produces sound as a result of these calculations.
A simple answer could be 'computer software that I play into and it then takes
that sound, processes it and puts out sound of its own to form a joint musical
performance'.

Is this how a lay person would characterise the computer in these circumstances?
It seems to be causing a sound to be heard; certainly there are non-human sounds
coming out of speakers that appear to be attached to the computer. Let us assume
that this lay person is willing to accept just about anything as music (conveniently
ignoring problematic aesthetic judgements) so that we might say that the computer
is a thing that makes or contributes to the music-making by producing sound.

This seems a lot like what a musical instrument does, even if it doesn't look much
like one. If I pursue this line of thought (as I am about to), then a question pops
up. If we suppose that it is indeed an instrument then what kind is it? Given the
details of my background outlined above (especially in section 1.2.3), my thoughts
turn immediately to working out what the salient features of a given musical entity
might be – the 'subject' of the system, as it were – then using a classification
scheme to fit them into an appropriate category.

This section discusses classification schemes, examining whether they can be of
use in understanding the nature of systems and how they might be differentiated.

5.2.1 Conventional classification of instruments

The Hornbostel-Sachs scheme (H-S) is the standard taxonomy for musical instru-
ments (Montagu, 2007). It was first developed in the late 19th century by Mahillon,
who built on a centuries-old system from India that classified instruments accord-
ing to the manner in which vibrations are made. Later, in 1914, Hornbostel and
Sachs adapted it to use a numbering system akin to Dewey Decimal Classification

with descriptions of the vibrating action, such that it became "culture-free". An instrument would be given the appropriate Hornbostel-Sachs number instead of it having a culture specific label. For example:

> The description Rahmentrommel (ohne Stiel), einfellige ('single-skin frame drum (without handle)') and its number, 211.311, may be applied to any such instrument throughout the world, including the English tambourine, the Arabic duff, and the Irish bodhrán. No people is forced to use any language but its own, provided that it also uses the Hornbostel-Sachs number (Montagu, 2007).

The approach of avoiding culturally specific names is worth bearing in mind in this discussion.

It is common to see performers listed as playing 'electronics' or 'laptop', but the specifics of their practice are unclear as these terms are catch-alls, almost culturally neutral, more a signpost for sound physically produced by speakers. How might these 'instruments' fit in H-S?

H-S initially had four top-level classes – aerophones, chordophones, idiophones and membranophones – each with sub-classes that add greater specificity. Later, another top-level category was added by Galpin, that of electrophones (Montagu, 2007). Sachs himself seems to have been quite dismissive of these 'electric instruments' – "they surely owe their existence to the experimentations of electroengineers rather than to any musical need" (Sachs, 1940) – however, he does discuss them in the same way as other instruments and set out three sub-classes, summarised here by Paine (2010):

1. instruments with an electronic action

2. electro mechanical – acoustic sounds transformed into electric through amplification

3. radioelectric – instruments which are based on oscillating circuits.

Kartomi (1990) states that "logically [H-S] should include only the first and third of Sachs' three subcategories. As the basic character of division of the Hornbostel and Sachs scheme was the 'physical characteristics of sound production', only instruments that actually produce sound by electrical means should in fact be included, not instruments that produce sounds in traditional ways and then alter or amplify their sounds through an electrical device".

This is a logical argument, with merit. However, adapting a comprehensive system to remain comprehensive in the face of new technological developments also has merit.

Bakan et al. (1990) go some way to try to accommodate electronic instruments in a detailed manner. They proposed a revision of the H-S electrophone class. They provide for nuanced description with modifiers (e.g. 12.12 digital step-time hardware music processor) and suffixes (e.g., Rm = rack mount, My = on-board memory). The instruments they were accommodating were somewhat limited in their capabilities and so their sub-divisions are based on each instrument being essentially being capable of a single type of function (for example, 521.12 analog magnetic tape automatic sampler).

More recent modifications to H-S introduced a range of electrophone sub-categories, of which software was one (MIMO Consortium, 2011). However, existing as code on a data storage device, software itself has no sound making apparatus, only the potential to make sound when connected to speakers or other sounding devices. As a result, it remains as far from classification by vibration causation as it is possible to be.

As a result, these changes feel messy, and the elegant precision of the original H-S classification is lost. This seems to be because the new objects are not instruments in anything like the same sense as acoustic instruments. Interestingly, Paine (2010) points out that there is no stated concept of 'instrument' in conventional taxonomies, thus these new objects are a challenge to an 'ontology of instrument' that is *felt* rather than defined.

Could there be criteria of instrumentality, like those suggested by Croft (2007), with which to judge whether a new paradigm 'instrument' could be admitted to H-S? Perhaps, but many examples may exhibit such criteria *in addition* to other, non-instrumental characteristics that follow other paradigms. This would artificially split the field, accommodating only a proportion of the available system examples which, when viewed outside H-S, sit together quite happily. As such, it seems less appropriate to shoehorn it into a system like H-S when a better solution could be to admit the limits of H-S and create new ways of classifying these new technologies.

5.2.2   Taxonomy of interfaces for electronic music performance

The Taxonomy of interfaces for electronic music performance (TIEM) project (Paine, 2010) sought to create a taxonomy that covered a wide variety of DMIs, using that term to cover a range of different approaches to system design. The project gathered information on DMIs via a questionnaire which received 80 responses from system-makers and presented a draft taxonomy as "a step towards a

considered inclusion of DMI within the existing musical instrument classification frameworks" (Paine, 2010).

Paine embeds Godlovitch (1998)'s specifically WAM-based philosophy of performance in his taxonomy, even though he (Paine) found it wanting in how it deals with the new musical technologies. Even though IMS/DMI are rooted in this WAM milieu (Born, 1995), these new devices display a crucial difference to the instruments that preceded them, ie. that they have multiple imbedded functions/processes, and this requires a different (or at least revised) philosophical basis.

Figure 5.1: Draft taxonomy of interfaces for electronic music performance (Paine, 2010)

Unfortunately, TIEM (see figure 5.1) ultimately came to nothing. Like H-S, it appears to be hierarchical in nature and focuses only on control mechanisms. This is despite Paine highlighting that using a hierarchy is incompatible with the systems it would hope to classify. Forcing systems into particular places in a hierarchy is not going to be overly useful if they fit in multiple places, and is not going to provide much in the way of "meaningful categories that facilitate comparative studies of DMI" (Paine, 2010).

The TIEM project was underway before the 2011 revisions of H-S mentioned in the previous section (5.2.1) (MIMO Consortium, 2011), and has not reported since

2010. The one thing that may have had lasting benefit is a database of systems, but this is now only partially archived[1].

5.2.3 Rowe

A three-dimension outline classification of interactive music systems was proposed by Rowe (1993), with two continuous and one discrete dimensions as follows:

- score-driven——→performance-driven

- response methods:

  - transformative

  - generative

  - sequenced

- instrument——→player paradigms

Rowe (1993) states that his motivation for classification "is not simply to attach labels to programs but to recognize similarities between them and to be able to identify the relations between new systems and their predecessors." He is clear, too, that his scheme is intended to be an aid for identifying "musical motivations" in the system, but that "the points should not be considered distinct classes, however. Any particular system may show some combination of the attributes outlined here". The simplicity of these three dimensions is appealing as they very easily give some clear information about the purpose (score/performance), the technique (response methods) and the behaviour (instrument/player) of a given system.

Of particular interest to me is the instrument——→player dimension:

- Instrument:

  - input analysed and this guides an "elaborated output exceeding normal instrumental response"

  - "imagining such a system being played by a single performer, the musical result would be thought of as a solo"

- Player:

  - artificial player constructed

---

[1]https://web.archive.org/web/20151026150403/http://vipre.uws.edu.au:80/dmi/

- "a musical presence with a personality and behavior of its own"

- can vary in how much it follows human's lead

- "A player paradigm system played by a single human would produce an output more like a duet" (Rowe, 1993)

There is some overlap between Rowe's dimensions and the "paradigms of the relation between performer, instrument, and electronic sound" of Croft (2007). These paradigms focus on the role of the electronic sound in a performance:

- backdrop

- accompanimental

- responsorial/proliferating

- environmental

- instrumental

Croft notes that these paradigms can be combined in a performance, with the 'instrumental' being "clearly unique in the above taxonomy in the applicability of the principles of proportionality and transparency in the performer-computer relation". Being mindful that systems can adopt multiple paradigms is key to understanding their nature.

5.2.4   Birnbaum et al

Birnbaum et al. (2005) treat systems as unique entities to be described separately, rather than forcing them into shared categories. They set out seven axes to show "holistic, informative" visualisations of the characteristics of "musical devices" to allow intuitive comparison (see figure 5.2).

They chose axes "that would meaningfully display design differences among devices", while the devices covered ranged "from digital musical instruments to sound installations". Comparing plots of several systems (such as those seen in figure 5.3) allowed them to identify "visible trends between plots of related devices, with instrument-like devices tending to form one distinct shape and installations forming another shape".

Birnbaum et al. (2005) include a note of caution regarding the subjective nature of the assessments that produced the data that populated the plots. However, their method may have produced more consistent judgements than the large number of

Figure 5.2: The 7-axis dimension space of Birnbaum et al. (2005)

respondents to the questionnaire of Paine (2010) who would be expected to have individually divergent calibrations for their responses.

It is easy to see how useful Birnbaum et al. (2005)'s approach is for comparing systems in a meaningful way. By refining the axes to take into account the most important criteria to, say, a specific research question, it would be relatively straightforward to assess the systems and to visualise their data accordingly (if the information about the systems is usefully available, of course – see section 5.1.2 above).

As a static snapshot method these plots would inevitably struggle to show the true nature of a system that was designed to exhibit behavioural changeability. That being said, though, if the plots were shown digitally they could incorporate a useful animation to show the extents of any behaviour changes.

The use of multiple criteria can be seen as a more promising strategy to take with systems, an approach which has a foundation in information management.

Figure 5.3: Dimension space plots from Birnbaum et al. (2005). The systems are: (a) Waisvisz (1985); (b) Palacio-Quintin and Zadel (2008); (d) Fels and Vogt (2002); (e) Newton-Dunn et al. (2003); (f) Paradiso (2010); (g) Tanaka and Bongers (2001); (h) Winkler (2000). Plots for "instruments" tend towards the right, "installation" plots tend towards the left.

5.3 Faceted classification

The multi-dimensional approaches of Rowe (1993) and Birnbaum et al. (2005) have commonalities with faceted classification. As O'Brien (2003) describes,

> "Subjects are analysed into 'their component elemental classes' rather than by starting with the whole world of knowledge and dividing it up into useful segments. Thus, a concept is classified by assembling its component elemental classes, e.g. the activity of building may be composed of the facets 'thing built', 'building materials', 'method of building', etc. This leads to a more rigorous, as well as a more economical, approach to devising schemes."

Single category schemes can be adapted for this purpose if they possess the necessary categories. Indeed, "Sachs and Hornbostel identified ways of creating numerical codes for instruments such as bagpipes, which comprise more than one category, giving examples of ways in which the code might be reconfigured to highlight different aspects of a given instrument... Thus the full numerical code for the Highland bagpipe would appear as 422.112-7+422.22-62 Double-reed chanter, conical bore (-7 with fingerholes) + set of single-reed drones with cylindrical bore (-62) flexible air reservoir for all pipes" (MIMO Consortium, 2011).

However, this faceted approach still would not account for many of the important features of interest in systems, especially if they are best described as a (shifting) point on a continuum rather than a fixed object or process. Instead, a bespoke faceted classification would be necessary, using axes, dimensions or paradigms like those offered by Rowe, Birnbaum et al and Croft, coupled with a suitable method of quantifying the position of a system in relation to any given criterion. The information would need to be gleaned from the system, either by a classifier or by the system-maker (though this would need to be moderated), and then subsets of comparative data could be produced for a user's specific requirements. Information retrieval methods are more than capable of dealing with multi-dimensional classification, and "fully faceted classifications are most appropriate for display and browsing in electronic environments because users may choose the order of facets – in effect they may create their own classifications to suit their purposes" (Anderson, 2003).

5.4 Conclusions

As a diverse group, systems do not fit in the standard hierarchical classification scheme for musical instruments. There is little to be gained from trying to modify the scheme to fit systems owing to the Hornbostel-Sachs scheme being based on physical sound production and systems having no intrinsic means of sound production.

An approach that uses more than one aspect of a system to make judgements about its nature is much more useful. The multi-dimensional approach of Birnbaum et al. (2005) could be used in a faceted classification scheme of some kind. The usefulness of such a scheme would depend on the specific criteria used.

It would be of benefit to the NIME community for a set of common criteria to be developed so that systems might be easily described. If the criteria set is rich enough (i.e., contains criteria enough to cover the majority of potential system characteristics), then anyone wishing to use them will be able to narrow down their focus to only those aspects that are pertinent to them. System-makers would be able to characterise their systems, and to easily situate them in context with like-natured others.

The criteria of Croft (2007) and Rowe (1993) are both useful starting points, those of Birnbaum et al. (2005) also.

In examining classification and how systems' natures might be accommodated, I have become clearer about those aspects of systems that I value. I have not, however, devised a list of bespoke criteria. This is because I do not think I have a need of one.

Instead, for my own practice, I find that the phrase 'generous player' sums up the optimal system for me at this point. It marries Rowe's player paradigm with the idea of generosity. By generosity, I mean a spirit of support that looks out for the musicians around it. This is perhaps a tall order, but systems should be judged ultimately on their musicality rather than any technical wizardry that they might exhibit.

Chapter 6

Laminate

Contents

The second system I will look at in depth is my own *Laminate* which I built to simulate the experience of playing with an ensemble of several improvisers. It is created in MaxMSP (version 6)[1] for a single improviser.

---

[1] https://cycling74.com/products/max/

Laminate stems directly from an earlier simulation of multiple improvisers, *Treading*, a seven channel fixed-media piece[1].

6.1 What is *Laminate*?

Laminate takes the form of an improvised crescendo. The aim is (1) to slowly create a continuous texture, then (2) to layer up the texture into a thickly detailed mass of sound that envelops the audience. My ideal set-up would have been to have several improvising agents (e.g., several iterations of OMax (Bonnasse-Gahot, 2014)), but that did not happen. Instead, I worked out that a suitable simulation would be a number of delay lines with their output fed back into their inputs to create loops that would act like disembodied versions of me.

Laminate's form came about through performed experimentation and has resulted in a straightforward loop-based system, but one which is far from simplistic to perform. Before describing the experience of performing *Laminate*, I will describe what it is that I am expecting of the system prior to performing.

1. An improviser's audio is recorded via microphone.

2. A gating process then performs two functions. First, the signal is divided into discrete segments of a pre-defined duration. Second, each segment is passed onwards into one of a number of buffers (minimum 2, maximum 8), each of which corresponds to a single channel in the resultant work. The channel selection order is randomised, but remains balanced so that the sound material is evenly distributed as the work progresses. A representation of this process is shown in figure 6.1.

3. The output of each buffer, delayed by the segment length, is 'looped back' and added to the incoming audio, thus more and more segments of audio are combined over the course of the work. A representation of this process is shown in figure 6.2 for a system with 4 output channels.

4. Segment lengths are shortened in duration as the work progresses – 11 seconds at the start, then 7, 5, 3, 2 and finally 1.

The performer is requested to hide the looping mechanism as much as possible, primarily by populating the loop buffers with noise-based material, avoiding easily

---

[1]See https://soundcloud.com/maxhummus/treading. *Treading* is made up of seven improvisations, each following the same two-crescendo structure, and each placed in a separate channel. During public performances I would always want to push it forward but not be able to, owing to its fixed nature, hence the desire to make a version for live performance.

Figure 6.1: Schematic depiction of dispersion of audio segments between channels.

Figure 6.2: Schematic depiction of the channel picking and subsequent delay+sum structure

recognisable sounds (such as pitched notes or strong rhythmic features) for as long as possible. Once a continuous texture has been achieved, the aim is to add layers that use the instrument's entire pitch range, resulting in a wide and dense frequency spectrum.

The layering effect of the system is shown as a schema in figure 6.3, allowing an appreciation of the number of layers that might be heard at any one time, and the increasing rate at which they accumulate towards the end of a performance.

6.1.1   Laminate set-up

The *Laminate* set-up places loudspeakers around the audience to give an immersive experience. My usual number of speakers has become four, corresponding to the

Figure 6.3: Schematic depiction of the layering in *Laminate*.

four channel version that I play most often, with up to eight speakers/channels possible if desired.

Apart from the loudspeakers, the other sound source is the acoustic instrument. The speakers' output level is set in rehearsal to correspond with the levels of the acoustic sound at the very start, such that the first delayed sounds to be heard played back should be at a perceptually-similar loudness to when the instrument first made them. This makes the speakers and instrument 'equal voices', as if the performance is for n+1 channels. Using a microphone to pick up the instrument's sound means that placing the performer within the 'ring' of speakers could unbalance the input signal with too much speaker output, so the performer should be placed on or just outside the ring, thus behind the speakers nearest to them as shown in figure 6.4.

