Compositional Strategies for Timbral Blend in Mixed Electroacoustic Music and Portfolio of Original Compositions



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Note

This submission consists of two components: a portfolio of compositions with prefaces and a standalone thesis. Although aesthetic issues concerning timbral blend and timbre more broadly are shared across and have mutually influenced both parts of this submission, they should be treated primarily as independent forms of research.

Compositional Strategies for Timbral Blend in Mixed Electroacoustic Compositions

Matt Collins

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Abstract

In this thesis, I examine the role that timbre may play in the oft-perceived aesthetic disconnect between the acoustic and electronic forces in mixed electroacoustic music by establishing an analytical framework with which to carry out timbral analyses on a set of mixed electroacoustic works: 'Salt Canyons' from *The Inner Universe* (1983) by Priscilla McLean; *RAS* (2000, rev. 2011) by Natasha Barrett; and *Scirocco* (1983) by Maggi Payne. This framework develops on Walther-Hansen's theory of sound as a combination of the 'sound-in-itself' and the sound's apparent source, Wallmark and Kendall's application of conceptual metaphor theory to timbre semantics, and Walther-Hansen's model of metaphorical descriptions for recorded sound. Within this framework, I conceptualise timbre phenomenologically as an ever-shifting combination of its source and its contents, and systematise the use of culturally situated intersubjective metaphor to describe said contents. I also introduce two concepts for the purposes of the analyses: a timbral thread, which contains any sound or set of sounds over time that could be reasonably perceptually categorised as being produced by one source; and timbral blend, which I define as the capacity of sounds from two or more physical sources to coalesce so that a listener is not likely to determine that there is an aesthetic disconnect between them. I also establish a means for graphically representing these timbral threads using a flowchart-type method. Using this framework, I analyse the works by describing and graphically representing the timbral threads that can be delineated within them, and thus establish shared common compositional strategies used to achieve timbral blend between the acoustic and electronic forces across the set of works. Each analysis is also contextualised by a review of any relevant compositional preferences from the composers concerned, so that any influence these may have had on the compositional strategies used for timbral blend can be determined.

Chapter 1: Introduction

1.1: A meeting of two worlds or a single sonic dimension?

It is an early autumn morning in 2015 and a small group of undergraduate music students have settled into the small, clinically lit room at Brunel University in the west of London, ready for their fourth 'Sonic Arts' seminar of the term. The session starts, as it always does, with a playthrough and discussion of the compositional responses to the previous week's material that each of the students has submitted. Each response is listened and responded to – by everyone in the room – with genuine respect, open-mindedness, and humility. Thereafter, the composer leading the seminar, Dr Harald Muenz, plays recordings to the students of two seminal mixed electroacoustic compositions: *La fabbrica illuminata* (1964), for female voice and tape, by Luigi Nono; and *Musica su due dimensioni* (1952), for flute, cymbal, and tape, by Bruno Maderna. The room is filled with a paradoxical silence while the students listen intently to the works, modelling Dr Muenz's own level of unconditional engagement that he always brings to the sessions. Once the recordings finish playing, the students are presented with a question to take away and respond to in their 'learning diaries' – small written responses to each week's seminar that the students must complete to test their level of engagement with the module. The question: 'When electronic sounds and instruments come together, is this, for you, a "meeting of two worlds", or rather the articulation of one single sonic dimension?'

As one of the students in this room, this seminar made such an impression on me that it has informed and influenced my compositional work ever since. It was, as a second-year undergraduate, my first proper introduction to the world of mixed electroacoustic music, since my music education up until that point had not exposed me to anything much more contemporary or electronic-sounding (at least in the classical world) than Steve Reich's *Electronic Counterpoint* (1989).[1] Thus, for someone grappling with composing

[1] I understand that GCSE and A-Level Music syllabi in the UK now have a better diversity – of composer background as well as of musical genre/forces – than when I studied for my exams in 2012 and 2014 respectively. For example, the current Edexcel A-Level syllabus (as of November 2023) features *Petals* (for cello and live electronics, 1988) by Kaija Saariaho – see 'Specification:

electroacoustic music of any kind for the first time, this learning diary question continually played on my mind. I found myself often hearing mixed works for the first time where I personally felt that the technology hindered rather than enhanced the music. The revolution of the computer (alongside other electronic instruments) and its use in composition posed so many aesthetic, technological, and social questions. For me, one of the most interesting questions was how to make the most of the timbral possibilities afforded by electroacoustic music while simultaneously allowing for the acoustic instruments I so wished to write for to also play an equal part.

I have described this personal experience of mine because it provides an insight into the roots of the subject matter of this thesis. Whilst many composers, of whom Nono was certainly one when writing his aforementioned work, wish to deliberately juxtapose the acoustic and electronics forces in their mixed electroacoustic works, others, such as Maderna in his work, may wish to incorporate these "two worlds" in order to "articulate a single sonic dimension".[2] How a composer might realise the latter has been explored in various forms over the last few decades. In this thesis, I consider the role that timbre may play in bridging these worlds and establish common compositional strategies relating to timbre in existing mixed works that have been employed to do so.

Pearson Edexcel Level 3 Advanced GCE in Music (9MU0), Issue 7' (Pearson Edexcel), 7, accessed 8 November 2023, https://qualifications.pearson.com/content/dam/pdf/A%20Level/Music/2016/Specification%20and%20sample%20assessments/Pearson_Edexcel_Level_3_Advanced_GCE_in_Music_9MU0_specification_issue7.pdf.