The performer will have the computer within reach so that they can start the performance with a single keypress. The computer's screen display shown in figure 6.5 has progress indicators to allow the performer to keep track of where they are in the performance. There is an overall timeline with a moving 'you are here' bar with segment length changes marked, a clock showing minutes and seconds elapsed, a

segment progress bar which tracks progress within the current segment, the number of the channel to which the audio is currently routed, and levels for input and output.

To end the performance the performer does not need to do anything as the system will stop when the timeline is complete, at which point the system goes silent abruptly.

Figure 6.4: Example of *Laminate*'s physical layout in performance

Figure 6.5: Example of *Laminate*'s screen display prior to the beginning of a performance.

6.2 Performing *Laminate*

Having described the concept and set up, this section describes what it is like for me to play *Laminate*.

I approach the start anxiously. Even without the nerves associated with a typical musical performance, the possibility of the system not behaving as expected is very real (see Berweck (2016) for a full exploration of the experience of "it worked yesterday"). Will it make any sound, or will it leave me stranded?

I tune my instrument, giving me a chance to get it settled and to get a feel of the room, and the audience too gets a chance to calibrate their listening[1].

I hit the space bar on the computer. The display gives a five second countdown before the first segment begins and the segment progress bar starts to move.

Nothing happens, there is no sound.

I choose a sound and play it.

Still nothing from the speakers.

---

[1] I have often been asked why I tune, as what I play seems not to require it. I say it is a comforting activity, it resets the instrument to its natural, 'neutral' sound, it ties in to the historical essence of the instrument and it sets up expectations that are subverted.

Wait...

Eleven seconds after I made my first sound is the moment of truth – will it have worked, or will I have to do the restart of shame? Did I turn on the adc∼?![1] Having to start again is obviously not a total disaster, but when I am setting out to have what we might call a traditional progression from off-stage to performing (like that described at length by Small (1998)), losing momentum can certainly be unhelpful. But I digress – let us imagine that everything is running smoothly, and the techno-anxiety can subside...

6.2.1 Opening section

The sound palette I use most frequently to open *Laminate* consists of creaks made by pivoting the bow on the strings without push or pull. These are sounds that I settled on even while developing the system (originally from the start of *Laminate*'s precursor *Treading*, mentioned at the top of this chapter) so are the legacy from a decision made several years previously, and they are the origin and fulfilment of the instruction to 'hide the looping mechanism'. I could change my material, but it works so well for me in the opening that I am happy to keep it as a significant part of my interpretation of performing *Laminate*. This is especially so for its contrast to the tuning that I will always do beforehand, even as a touch of humour.

The creak that I made sometime in the first eleven seconds is played back from a speaker away from me. I could work out in advance which speaker it will come from, but I generally do not because it adds an element of anticipation that offsets to some extent the predictability of the sound to come. Keeping in mind that I am aiming to hide the looping mechanism, I put another similar sound next to the first, perhaps as a consequence just after, or an anticipation just before. This gives the audience a (potential) distraction from it being the exact same sound played back, not only because of a new sound, but also because my visual and aural presence in the room can attract more attention than the inert technical set up, the 'disembodied other' (Emmerson, 2009).

In the third segment, then, the first sound will come from one direction and the second will come from another. As the original sound first came from my instrument and subsequently from one of the speakers, these have already changed the place and direction from which they have come, so there is potential here for a muddying of the obviousness of the loop. I might feel that I can choose another time to put my third segment sound(s), so that I start to dot my material over the

---

[1]Analogue to digital converter, and a MaxMSP shorthand for getting the audio computation running. If it is off, there will be no sound and thus no performance.

length of the segment rather than simply building out either side of a single point. This dotting around of material is my usual approach as I like to fill up the silence as evenly as possible over the segment length, it fits well with the overall shape of the gradually-building performance.

In the first part of the performance, when a sound is clearly discernible, the system is unforgiving of anything unintentional – what goes in stays in, and keeps coming back (at least until the segments are truncated later on). There is no lessening of the sound and it cannot be changed except by altering its context within the texture by adding more material. As a result, I take extra care to control my movements until this is no longer an issue, a self-imposed self-control in a performance that has few constraints.

If, by mistake, a sound I make is too recognisable for my liking, I very often make an effort to mask it by playing a simultaneous new sound when it comes around in the next segment, often consciously stronger than the 'error'. This can be a stimulus to ramp up my material, to play much more than perhaps I intended, say if I am trying to pace myself to not put in too much effort/material too soon – more earlier on will frequently mean *much* more is needed later.

The next few segments will come and go, more sounds added to the texture. At a certain point (often a minute and something in, but completely dependent on activity thus far) I will get a sense that there are unevennesses in the emerging texture. Noting where they are in the segment I will start to fill them up so that I will have both a 'complete' texture over the length of the segment (no silence) and an even layering of material, my input developing in nature and application as the performance progresses.

This filling of the texture has come to feel like a 'first section' of the performance trajectory. I have a lot of control over how it evolves and I can plan my material to some extent if I want. Generally, though, I like to have the speaker output at the front of my mind, as divorced as possible from its initial creation so that I have a fresh and reactive response to an 'outside' agency. This is helped by the long delay time and the spatial remove.

6.2.2 Transition to a new section

There is no clear boundary between the first and second sections. If the first can be characterised as the filling in of silence to create an even, continuous sound, then the second section is one of different material coupled with increased layering and effort.

What I have at this point is a texture that is continuous, but still fairly thin, i.e. not much layering, such that at some points there may only be one sound in each channel, if that. Having filled the silence, I now have to start building up the layers. In contrast with filling silence where the effect is to go from no sound to some sound, when layering up in this section the effect is to go from some sound to a bit more sound. It is harder to perceive the effect of a slight increase of sound than the obvious from-absence-to-presence change. Thus, the overwhelming feeling is one of greatly increased effort for little perceptual change.

I will have developed an initial idea from the start (e.g. a creak), but I get to a point where I have done as much as I am interested in doing with it. However, with a clearly set up texture that is quite homogenous, there is often no obvious way to make the transition to contrasting material without there being a jarring jump. Thus the choice of new material and how it is introduced has to be achieved with care and so changing the sound world I am inputting is always a conscious move.

The material expands not just in range but also in energy and size of gesture. Up to this point, my performance is usually quite contained physically, close in to the instrument with relatively little moving around. As my usual creaking material for section one is quite contained in the middle/lower end of the instrument, I often take the opportunity in section two to go higher up, starting to address the instruction to add layers that cover the instrument's entire range. However, the selection of specific material is not so critical given that the constantly sounding texture ensures that nothing is going to be as exposed as it was at the start.

6.2.3 Second section

Here, my connection with the system is less direct and compelling than in section one because the impact of my playing is harder to discern. Much of my motivation has to come from me, and in a more strategic way. I have to be mindful of both putting a lot more material into the system and of not overplaying – doing too much at this point may tire me out unnecessarily, physically and mentally.

How do I play in this second section? Differently and carefully. As mentioned above, I may start to go higher up the instrument where there is far less sound in the texture to mask new material. This keeps the new input audible. As well as changes in pitch, I may go for different gestural shapes – where the creaks may come in slow, gentle swells, this new higher frequency material could be sharper in attack and shorter in length, making peaks come out of the texture. Traversing of registers may be more common, instead of staying roughly in the middle of the instrument's range. All in all, the material played becomes much more heterogenous and the

continuity of the soundspace is thus swapped for articulation of less-connected sounds.

Continual playing is unrealistic and, even if it were possible, usually undesirable to the performer. For a long form piece as *Laminate* can be, too much too soon can store problems for later on down the line. Levels may become hugely inflated and cause signal distortion and, more importantly, potentially harmful discomfort for all listening. Instead of a turbo-charged approach, then, I aim to continue the gradual addition of new material and still to have a discernible effect on the sound as I am playing whilst I can still be heard against the system output.

Moreover, as I am still playing eleven second segments, to get one more layer in each of n channels I will need to play continuously for 11n seconds. So for a four channel performance, I will need at least 44 seconds of material just for one extra layer overall. That is quite a lot, and with each extra layer the effect of another is less and less perceivable, especially if the material played is not greatly contrasting, an evolution of the first sound world rather than a disruption, say.

So the experience of performing here is different to the first section, it feels effortful and slow to get through. At some point around the middle of the performance will be the first time I think to look at the timeline. If it is indeed in the middle, there is still some way to go before a significant change in the system's behaviour. At 61.8% of the way through, the segment length will abruptly become seven seconds. Getting through to this point can often feel like wading through treacle, a lot of effort for little movement. But I have to remind myself that I can have faith that I am doing enough, as the trajectory of the piece dictates that it will work out by the end[1]. I can concentrate on filling out the frequency spectrum, attempting to get as full a spread as I can.

It may be around this time, too, that it is almost impossible for me to be heard above the system output, except perhaps for hard percussive sounds, perhaps the bow banging against the bridge. As per the instructions outlined above, the speakers' output is to correspond with the acoustic sound at the very start and the levels left without adjustment[2] so this overtaking of the acoustic by the electroacoustic is probable if not inevitable.

---

[1]Times have been when I have doubted this too much and have turned up the gain on the microphone to get more sound going into the system, sometimes then having to turn it down again as the output gets too hot.

[2]If there happens to be an audio engineer 'doing the sound' at a mixing desk, then my instructions are to leave levels be after initial settings are made, but to ride the faders to keep things within reasonable bounds if decibel levels look likely to go too high. I do not want to cause unnecessary hearing damage.

6.2.4   A third section?

At the point I become essentially inaudible, I am in a sense liberated from further aural scrutiny. I am still very much visible – my movements are still obvious – but the audience now has to put in much more effort if they want to pick out what I am playing. It will be apparent that the layering has gone well and there is enough material in the system to have made a thick texture that starts to become less about the individual components and more about a physically tangible mass of sound.

The effect of this aural anonymity on my performance is freeing. Any feeling of effortfulness is most likely gone by now, replaced by an opportunity to really let loose. I hope to find flow in this opportunity, and sometimes my inner monologue stills enough for me to achieve this. Certainly, without the chance of being judged on my sound (the primary criterion that causes most concern), I can thrash around to my heart's content. Directing my physical movements, the 'effort at one remove', becomes the principal manner in which I play as I often cannot hear what I am playing myself at this stage.

The segment length shortens again at 77% of the way through, this time to five seconds long. As a result, the loop is that little bit more apparent. The energy associated with its repetition is not yet as insistent as it will become nearer the end, so the feeling whilst playing is one of some progress made but still a way to go. There is no urging it on as might be possible with a human in control of the system, so the effect can be quite moderating ('hold your horses, we'll get there in due course'), stopping me from rushing through it and reminding me that my perception of time speeds up while improvising. The shortened segment length makes it quicker and easier to build the layers, accelerating the thickening of the texture. Around this point, too, the system output will be coming back in through the microphone to further inflate the input. This effect is something that I try to account for when producing earlier input, stopping myself from producing too much too soon.

The segment length changes to three seconds at 87% of the way through, to two seconds at 93% and to one second for the last seven seconds before the end. This stepped truncation gives a palpable acceleration but is not in any way extreme. In the system's development, I set these changes right at the time when I moved the form from the double build-up to one single long one. Only now have I considered the decision to end at a one second segment. There is little fine control of the material in the final segment length, so the impulse is firmly at the 60bpm mark. I wonder whether, if maybe an audience could be expecting it to accelerate further, limiting this quickening to a moderate one makes the ending seem more abrupt. The benefit for me performing is that I have enough time to aurally register the ending (if I have not been watching the display closely) and to coordinate my own

ending with that of the system – there is always a danger that I could continue playing acoustically beyond the system cut-off by mistake. My ideal ending is to have the instrument ringing into the silence, though that is often only discernible to me and perhaps the closest audience members.

After the ending, it only remains for me to confirm to the audience that it really is the end, and that their attention can change. I might stand up or make another unambiguous gesture, just as in any other performance.

6.2.5 Effect/influence of the system

The effect of the system changes as the performance progresses. It moves from a transparent sonic partner to being an almost totally opaque wall of sound. The electro-acoustic output subsumes acoustic input. In the first section the system is aurally noticeable, exposed, equal to the instrumental sound. In the second the system has a constant texture, letting through louder/contrasting acoustic material which can 'pop' out of that texture. In the third, the system is overwhelming, the instrumental input is only perceivable as a visual activity which is generally much more exaggerated, matching the greatly increased overall volume. By the end, a lot of the input is the inevitable bleed from the speakers, augmented by any loud instrumental sounds.

The course of the piece also sets up a gradual channeling of the output into regular rhythmic repetitions. As the segment length decreases so the segmented nature of the music becomes more apparent to the listener.

6.3 Analysis

To complement the above description of a performer's experience of playing *Laminate*, I have undertaken some analysis of the music. Analysing this type of music is a tricky challenge – Young (2016) calls it "a quagmire for the musical analyst".

Certainly, music that involves a large amount of improvisation and is without a substantial (or any) score is difficult to analyse in a traditional musicological manner. Cook (1987) points out that "the more experimental a piece of music is, the harder analyzing it tends to be".

Without fixed notation to use out of real-time, conventional analytical methods cannot be used. The music made in my augmented practice is further complicated in that any two performances may be completely different, thus an 'exemplar performance' cannot be generalised in terms of the sound, moment to moment.

I have gone some way to accept this analytical challenge, choosing to ascertain whether the instructions given to a player of *Laminate* are borne out across performances.

As outlined in section 6.1 above, *Laminate* is conceptually simple. Its form can be fixed to enable repeat performances that share important structural timing and, usefully for this study, are thus straightforward to analyse. Taking multiple performances and subjecting them to various analyses, it is possible to confirm some of the inherent features of the system, enabling a comparison of the aims of work with the actual sonic results in multiple performances.

These analyses took the form of a listening analysis and three computational analyses. Data, in the form of recordings of performances, was collected as follows.

Data collection

The form of the work was fixed for all performances with predetermined parameter values for total duration (8 minutes and 20 seconds), number of input channels (1), number of output channels (4), number of segments for each of the different segment lengths (28, 11, 10, 10, 14, 7) and segment durations within each section (11, 7, 5, 3, 2, and 1 second(s) respectively). Performances were recorded in five channels (1 input, 4 outputs) by means of an auto-record functionality coded within the MaxMSP patch. The input microphone was positioned close to the acoustic instrument. To eliminate sound from the speakers entering this channel, the output channels were instead presented to the performer over stereo headphones, two channels per ear. For the purposes of the following analyses, four performances were recorded under rehearsal conditions (i.e., not in front of an audience).

6.3.1 Listening analysis

To test the feasibility of manual analysis to compare performances of *Laminate*, I took the instrumental input of a single performance, separating it from the output (the audio recording of this input can be found in Appendix A.2.). Concentrating on the input maintains the focus on the performer's actions.

Following the outline of a listening analysis set out by Cook (1987), a waveform of the input audio was printed out with space for written annotations, as shown in figure 6.6. As a 'first pass', brief descriptions of sound were given to passages of several seconds that had some internal unity/coherence, along with timings to the nearest second. Table 6.1 shows the descriptions extracted from this first pass analysis.

Figure 6.6: Waveform of the instrumental input of a performance of *Laminate*. Written annotations detail the sounds made and show the development of the input.

Table 6.1: Example of a first pass analysis of the input from a performance of *Laminate*.

Time	Description
0m00s	Creaking, sporadic, almost dual tone, sometimes with a third 'top-note'. Slight sense of pitch that moves between registers. Almost semitonal movement.
0m40s	Tick-tick-creeeak. Prolonged with articulation at 52s.
1m00s	More ticking, individual components of the creak are more prominent, deccelerating then accelerating. Offbeatness
1m10s	More pressure/tension. Sense of reaction, more articulation, increase in power.
1m40s	Clicks decreasing in pitch. Getting more pointed.
2m00s	Increasing movement, rotationally and across strings high to low. Quick grace notes before creaks, peaking at 2m15s and going away to a friction stop.
2m23s	Two types of movement – rotational and sudden arm pushes. Gives continuous texture with big articulations.

2m35s	Getting more sporadic, the continuous texture giving way to more of the articulations. Sense of less confidence/sureness.
2m55s	Transition from creak to more pitched material – high squeaks, more pontilistic.
3m18s	First pluck. Flexible regularity in rhythm, groups of short phrases. Points with some wedge crescendos. High to low register.
3m41s	Biggish slide, 3m16 first big low note. More groupings of different bow strokes. Heterogenous. Mid/high range alternation.
4m05s	Low range, fair amount of sliding, getting scrappier by 4m30, with more rapid bowing, range increasing with fairly quick register changes.
4m50s	Extended patch of rapid bowing (7-8s)
4m58s	Percussive, rhythmic phrases, low register, quicker at end – duuur de d d duh – then (moving across golden section) scribbly rise to high register diddly dee, LH [left hand] wobbling to 5m27.
5m27s	High point of some slides up and down. Bow starts wobbling at 5m32, moving into sliding around, slurred and scrubbing bow. Noisier. The range changes to low, leading into...
5m55s	Low creaks start, articulation is regular, subharmonics appearing subtly then strongly into 6m10 and onwards
6m25s	Subharmonics moving up the strings. Sustained bows with bow change articulations.
6m50s	Arriving at unstable ALF [anomolous low frequencies, or subharmonics. See Kimura (2010)] on ?top string. LH possibly becoming involved at 7m.
7m05s	Regular bow changes circa every half second. Bigger LH movements. More unstable ALF at 7m17, then LH hitting over bow changes.
7m25s	Zigzagging motion low string, low LH to high string, high LH. Short break at 7m35 then
7m36s	Across ranges, first percussive bow, then big bows and into scrubbing.
8m00s	Saving bow, sliding LH, moving into col legno hits. Definite sense of zeroing in on a particular rhythm, triplet then duplety, though none too exact.

This gives a detailed overview of the sounds and musical ideas being used, and can be used to identify structurally significant moments. The things of greatest interest to me were periods of evolution of a sound or idea, the moments of more marked change.

Once the entire performance had been sketched out like this, I made a second pass, this time using the written analysis to identify moments of change that are more marked than simple evolution of the musical ideas being played.

Table 6.2: Example of a second pass analysis of the input from same performance of *Laminate* as figure 6.1.

Time	Description
0m00s	Creak soundspace chosen.
0m40s	Starts to develop within soundspace.
1m00s	Rhythmic elements more prominent. Tension/release more evident.
1m10s	Continued evolution.
2m23s	Sounds are more continuous.
2m35s	Start of a change – section end/beginning.
2m35s	End of homogenous section, beginning of heterogenous. Leaves the middle register for high. Continuity/development of a soundspace swapped for articulation of less connected sounds. Traversing of registers more fluid.
6m25s	Much more power. Perhaps section end/beginning. Flow.

I find that I can see in the analysis the same fluid three-section form that I experience in performance: the evolution of the sound world; the change in material to heterogenous; and the powerful 'flow' at the end. On the level of an individual performance it can give some insight, but when considering the comparison of multiple performances with each other it looks less helpful. It would necessitate a number of these analyses to be made and this is less than ideal for two main reasons. First, it is very time consuming – the process takes far longer than the length of the audio recording. Second, producing an (overly) detailed description of the sound on a second-by-second basis is not all that useful: detailing all the material a performer produces puts us in danger of overfitting, giving what Bailey called "only a more exact picture of the irrelevancies" (Bailey, 1992).

With this in mind, I switched to a computational approach to compare multiple performances of *Laminate* . This approach is introduced in the next section.

6.3.2 Computational analysis

By analysing audio recordings using a computer and then making visualisations, I was able to make intuitive assessments of multiple performances of *Laminate*. The particular method was as follows[1]:

Visualisation

In order to see whether the aims outlined in the work definition (cf. 6.1) had in fact been achieved in performance, three specific audio analyses were carried out using readily available software: the MATLAB-based MIRtoolbox (Lartillot et al., 2008; Mathworks, 2013), and Sonic Visualiser (Sonic Visualiser, 2013). To allow the input and output signals to be separately investigated, the multichannel performance data was first split by channel into mono audio files using the command line tool SoX (SoX, 2013). Additionally, the four 'speaker' channels were recombined into a single mono file using SoX's 'mix-power' combination method, whereby the resulting output signal has a power approximately equal to the input.

Improvised crescendo

Time (8m20s) ⟶

Figure 6.7: The energetic curve of four complete performances are summarised using one root-mean-square energy value per second. A high degree of local variation between performances is visible in the player's input signal at the microphone.

Figures 6.7 and 6.8 present the results of an energy trace through time, for four performances of *Laminate*. Using the MIRtoolbox (Lartillot et al., 2008; Mathworks, 2013), a summary root-mean-square energy value was computed once per second through the entire duration of the work. While the input signal was locally variable between performances (fig. 6.7), and also variable within segments (the regular 'wobble' seen instead of a smooth line), the output signal clearly shows a continually rising signal level overall for every performance recorded (fig. 6.8).

---

[1] I am indebted to Dr Amy Beeston for her help in translating my analytical needs into working code. This work has been presented at two conferences, one in computer music (Summers et al., 2014) and the other in music analysis (Summers et al., 2015).

Time (8m20s) ⟶

Figure 6.8: The energetic curve of four complete performances as for figure 6.7 but showing the signal output from the speakers which displaya a globally consistent rising pattern despite the high degree of local variation of the input.

6.3.3 Continuous texture

Figure 6.9 shows the opening 88 seconds of a single performance (8 segments of 11 seconds duration each). The analysis was again carried out with the MATLAB-based MIRtoolbox, and takes as its premise the idea that the process of building a texture can be viewed as a 'filling up' in the time domain. We saw previously (at the far left of figs. 6.7 and 6.8) that the work begins very quietly, i.e. at a very low signal level which requires attentive listening to perceive. In figure 6.9, signal strength (computed here using the across-channel sum of the temporal envelope in each channel of a Gammatone filterbank analysis) has been renormalised, line by line, in order that the audio content is perceivable by sight. Instrumental gestures can be seen to interleave, gradually forming a continuous texture which is emitted through the speakers.

6.3.4 Layering up

Following the texture generation stage discussed in the previous section, the work definition next requires that layers are added using the instrument's entire range to create a wide and dense frequency spectrum (cf. section 6.1). Thus, whereas the previous analyses assessed a filling up in the time domain, the idea of an instrument's pitch range needs to be considered as a filling up in the frequency domain. Figure 6.10 presents a spectrogram created with Sonic Visualiser (Sonic Visualiser, 2013) of the performance seen in figure 6.9, using a log-frequency axis, with signal strength determined in proportion to the log of the square of the bin value. The density of the spectrum clearly increases as the work progresses, with a marked extension in both high- and low-frequency areas in the final minutes of the performance.

Time (11s) ⟶

Figure 6.9: Temporal envelope visualisation of segments 1 through 8, *top* to *bottom*, for a single performance. Instrumental gestures *(dark)* interleave to gradually form a continuous texture which is emitted through the speakers *(light)*.

Figure 6.10: Spectrogram for a complete performance of *Laminate*, inputs and outputs combined.

6.3.5 Performance by other players

In addition to the analyses of my own performances shown above, Summers et al. (2014) presented data from a further two performances, one each by a bass clarinetist and a pianist. The recordings were made under the same conditions as outlined above in section 6.3.

Figure 6.11: Temporal envelope visualisation for the texture generation as performed by a bass clarinetist (Summers et al., 2014). Other details remain as described for fig. 6.9.

Although the three players produced differing 'shapes' in audio, it is evident in the bottom line in figures 6.9 and 6.11 that the individual instrumental gestures (the input signal, *shaded dark*) have in each performance woven together to form a continuous texture in the output (*light*) as instructed, albeit in significantly different ways.

The development of the *Laminate* system has led me to a particular way of performing with it. Seeing analyses of two differing performance approaches has been instructive and has led to a relaxation in my own playing. Whilst I see the fuller frequency-filling in my own performances as a good thing, I take keen note of the alternatives for silence-filling shown in figures 6.11 and 6.12 as encouragement to take more time and not rush to fill the silence too quickly.

This observation has been of particular benefit as I gradually lengthened my performances of *Laminate*. My tendency has been to fill the silence quickly, certainly more quickly than it *feels* when performing. The difference in my experience of time between listening and performing is made clearer with the results of the analysis, and I have used this to be more relaxed about the silence, to give myself (and the audience) more of a chance to appreciate a sound before adding another as soon

Time (11s) ⟶

Figure 6.12: Temporal envelope visualisation for the texture generation as performed by a pianist (Summers et al., 2014). Other details remain as described for fig. 6.9.

as possible. I have carried this with me into other parts of my practice, mitigating my compulsion to make sound constantly, rather than letting the music breathe more naturally, using the gaps between gestures more effectively.

Thus the performance analysis undertaken here can be seen to have had a direct and meaningful effect on my practice.

6.4 Comparison of aims and outcomes in *Laminate*.

The visualisations employed here allow one to query whether a performer has indeed achieved the specific aims of the work. Despite the absence of a score, and despite the improvisatory instruction (which lacks a formalised musical language and therefore makes harmonic/melodic analysis redundant), the above analysis methods nonetheless afford opportunities for interrogation of performance practice.

Looking at the output signal in figures 6.7 and 6.8, it is clear that a general increase in amplitude has occurred over the whole duration of the work, the 'improvised crescendo'. Through the inbuilt structure, the work has enforced a high degree of consistency between performances in the audio signals that resulted at the speakers. This contrasts with the relative inconsistency of the improviser's input signal.

Whilst a common overall shape can be seen on the global level (correlating to the overall crescendo), a high degree of (temporally) local variability is visible between the different performances.

Figures 6.9, 6.11 and 6.12 display the beginning of the texture development (here, the first 88 seconds) as improvised by three different performers. In each example, sound events are introduced to fit into gaps in the signal (i.e., into portions of relative silence), in order to create a continuous mass of sound through time.

Comparing the three performances, a difference can be seen in the density of events incorporated by the three instrumentalists: my performance 6.9 includes numerous impulsive (yet quiet) bouts of activity from the very outset, making creaking sounds with a pivoting bow movement. The bass clarinetist's (figure 6.11) more measured approach to the texture creation objective may have arisen from the physicality of his instrument, particularly the use of breath. The pianist (figure 6.12) gives a fairly regular rhythmic performance.

Following the low-amplitude texture generation, gradually thickening layers of increasing density are added with exaggerated frequency ranges. The building of this sound mass can be seen in the horizontal stripes of figure 6.10, as more and more frequency bands are gradually populated with sound material and the spectrum gradually fills up. In the final minutes of the work, both the high- and low-frequency regions are markedly extended, suggesting that I have managed to assess the system output and select new material to fill missing bands in the spectrum.

6.5 A musical work?

Laminate can feel very much like a musical work in a similar way to notated works. The experience of playing and the above analysis would seem to support that notion. But is this also supported by an ontological inspection of the music? If so, could this lead to the conclusion that, although I exclusively improvise, some or all of my practice is underpinned by works?

In the next chapter, I will examine these questions in more detail.

Chapter 7

Are there underpinning works?

Contents

In my augmented practice, my playing is bound up with and thus directly related to the sounds produced by the systems. Given this relationship, I wanted to investigate whether I am purely improvising, or performing a given work, since it shed light on the nature of my actions in augmented performance.

The work-concept and the idea of *Werktreue*[1] are so entrenched in Western art music (WAM) that they are largely unquestioned by musicians in that area. As music has developed in the last hundred or so years, the forms of music played by performers of contemporary music have become much more diverse and fluid in nature, seemingly stretching the work-concept. However, even in those areas of

---

[1]"The notion of being true or faithful to a work" (Goehr, 1992).

contemporary practice that experiment with less rigidly structured ways of working, the work-concept and its associated hierarchy still have a strong hold on practitioners. Take for example, performances of graphic scores, where the sounding music is entirely the improvisation of the performer – the attitude of that performer will most often be that they are performing a musical work that is the creation of another.

Those experimenting with new technologies can display the same tendency towards (perceived) works. This is unsurprising, though, given the "so far unrefuted thesis that the overwhelming majority of computer music research and compositional activity locates itself (however unsteadily at times) within the belief systems and cultural practices of European concert music" (George Lewis (2000), remarking on Born (1995)).

My musical education has supported this commonly ingrained position that WAM and its derivatives are largely underpinned by works and, moreover, that the performer is in service to the will of the composer of those works. Because I have taken this route to improvising with computers, through a WAM-based education, such attitudes have seemed natural and have been deep-rooted. Thus, in my practice as in many others, there has been a bias towards the work-concept to account for. It would be easy to assume and accept that the systems discussed in this thesis would fit into the work-concept mould in some way. It is largely unquestioned and, as Pace (2014) puts it, "very little of this debate has filtered through to those regularly involved with the production of new music".

Rather than making assumptions based on how I might feel about how things are, in this chapter I ask whether there is a way to tell one way or another if what I am doing is performing works.

7.1 Underpinnings

What is going on if performances of *gruntCount* and *Laminate* feel like performances of works? Is what I do underpinned by works or should I fundamentally re-think how I should view my practice?

In addressing these questions, first I need to be clear on what I do:

- I improvise music on a viol.

- Sometimes I use systems to improvise with.

The first statement is simple. The second – using systems – is where ambiguity lies. I could be improvising pure and simple, or I could be filling out the under-defined parts of a musical work.

Ambiguity is a very present thing when considering music with systems,w and multiple perspectives could be taken. For instance, performances are often billed as 'system x' by 'composer y', performed by 'performer z'. They often have no instructions beyond the need to improvise into the system, which will then do something to contribute to the performance. The music made here seemingly lies somewhere between music-making *simpliciter*[1] and the performance of musical works.

Having raised the question, it has become important to me to decide whether there are works in some, all or none of my practice. For example, I might want to know if I can use a system only for its creator's purposes (e.g. performing a work of theirs), or for some other, unconnected purpose (e.g. improvising with it). If performing with a system instantiates a work, then arguably it should only be used to perform that work. If, on the other hand, it is a tool for use in improvisation, then it could be used in improvisation, or as part of the performance of a work devised by someone other than the system creator.

7.2   Looking for work-ness

The concept of the musical work has become a central part of musical doctrine to the extent that we seldom question whether something is a work or not (see Stansbie (2017) for ideological aspects of works). Do we perhaps *feel* the presence of a work? Is it the case that, to co-opt Nettl's assertion about improvisation (Nettl, 1974), that "while we feel that we know intuitively what [a work] is, we find that there is confusion regarding its essence"?

The question of whether or not a particular music is a work, however, appears to me to be conspicuously absent from most ontological discussions. Rather, a particular bit of music is *assumed* to be a work and then used as the basis for constructing a definition of a work *post hoc*. But should intuition (or whatever this is) be relied on to guide us in this question? I am not against intuition *per se*, but a more thorough questioning is necessary here if I am to answer my underlying question.

Scruton (1997) states that ontological questions, such as those explored throughout this chapter, are "raised whenever people listen to music, and whenever they experience the thing listened to as 'the same again'". The music in my practice leads to many experiences of 'the same again' and it does indeed lead me to raise ontolog-

---

[1]"Spontaneous and unregulated musical playings that are not of works" (Davies, 2001).

ical questions. I begin by asking how I might tell whether something is a work or not. What are the features or criteria that mark some music out as a musical work and other music as not a musical work? What is the 'work-ness' (Talbot, 2000a) that I might identify?

The music that I make shares few of the attributes of music commonly associated with musical works, at least on the surface. Therefore, it is important to try to establish those independent variables that can identify a musical work, variables that are style-neutral. As Jacobs (2008) puts it, "criteria by which any theory of the identity of a musical work should be judged... should be able to account for all kinds and periods of music, e.g., electronic, aleatoric, non-Western, Baroque, contemporary, and un-scored music".

7.3   A 'Western' ontology?

Ontological theorising is typically rooted in WAM, where commonly a standard, paradigmatic work is picked and discussion proceeds from there. So, too, the form of musical works selected for study is fairly standard, very often transmitted from composer to audience via written scores followed by performers. An example of a such basis for ontological discussion can be seen in the following statement:

> "I should make clear that I am confining my inquiry to that paradigm of a musical work, the fully notated "classical" composition of Western culture, for example, Beethoven's Quintet for piano and winds in E-flat, op.16" (Levinson, 2011).

There is, no doubt, a historical reason for this, with WAM remaining the main focus of ontologists because of its continued cultural value as a 'pinnacle' achievement of civilisation. Indeed, Levinson (2011) states clearly his reasons: "the choice of Beethoven was natural, since he occupies in both popular and the learned mind the place of classical composer *par excellence*".

This intentional restriction to a small subset of the music available in the world leads to a reinforcement of the musical work's association with that subset. But has this subset been chosen because it is the best example, or has the musical work been moulded to fit what has been considered the 'best' music? And was the work of a long-dead teutophone chosen because it is a work, *a priori*, or has the definition been made to fit the chosen pieces, *a posteriori*?

Even when attempts are made to include other traditions and their (probable) works, as in Davies (2001), the discussion is often so heavily weighted towards

WAM in its terms, and in the proportion of words devoted to it, as to make such attempts little more than moments of passing interest. Not only do such discussions not manage to incorporate all works, they do not cover (or even attempt to cover) many works that stem directly from WAM tradition yet which do not conform to that paradigm of 'pitched tones'.