[2] See Simon Emmerson, 'The Relation of Language to Materials', in *The Language of Electroacoustic Music*, ed. Simon Emmerson (London: Macmillan, 1986), 29–30; Simon Emmerson, *Living Electronic Music* (Burlington, VT: Ashgate, 2007), 10–11. Emmerson sets out the aesthetic and political intentions in Nono's music, explaining that the goal of works such as *La fabbrica illuminata* is to not only induce in the listener an appreciation for the abstract formal elements of the work, but also for the material itself to invoke extramusical imagery. In this case, the work 'pits the humanistic lyricism and anger of a solo soprano against the factory sounds of the Italsider factory in Milan and crowds chanting slogans', in order to critique the 'oppressive system of production' that is the capitalist system. The acoustic and electroacoustic forces are deliberately and provocatively juxtaposed for maximal aesthetic and imagistic effect, therefore. Conversely, according to Peter Roderick, in 'Rebuilding a Culture: Studies in Italian Music after Fascism, 1943-1953' (PhD thesis, University of York, 2010), 313, 321, Maderna's aim in his composition was to create a 'seamless whole', incorporating the acoustic and electroacoustic worlds. Roderick claims that despite this, a consolidation 'at the phenomenological level' was not attained.

1.2: Thesis overview

Since the invention of the loudspeaker, the computer, and the proliferation of electronic instruments in the early twentieth century, one perceived issue that many composers working in the Western art music tradition have been confronted with is the difficulty of producing musical works that employ both acoustic and electroacoustic forces without some sense that there is an aesthetic disconnect between them. Whilst many composers have embraced and engendered this disconnect in their music, others have either criticised or suggested their own methods for overcoming it.[3] Recent contemporary music literature has often attempted to address this issue by focusing on concerns relating to retaining or avoiding a sense of liveness or instrumentality, while the role that timbre may play has not been the subject of much discussion to date.

This thesis examines the role that timbre may play in this oft-perceived aesthetic disconnect. By carrying out a series of timbral analyses on a selection of mixed electroacoustic works from the last sixty years, and thus determining how timbral blend has been achieved between the acoustic and electronic forces within them, I intend to establish successful compositional approaches to timbre that one could adopt if they wish to bridge this disconnect in their own compositions.

1.3: Thesis structure

I lay the necessary groundwork for the timbral analyses that take place in Chapter 5 by conducting a review of liveness and its applications to mixed electroacoustic music in Chapter 2, a review of timbre as a phenomenon, concept, and term in Chapter 3, and a critical analysis of contemporary approaches to timbre analysis in Chapter 4.

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[3] For examples of critical comments from composers, see Jean-Étienne Marie, 'De Quelques Expériences d'électro-acoustique Musicale', in *Varèse, Xenakis, Berio, Pierre Henry : oeuvres, études, perspectives* (Paris: La Revue musicale, 1969), 129–49, as translated and quoted in Friedemann Sallis et al., eds., *Live-Electronic Music: Composition, Performance, Study* (Abingdon, UK; New York, NY: Routledge, 2018), 5–6; Jean-Claude Risset, 'The Use of the Computer in my Music: A Musical Interface', in *Komposition und Musikwissenschaft im Dialog III*, ed. Imke Misch and Christoph von Blumröder (Münster: LIT Verlag, 2003), 135; Jonathan Harvey, *In Quest of Spirit: Thoughts on Music*, Ernest Bloch Lectures (Berkeley: Univ. of California Press, 1999), 62.

Chapter 2: Liveness in mixed electroacoustic music

This chapter focuses on recent literature that discusses liveness in relation to its applications in mixed electroacoustic music, and the role that it may play in any perceived disconnect in mixed electroacoustic compositions. I contend that the articles under discussion do not examine in depth the role that timbre may play in this oft-perceived disconnect, and that this potential role should be explored.

Chapter 3: Definitions and concepts of timbre

In this chapter, I review contemporary academic discourses on timbre that cover a variety of psychological, empirical, ethnographic, and sociological perspectives. In responding to these perspectives, I suggest that a phenomenologically grounded conceptualisation of timbre may be useful for the purposes of this thesis, as it can be conceived on the basis of how listeners directly experience timbre both in the moment of listening, and how they reflect upon the phenomenon and its effects on the music to which they have previously listened. I also argue that Lakoff and Johnson's explication of conceptual metaphor theory, as applied to listeners' experience of timbre by Wallmark and Kendall, might allow for a form of timbral analysis that uses descriptive and metaphorical language to convey the timbral devices employed in a musical work to the reader in a way that may allow said devices to be meaningfully understood.[4]

Chapter 4: Contemporary approaches to the analysis of timbre in musical works

This chapter examines a series of contemporary timbral analyses in the music analysis literature, split into those that rely on spectrographic analysis or other spectral graphical representations, those that combine spectrographic analysis and descriptive analysis, and those that focus on the use of descriptive analysis in combination with novel graphical aids. Based on this review, I suggest that spectrograms are one of the more popular means by

[4] George Lakoff and Mark Johnson, *Metaphors We Live By* (Chicago: University of Chicago Press, 1980); George Lakoff and Mark Johnson, *Philosophy in the Flesh* (New York: Basic Books, 1999); Zachary Wallmark and Roger A. Kendall, 'Describing Sound: The Cognitive Linguistics of Timbre', in *The Oxford Handbook of Timbre*, ed. Emily I. Dolan and Alexander Rehding (New York: Oxford University Press, 2018).

which to analyse timbre in musical works, although there is recognition that using these alone does not capture in full how timbre functions and is perceived by individual listeners. I further contend that some of the analyses do not successfully manage to anchor their timbral descriptions within their theoretical frameworks, as the framework is often merely expounded before the analysis proceeds in a form that borders on the personal and subjective. I further argue that many of the graphical aids could serve to better aid understanding by being a core part of the analyses themselves, rather than by being used in a supplementary way.