Davies' mistake is that he is using the vocabulary of a particular genre (conventional WAM) to attempt to describe the work-concept which is supposed to fit musical works in general. That the work-concept could be shared by many traditions which do not necessarily share the vocabulary (musical or textual) means that the discussion will limit itself because it is too tradition-specific and, as such, fail to describe musical works fully. Davies does state an aim to avoid this tendency, so he is not ignoring it. However, despite this, his later discussion of sound structures ("A sound structure is a sequence of tones.") clearly shows that he is firmly rooted in WAM.

A continued emphasis on this paradigm means that there are musical works that are not served particularly well by such theories, especially more recent works which do not closely fit the mould, often bearing no resemblance to Beethoven's quintet at all. Thus it is probable that many musical works are left out of the discussion, and the resulting theories are poorer for it either because their descriptions of the work-concept are a bad fit or because 'other' musical works are excluded unfairly.

Certainly, with the expansion of the boundaries of music that originates in WAM, cross-fertilised with other genres, there is a need to widen the scope of the work definition, generalising it further onto a more conceptual, less specific level, to describe the work-concept in more abstract, generalised terms onto which one can subsequently pin genre-specific vocabularies (c.f. the taxonomical approach outlined in 5.2.1. In this way, the work-concept could be applied to those works that stem from WAM but which do not use pitched tones as basic building blocks, instead using whatever sonic material that is employed to build a more specific work-concept.

In the cases where an author has made an attempt to deal with newer forms from within the work-concept, the approaches have been mixed. For example, Davies (2001) makes categories of works that account for the different presentations that recording technology has afforded us, offering us works for performance and works for playback. Ferguson (1983) takes a different approach when dealing with music of a certain type (tape composition, which Davies would see as a subset of works for playback) by denying it the status of music because it is not 'performed', thus sidestepping the need to reconcile it with conventional ontology.

In stark contrast to Ferguson and going further than Davies, Stansbie (2017) argues that not only is tape music performed, it has a much richer variability than has been

admitted by more traditional thinkers. Also considered by Stansbie are other electronic musics that have an "unprecedented degree of instantial novelty", but still the "underlying ontological relationship, between works and their performances, is remarkably similar, if not identical, to those found elsewhere".

7.4 Resolving a confusion of questions

The previous section showed that binding a discussion of musical works to a particular style of music limits the potential for discussion of other musical types as it places too much emphasis on one style to the exclusion of others. Often, the limitations are openly imposed by the choice of paradigmatic work, at other times they are evident despite attempts to account for them.

One solution would be to remove any stylistic limitations for the discussion, instead looking at music in general without reference to specific stylistic qualities – accepting music as being present, but making no attempt to pin it down to having any particular sonic/semantic properties.

The simplest way to achieve this is to remove music from the specific question we are asking, reformulating the question (a) 'what is a musical work?'. Reversing 'musical work' to separate its constituent parts a little more gives us 'work of music', making the question (b) 'what is a work of music?'. Removing music from this gives (c) 'what is a work?', a question that is almost exactly what we need here. Almost, because we have still to remember that works exist in other art-forms. So a final formulation could be (d) 'in the context of music, what is a work?' .

Table 7.1: Redefining the question to isolate work-ness

> a. What is a musical work?
>
> b. What is a work of music?
>
> c. What is a work?
>
> d. In the context of music, what is a work?

The question of interest here becomes clear, namely 'what is a work?', without the encumbrance of negotiating the nature of music. This approach might make locating the difference between a work and a non-work easier to see as the element that is common to both (the music) is immediately side-stepped. With an idea of the difference, a more objective judgement can be made as to the nature of a given musical entity.

Looking at the literature then, anything that is a description of music (e.g. melody, harmony) can be discounted as irrelevant when looking for 'work-ness'. Thus it is clear that if a philosopher discusses the high level elements of music in a discussion of musical works, then they are confusing the question 'what is a musical work?' with 'what is music?', spending most of their time on the latter.

7.5 Possible work-ness criteria

I have essentially talked myself out of looking for criteria of work-ness in more traditional ontological discussions as their reliance on WAM features makes them problematic to reconcile with the music that I make. This section introduces the work of three authors who have considered this question in a more open manner.

Talbot (2000b) suggests three essential characteristics of a work, about which there is "at least broad agreement":

1. discrete – "a fixed beginning and end, and the property of being separable from other works".

2. reproducible – "a smooth continuum stretching from perfect mechanical replication... all the way to the most distant echoes in the form of jumbled fragments".

3. attributable – "includes authorship – but only as one of many possibilities. Besides a composer, a performer (or group of performer), a producer, a DJ or a studio technician may legitimately step forward to claim whole or partial credit for a work".

We can also learn from the analysis of Davies (2003) who asks of Cage's *4'33"* whether what is heard/happens in this work is music. He considers a number of factors that have a bearing on whether the piece is a work:

1. "Cage supplies a frame so that the audience can focus on the noises it encompasses".

2. "One sign that Cage's creation is a work of art is that it has a title".

3. "Cage's artistic act draws the limits of the work, leaving the content and form to take care of themselves".

4. "*4'33"* is a temporal artwork; it has a fixed duration".

5. "*4'33"* is a work for performance, as is evident from Cage's creation of a score, scores being sets of instructions addressed to performers. As such it is a work that can be multiply instanced".

6. "What is necessary for a performance of *4'33"* is an appropriate causal chain linking what the performer does to the instructions penned by Cage".

7. "As a work for performance, *4'33"* is written for musical instruments, as the score makes clear".

8. "*4'33"* is to be approached against the background of a knowledge of the tradition of musical works and performance practices."

Summing up, Davies (2003) states that "the piece is titled, temporal, multiple, and for performance (by musical instruments, if not on them). In most of these respects *4'33"* is like Western paradigms of musical works". He concludes, though, that the aural content of the piece is not music, and that the piece is therefore not a musical work. That it is not a musical work stems from this conclusion that the sound is not music, even though in other respects the piece strongly resembles a musical work. Rather, he concludes that it is a theatrical work[1].

A different approach to describing work-ness is taken by Horn (2000) who suggests a (non-exhaustive) list of different "shades of meaning". He describes "nine different senses which are, or can be, attached to the term 'work' when it is used in what we might for convenience call Western aesthetic discourse" (emphases as in original):

1. "The **piece** of music: the discrete, identifiable musical object"

2. "A piece of music with its own **identity**"

3. "An **achievement**, the outcome of endeavour"

4. "The endeavour is that of an identifiable **author**"

   (a) "The author has shown **creativity**"

   (b) "That creativity lends **authority** to both the piece and its author"

5. "The work can be said to have **originality**"

6. "Originality in its turn bequeaths two things"

---

[1]It has been suggested that a similar conclusion would be drawn with respect to copyright law (Pila, 2017). See chapter 9.2.1.

    (a) "The potential to obtain **status**"

    (b) "[The potential for] **canonisation**"

7. "To exude a hard-to-define sense of artistic sanctity, the phenomenon that Walter Benjamin termed the **aura**"

8. "A work is a piece of property"

9. "The work's existence incorporates some form of **blueprint** or template for performance" (Horn, 2000)

Much of this list fits with that of Davies. The items that do not fit, such as the 'aura' or potential for canonisation, are aftereffects of work-ness and would be impossible to identify in a piece of music – they are not direct attributes of work-ness so are not helpful for the identification of it.

Taken together, these three lists contain a number of features of a work, all without reference to the sound or construction of the music, which could be the source of a set of potential criteria for identifying work-ness.

The list of characteristics put forward by Talbot (2000b) is short and sweet, and is tempting to use *as is* for identifying work-ness in a system[1]. My tendency is to suggest 'repeatability' instead of reproducible, but this is perhaps so minor a difference as to be neither here nor there. So, assuming that it allows for repeatablity, I will keep 'reproducible'.

I would also add a note of clarification about 'fixed' endings. There may be times in my practice when an ending is not fixed in the typical sense (i.e. that there is a clearly-defined end with some sort of absolute delineation, like the double barline at the end of a score), but instead there is a process of working out when an ending should come, a process to be followed that is set out in advance of starting.

I will add two more characteristics from Davies' list, namely that a work needs to be for performance. However, this is perhaps a redundant term when we are considering the question of 'what is a work, in the context of music?' as the necessity for of *doing* is bound up in the concept of music (especially so if embracing Small (1998)'s idea of musicking).

---

[1]I have a slight reservation with the idea of reproducibility, though only because some music is through verbal instructions (like Lucier's *I am sitting in a room* (Broening, 2005)) or instructions for movement (like Lachenmann's *Pression* (Orning, 2012)).

These, then, are the criteria that I will use. For work-ness to subsist, a musical object[1] should be:

1. discrete, with:

    (a) a fixed beginning,

    (b) a fixed end,

    (c) separable from other works.

2. reproducible, capable of being performed.

3. attributable, there is one or more associated creator.

And to account for the 'context of music', I will append another criterion:

4. a performance should contain music.

7.6 Works in my practice with systems

This thesis discusses my use of systems to augment my improvisation. One by-product of this augmentation is the possibility that the introduction of a tangible 'musical object' into an otherwise totally improvised practice raises the very real possibility that I will be performing works.

I have found it all too easy to say 'this system is a work' or similar (e.g. Summers (2014)). I have mistakenly used this formulation in the past, but as easy a statement as it is to make, systems are not themselves works, any more than a score *is* a work. To suggest otherwise is to perpetuate a fundamental misunderstanding of the system's place in the process of work-instantiation.

Thus, I ask whether my performances with these systems instantiate works and, if yes, am I therefore underpinning my augmented practice with works?

Although I have musical objects I can examine (the systems), it is not necessarily clear whether they will be any help in identifying any signs of an associated work. A system may potentially be equivalent to a score, but it is unlikely to *be* a score in a form recognisable to a traditional ontologist. Where, then, should I look?

---

[1]I use the term 'musical object' following Horn (2000), meaning the bit of musical material that is being examined for work-ness. It could be a work or not a work.

7.6.1 Systems and work-ness

A primary motive behind the creation of these systems is to enable musicians to make, or to have, novel improvisation experiences and, as a result, performing with systems offers a high degree of autonomy to performers who use them in their practice. Unsurprisingly, non-texted music like this presents a significant challenge for ontologists in terms of understanding whatever emerges during a given performance. The various choices made by performers prior to and during the act of performance do not necessarily correspond with those made in other musical traditions.

There are clues about the nature the underlying musical ideas (whether works or not) to be found in a system's interface. This will show what we can assume the system-maker regards as the important information that a performer should have in front of them. *Laminate*'s interface features aspects of time – time elasped, progress through current segment and time aimed-for. *gruntCount* shows its performance curve, the path between presets, with moving cross-hairs that show the performer where they are in their flexibly-timed journey. *_derivations* (see chapter 8) has a lot of information about system processes, with many options to experiment with when fine-tuning it to respond 'well' to a performer's input.

Here, I take Talbot (2000b)'s three criteria and ask whether there is evidence of work-ness in the three selected systems.

discrete

"a fixed beginning and end, and the property of being separable from other works"

A performance with any of the systems will inevitably yield a beginning. A performance with *Laminate* starts when the clock begins counting up towards the end. *gruntCount* will kick into life when the performer makes enough sound to go above the amplitude threshold. *_derivations* will start after a small number of phrases have been detected. The differences here are that *Laminate* will start as soon as the instruction is given, whereas the other two will start at a variable, though predictable, point when the performer's input fulfils certain criteria.

As for a fixed end, they are again different. *Laminate* will stop abruptly when its timeline has run its course, *gruntCount* when the end of the performance curve is reached. In stark contrast, *_derivations* will stop only when it is told, a click of the stop button at some point after the system has started and thus has no fixed ending.

One question to note is whether the end of a system's contribution is the end of a potential work. It is possible to play after the system has stopped, as I did on

the gruntCount album[1] where I made one extra, deliberate sound after the system had cut off. In contrast, when the performer clicks the stop button on *_derivations*, the system will continue for a short while afterwards before stopping. The answer to this question is specific to each system and/or to each performance of it. The system has a strong voice, and any deviation from a performance stopping when it stops needs to have a solid musical reason behind it.

Last, each of the systems is separable from any other (indeed, I hesitate to load more than one at once for fear of instability arising from too much computation, let alone using two or more in tandem) and their identities are obvious from their distinctive musical behaviours.

reproducible

"a smooth continuum stretching from perfect mechanical replication... all the way to the most distant echoes in the form of jumbled fragments"

For Talbot (2000b), the site of reproduction is a live performance in which the performer should be faithful to a score.

Taking this on Talbot's terms, it is perhaps possible to argue that the architecture or design of a system constitutes something roughly equivalent to a score. For example, one might suggest that a patch or set of code communicates a set of performance-related directives or instructions, thus relaying the broad parameters in which an improvising musician could, or should, operate. Whilst this may be true, such a reconceptualisation of the score requires a considerable degree of specialisation, both in terms of 'reading' particular technologies and understanding the underlying assumptions about their use. Moreover, there is no guarantee that an understanding of the architecture/design of a given system will illuminate the full nature of it or any artwork with which it may be associated.

An easier alternative is to view the system as doing part of the reproduction, alongside the performer who is following instructions of some kind (*Laminate* and *gruntCount* have verbal performance instructions, *_derivations* has improvising as its stated purpose, essentially an instruction to improvise). Each performance with a system will contain a performance of the system's normal functioning. The systems will necessarily be following the instructions given in their code. By having both performer and system playing their respective part, performances easily fulfil the reproducibility criterion.

---

[1]https://sumtone.bandcamp.com/track/frau-mausi

attributable

"includes authorship – but only as one of many possibilities"

Each of the systems is attributable because each has a maker. Each of the performances has an identifiable performer so those, too, are attributable. Attribution is most often thought of in terms of authorship, and the question of authorship or responsibility for the *music*, who it can be attributed to, is an important one and will be discussed in chapter 9.

7.6.2   Can work-ness be found?

To find work-ness, two things are needed. First, a decision on where to look, what exactly to look at.

A work is not coterminous with a score, likewise a work is not coterminous with a system. A score gives instructions for performance, a system holds the potential for sound for a performance, the precise nature of which could only be realised during a performance, and it may also provide a framework for performance. The work-ness I am looking for will be in an intangible work which is only possible to be examined via a (potential) performance. So does a performance with a system exhibit work-ness and therefore instantiate a work that is entangled in the system?

Second, a decision about how to apply work-ness criteria. If work-ness can be said to exist where these criteria are met, then it follows that a musical object that satisfies all the criteria will have work-ness. It is less clear what is the case when not every criteria is met. If, say, all but one are satisfied, then is there work-ness? I have decided to say no, this is not enough, rather every criteria must be met.

In my practice, both *Laminate* and *gruntCount* satisfy all the work-ness criteria. They have fixed beginnings and endings, are separable from other works, they are capable of being performed and when they are performed they contain music. Thus, in performance they can both be said to instantiate musical works. The ending in *gruntCount* has some ambiguity but this can be accounted for by performing the ending with musical care.

_derivations satisfies all but one of the work-ness criteria. The key difference is in the lack of a fixed or foreseeable ending encoded in the system. In the absence of any guiding instructions to indicate a composer's hand, so to speak, the obvious conclusion is that performing with *_derivations* does not instantiate a musical work.

This corresponds to my experience of playing with *_derivations*. It has more focus placed on the act of music-making, and the flexibility of the system's parameters

that allow it to be customised to respond to a particular performer's music. Whilst it is designed with performance in mind, it gives a strong sense that allowing an experience of the process of music-making is its primary function.

7.7 Partial underpinnings

On the basis of the three systems examined here and the discussion above, it is clear that my practice is partially underpinned by the performance of works. This analysis fits with the feeling that I have had that I give performances *of* works and performances *with* systems, and that these two 'modes' overlap.

This overlapping is reflected in the three systems here that each have a different feeling stemming from the different experiences of playing. *Laminate* feels very work-like, and this is born out in the strong feeling of it being *performances of*. *_derivations* is very much *performances with*, whilst *gruntCount* sits in the middle between the two, with performances being both *of* and *with*.

This chapter has described the process by which I have come to regard performances as the central feature of my practice, where varying elements come together in different combinations. Works are still important, but how I view them no longer places them above performance but within it, on a very much more equal footing. This feeling of equality is especially important in a practice where so much creative effort comes from the performer rather than just a composer.

This shift in emphasis brings my thinking away from WAM and more into line with ontologies of jazz (Kania, 2011) and popular music (Horn, 2000). Here, too, performers bring the music to life, making nascent musical ideas into fully formed ones through their performances, where "'work-ness' is a peripheral, not a central, phenomenon" (Talbot, 2000b) – the material is "not an object but a potential event" (Horn, 2000).

And, of course, this more pluralist approach to music is in tune with the idea put forward by Small (1998), that music is above all an activity, something we do.