Chapter 5: Compositional strategies for timbral blend in mixed electroacoustic music

In this chapter, I conduct timbral analyses on a set of mixed compositions so that successful compositional strategies used to achieve timbral blend can be established. The works I analyse are: 'Salt Canyons' from *The Inner Universe* (1983) by Priscilla McLean; *RAS* (2000, rev. 2011) by Natasha Barrett; and *Scirocco* (1983) by Maggi Payne.[5] Before carrying out these analyses, I present the theoretical framework that underpins them, which is based on Walther-Hansen's theory of sound as a perceptual combination of the 'sound-in-itself' and the sound's perceived source, Wallmark and Kendall's application of conceptual metaphor theory to timbre semantics, and Walther-Hansen's model of metaphorical descriptions for recorded sound.[6] For the purposes of this framework, I introduce the concept of a timbral thread: that which contains any sound or set of sounds over time that could be reasonably perceptually categorised as being produced by one source. I also introduce the concept of timbral blend, which I define as the capacity of sounds from two or more physical sources to coalesce in such a way so that a listener is not likely to determine that there is an aesthetic disconnect between them. I also establish a means for graphically representing these timbral threads using a flowchart-type method. Using this framework, I then analyse the works by describing and graphically representing the timbral threads that can be delineated

[5] Priscilla McLean, *The Inner Universe* (New York: MLC Publications, 1983); Natasha Barrett, *RAS* (Oslo: NB noter, 2011); A score for *Scirocco* is not available in the public domain.

[6] Wallmark and Kendall, 'Describing Sound: The Cognitive Linguistics of Timbre'; Mads Walther-Hansen, *Making Sense of Recordings: How Cognitive Processing of Recorded Sound Works* (New York: Oxford University Press, 2020).

within them and invoking the use of metaphor where necessary to do so. By examining the timbral threads and how they interlink, I establish shared compositional strategies used to achieve timbral blend, and thus a lack of aesthetic disconnect, between the acoustic and electroacoustic forces across the set of works. Each analysis is also preceded by a review of any relevant compositional preferences espoused by the composers concerned, so that it can be determined whether these influence the compositional strategies used for timbral blend.

1.4: Electroacoustic music terminology

Within the discourses of electroacoustic music, there has been a variety of conflicting and overlapping terminology used to define musical genres featuring both acoustic and electronic sound as they have developed over the course of the twentieth and twenty-first centuries.[7] 'Live electronic music', 'mixed electroacoustic music', and 'mixed music' – or its French antecedent '*musique mixte*' – have often been used to categorise works with the same instrumentations or uses of technology.[8] Despite these generic ambiguities, a large portion of the literature that discusses any of these categorisations is relevant for the kind of musical works that I am considering for the purposes of this research: any composition whose instrumentation consists of both acoustic and electronic instruments, whereby an acoustic instrument is any that solely relies on its own physical body to produce its sound, whereas an electronic instrument is any that depends on a loudspeaker to be heard within the context of a live performance. For consistency, I use 'mixed electronic music', 'mixed music', or 'mixed works' as generic terms to refer to any musical work that features these forces throughout this thesis.

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[7] 'Electroacoustic music' can be defined here as any music that features any kind of electronic sound. See Leigh Landy, 'Electroacoustic Music Studies and Accepted Terminology: You Can't Have One without the Other', in *EMS: Electroacoustic Music Studies Network - Beijing 2006* (Beijing: Electroacoustic Music Studies Network, 2006), http://www.ems-network.org/IMG/EMS06-LLandy.pdf, for a broader overview of the confusions in electroacoustic music terminology.

[8] See, for example, Nick Collins, Margaret Schedel, and Scott Wilson, *Electronic Music* (Cambridge: Cambridge University Press, 2013), 133–34; Valentina Bertolani and Friedemann Sallis, 'Live Electronic Music', in *Routledge Encyclopedia of Modernism*, 1st ed. (London: Routledge, 2016).

Chapter 2: Liveness in mixed electroacoustic music

2.1: Introduction

There is much disagreement about the exact origins of the term 'liveness' within musical and non-musical discourses. The concept derives from the notion of something as being 'live' – a word that Philip Auslander claims, as used to mean hearing or watching something at the time of its occurrence, was first written in the BBC Yearbook in 1934. In the corporation's annual review of its programming, it reported that 'listeners have… complained of the fact that recorded material was too liberally used', but justified this by explaining that pre-recorded audio was being played because 'broadcasting "live" material' to far-away time zones was 'inconvenient'.[9] Paul Sanden argues, however, that even if the term 'live' had not been used previously, the discussion regarding how 'recorded' music is valued – as opposed to 'live' music – began much earlier.[10] He cites John Philip Sousa from 1906 as an example, who wrote: 'I foresee a marked deterioration in American music and musical taste… by virtue – or rather vice – of the multiplication of the various music-reproducing machines.'[11] Aside from this particular debate on how the concept originated, Auslander writes that, in its initial explicit usage at least, the term was required to maintain a discursive differentiation between live and recorded audio, as the development of radio meant that the two were no longer perceptually distinguishable.[12]

Since then, liveness as a concept has taken on a series of different meanings within various musical disciplines, but also in such disciplines as media studies and film studies. As Sanden succinctly explains, recent writings about liveness have tended to focus upon the following:

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[9] Philip Auslander, 'Live From Cyberspace: Or, I Was Sitting at My Computer This Guy Appeared He Thought I Was a Bot', *PAJ: A Journal of Performance and Art* 24, no. 1 (2002): 17; B.B.C. Year-book (1934), quoted in 'Live, Adj., Sense 10.a', in *Oxford English Dictionary* (Oxford University Press, 2023), https://www.oed.com/dictionary/live_adj1?tab=meaning_and_use.

[10] Paul Sanden, 'Rethinking Liveness in the Digital Age', in *The Cambridge Companion to Music in Digital Culture*, ed. Nicholas Cook, Monique M. Ingalls, and David Trippett, 1st ed. (Cambridge University Press, 2019), 191.

[11] John Philip Sousa, 'The Menace of Mechanical Music', *Appleton's Magazine* 8 (1906): 278.