Chapter 8

_derivations

Contents

The third system I look at in detail is _derivations_, built by Carey (2016). He characterises it as follows:

> "_derivations_ is an interactive performance system designed for use in improvisatory musical performance. Acting outside the direct control of any human operator, _derivations_ listens to the performance of its collaborators and uses this information to make decisions about its own contribution to the unfolding musical dialogue. The resulting interactions are often abstract, intricate and playful, and showcase the

unique possibilities afforded by placing both human and machine on an equal footing in performance"[1].

_derivations is presented in a MaxMSP patch needing only audio in and audio out. I use the standard build of the system, version 1.08, with one adjustment. I altered the *sfrecord* object to record the output of the patch in six channels – the raw acoustic input, the raw computer output and the two as combined by the patch (master output), each in stereo. This adjustment allows more production flexibility than having just the two channel master output recording setup that comes with the patch as downloaded.

8.1   What is *_derivations*

Though faced with a interface that displays many aspects of the system's operation (see 8.1), a default setting is provided which allows an improviser to get playing with *_derivations* very quickly. That is, it only requires a small number of mouse clicks, and no decision-making at this stage. Of course, as a default mode, these settings are not optimised for a particular improvising style.

When up and running, the system will record the performer's audio input, segment it into phrases, and save data corresponding to its audio features. Segmentation is done principally by way of two amplitude thresholds – phrases start when the input goes above the onset threshold, and end when it dips below the offset threshold. For sustained input that will not dip below the offest threshold, a forced phrase end can be set (default is after 4 seconds), ensuring phrases are not overlong.

Once set in motion, an improviser can expect *_derivations* to wait for a short while before playing its own audio. When it occurs, this will sound like a modified and/or reassembled version of what the improviser has played moments before, in line with "the system's goal of deriving its sonic vocabulary directly from the history of the live performer" (Carey, 2016). Over the course of a performance, the system will listen to and sample the improviser, and contribute to a musical dialogue. This will continue until the system is stopped with a mouse click.

There are three types of audio to expect from the output modules:

1. **phase vocoder**: this "enables a sound to be sped-up or down in time, without changing its pitch. Conversely, it enables a sound to be transposed, without

---

[1]http://derivations.net/about/presentation/

Figure 8.1: The *_derivations* interface.

changing [its] length". There are four phase vocoders that work independently, and their sound is of recognisable captured audio shifted by speed or pitch.

2. **sound file granulator**: this "creates new gestures from our source phrases by rapidly outputting small grains of sound that overlap to create abstract textures". The sound made can vary "from sparse clicks to dense drones – depending upon the source phrase".

3. **pitch models**: this uses "snapshots of the spectrum of the improviser's sound during performance... to re-synthesise new gestures using additive synthesis, which takes the individual frequency and amplitude pairs of a spectrum and then synthesises them using banks of sine wave oscillators". This generates discretely pitched material.

All quotations from Carey (2016).

The output of the three modules combines in a way that gives the system's sound a unified feeling to work with. It has been easy for me not to consciously differentiate between the modules, preferring to perceive them as a single entity.

On the main patch window there is relatively little to pay attention to while playing, so there is no need to be glued to the screen. There are two extra windows that can be opened to show extra information if desired, one showing progress in time (minutes/seconds/milliseconds) and one showing progress over a set density curve (discussed in section 8.2.1 below).

8.2 Modifying settings

8.2.1 Density curve

An option given to the performer is the ability to set a 'density curve'. Carey (2016) states that "density is the extent to which phrases overlap during a performance". In the interface for this feature, a curve can be drawn to vary the density between sparse and full. The time over which this is to take place can also be set so that, in theory, a performance length can in some way be pre-set. However, reaching the end of the curve does not automatically stop the performance. Rather, the audio will continue until the stop button is clicked, whereupon the system will come to a halt after a few phrases.

Figure 8.2: The _*derivations* density curve.

8.2.2 Analysis parameters

Three of the parameters that I have experimented with are the segment length, offset threshold and the silence threshold. At the time of writing, my segment length is set to 2000ms. It is not clear, though, whether I have settled on the 'best' setting here, but it seems to work. As the correlation between this parameter setting

and the output audio is not direct, it will take much more experimentation to find the optimal length(s). Moreover, this parameter is likely to have different 'best' settings for different types of audio input.

The offset threshold is one that is particularly useful to my set up. The long resonance of my instrument (see section 3.1.3) means that there is a relatively large amount of sound that continues after I have stopped playing. As such, the amplitude does not have the marked drop that would be expected on other instruments where there is no inbuilt resonator (such as the saxophone). Setting the threshold quite high means that the end of a phrase is picked up more quickly and thus more accurately.

I have reduced the silence threshold considerably from the default 1000ms. This is to account for my style of playing which is often fairly continuous. A much shorter 100ms silence threshold level allows the system to recognise my playing as a series of phrases strung together rather than fewer long phrases, thus matching my conception of this type of playing more closely.

8.2.3   Adding a session database

It is possible for the system to build 'session databases' of stored material. These are audio recordings of the input that are stored with the system's analysis. This means that musical material from previous performances or rehearsals can be retrieved and manipulated in a new performance. I took this opportunity to use my solo album as a bank of stored material by allowing the system to take a file of the tracks concatenated and to analyse and save the metadata. In this way, the album is a ready source of material that is 'of me', and which could be a rich source for an artificial co-improviser.

To start with, I used the released version of the album, but this did not work as I had originally expected. However, loading a version of the album that included only the 'raw' recording from the on-instrument microphone has made an improvement in the responsiveness of the system. I suspect that the difference between the signal from my on-instrument microphone and the signal coloured by mixing and mastering for release was enough to create a mismatch in the data representation of sound which is perceptually similar to human listeners. This would be a place where it would be useful to have "robust audio interfacing based on psychoacoustic principles of hearing" (Beeston, 2015).

8.3 Performance experience

In this section, I provide a performer's account of the performance experience, highlighting the themes that emerged.

I go through the setup procedure, starting the system from scratch just in case. Everything seems in order, so I click on start.

Nothing happens so I play a little. I can see that the system is hearing something. The number of phrases rises as I play and the system captures my audio. After a few phrases the system puts out its own sounds. Processed versions of me, glitchy and pulsating, or maybe pitchy and synthesised. It comes and goes as I play with it, much of the response being recognisable as having an acoustic origin yet unmistakably computationally constructed. The sound world feels very familiar, much like that which I have been used to playing with other musicians controlling computers (for example, with Martin Parker, see section 1.2.2).

In some performances where the computer has a saved database of phrases from previous runs, it might start its contribution as soon as the start button is clicked. It may continue to play as a very present voice, it may stop for long periods of time or it might come and go. Each run is different and as yet impossible to predict.

At some point I will decide that I have had enough, or that an ending has presented itself and I will lean over and click on stop. Drawing to an end, the system may continue for a few seconds before it goes to silent.

From spending time playing with _derivations, it has become clear that the relationship between me and the system is something that needs careful attention. At times we can play happily together and then at other times there is no connection, by turns gratifying and frustrating.

The notes that I have taken while playing with _derivations contain a number of themes have emerged regarding my interactions with the system. These are discussed in turn in this section.

8.3.1 Novel material

The system's periodic injection of novel material brings some welcome variety. By novel I mean a musical idea that is different enough to stand out from what the system had been playing up to that point. Sometimes it can be as simple as an abrupt change in voice and amplitude, or a different layering of material. Whatever happens, it is something that I have not been expecting.

Each time it happens, this novelty is a boost to my playing, providing enough surprises for playing with the system to be a rewarding experience. Having fresh impetus in this way keeps the music alive, so when the computer is more active in this regard it is always more satisfying to me as a performer.

8.3.2 Amount of response/space

Figure 8.3: The waveform of a c.10 minute performance of *_derivations*, showing two channels of the audio waveform, where the improvised input (top) and system output (bottom) have been condensed from stereo to a single channel each.

Playing with the system, I have been struck by the amount of silence/space in the computer output, especially when compared to Carey's quick-start video[1] which has a lot more happening in the audio output than I am typically experiencing. The input there is fairly uniform and continuous, being the voice-over heard on the video. A lot comes back from the system in response and the sound is temporally full.

Many times when I have played, I get a lot less back from the system. This can be in terms of low volume and/or large gaps in the audio. To start with this could feel good as it made a change from the other systems which can have very little silence. However, the reduced amount of response can be frustrating. Performances can lose their momentum when the system output reduces from a relatively steady stream to small drips.

I have found that trying to reinvigorate the system in these circumstances is difficult. There seems to be no sure way to encourage it to make more sound, even with lots of effort. It can be like trying to resuscitate a dying fire – you can blow on the embers but they only really glow for a short while before dying down, certainly not catching, so the only thing to do may be to re-set the fire, to start again.

---

[1]https://vimeo.com/69298047

8.3.3 Control/influence

There is a definite sense that the system is not under any sort of control. For me, this is fine as I only want to influence the performance, not dominate it. My musical nature is to try to make a musical experience as good as possible, helping those around me to get the best from themselves as well as from myself.

However, when the musical experience is not satisfactory I want a way to improve it. At such times, more control would be useful, for example to force a glut of material in a long moment of sparseness, or vice versa.

8.3.4 Uncertainty

Not knowing exactly how the system will behave has introduced a certain amount of continual uncertainty. Building on the knowledge that the system can sometimes be waiting for me to stop playing, I try to leave more silences, so giving the computer more space to respond. This can sometimes lead to the feeling that the computer might not do anything, especially in a silence that becomes too long. As a result, I play too much, gabbling through the silences. This is not ideal.

With *_derivations* there is no way to know if the system will do something musically useful (let alone something actually musical). From the frustrations I have experienced, it is plain to me that what I crave is that musicality, the ability to adapt to a situation effortlessly. This is something a human can do intuitively, for example like a continuo player who can play an appropriate accompaniment in performance even though the soloist is playing in a way that they have never tried before in rehearsal.

8.3.5 Not a human

I do not feel that I have yet found the best relationship with *_derivations*. This makes me more keenly aware of the non-human nature of the system and, in contrast, highlights the benefits that derive from human-to-human communication in improvisation.

The difference between human-computer and human-human interaction can be emphasised in performance. An example from my notes describes a point where I had been noodling away for a while around the middle E string. I was settling in for a bit of exploration of the subtle pitch differences between stopped and open notes. In a human+human situation I would expect the other player to maybe come in and start playing with me, either picking up on my ideas or introducing an interesting counterpoint. This did not happen here. Only when I stopped did I get any re-

sponse from the computer. And, unfortunately, when I started again to join in the computer stopped more or less immediately.

Another example comes from a time when I made a significant change, suddenly producing a lot more material. The system did not react to my change. I hoped that it would join in with the torrent of notes, where there had been sparser textures before. That sea-change would typically precipitate a greater response in a human improviser.

Sometimes things do appear to my ears to happen but the sound-only manifestation of the system's response means it is impossible to tell whether sonic events are correlated and causal. For example, lingering in a silence that was getting too long I came in again, but the computer chose the same moment to come in as well. Was this coincidence?

If another musician were present and participating, this may be managed through some kind of extra-musical communication, say by a look, or by having built up the expectation with some kind of musical device. This suggests that playing with *_derivations* is like ensemble improvising but without the benefits of extra-musical communication. I am unable to use eye contact, bodily gestures or musical suggestion to manipulate or steer the structure where I might want to go.

This makes it a very different situation to playing with another person, where the signs can be subtle but appreciable: "Occasionally, Parker turns to Summers, leaning his joystick suggestively towards the body of the viol. Now and again, Summers leans over Parker's shoulder, takes a look at the hidden screen, and smiles" (Mohr-Pietsch, 2003).

8.3.6 Ending

The lack of a fixed or predictable ending has given me much pause for thought. In my experience, endings in improvisation often show themselves musically, something that has only rarely happened for me with *_derivations*. A common experience when improvising with others is that collectively you build the ending, all coming together to build the music to the point where an ending is inevitable. The trouble for me is that I cannot negotiate an ending with the system, nor can I predict when the system may leave space for me to play the end.

Moreover, the need to physically touch the computer itself to end the performance (i.e. to press the stop button) means that my desire to limit physical interaction with the computer to only the start cannot not fulfilled.

Figure 8.4: *_derivations* download page, as of 2 March 2018.

8.4 CC licence

_derivations is available as a download from http://derivations.net/. It comes with a Creative Commons (CC) licence which is designed to set out what a user can and cannot do with a copyright work, and what a user must do as a condition of their use. This is intended to enable a more flexible control of the use of the system than would otherwise be possible without the licence.

But does the CC licence function properly in this case, i.e. does it do what is intended?

To answer this question it is necessary once again to ask what this system is, this time in terms of copyright law. Does it qualify for copyright protection and, if so, which type(s) of work[1] is it?

The identification of the type of copyright work is necessary to be able to assess whether the CC licence is effective.

_derivations is presented on the download page as 'software' (see figure 8.4). If software is indeed what it is (and assuming that it fulfils the originality requirement), then under UK law it is protected as a literary work[2]. Looking at the li-

---

[1]Those set out in the Copyright Designs and Patents Act 1988 are literary, dramatic, musical or artistic works, sound recordings, films, broadcasts or typographical works.

[2]CDPA 1988, 3(1)(b) specifically includes protection of "a computer program".

cence[1], there is no mention of software in its definition of "work"[2], but software is still potentially covered by the licence, given that the list is non-exhaustive.

It is easy to accept that _derivations is a piece of software because fundamentally it is made up of code. However, it would be a mistake to assume that the system is exactly and only that as we are dealing with a piece of software whose primary function is the (joint) performance of music. This raises the question of whether this software might also contain a fixation of a musical work and thus qualify for a second layer of copyright.

This situation raises questions, too, about a system-maker's relationship to the output of their systems. Are they authors of the music? Is any responsibility they have for the music reflected in their legal relationship with it? I will address these questions in the next chapter.

---

[1]CC Attribution-ShareAlike 3.0 Unported https://creativecommons.org/licenses/by-sa/3.0/

[2]This is because the Creative Commons organisation has stated that "We recommend against using Creative Commons licenses for software" (https://creativecommons.org/faq/#Can_I_apply_a_Creative_Commons_license_to_software), but this appears to be for reasons which are unlikely to affect this scenario – "Unlike software-specific licenses, CC licenses do not contain specific terms about the distribution of source code, which is often important to ensuring the free reuse and modifiability of software. Many software licenses also address patent rights, which are important to software but may not be applicable to other copyrightable works. Additionally, our licenses are currently not compatible with the major software licenses, so it would be difficult to integrate CC-licensed work with other free software".

Chapter 9

Who is responsible for the music?

Contents

Chapter overview

Thus far, I have discussed aspects of my practice through examinations of classification (chapter 5) and ontology (chapter 7). The motivation for this discussion stems from the ambiguity of the nature of computer systems and the music that results from their use. We saw that it is not straightforward to reconcile systems with conventional musical categories of 'instrument' or 'work'.

Similarly, the music performed with systems presents an interesting challenge to accepted categories of protectable material in copyright law.

I approach this chapter as a musician with knowledge of copyright law. I am not aiming to provide a comprehensive examination of what is in effect unknowable – certainty for any arguable case of copyright can only come after all legal avenues has been exhausted and a final judgement made. Instead, I use copyright legislation and case law to afford another perspective on improvising with systems, an approach similar to that of Auslander (2008) in his consideration of liveness through copyright law.

The difficulty in the situation of augmented practice is the way in which creativity is brought to the music. How the performance relates to any musical works that may be present has a bearing on how that creativity is recognised and whether the creators will enjoy any ownership of copyright. A system is made to take part in music-making but the system-maker does not take part in the performance where the final form of the music takes shape. In that performance, a performer improvises large amounts of music which are an integral part of that final musical form.

There is no straightforward explanation of the situation.

As a performer who sometimes makes his music available to the public, copyright and associated rights are concrete realities rather than abstract concepts. For example, I released my album of solo improvisation (see section 3.2 above) in late 2016, registering the tracks with the relevant collecting agencies[1]. Part of this process involved stating the copyright owner(s) and beneficiaries of performance royalties. In this case it was fairly simple as I was ultimately in control of all aspects of the material, so assigning 50% of those rights and royalties to my producer was straightforward.

However, when it comes to releasing an album of my augmented practice with systems, how should I register the ownership and performance rights? Is there a difference between the dividing up of copyright interests that conform to the law and that which might be expected by the musicians involved? I suggest that this is an area that displays what Bently (2009) sees as "the failure of copyright law's rules on authorship, initial ownership and infringement to reflect the particular practices of musical production that have developed".

I am not suggesting that copyright law will provide answers that work for a performer in this situation (the performer being the true centre of this research) but, rather, this body of law provides the opportunity to use documented decisions and

---

[1]PRS/MCPS and PPL.

the reasons that underpin them to fuel discussion. In this chapter, therefore, I am questioning the situation as it presents itself to me when I am engaged in my creative practice, hoping to to discover more what one *could* argue than what one *should*.

9.1 UK law

The UK is a common law jurisdiction, meaning that 'the law' is a mixture of legislation (written rules enacted by parliament) and case law (interpretations of those rules by precedent-setting judicial decisions that deal with real world situations).

Case law consists of judicial decisions that detail the facts of a case and the judges' interpretation of how the facts fall within the law, both legislation and case law. In this way, decisions are made with reference to preceding decisions, and in a recurrent manner. To look only at legislation is to ignore the interpretive part of law, the part where much of the finer detail is to be found.

As such, this chapter will draw on the relevant parts of the copyright act and to pertinent cases, applying the underlying concepts to the scenario of augmented improvisatory practice.

In the Copyright, Designs and Patents Act 1988 (CDPA)[1], musical works are protected with their own category of copyright works[2]. On the other hand, software is protected as a literary work[3].

In the case of literary, dramatic, musical and artistic works, the legislation holds that works have an author, and that the author is "the person who creates it"[4]. An exception is made for works that are computer-generated[5], the author being the "person by whom the arrangements necessary for the creation of the work are undertaken"[6]. Moreover, a work may have more than one author in cases where a work is "produced by the collaboration of two or more authors in which the contribution of each author is not distinct from that of the other author or authors"[7].

---

[1]The CDPA is the principal piece of legislation governing copyright in the UK. See https://www.legislation.gov.uk/ukpga/1988/48/contents.

[2]CDPA 3(1)(d): ""musical work" means a work consisting of music, exclusive of any words or action intended to be sung, spoken or performed with the music".

[3]CDPA 3(1)(b): "["literary work" includes] a computer program".

[4]CDPA 9(1).

[5]CDPA 178: ""computer-generated", in relation to a work, means that the work is generated by computer in circumstances such that there is no human author of the work".

[6]CDPA 9(2).

[7]CDPA 10(1).

Legislation also stipulates that the work must be fixed for copyright to subsist, and that copyright subsists automatically once that fixation has occurred.

9.1.1 Assumptions

To clarify the discussion in this chapter, I make the following assumptions:

1. Performances of the music are being made in the UK by UK citizens.

   Thus UK copyright law applies unquestionably, so as to avoid having to consider different jurisdictions.

2. Audio recordings are made.

   An audio recording fixes a performance, allowing copyright to subsist.

3. The improviser and system-maker are two different people.

   The question of shared authorship is moot if the same person makes the system and gives the performance.

4. Any works are original.

   Legislation stipulates that literary, dramatic, musical or artistic works must be original for copyright to subsist[1]. The criteria for deciding originality have been developed largely via case law. Consideration of this area is not central to my thesis so will not form part of this discussion.

9.1.2 Scenario

The performance scenario (from here on 'the scenario') is the same as that which has been discussed to this point. However, it bears another summary to aid precision.

A musician (from here on 'the performer') improvises music using an instrument. A microphone attached to a computer picks up the improvised music which is converted into digital data by an audio interface. A piece of software (from here on 'the system') then processes this data in some way and outputs sound from speakers.

From this performance, a listener seated live in the room will hear a mixture of acoustic and electroacoustic sounds in varying amounts (for example, the acoustic sound may be partially or totally masked by the electroacoustic sound).

---

[1]CDPA 1(1)(a).

The performer

The performer's improvisation could be either constrained somehow or as free as is possible within the bounds of the intention to produce music in conjunction with a system. The constraints may be encoded in the system and/or in a score (or other representation of some structural sense), and they could be stylistic (sound of the music) or for a mechanical purpose (for example a need to do certain things to control or direct/influence the system).

The system

The system causes sound to be produced from the speakers. It may be described by numerous terms, for instance as a work, a piece, an environment, an interactive music system, an extended/augmented instrument or something else entirely.

The system may take audio data from the improviser and derive secondary data from it (timbre, pitch etc.) to make control data. It may use the audio data directly in the sound it produces, affected or not by the secondary data. It may use the secondary data to control independent sound synthesis or other process.

9.2 Musical works

It is important to know what a musical work is in order to identify whether the sounds resulting from the scenario can be protected as musical works.

There are close ties between the musical work in fields of copyright and philosophy. In her account of the evolution of copyright, Goehr (1992) portrays the law in the UK as lagging behind the developing work-concept, but that "the intimate relation between the elusive, abstract presence of works and their concrete scores and performances was, however, recognised in the British Copyright Act of 1911, where a distinction is drawn between the abstract property of the copyright and the material (concrete) objects representing it".

However, Barron (2006) opposes the view that the law lagged behind the development of the work-concept, rather she shows this influence to be the other way around:

> "far from simply absorbing Romantic ideas about musical or other cultural practices, copyright's categories have developed relatively autonomously of these and other 'external' influences. Further, being only relatively autonomous, they have also actively helped to shape

what is assumed – by Goehr, Lütticken and other historians of culture – to have shaped them. In short, my claim is that the work done by intellectual property discourse in forging conceptions of cultural form has been significant and important, and that copyright doctrine has accordingly played a major role in producing that construct which is known as 'the' musical work-concept" (Barron, 2006).

Either way, the legal musical work is very much in line with that of musical philosophy. Bently (2009) notes "copyright law's reliance on the notion of a 'work' which is fixed and identifiable, and the relegation to secondary status of 'performance' and 'recording'", though "the concept of the musical work in copyright has received little elaboration in the case-law". However, we should not assume that the philosophical and legal concepts of the musical work are interchangeable.

In Sawkins v Hyperion, Mummery LJ gave the following important interpretation:

> "In the absence of a special statutory definition of music, ordinary usage assists: as indicated in the dictionaries, the essence of music is combining sounds for listening to. Music is not the same as mere noise. The sound of music is intended to produce effects of some kind on the listener's emotions and intellect. The sounds may be produced by an organised performance on instruments played from a musical score, though that is not essential for the existence of the music or of copyright in it. Music must be distinguished from the fact and form of its fixation as a record of a musical composition. The score is the traditional and convenient form of fixation of the music and conforms to the requirement that a copyright work must be recorded in some material form. But the fixation in the written score or on a record is not in itself the music in which copyright subsists. There is no reason why, for example, a recording of a person's spontaneous singing, whistling or humming or improvisations of sounds by a group of people with or without musical instruments should not be regarded as 'music' for copyright purposes"[1].

Bently (2009) suggests that this "points at a broad and flexible notion of the concept of musical work... miles away from the image of the completed, notated score awaiting conversion by musical automatons – performers – into sounds appreciated by reverent, sedentary, passive audiences".

---

[1] Hyperion Records Ltd v Sawkins [2005] EWCA Civ 565.

9.2.1   Content of musical works

The law has a inclusive view of music, and "does not even confine the components of music to matters which are capable of notation: all sounds improvised, whether on instruments or not, are included" (Bently, 2009).

Justice Arnold (2010) concurs, saying "if sounds are presented and consumed as music, that is to say, for aural enjoyment, then they are music", and that "all aspects of the music which affect the recorded sounds form part of the musical work contained in the recording".

Aspects that might otherwise be thought of as non-musical can be included as music, according to the reasoning given in Sawkins v Hyperion that

> "In principle, there is no reason for regarding the actual notes of music as the only matter covered by musical copyright, any more than, in the case of a dramatic work, only the words to be spoken by the actors are covered by dramatic copyright. Added stage directions may affect the performance of the play on the stage or on the screen and have an impact on the performance seen by the audience. Stage directions are as much part of a dramatic work as plot, character and dialogue.
>
> It is wrong in principle to single out the notes as uniquely significant for copyright purposes and to proceed to deny copyright to the other elements that make some contribution to the sound of the music when performed, such as performing indications, tempo and performance practice indicators, if they are the product of a person's effort, skill and time... The work of Dr Sawkins has sufficient aural and musical significance to attract copyright protection."[1]

This ties into the earlier discussion of Cage's *4'33"* in section 7.5 above. Pila (2017) suggests that "if a work such as John Cage's *4'33"* is to be protected by UK copyright, it will be protected as a dramatic work only, on the ground that it includes movements that are stable in the sense of repeating or enduring in performance, but no combination of sounds possessing the same stability".

Going by the decision in Sawkins v Hyperion, though, it is less clear whether we can discount the 'musicality' of the directions if Cage's intention was to frame "sounds for listening to" and that his piece was "intended to produce effects of some kind on the listener's emotions and intellect"[2]. Moreover, if there is a direct

---

[1] Hyperion Records Ltd v Sawkins [2005] EWCA Civ 565.
[2] Mummery J in Hyperion Records Ltd v Sawkins [2005] EWCA Civ 565.

comparison to dramatic works, can we overlook the fact that, in the legislation, a dramatic work does not need to contain spoken words[1]. However, an argument would need to be raised to convince a judge that the sounds heard are music, given that the definition of a musical work includes a distinction between the music and any action that might accompany it[2]. Also, another statement made by Mummery in Sawkins v Hyperion, that "music is not the same as mere noise", is potentially problematic to a piece that arguably includes environmental 'noise'.

The current discussion of the content of musical works is relevant in this chapter because of the potential for instructions for producing as yet unfixed sounds to be permissible as constituents of a musical work. 'A set of instructions for producing sound' is one way to view the systems, none of which have fixed sounds stored within them, but which contain many instructions for making sounds when the system is run. These are clearly "elements that make some contribution to the sound of the music when performed"[3].

9.2.2   The subject work

Arnold (2010) states that: "in assessing claims to co-authorship of musical works, the vital first step is for the court correctly to identify the work [which is] the subject of the claim to copyright and to distinguish it from any antecedent work."

Because the music in the scenario is unlikely to be the same twice, each performance sounds very different. It is in a performance that we find "the final musical expression – what the audience will hear"[4]. Because of this, and in light of the conclusions I made in chapter 7, I will deal with the music in terms of individual performances.

As per section 9.1.1, these performances are recorded, and their fixation is by way of these sound recordings. At this point there is a sound recording in which copyright subsists with its underlying musical work that is described by the 'sound sculpture' in the recording, and in which separate copyright subsists.

Bently (2009) suggests that "copyright law requires that a 'musical work' be invented *ex post facto* out of the 'sound sculpture' produced by the artists". This

---

[1]CDPA 3(1): ""dramatic work" includes a work of dance or mime".

[2]CDPA 3(1): ""musical work" means a work consisting of music, exclusive of any words or action intended to be sung, spoken or performed with the music".

[3]Hyperion Records Ltd v Sawkins [2005] EWCA Civ 565.

[4]Beckingham v. Hodgens [2002] EMLR (45) 1005.

musical work is "a whole composition with shape and drive provided by its constituent aural elements"[1] (Pila, 2017).

It is these musical works as described in sound recordings of performances that are the focus of the following discussion (from here on 'the subject works'). Following the scenario, we can state that in the subject works the music is made up of:

1. music improvised by the performer; and

2. sounds produced by the system which may consist of:

    (a) synthesised sounds; and/or

    (b) sounds sampled from the performer's improvisations which may or may not be processed in some way.

9.3 Authorship

This section addresses the question of who might be an author of the subject work. As stated in section 9.1 above, musical works have an author and they are "the person who creates it"[2]. The question of who that author is can be less than straightforward, however, and can, in certain circumstances, be the key to large royalty payments.

The identity of the author(s) of the subject works is not immediately clear. There are two people who could be eligible – the performer and the system-maker – but neither can be automatically said to be an author, owing to the ambiguous nature of their contributions.

It could be that the subject works can be grouped as a set of related works where the common factor is a modified scenario that includes a specific performer and a specific system. Thus, for example, all subject works resulting from my playing with _derivations are related works.

It could be that there is an actual underlying musical work of which the subject works are arrangements. If this is the case, then the most likely place for the underlying musical work would be associated with the system. The system, then, would have to be deemed to be a fixation of music of some fashion.

Blackburne J in Fisher v Brooker stated a general principle regarding authorship, that

---

[1] Stuart v Barrett [1994] EMLR 448 (Ch) 460.
[2] CDPA 9(1).

"provided the contribution of the individual band member to the overall work is both significant (in the sense that it is more than merely trivial) and original (in the sense that it is the product of skill and labour in its creation) and the resulting work is recorded (whether in writing or otherwise), that band member is entitled to copyright in the work as one of its joint authors and to any composing royalties that follow"[1].

What is certain is that both performer and system-maker are contributing to the subject works. But is each of their contributions of the right kind to qualify them for authorship?

9.3.1 The performer

The performer improvises music. There are conflicting precedents in case law about whether this is authorship or 'simply performing'.

Two precedent-setting cases are discussed next. These cases, Hadley v Kemp[2] and Beckingham v Hodgens[3], both considered the question of authorship of music through improvised performance. The decisions in these cases are essentially opposites, Hadley v Kemp saying that improvising performers cannot be *authors* in terms of copyright, Beckingham v Hodgens saying that they can be.

1. **Hadley v Kemp**

   In Hadley v Kemp, members of Spandau Ballet attempted to be recognised as co-authors of some of the band's songs. The band's way of working saw Gary Kemp, the band's guitarist and songwriter, bring song outlines which were then worked up by the band into the songs as recorded.

   The court rejected their claim, ruling that Gary Kemp was sole author. The reason for this was that the claimant band members were judged to be interpreters of the music, not authors. Park J maintained that "there is a vital distinction between composition or creation of a musical work on the one hand and performance or interpretation of it on the other"[4]. Their skill was in bringing out extant elements of Kemp's music in their performance and, as Bently (2009) summarises, "performance was to be ignored not because

---

[1]Fisher v Brooker [2006] EWHC 3239
[2]Hadley v. Kemp [1999] EMLR 589.
[3]Beckingham v. Hodgens [2003] FSR 238.
[4]Hadley v Kemp.

of any absence of creativity or individuality, not because the performer was merely attempting to execute perfectly the composer's intentions, but simply because it was performance" (Bently, 2009).

2. **Beckingham v Hodgens**

   In Beckingham v Hodgens, a session violinist (Beckingham) was brought in by the band The Bluebells to play for their recording of the song "Young at heart", written by Hodgens. During the session, Beckingham was asked to play 'something jiggy' as an introduction. This was included in the released version of the song. When the song was used on an advert several years later it gained sudden popularity and Beckingham decided to assert his co-authorship of the song.

   The court's decision was that Beckingham was a joint author of the song because the violin part that he improvised was significant and that the requirements of joint authorship had been met, that there had been collaboration, authors had each made a significant contribution, and the contributions are not separable.

Therefore, an improvising performer could be performing and not authoring or performing *and* authoring. From the perspective of an improvising musician, Hadley v Kemp feels wrong to me. The significant creativity invested by improvising musicians is, I suggest, literally *making* music, just the same as someone writing it down on paper (which the judge would accept as authoring, no doubt).

There is some doubt about the validity of the Hadley v Kemp case. In later commentary, Arnold J suggests that it was a flawed decision, "problematic for a number of reasons" (Arnold, 2010). One of these reasons was that "it fails to distinguish between the original songs created by Gary Kemp accompanying himself on the guitar or piano and the arrangements of the songs which were recorded by Spandau Ballet for commercial release. Indeed, the judge did not even use the word "arrangement" in the parts of his judgment dealing with the claimants' claims" (Arnold, 2010).

If, then, we take the precedent set by Beckingham v Hodgens, does my improvising count as authorship? I would say yes. My contribution to the subject works is significant (non-trivial) and extensive. My improvising contributes to the final sound of the subject works both in what I play acoustically, but also in those elements that are picked up by the system to use in its contribution to the sound.

9.3.2   The system-maker

The system-maker builds a system that makes sounds for musical performance, but is coding a system for performing music the same as authoring music? Looking to Sawkins v Hyperion, I would suggest that the inclusive conception of music set out does not preclude viewing code as "elements that make some contribution to the sound of the music when performed" because the code has "sufficient aural and musical significance to attract copyright protection" [1].

Thus it would not be too great a step to argue that the code fixes a musical work, albeit one that may have a great deal of flexibility in resulting sound, and that the work would be protected whatever the particular notation used to record it[2].

Of course, it may be that, despite the fixed nature of the code, the completely unfixed nature of the sound produced would count against the fixation requirement (see section 9.1).

However, this would all relate to authoring an underlying musical work, but not directly authoring the subject works. Following Arnold (2010), if there is an underlying work then we can view the subject works as arrangements thereof. In this case, does the system-maker have any hand in authoring these arrangements?

Here we have to consider joint authorship.

9.3.3   Joint authorship

"A "work of joint authorship" means a work produced by the collaboration of two or more authors in which the contribution of each author is not distinct from that of the other author or authors"[3].

Case law has elaborated on what it means to have collaborated and for the contributions not to be distinct.

The decision in Ray v Classic FM clarified that merely contributing ideas to a work is not sufficient, that there needs to be some form of direct personal involvement to qualify as an author: "what is required is something which approximates to penmanship. What is essential is a direct responsibility for what actually appears on the paper"[4]. As such, can someone who does not display 'penmanship' be said to have collaborated?