[12] Auslander, 'Live From Cyberspace', 17.

the importance (or lack thereof) of live performance; whether the elements of live performance that have traditionally been valued by audiences can be retained despite the development and utilisation of new performance technologies; and how liveness can be 'defined or re-defined' in this contemporary context.[13]

The focus in this non-exhaustive review is on recent literature that discusses liveness in relation to its applications in mixed electroacoustic music. Since the very first electroacoustic works, performers and composers have had to, as Mike Frengel writes, 'come to terms with issues of liveness in their art'.[14] Especially in early electroacoustic compositions, which often did not feature any live performers but were rather fixed works recorded onto reel-to-reel tape, liveness – as it was previously conceived of – was suddenly and arguably completely absent from the performances of these works. Whilst traditional notions of liveness have often been reincorporated in various forms since then, the issue of a disconnect between what is perceived as live and what is perceived as something other than live in a work has persisted, particularly in mixed compositions featuring both acoustic and electroacoustic forces. For the purposes of this review, the literature on liveness is grouped into three common approaches: those that promote traditional forms of liveness; those that argue against traditional forms; and those that promote a sense of caution against any kind of one-sided conception of the term.

2.2: Traditional notions of liveness

An example of an approach that endorses traditional notions of liveness is outlined by John Croft, who contends that if a work wishes to embody an 'instrumental' paradigm, it must 'create the unified expressive persona normally associated with a solo performance.'[15] Croft defines the 'instrumental' paradigm here as the attempt to create a 'composite instrument',

[13] Paul Sanden, 'Virtual Liveness and Sounding Cyborgs: John Oswald's "Vane"', *Popular Music* 31, no. 1 (2012): 45.

[14] Mike Frengel, 'Interactivity and Liveness in Electroacoustic Concert Music', in *The Oxford Handbook of Interactive Audio*, ed. Kasey Collins, Bill Kapralos, and Holly Tessler (New York: Oxford University Press, 2014), 302.

[15] John Croft, 'Theses on Liveness', *Organised Sound* 12, no. 1 (2007): 63.

whereby 'the relation that normally exists between a player and her instrument is extended to include the live electronics'.[16] Although Croft tries to avoid suggesting that music must invoke a strong causal link between 'bodily effort and sound', he does problematise 'the disengagement of musical performance and corporeal energy' associated with 'music which merely accepts or indeed celebrates an arbitrary relation between bodily action and the acoustical effect'.[17] He argues that music that does accept this arbitrary relation is therefore not progressively reacting to the 'cultural products' that are characteristic of the 'cultural manifestation of late capitalism' – a reference to Frederic Jameson's theory that these products prevent humans from being able to cognitively and perceptually situate themselves in and in relation to their environments.[18]

Croft outlines a convincing and comprehensive theory here for the different paradigms of liveness that can inform mixed electroacoustic works, and he also makes a compelling case for the problematic state of music that avoids any sense of causality between what we see and what we hear. However, I would argue that Croft's rebuttal to d'Escriván's notion that there is nothing problematic about a lack of causal connection between body and sound is less persuasive.[19] In his refutation, Croft appeals to Jameson's aforementioned theory and writes that whether we should consider this disconnect as problematic depends on 'the extent to which we are happy for music to reflect' this 'postmodern condition', but he does not articulate why we should not be happy that music might reflect this state.[20]

2.3: Against traditional notions of liveness

Scott McLaughlin, arguing against traditional notions of liveness, frames his assertions around what he sees as 'the need to create music that avoids the obviously causal in live

[16] Croft, 62.

[17] Croft, 62–64.

[18] Croft, 63; Frederic Jameson, *Postmodernism, or, the Cultural Logic of Late Capitalism* (London: Verso, 1991), 44.

[19] Julio d'Escriván, 'To Sing the Body Electric: Instruments and Effort in the Performance of Electronic Music', *Contemporary Music Review* 25, no. 1–2 (2006): 183–91.

[20] Croft, 'Theses on Liveness', 63–64.

electronic music'.[21] He claims that liveness in mixed electroacoustic music privileges 'instrumentality and interaction in the form of a clear causal relationship between the instrument and the electronics', and gives two examples as evidence for this.[22] In the first of these, McLaughlin refers to how mixed music often uses 'non-live elements' in the software that provides the electroacoustic sound in a way that is not obvious to the audience, and argues that this is an example of an 'aesthetic that valorizes the causal' and treats the audience as if they will be unaffected by anything of which they are not perceptually cognisant.[23] In his second example, McLaughlin contends that performers of mixed music attempt to persuade the audience through their movements that the interplay between the live and electronic is causally related and thus 'authentic'.[24] The author goes on to claim that, although he does not wish to 'pass judgement on what music should be composed', this kind of causality-based liveness is a 'paradigm of a previous age' as, like the idea of authenticity in performance, both of these concepts are 'subjectively connected to their contexts.'[25] He argues, moreover, that this 'sentiment for a purity of performance' which is associated with causality-based liveness is 'particularly conservative in relating mixed music to the modernist instrumental music from which it is partly derived.'[26]

McLaughlin proceeds to examine a series of his own compositions as case studies, in 'an attempt to posit authenticity from the perspective of experimental music as liveness.'[27] One example, a composition written for solo woodwind and live electronics, features a performer playing offstage for the duration of the performance. As the work is a text score 'constructed in real-time by the performer', McLaughlin argues that the liveness in this

[21] Scott McLaughlin, 'If a Tree Falls in an Empty Forest... : Problematization of Liveness in Mixed-Music Performance', *Journal of Music, Technology and Education* 5, no. 1 (2012): 18.

[22] McLaughlin, 18.

[23] McLaughlin, 20–21.

[24] McLaughlin, 21–22.

[25] McLaughlin, 19, 22.

[26] McLaughlin, 23.

[27] McLaughlin, 23.

composition is generated through every performance of the work being different – an idea that he terms 'the cerebral structure-forming aspect' of the work.[28]

Through this approach, McLaughlin makes a persuasive case for looking beyond traditional forms of liveness on the basis of its conservatism and subjectively based authenticity. On the other hand, I would argue that McLaughlin does not make clear enough the exact context to which his 'experimental' case studies are connected – the context that should provide the constructed base of authenticity which the author proposes to use as an alternative to the conceptions of authenticity that surround traditional notions of mixed music. An example of this lack of clarity is where McLaughlin first outlines a series of definitions for his experimental-based authenticity – the one which he relies upon most refers to 'challenging our assumptions about music' – before he proceeds to claim that his case studies 'originate from experimental music, and attempt to question what can be live in the context of mixed music'.[29] However, if the only necessary criterion to be 'experimental' here is to challenge our musical assumptions, then this is perhaps too vague and broad a concept to be captured by a singular musical tradition.