---

[1]Sawkins v. Hyperion [2005] 1 WLR 3281.
[2]Bach v Longman (1777) 2 Cowp 623.
[3]CDPA 10(1).
[4]Ray v. Classic FM Plc [1998] EWHC Patents 333.

A recent case, Martin v Kogan, clarifies what it means to collaborate:

"Consent by an author to the use of his or her work product in combination with that of another is no doubt necessary for collaboration, but not sufficient. There must have been a 'common design' to use the words of Keating J, i.e. co-operative acts by the authors at the time the copyright work was created, which led to its creation. Thus the collaboration must have been in relation to the specific copyright work in issue"[1].

Does the contribution of the system-maker have any 'penmanship'? They do not make any direct 'marks' on the subject works, indeed a subject work can be made without their presence or even their knowledge. Therefore, it seems reasonable to conclude that the system-maker in the scenario has not collaborated in the authoring of the subject works.

9.4   Computer-generated works

One potentially complicating factor here is the question of whether the subject works, or just the system's contributions, are computer-generated works. The system's output is computer-generated, so we can assume that if the outcome of that generation is a work then that will be a computer-generated work. In that case, the author of the work is the "person by whom the arrangements necessary for the creation of the work are undertaken"[2]. This is similar wording to that which defines a 'producer'[3], the author of the copyright in a sound recording[4]. For sound recordings, 'arrangements' could include hiring equipment or engaging a sound engineer to take care of microphone placement, so this could suggest that for computer-generated works the arrangements might only be setting up the system and routing its output into some speakers.

However, Guadamuz (2017) cites the Whitford Committee (whose work led directly to the CDPA) which stated that, in the case of computer-generated works, "the author of the output can be none other than the person, or persons, who devised the instructions and originated the data used to control and condition a computer to produce a particular result". So it would seem that the system-maker has a claim to authorship, rather than simply the person who sets up the system for a performance, perhaps just pressing the start button.

---

[1]Martin v Kogan [2017] EWHC 2927.

[2]CDPA 9(3).

[3]CDPA 178: ""producer", in relation to a sound recording or a film, means the person by whom the arrangements necessary for the making of the sound recording or film are undertaken

[4]CDPA 9(1).

Mindful that a computer-generated work "is generated by computer in circumstances such that there is no human author of the work"[1], we must consider the performer again. If the performer is not an author, as per Hadley v Kemp, then indeed the subject works have no human author. If the performer *is* an author, as per Beckingham v Hodgens, then there is a human author.

Does this mean, therefore, that the subject work cannot be computer-generated?

According to the authoritative work[2] of Laddie et al. (2011), apparently not. The subject work is a case where, as Laddie puts it, "one would have to say of the finished product that it was partly created by a human author and partly computer-generated". In this circumstance, "the logical thing to [do is] to treat the result as a work of joint authorship". However, Laddie's reasoning is that if is possible to separate the work of the person and the computer then there should be two parallel copyright works, one for the person and one for the person who made the arrangements for the computer to do its functions.

In our subject works, though, arguably the two contributions are not separable. In which case, would the authorship rest with the human? After all, there cannot be a computer-generated work where there is a human author.

Counterintuitively, Laddie et al. (2011) suggests that the opposite should be the case. "However, [the parallel works] solution is not available in all cases, eg where the end-result is the product of a reiterated interaction between human and computer. Where this is so, the consequences must follow. That is, the work, insofar as it is a joint work, is produced by neither".

There is no reason given for this seeming leap of logic, one that would essentially make the work an instant orphan[3].

9.5   Who is an author?

The subject works, then, are of ambiguous authorship.

The performer has claim to authorship if the (good) precedent of Beckingham v Hodgens is followed. They are an author by virtue of their significant contribution to the final form of the subject works.

---

[1]CDPA 178.

[2]At times, judges will cite reasoning from 'authoritative' works by legal scholars as part of their decisions.

[3]An orphan work is one that has no known author.

The system-maker appears only to have claim to authorship if the subject works are found to have been computer-generated. This could only be the case if the (bad) precedent of Hadley v Kemp is followed with regard to the performer's authorship.

If the subject works are found to be computer-generated whilst the Beckingham v Hodgens precedent is followed then, according to Laddie, there is no author.

There is, however, the matter of the potential underlying musical work, which is arranged in performances to become the subject works. Here the system-maker would seem to have at least a good chance of a claim to authorship because of the wide latitude Sawkins v Hyperion gives regarding what can be considered music. Were a musical work found to be fixed by the system, then the system-maker would have an indirect interest in the subject works, not directly as an author thereof, but by virtue of the system's musical work being an antecedent to the subject works (which are arrangements of the system's musical work).

9.6   Does legal authorship follow musical responsibility?

Given the above conclusions, can we say that authorship would be granted to those who are 'musically responsible' for the music in performance? It looks unlikely.

Much of the discussion in cases that deal with authorship is around whether the work done is the right kind of work. We can see that in the Hadley v Kemp case where the judge decided that improvisation was not of the right kind. We can see it too in the idea of 'penmanship', where it has to be as if an author has written on the page.

Musically, what can we say about the kind of work done? The performer in the scenario makes music which is a significant part of what is heard. It is logical that this is the right kind of work in a musical context. The system-maker builds a system that makes a musical contribution which is again a significant part of what is heard. We might say that there is an interdependence that means that the two people are equally responsible for what is heard, and thus equally responsible for the subject works.

As for my own views on who is responsible for the music and thus deserving of authorship', I agree with Carey (2016)'s sentiments when he suggests that "musical performances with interactive performance systems may be seen as an instantiation of the combined musical ideas of the system developer, the musician navigating this space of ideas, and the interactively instantiated contributions of a machine to the performances".

It is unclear whether copyright law as it stands can fully recognise all creative participants in this situation and automatically reward them with the legal authorship that is musically due to them.

Chapter 10

Augmented learnings

Contents

In this thesis, I have presented an examination of my practice, both with and without systems. In chapters 1 and 2, I introduced my approach to this project, how I set about doing it and how I have presented it in two albums, a written thesis and an audio appendix. In chapter 3, I gave an overview of the sound of the viol and an in-depth commentary on my solo improvisatory practice as shown in Album 1.

In chapter 4, I introduced the first of the three systems I have examined in detail – Martin Parker's *gruntCount*. Questions about the nature of the system led to chapter 5 which, after a review of systems, asked whether it is possible to classify them. In chapter 6, I introduced the second system, my own *Laminate*. An analysis of performances showed that they had characteristics of performances of works. Chapter 7 asked whether this was true ontologically. In chapter 8, I introduced the third system, Ben Carey's *_derivations*. Questions about whether the included Creative Commons licence was appropriate intellectual protection for the system led to a discussion in chapter 9 about authorship and responsibility by way of copyright law.

Here in chapter 10, I conclude this thesis by looking at what augmenting my improvisatory practice has meant for me.

10.1 Similarities and differences

In my commentary on Album 1 (section 3.2), I noted a number of different themes that emerged from the individual tracks. As a group, these themes provide a way to gently assess the differences that augmentation makes to my practice. I address the relevant themes here.

- Starting point that then finds its centre of gravity.

- Searching for a purpose.

- Germ of an idea becomes a whole track.

The architecture of the situation has changed completely with the addition of a system to the acoustic instrument. A solo improvisation is an internal process. The musical choices can come entirely from within.

With a system, however, the internal choices now have a strong external factor. When another musical entity is sharing the music, my choices are constrained – while I might want to do something, it may be musically impossible or inappropriate if the system is doing something that clashes with my inclinations. Thus, I am no longer free to do exactly what I want.

- Introduction of aural stimulus.

The reduction in freedom of choice is nowhere near a wholly negative situation. When recording Album 1, I had many moments of not knowing where to start. In contrast, when playing with a system, I am pushed towards certain materials or ways of playing so I no longer have to make all such creative decisions on my own. The external stimulus gives great support to my performing as, generally, I know that I will have a musical partner that will take some of the pressure off me.

- Unintentional elements.

Playing in a partnership offers more opportunities for pleasing things to happen that are not entirely intentional, if at all. There are moments on Album 1 that surprise me with how much I enjoy listening back to them, yet over which I did not have total conscious control.

With a system, too, there may be such times when the conscious control is diminished or lost, especially if it is a system that provides unexpected output. More

common, though, is a different but related feeling, where the system and I have 'come together' in such a way that a 'moment of magic' happens (comparable to that in section 3.2.5).

An example of this 'coming together' for a 'moment of magic' is in track 1 of Album 2, the performance of gC-2018. At 2m53s, the system goes (almost) silent. This is very unusual – in other performances this has not happened. Because of the way that *gruntCount* makes its decisions, there will have been a point in the preceding minutes where I played something (or nothing) which later caused this sudden dip in output. I do not know where this point was, but the effect in performance was uplifting, especially as I was able to react in such a way that the moment was enhanced rather than muddied.

- Conventional musical material that has more grit.

- Physical acoustic phenomona.

Section 3.2 has much to say about the musical material on Album 1. In that album, I was solely responsible for the sound, and my intention was fully focussed on making that sound.

There is a great difference between that and my playing on Album 2. Here, my attentional focus is on the interplay between me and the system, on giving the system some sonic input for its various audio processes. This may not be appreciable aurally at all times, but I feel the effect of this change of focus is a reduction in nuance, especially in the surface elements of the sound.

Moreover, the way that the system's output occurs from multiple loudspeakers expands the sound-making space from a single point (me) to multiple points, often widely spaced in the room. To adjust for this, my spatial attention span needs to be wider when playing with a system. It no longer has a single focus but a wide plane. It is akin to the visual difference between seeing using the point of greatest acuity (the central focus point) and using peripheral vision to take in a whole scene. The amount of attention able to be given is the same, but is now perhaps spread thinner across a wider area. I assume this difference between acoustic performances and those with systems holds for the listening audience as well.

- Influence of instrument.

- Resonance.

- Instrumental resistance.

As stated above, the level of nuance appears reduced to me when playing with systems. It is in the nuance that the influence of the instrument is most obvious. The unintentional soundings that the instrument makes are no longer as audible and therefore are unable to exert as much influence on my overall soundworld.

While the influence of the instrumental sound itself is decreased, the instrument's resistances can be palpably heightened. As the system's output encourages me to play in more extended and extreme ways, so the physical resistances of the instrument become stronger and push back harder on me. This in turn can encourage me to play into this feeling until I am playing right on the edges of what is possible.

- Forms or ideas from 'old' music.

- Harmony.

- Tension and release.

- Dissonance/resolution.

With the introduction of systems to my practice, the opportunity for drawing forms and ideas from 'old' music is greatly reduced. However, there is still some lingering influence. This can perhaps be seen in the curve that I made for gC-2018 (see figure 4.2). Here I was constructing a path through the presets that would give a rewarding performance experience. My preferences regarding what is rewarding have been formed by my accumulated experience of musical form, encompassing all types of music, including the 'old'.

Harmony, too, has a much diminished place when playing with systems. There is little opportunity to use it in anything but a fleeting manner. The main reason for this is that the systems often use pitches, sometimes seemingly in a random way, and their presence would only interrupt any harmonic progression that I might be carefully setting up. Therefore, I leave harmony aside as a conscious device, save for those moments when I might join with the system's own pitches.

I use tension/release and dissonance/resolution throughout my improvisation in both solo and augmented practice. They are a vital part of musical discourse and rhetoric. When playing on my own, they can be used overtly in the musical material that I create. With systems, these elements inhabit moments of the music, but are perhaps most tangibly felt in the physicality of playing, that is as a very literal tension and release.

- Missed ending.

- Time perception.

The nature of systems is such that often the ending is fixed. Missing an ending is therefore a much more practical thing, rather than bound up in an improvisational decision about when to stop (though this decision is still necessary in *_derivations*).

The perception of time is still flexible for me when playing with systems. As in my solo practice, I still tend to experience time as being longer than it actually is, but the systems allow me a reference against which to temper this quickening. The three systems discussed in this thesis each have a different feeling of time: *Laminate* is fixed, *gruntCount* is flexible but within a finite journey along the curve, and *_derivations* has the potential to go on forever.

- Relaxation.

- Virtuosity.

Systems allow breathing space. Breathing allows relaxation. Relaxation allows virtuosity.

Systems can give me the support to be able to stop making sound, providing breathing space and a moment to collect myself. They can also provide a 'sound blanket' that can stop me from feeling so exposed. This allows me to relax, to reduce any anxiety about making material or of having to play to keep the music going. This relaxation in turn allows me to put myself fully into the music-making, to let myself play in any way within the capabilities of the combination of me and my instrument. Often this means that I can go 'all in', leading to exciting playing at the edge of the physically possible. My instrument has the scars to show for this, a testament to letting go and totally investing in a performance.

10.2 Generosity

In concluding chapter 5, I introduced the idea of 'generosity'. This is a concept that has become clear in its importance to me in my playing with systems and, by extension, in my playing with any other music-maker. I use the term to engage with the essence of a musical relationship. A generous system could be one that gives me just the right amount of output at just the right time, it could support me as I go off on a musical tangent or it could introduce an exciting one of its own, it could give me space or smother me with musical hugs when I need them most.

I have developed this concept in the later stages of this project by way of both my work with systems and, in the wider world, in addressing the challenges of my mental wellness.

Young (2010) puts forward the idea of mixed-music performance as "a structured therapeutic process", which "can be read as a metaphor for anthropomorphism, human participant as analyst; seeking human-like intentions, analytic methods and expressivity in the computer's musical output, or reading the output in terms of the ego of the originator/designer" (Young, 2010).

This resonates with me and with my experience of playing with systems, but I see it in a slightly different fashion to that put forward by Young. The therapeutic process can be the site of experimentation with an altered approach to an issue or situation. This allows a participant to essentially practice the feelings about and reactions to a difficult thing within a safe space. The safety allows observation and analysis. Transposing this to the playing of music with systems, there is a sense that the relationship with another player can be tested in a safe space, allowing a performer to learn about themselves in that situation without fear of interpersonal repercussions.

I have come to know more about my musical personality through this process than in any other way. The inhuman nature of the systems has allowed me to realise what it is about human musicians that I value, often from the systems exhibiting opposite behaviours or a simple lack. A common trigger for realisation has been 'if it was human, it would.../I could...'.

It is in this space that I learnt about the importance of generosity in music-making. Being a player of the bass line, my musical life has been mainly in a supportive role. A large part of that is to bend my playing to that of others, to adapt to any foibles or errors that might creep in and, when appropriate, to do it as unobtrusively as possible. I strive to be generous in this way to my fellow musicians.

10.3 Music is life

Recognising the importance of generosity has been an important lesson for my life in general. I am a better person when I am playing music. It is the person that I would like to be all the time. It is this realisation that allowed me to appreciate what Small (1996) meant when he wrote:

> "The act of musicking establishes among those present a set of relationships, and it is in those relationships that the meaning of the act of musicking lies. It lies not only in the relationships between the humanly organized sounds which are conventionally thought of as the stuff of music, but also in the relationships which are established between person and person within the performance space. These sets of relationships stand in turn for relationships in the larger world outside

the performance space, relationships between person and person, between individual and society, humanity and the natural world and even the supernatural world, as they are imagined to be by those taking part. And those are important matters, perhaps the most important in human life" (Small, 1996).

References

Anderson, J. D. (2003). Organization of knowledge. In Feather, J. and Sturges, P., editors, *International encyclopedia of information and library science*, 471–490.

Arnold, R. (2010). Reflections on "The triumph of music": copyrights and performers' rights in music. *Intellectual Property Quarterly*, 2010(2):153–164.

Auslander, P. (2008). *Liveness: performance in a mediatized culture*. Routledge, Abingdon, 2nd edition.

Bailey, D. (1992). *Improvisation: its nature and practice in music*. Da Capo Press, New York.

Bakan, M. B., Bryant, W., Li, G., Martinelli, D., and Vaughn, K. (1990). Demystifying and classifying electronic music instruments. *Selected Reports in Ethnomusicology*, 8.

Barron, A. (2006). Copyright law's musical work. *Social & Legal Studies*, 15(1):101–127.

Beeston, A. V. (2015). Do we need robust audio interfacing based on psychoacoustic principles of hearing? In *2nd Workshop on Philosophy of Human+Computer Music*, Sheffield.

Bently, L. (2009). Authorship of popular music in UK copyright law. *Information, Communication & Society*, 12(2):179–204.

Berthaut, F. and Knibbe, J. (2014). Wubbles: a collaborative ephemeral musical instrument. In *Proc NIME*, 499–500, London.

Berweck, S. (2016). *It worked yesterday: on (re)performing electroacoustic music*. PhD thesis, University of Huddersfield.

Birnbaum, D., Fiebrink, R., Malloch, J., and Wanderley, M. M. (2005). Towards a dimension space for musical devices. In *Proc NIME*, 192–195, Vancouver.

Bonnasse-Gahot, L. (2014). An update on the SOMax project. Technical report, IRCAM.

Born, G. (1995). *Rationalizing culture*. IRCAM, Boulez and the institutionalization of the avant-garde. Univeristy of California Press, Berkeley.

Bown, O., Eldridge, A., and McCormack, J. (2009). Understanding interaction in contemporary digital music: from instruments to behavioural objects. *Organised Sound*, 14(2):188–196.

Braasch, J., Van Nort, D., Oliveros, P., Bringsjord, S., Govindarajulu, N. S., Kuebler, C., and Parks, A. (2012). A creative artificially-intuitive and reasoning agent in the context of live music improvisation. In *Proc Music, Mind, and Invention Creativity at the Intersection of Music and Computation*.

Broening, B. (2005). Alvin Lucier's *I am sitting in a room*. In Simoni, M., editor, *Analytical methods of electroacoustic music*, 1–12. Routledge, New York.

Burnham, E. M. (1961). *A dozen a day: pre-practice technical exercises for the piano*. Chappell & Co, London.

Campbell, M. and Greated, C. (1988). *The musician's guide to acoustics*. Schirmer Books, New York.

Carey, B. (2016). *Derivations and the performer-developer: co-evolving digital artefacts and human-machine performance practices*. PhD thesis, University of Technology, Sydney.

Cassidy, A. and Einbond, A., editors (2013). *Noise in and as music*. University of Huddersfield Press, Huddersfield.

Collins, N. (2007). *Towards autonomous agents for live computer music: realtime machine listening and interactive music systems*. PhD thesis, University of Cambridge.

Colton, L. (2017). CD review. *The Viol*, (46):33.

Cook, N. (1987). *A guide to musical analysis*. Oxford University Press, Oxford.

Croft, J. (2007). Theses on liveness. *Organised Sound*, 12(1):59–58.

Crum, A. and Jackson, S. (1992). *Play the viol: the complete guide to playing the treble, tenor, and bass viol*. Oxford University Press, Oxford, new edition.

Davies, S. (2001). *Musical works and performances: a philosophical exploration*. Oxford University Press.

Davies, S. (2003). *Themes in the philosophy of music*. Oxford University Press.

de Montaigne, M. (1877). *The essays of Michael de Montaigne*. John Templeman, London.

Dyer, G. (2013). *Zona: a book about a film about a journey to a room*. Canongate Books, Edinburgh.

Edwards, M., Marais, M., Parker, M., Summers, M. A. C., and Williams, D. (2005). *Skin [album]*. dialogues, Edinburgh.

Emmerson, S. (2009). Combining the acoustic and the digital. In Dean, R. T., editor, *The Oxford handbook of computer music*, 167–188. Oxford University Press, Oxford.

Fels, S. and Vogt, F. (2002). Tooka: explorations of two person instruments. In *Proc NIME*, Dublin.

Ferguson, L. (1983). Tape composition: an art form in search of its metaphysics. *Journal of Aesthetics and Art Criticism*, 42(1):17–27.

Fritz, C., Blackwell, A. F., Cross, I., Woodhouse, J., and Moore, B. C. (2012). Exploring violin sound quality. *The Journal of the Acoustical Society of America*, 131(1):783–794.

Furniss, P. (2018). *The present performer: a humanised augmented practice of the clarinet*. PhD thesis, University of Edinburgh.

Furniss, P. and Parker, M. (2014). gruntCount (bass clarinet edition) . In *INTER-FACE International Conference on Live Interfaces*, Lisbon.

Galpin, F. W. (1932). *Old English instruments of music: their history and character*. Methuen & Co., London, 3rd edition.

Geeves, A. and McIlwain, D. (2009). That blissful feeling: phenomenological conceptions of music performance from one performer's perspective. In *International Symposium on Performance Studies*, 415–420.

Godlovitch, S. (1998). *Musical performance: a philosophical study*. Routledge, London.

Goehr, L. (1992). *The imaginary museum of musical works: an essay in the philosophy of music*. Clarendon Press, Oxford.

Gray, C. (1996). Inquiry through practice: developing appropriate research strategies. In *No guru, no method? International conference on art and design research*, Helsinki.

Green, O. T. (2013). *User serviceable parts: practice, technology, sociality and method in live electronic musicking* . PhD thesis, City University London.

Green, O. T. (2016). The situation of practice-led research around NIME, and two methodological suggestions for improved communication. *Leonardo*, 49(1):78–79.

Guadamuz, A. (2017). Do androids dream of electric copyright? Comparative analysis of originality in artificial intelligence generated works. *Intellectual Property Quarterly*, 2017(2):169–186.

Gurevich, M. (2014). Methodology soup: diversity in NIME research practices. In *Proc NIME*, London, UK.

Harrison, J. (1999). Diffusion: theories and practices, with particular reference to the BEAST system. *CEC eContact!*, 2.4.

Haseman, B. and Mafe, D. (2009). Acquiring know-how. In Smith, H. and Dean, R. T., editors, *Practice-led research, research-led practice in the creative arts*, 211–228. Edinburgh University Press.

Horn, D. (2000). Some thoughts on the work in popular music. In Talbot, M., editor, *The musical work: reality or invention?* Liverpool University Press, Liverpool.

Igweonu, K., Fagence, B., Petch, M., and Davies, G. J. (2011). Revealing the elusive obvious: making sense of creative practice through reflection and writing out. *Journal of Writing in Creative Practice*, 4(2):225–238.

Impett, J. (1994). A meta-trumpet(er). In *Proc ICMC*, 147–150.

Jackson, B. G. (1974). Hubert LeBlanc's *Defense de la viole* (continuation). *Journal of the Viola Da Gamba Society of America*, 11:17–59.

Jacobs, J. E. (2008). Identifying musical works of art. *Journal of Aesthetic Education*, 24(4):75–85.

Jecklin, J. and Josephson Engineering (2016). Optimum stereo signal recording with the Jecklin disk. Technical report.

Jordà, S. (2004). Instruments and players: some thoughts on digital lutherie. *Journal of New Music Research*, 33(3):321–341.

Kania, A. (2011). All play and no work: an ontology of jazz . *The Journal of Aesthetics and Art Criticism*, 69(4):391–403.

Kartomi, M. J. (1990). *On concepts and classifications of musical instruments*. University of Chicago Press, Chicago.

Kimura, M. (2003). Creative process and performance practice of interactive computer music: a performer's tale. *Organised Sound*, 8(3):289–296.

Kimura, M. (2010). How to produce subharmonics on the violin. *Journal of New Music Research*, 28(2):178–184.

Klien, V., Grill, T., and Flexer, A. (2012). On automated annotation of acousmatic music. *Journal of New Music Research*, 41(2):153–173.

Laddie, H., Prescott, P., and Vitoria, M. (2011). *The modern law of copyright and designs*. LexisNexis, London.

Lartillot, O., Toiviainen, P., and Eerola, T. (2008). A Matlab toolbox for music information retrieval. In *Data Analysis, Machine Learning and Applications*, 261–268. Springer, Berlin, Heidelberg.

Levinson, J. (2011). *Music, art, and metaphysics: essays in philosophical aesthetics*. Oxford University Press, Oxford, 2nd edition.

Lewis, G. E. (2000). Too many notes: computers, complexity and culture in *Voyager*. *Leonardo Music Journal*, 10:33–39.

Linson, A. (2014). *Investigating the cognitive foundations of collaborative musical free improvisation: experimental case studies using a novel application of the subsumption architecture*. PhD thesis, Open University.

Lloyd, E. (2016). *Determinacy, indeterminacy and collaboration in contemporary music-making*. PhD thesis, University of Edinburgh.

Mace, T. (1676). *Musick's monument, or, a remembrancer of the best practical musick, both divine and civil, that has ever been known to have been in the world*. Thomas Mace, London.

Machover, T. (1992). Hyperinstruments: a progress report 1987-1991. Technical report.

Mathworks (2013). MATLAB [software].

McPherson, A. P. (2010). The magnetic resonator piano: electronic augmentation of an acoustic grand piano. *Journal of New Music Research*, 39(3):189–202.

MIMO Consortium (2011). Revision of the Hornbostel-Sachs Classification of Musical Instruments. Technical report, MIMO Consortium.

Miranda, E. R. and Wanderley, M. M. (2006). *New digital musical instruments: control and interaction beyond the keyboard*. A-R Editions, Middleton.

Mohr-Pietsch, S. (2003). Electronica classical: NED. *The List*, (463).

Montagu, J. (2007). Instruments, classification of. *Oxford Music Online*.

Nettl, B. (1974). Thoughts on improvisation. *The Musical Quaterly*, 60(1):1–19.

Newton-Dunn, H., Nakano, H., and Gibson, J. (2003). Block jam: a tangible interface for interactive music. In *Proc NIME*, 170–177, Montreal.

Nicolls, S. L. (2010). *Interacting with the piano : absorbing technology into piano technique and collaborative composition : the creation of 'performance environments', pieces and a piano*. PhD thesis, Brunel University.

Nowotny, H. (2012). Foreword. In Biggs, M. and Karlsson, H., editors, *The Routledge companion to research in the arts*, xvii–xxvi. Routledge, London.

O'Brien, A. (2003). Bibliographic classification. In Feather, J. and Sturges, P., editors, *International encyclopedia of information and library science*, 33–35. Routledge, London.

Olmos, A., Rushka, P., Ko, D., Foote, G., Woszczyk, W., and Cooperstock, J. R. (2011). Where do you want your ears? Comparing performance quality as a function of listening position in a virtual jazz band. In *Proc SMC*, Padova.

Oppenheim, C. and Summers, M. A. C. (2008). Citation counts and the Research Assessment Exercise, part VI: Unit of assessment 67 (music) of the UK Research Assessment Exercise. 13(2).

Orning, T. (2012). Pression – a performance study. *Music Performance Research*, 5:12–31.

Otterstedt, A. (2002). *The viol*. Barenreiter, Kassel.

Pace, I. (2014). Beyond Werktreue: ideologies of new music performance and performers. In *Royal College of Music Lecture*, London.

Paine, G. (2009). Towards unified design guidelines for new interfaces for musical expression. *Organised Sound*, 14(2):142–14.

Paine, G. (2010). Towards a taxonomy of realtime interfaces for electronic music performance. In *Proc NIME*, Sydney.

Palacio-Quintin, C. and Zadel, M. (2008). Interactive composition and improvisation on the hyper-flute. In *Proc ICMC*, Belfast.

Paradiso, J. A. (2010). The brain opera technology: new instruments and gestural sensors for musical interaction and performance. *Journal of New Music Research*, 28(2):130–149.

Parker, M. (2005). Environment. In *Skin [album]*. dialogues, Edinburgh.

Parker, M. (2011). gruntCount. sumtone.

Pestova, X. (2008). *Models of interaction in works for piano and live electronics*. PhD thesis, McGill University.

Pila, J. (2017). *The subject matter of intellectual property*. Oxford University Press, Oxford.

Puig, S. J. (2005). *Digital lutherie: crafting musical computers for new musics' performance and improvisation* . PhD thesis, Universitat Pompeu Fabra.

Purcell, H. (1693). Of all the instruments that are. In *Comes amoris, or, the companion of love:*. John Carr and Samuel Scott, London.

Rice, T. (1994). *May it fill your soul: experiencing Bulgarian music*. University of Chicago Press, Chicago.

Risset, J.-C. and Van Duyne, S. (1996). Real-time performance interaction with a computer-controlled acoustic piano. *Computer Music Journal*, 20(1):62–75.

Rodgers, G. (2018). 50 things: Simon Emmerson's *Spirit of '76*.

Rowe, R. (1993). *Interactive music systems: machine listening and composing*. MIT Press, Cambridge, MA.

Rutledge, J. (1979). How did the viola da gamba sound? *Early Music*, 7(1):59–69.

Sachs, C. (1940). *The History of Musical Instruments*. W.W. Norton, New York.

Sayer, T. (2006). A conceptual tool for improvisation. *Contemporary Music Review*, 25(1-2):163–172.

Schroeder, F. (2015). Bringing practice closer to research – seeking integrity, sincerity and authenticity. *International Journal of Education Through Art*, 11(3):343–354.

Schubert, E. and Wolfe, J. (2016). Voicelikeness of musical instruments: a literature review of acoustical, psychological and expressiveness perspectives. *Musicae Scientiae*, 20(2):248–262.

Scrivener, S. (2000). Reflection in and on action and practice in creative-production doctoral projects in art and design. Technical report.

Scruton, R. (1997). *The aesthetics of music*. Oxford University Press, Oxford.

Small, C. (1996). Musicking: a ritual space. In *Aflame with music: 100 years of music at the University of Melbourne*, 521–533. Parkville, Vic.

Small, C. (1998). *Musicking: the meanings of performing and listening*. Wesleyan University Press, Middletown, CT.

Sonic Visualiser (2013). Sonic Visualiser [software].

SoX (2013). Sound eXchange [software].

Sparkes, A. C. (1996). The fatal flaw: a narrative of the fragile body-self. *Qualitative Inquiry*, 2(4):463–494.

Stansbie, A. (2017). Beyond the fixity fallacy: rethinking the work-concept in an age of electronic music. In *Music and sonic art*, 1–23. Cambridge Scholars Publishing,

Cambridge.

Sudnow, D. (2001). *Ways of the hand: a rewritten account*. MIT Press, Cambridge, MA.

Summers, M. A. C. (2001). La mort de la viole en France pendant le dix-huitième siècle. *Chelys*, 29:44–61.

Summers, M. A. C. (2014). Can improvisation-driven music systems be musical works? In *1st Workshop on Philosophy of Human+Computer Music*, Sheffield.

Summers, M. A. C., Beeston, A. V., and Stansbie, A. (2014). Audio comparison of repeat performances of an improvisational work of human+computer music. In *DMRN+9: Digital Music Research Network*, London.

Summers, M. A. C., Beeston, A. V., and Stansbie, A. (2015). A mixed approach to analysing works that use extensive improvisation. In *KeeleMAC Keele Music Analysis Conference*, Keele.

Talbot, M. (2000a). Introduction. In Talbot, M., editor, *The musical work: reality or invention?* Liverpool University Press, Liverpool.

Talbot, M. (2000b). The work-concept and composer-centredness. In Talbot, M., editor, *The musical work: reality or invention?* Liverpool University Press, Liverpool.

Tanaka, A. and Bongers, B. (2001). Global string: a musical instrument for hybrid space. In *CAST01 Conference on Artistic, Cultural and Scientific Aspects of Experimental Media Spaces*, 177–181, Sankt Augustin.

Van Nort, D. (2014). Sound and video anthology. *Computer Music Journal*, 38(4):119–127.

Van Nort, D., Oliveros, P., and Braasch, J. (2013). Electro/acoustic improvisation and deeply listening machines. *Journal of New Music Research*, 42(4):303–324.

Vasconcelos, E. F. d. S. (2011). "I can see you". *The Qualitative Report*, 16(2):415–440.

Vincs, K. (2007). Rhizome/MyZone: a case study in studio-based dance research. In Barrett, E. and Bolt, B., editors, *Practice as research approaches to creative arts enquiry*, 99–112. London.

Waisvisz, M. (1985). The hands, a set of remote MIDI-controllers. In *Proc ICMC*, 1–6.

Waterman, G. and Anthony, J. (2001). French overture. *Grove Music Online*.

Webber, O. (2002). Monteverdi violins. Technical report.

Whalley, I. (2009). Software agents in music and sound art research/creative work. *Organised Sound*, 14(2):156–167.

Winkler, T. (2000). Participation and response in movement sensing installations. In *Proc ICMC*, Berlin.

Wishart, T. (2002). *On sonic art*. Routledge, Abingdon.

Woodfield, I. and Robinson, L. (2001). Viol. *Grove Music Online*.

Young, M. (2009). piano prosthesis.

Young, M. (2010). Identity and intimacy in human-computer improvisation. *Leonardo Music Journal*, 20(online supplement):1–6.

Young, M. (2016). Interactive and generative music: a quagmire for the musical analyst. In *Expanding the horizon of electroacoustic music analysis*, 80–101. Cambridge University Press.

Appendix A

Additional audio material

A.1 Tongue and Groove I–IV: layered tracks

Tongue and Groove was recorded in four takes, with the previous track played back whilst the next is improvised against it. Thus T&G I was performed on its own, then I with II, II with III and finally III with IV.

The track titles are taken from the session metadata which stems from the between-track conversation of me and my producer.

A.1.1 Buffalo wings, with hooves

T&G I and II

A.1.2 Buffalo wings, with wings

T&G II and III

A.1.3 Buffalo wings, and claws

T&G III and IV

A.2 Laminate: analysed example

A.2.1 Laminate-v2p0-04.02.2014-16h29m04s-in

The input for the performance analysed in section 6.3.1.