2.4: Cautioning against a one-sided conception of liveness

Finally, Mike Frengel puts forward an approach that cautions against any dogmatic conception of liveness. He outlines what he calls a 'multidimensional framework of relations between live and non-live component pairs in mixed works' as a means of addressing the problem he describes as the 'perceptual dissonance' that frequently emerges in mixed electroacoustic works between the 'visual and aural stimuli' within them.[30] Frengel's framework consists of nine 'axes', which cover many issues but some of which pertain directly to liveness. For example, within the 'functional axis', which categorises stimuli according to the musical function they perform, there is a relationship that Frengel labels

[28] McLaughlin, 23–24.

[29] McLaughlin, 19.

[30] Mike Frengel, 'A Multidimensional Approach to Relationships between Live and Non-Live Sound Sources in Mixed Works', *Organised Sound* 15, no. 2 (2010): 96.

as the 'extension' relation: the idea of deliberately 'merging' live and non-live components into a 'single, musically inseparable identity.'[31] Frengel argues that utilising this function – where the 'level of unification between sources' is so considerable that listeners cannot perceive or recognise a 'non-live source' whatsoever – may be a more desirable approach to mixed electroacoustic composition. This is especially the case as, according to Frengel, the acousmatic nature of non-live components predisposes them towards exhibiting 'ambiguity' and thus can make an extension relationship very effective.[32] Conversely, Frengel also claims that trying to impose an extension relation often results in there being 'severe restraints on the electroacoustic sounds', and that the aforementioned perceptual dissonance 'may be viewed as an opportunity' rather than as something problematic.[33]

What Frengel puts forward here is nuanced, detailed, and allows for a broad understanding of the benefits and drawbacks, with respect to liveness, of utilising different kinds of relationships between live instruments and electronics. I would argue, however, that Frengel does not include a precise definition of the distinction he makes between live and non-live sounds. For example, he appears to deem electronics that are processed and generated in real-time (i.e. where the sound of live acoustic instruments is captured, processed, and relayed live during a performance) as 'non-live' – I would contend that it is not clear that 'non-live' is a more fitting term to use here than the term 'live'.[34]

2.5: Conclusion

This short literature review shows that how liveness does or does not relate to the perceptual disconnect between the acoustic and electronic forces in mixed electroacoustic music, or whether there is even a perceptual disconnect to speak of, is a highly contested issue. While determining the framework of liveness that most convincingly applies to mixed electroacoustic music is beyond the scope of this thesis, I would contend briefly that

[31] Frengel, 100.

[32] Frengel, 100–101.

[33] Frengel, 101.

[34] Frengel, 104–5.

Frengel's framework is the most persuasive, as it does not deem necessary either an explicit rejection or an endorsement of a causal link between the acoustic and electronic forces in a work. Rather, it calls for different compositional considerations to be made depending on the context – an approach that allows for a large range of instrumental relations to be permissible. However, apart from Frengel's article, which very briefly focuses on timbre as part of one of the aforementioned axes, none of the articles here examine in depth the role that timbre may play in this aesthetic disconnect.[35] I would argue that the potential role of timbre should be examined, as issues of liveness or instrumentality may not entirely explain this disconnect, and a full investigation might elucidate some compositional strategies that composers could adopt should they wish to avoid this disconnect in their own mixed works. In the next chapter, I examine timbre as a concept and phenomenon in existing literature in order to explore which conceptualisation of timbre may be useful for the purposes of the timbral analyses in Chapter 5.

[35] Frengel describes the 'timbral axis' as reflecting 'the degree of timbral coherence between live and non-live sources', and briefly describes categories of relations including 'equivalent, similar and dissimilar', but he does not explore in any detail what may render different combinations of sounds as exhibiting the relations described above – see Frengel, 98–99.

Chapter 3: Definitions and concepts of timbre

3.1: Introduction

Many scholars across various discourses of music consider Hermann von Helmholtz to be the first person to investigate and write about timbre as both a musical and psychoacoustic phenomenon.[36] In his seminal work on the subject, first published in 1863, Helmholtz argues that one particular feature of what he calls 'musical tones' is their 'quality of tone', which he defines as 'that peculiarity which distinguishes the musical tone of a violin from that of a flute… when all these instruments produce the same note at the same pitch'.[37] He goes on to claim that any differences in quality of tone are determined only by the 'presence and strength' of the harmonics within a given sound, and disregards any differences in 'phase' and any 'peculiarities' relating to the beginning and the end of a sound.'[38] The concept of timbre since these early investigations by Helmholtz has been the subject of much debate within musical and scientific scholarship. In this brief review, I focus specifically on examples of contemporary literature on timbre, which cover a variety of psychological, empirical, ethnographic, and sociological perspectives.

3.2: Empirical psychological studies of timbre

An extremely influential approach to the study of timbre over the last few decades has entailed the use of empirical psychological studies, with multidimensional scaling (MDS) being one of the most common methodologies employed in these. As Zachary Wallmark and

[36] See, for example, Emily I. Dolan, 'The Idea of Timbre', in *The Orchestral Revolution: Haydn and the Technologies of Timbre* (Cambridge: Cambridge University Press, 2013), 56; Cornelia Fales, 'Short-Circuiting Perceptual Systems: Timbre in Ambient and Techno Music', in *Wired for Sound: Engineering and Technologies in Sonic Cultures*, by Paul D. Greene and Thomas Porcello (Middletown, United States: Wesleyan University Press, 2004), 156; Kai Siedenburg and Christoph Reuter, 'Beyond Helmholtz: 150 Years of Timbral Paradigms', in *Proceedings of the 12th International Conference on Music Perception and Cognition and the 8th Triennial Conference of the European Society for the Cognitive Sciences of Music*, (Thessaloniki, Greece, 2012), 930–38.

[37] Hermann L. F. Helmholtz, *On the Sensations of Tone as a Physiological Basis for the Theory of Music*, trans. Alexander J. Ellis (Longmans, Green, and Co., 1875), 11–12.

[38] Helmholtz argues for a distinction between 'noises' and 'musical tones' for the purposes of his investigations, whereby the latter is defined as a 'simple, regular kind of sensation' – a constant sound. Helmholtz, 16, 186.

Roger A. Kendall explain, researchers using MDS ask listeners to subjectively rate the similarity or dissimilarity of pairs of different sounds played to them, in order to be able to generate a graphical two- or three-dimensional space that illustrates the timbral disparities perceived by listeners between various audio stimuli.[39]

Studies using this method have allowed those investigating to potentially correlate a number of acoustic features of sound with semantic descriptions of sound (termed as acoustic correlates), although they still leave much to be discovered about how the acoustic world interacts with our perceptual worlds – for example, Kai Siedenburg et al. note that only two acoustic correlates have been repeatedly established throughout these studies.[40] Furthermore, MDS has other potential shortcomings, including a fundamental problem that concerns the concept of reification. Wallmark and Kendall explain that this issue arises when researchers 'impose conceptual relationships onto timbre that may or may not accurately reflect how people actually process it', which risks presenting semantic descriptors as 'something somehow intrinsic' to the acoustic or perceptual features of sound.[41] For example, in one study by David Wessel, spectral centroid, which is an acoustic measure of where the spectral centre of mass is in a given snapshot of a particular sound, is marked as 'brightness', while attack time, which shows the amount of time between a sound's initial sounding and its peak amplitude, is marked as 'bite'.[42]

Another concern I would add is that the vast majority of these studies use monophonic and acoustically isolated sounds as their stimuli, instead of sounds in a fully musical and/or polyphonic context. Because of this limitation and the others previously mentioned, this particular empirical approach (at least in its current formulation) does not allow for an accurate ascertainment, especially in a real-world context, of how the acoustic features of

[39] See Wallmark and Kendall, 'Describing Sound: The Cognitive Linguistics of Timbre'.

[40] Kai Siedenburg, Ichiro Fujinaga, and Stephen McAdams, 'A Comparison of Approaches to Timbre Descriptors in Music Information Retrieval and Music Psychology', *Journal of New Music Research* 45, no. 1 (2016): 27–41.

[41] Wallmark and Kendall, 'Describing Sound: The Cognitive Linguistics of Timbre'.

[42] David L. Wessel, 'Timbre Space as a Musical Control Structure', *Computer Music Journal* 3, no. 2 (1979): 49.

sound precisely correlate with our perceptual responses to and subsequent semantic descriptions of it.

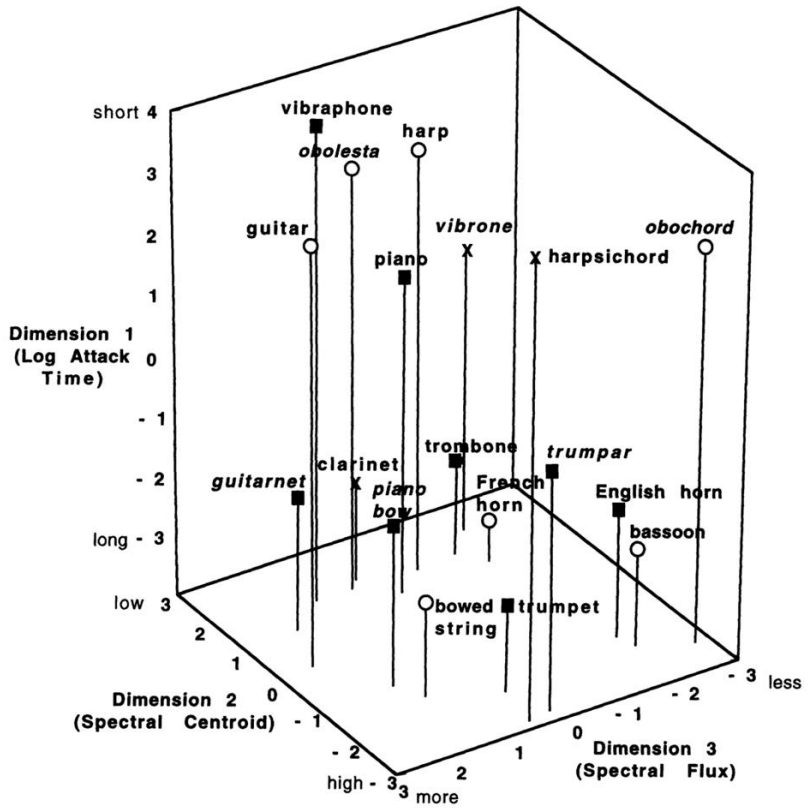


Figure 3.1: A 3D timbre graphical space taken from an MDS study by McAdams et al.[43]

3.3: Applying conceptual metaphor theory to timbre semantics

While the studies above concern the empirical attempts to establish which acoustic features of timbre correspond with which semantic descriptions of timbre, there have also been efforts to theoretically conceptualise how our perception of timbre corresponds with our semantic descriptions of it. Wallmark and Kendall, for example, contend that the field of cognitive linguistics provides a persuasive theoretical basis for understanding this

[43] This graphical space attempts to illustrate the timbral differences between a variety of FM-synthesised sounds along three dimensions – each dimension representing a different acoustic correlate. Spectral flux here is a measure of the rate of change of power in an audio signal. Stephen McAdams, 'Perspectives on the Contribution of Timbre to Musical Structure', *Computer Music Journal* 23, no. 3 (1999): 85–102; Stephen McAdams et al., 'Perceptual Scaling of Synthesized Musical Timbres: Common Dimensions, Specificities, and Latent Subject Classes', *Psychological Research* 58, no. 3 (1995): 177–92.

relationship between perception and description. Specifically, they argue that conceptual metaphor theory, as it is outlined by George Lakoff and Mark Johnson, 'yields considerable explanatory power' when applied to the field of 'timbre semantics'.[44] This theory is based primarily on the idea that language acts as a system for human embodiment. Wallmark and Kendall describe this system in terms of the mapping of 'abstract domains of human experience' onto 'concrete, embodied domains', and employ two of the most commonly used metaphors – 'sound is light' and 'sound is texture' – as model illustrations of this concept.[45] These metaphors link into the idea, they claim, that there is now 'fairly robust evidence for "weak synesthesia" between auditory, visual, and tactile modalities in non-synesthetic individuals.' They write that there are many possible explanations for this, but one, based on a theory by the psychologist Lawrence Marks, is that timbre-based synaesthetic metaphors provide a shortcut by which we can meaningfully distinguish cognitive stimuli for ourselves and to others.[46] This theory implies therefore, in my view, that the use of metaphor to describe timbre may not depend entirely on individual subjectivity, but rather reflects an embodied, culturally situated intersubjective form of communication. Mads Walther-Hansen has also made a similar case concerning the use of cognitive metaphors to describe what he terms 'sound quality' (which encapsulates, amongst other phenomena, timbre), and compiles a series of commonly used metaphorical descriptors based on a substantial linguistic corpus analysis in order to support his theory.[47]

3.4: Ethnographic approach to timbre

Cornelia Fales employs the use of ethnography, in combination with spectrogram analyses, to provide evidence to support her arguments with respect to timbre. Her primary assertion is that a paradox 'emerges with the observation that while timbre is a dimension of central

[44] Lakoff and Johnson, *Metaphors We Live By*; Lakoff and Johnson, *Philosophy in the Flesh*; Wallmark and Kendall, 'Describing Sound: The Cognitive Linguistics of Timbre'.

[45] Wallmark and Kendall, 'Describing Sound: The Cognitive Linguistics of Timbre'.

[46] Wallmark and Kendall; Lawrence E. Marks, 'On Colored-Hearing Synesthesia: Cross-Model Translations of Sensory Dimensions', *Psychological Bulletin* 82, no. 3 (1975): 303–31.

[47] Walther-Hansen's work will be further explored as part of my own theoretical framework for the upcoming timbral analyses in Chapter 5. Walther-Hansen, *Making Sense of Recordings*.

importance to identifying [sound] sources, it is also the dimension that is most divergent from the sound in the physical world', and therefore, timbre is a phenomenon that we experience without conscious awareness of the information it contains, ultimately giving it the tools to 'wield its power in music.'[48] Fales argues that, as a consequence of this paradox, timbre is able to break out, when treated in particular ways, from what is usually a 'seamless perceived world.'[49] More specifically, the manipulation of timbre 'forces an awareness of perceptualization' – a phenomenon that entails the cognitive ability to embellish the perception of a sound in a way that cannot be directly attributed to the acoustic features of said sound.[50] This awareness, according to Fales, may provoke an affective or emotional response in listeners consisting of, for example, a 'sense of perceiving something normally imperceivable', or a 'more general notion that music is an imperfect translation of something'.[51] In order to provide what she describes as 'broadly confirming evidence' for her theory, Fales proceeds to outline a number of ethnographic case studies in combination with the aforementioned spectrogram analyses, including studies of the Ghanaian balafon in combination with the mirlaton, Burundi melodic whispering accompanied by an inanga, and a particular musical ornament named a 'minde' on the sitar.[52]

Separately from her writings on the paradox of timbre, Fales has also argued, in collaboration with Harris M. Berger, that the empirical effort to 'correlate adjectives describing timbre with acoustic qualities that elicit those adjectives' is greatly complicated by the 'multiple interacting acoustic factors' that contribute to the perception of the phenomenon.[53] They also claim that the possibility of establishing correlating adjectives is made even more challenging by the fact that there is 'no relative scale for timbre', since

[48] Cornelia Fales, 'The Paradox of Timbre', *Ethnomusicology* 46, no. 1 (2002): 58, 91.

[49] Fales, 77.

[50] Fales, 77.

[51] Fales, 78.

[52] Fales, 59, 69–70, 70–71, 73–74.

[53] Harris M. Berger and Cornelia Fales, '"Heaviness" in the Perception of Heavy Metal Guitar Timbres: The Match of Perceptual and Acoustic Features Over Time', in *Wired for Sound: Engineering and Technologies in Sonic Cultures*, ed. Paul D. Greene and Thomas Porcello (Middletown, United States: Wesleyan University Press, 2004), 182.

'timbre does not progress in regular perceptual increments'.[54] This critique of an empirical approach to timbre forms part of a larger study on the perception of 'heaviness' in the timbres of guitars heard in the genre of heavy metal music. In this study, Fales and Berger assume there is community agreement among heavy metal fans that the genre has become timbrally heavier and heavier over time, before seeking out acoustic reasons for these perceived timbral changes by selecting songs known by the community to signify this change in heaviness, and then – once again with the aid of spectrograms – analysing the 'guitar timbres for acoustic changes that correspond to the perceptual change independently agreed upon by listeners.'[55] The results of these investigations purportedly show that guitar sounds with a higher perceived timbral 'heaviness' feature more noise, more high-frequency energy, and a gradual fading rather than an abrupt release of high-end energy at the tail end of sounds.[56]

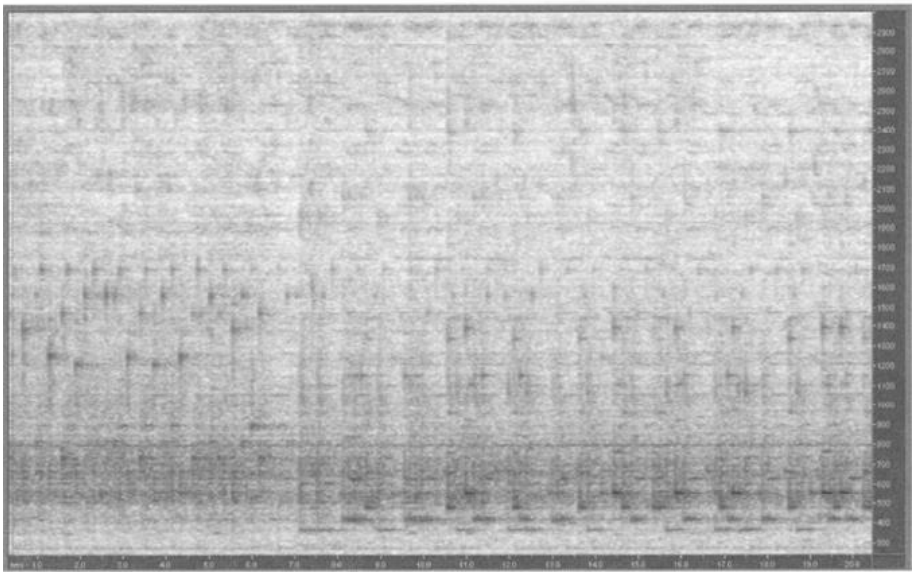


Figure 3.2: One of the spectrograms used by Cornelia Fales in her ethnographic case study of the Ghanaian balafon and the mirlaton.[57]

[54] Berger and Fales, 182.

[55] Berger and Fales, 183.

[56] Berger and Fales, 195.

[57] In this case study, Fales claims that the (perceivably) singular 'pitched, buzzy drone' produced by the sounding combination of the Ghanaian balafon and the mirlaton is an example of a timbre manipulation technique which forces an awareness of perceptualisation. This technique, which Fales calls 'timbre anomaly by redistribution', involves the perceptual redistribution of the

I would contend that the approach exhibited by Fales and Berger, among others, is very powerful in demonstrating community trends with respect to the semantic conceptualisation and description of timbre. However, it is potentially tenuous to attribute a set of specific acoustic factors – chosen by the researchers themselves and based on the analysis of a few exemplar songs – to a broad generalised perception of timbral change over time across a whole genre.[58]

3.5: Ecological approach to timbre

An ecological approach to timbre that emphasises states of timbral embodiment and disembodiment is proposed by Rebecca Leydon. Listening to timbre inevitably involves 'a fusing and fracturing of layers', according to Leydon, and 'mapping these transformations onto states of embodiment and disembodiment enables a particularly rich experience' of music that can be explicitly 'perceived as fused or as fractured.'[59] This account of how we may conceptualise timbre in music is convincing, especially as Leydon provides persuasive evidence for her theory from a variety of literatures. She also posits the existence of a spectrum of 'different timbral effects implying varying degrees of corporeal presence', and claims that there is only one 'effect' that allows sound to be expressed without a body: the pure sine wave.[60] One could argue here, however, that a listener may associate the sine wave with a synthesiser – a body in itself.[61]

components of a sound in such a way so that the resultant perceived sound is made up of components from multiple sources that bear 'little resemblance' to any of those sources when sounding alone. Fales, 'The Paradox of Timbre'.

[58] There are also issues concerning the use of spectrograms to conduct timbral analyses – these concerns are addressed in Chapter 4, however.

[59] Rebecca Leydon, 'Clean as a Whistle: Timbral Trajectories and the Modern Musical Sublime', *Music Theory Online* 18, no. 2 (2012): 8, http://mtosmt.org/issues/mto.12.18.2/mto.12.18.2.leydon.html.

[60] Leydon, 6.

[61] For more on the possible materialities of synthesisers, see Jonathan De Souza, 'Timbral Thievery: Synthesizers and Sonic Materiality', in *The Oxford Handbook of Timbre*, ed. Emily I. Dolan and Alexander Rehding (New York: Oxford University Press, 2018), 346–79.

3.6: Perspectives which eschew timbre

In contrast to the perspectives mentioned so far, there are also those which eschew the very concept of timbre completely. Michel Chion, for example, argues that timbre represents a 'qualitative catchall', and that it can be 'nothing other than the general physiognomy that allows us to identify a sound as emanating… from a specific source, which can be imagined or imaginary.'[62] Consequently, Chion claims, timbre can only be 'defined according to criteria that can be quite variable depending on the person (or sound) in question'.[63] He also questions the concept of instrumental timbre, asking 'what does the expression "a trombone's timbre" mean once one strikes the instrument rather than blowing through it in the traditional fashion?'[64] Chion's writings here show that it can be relatively simple to dismiss timbre as a meaningful term entirely due to the range of meanings it has been claimed to have. However, at least with respect to the arguments concerning physiognomy and instrumental timbre, I would argue that timbre can represent, at once, both the multidimensional acoustic, perceptual, and semantic criteria that allow one to identify a sound as emanating from a real or imaginary source, but also can represent the same criteria that specify the essence of a sound at a particular moment in time or across a period of time. Furthermore, as can be seen in some of the previous literature cited in this review, the degree of variability in the criteria used to measure, qualify, and/or quantify timbre is at times less varied than one might at first expect. Despite there often being a disagreement about the validity of these criteria, this does not necessarily mean that the concept of timbre becomes meaningless.

Independently from Chion but still influenced by his work, Denis Smalley adapts the previously quoted critique of timbre from Chion to provide his own definition of the phenomenon, writing that it is 'a general, sonic physiognomy whose spectromorphological

[62] Chion never precisely defined the term 'physiognomy' in relation to its application to sound, but does use it as an analogy to the 'general physiognomy' of an individual, which can be understood to mean a person's character as assessed or derived from the way their body appears. Michel Chion, 'Dissolution of the Notion of Timbre', *Differences* 22, no. 2–3 (2011): 237.

[63] Chion, 237.

[64] Chion, 238.

ensemble permits the attribution of an identity.'[65] Defined in this way, Smalley claims that electroacoustic music, and especially acousmatic music, makes timbre an unstable notion, as this conceptualisation of timbre relies on a period of time when 'music always involved identifiable sources.'[66] As a theoretical remedy for the claimed shortcomings of timbre, Smalley proposes a series of ideas that attempt to encapsulate how listeners ascribe identity and meaning to sound(s) in electroacoustic music. These include, but are not limited to: the concept of 'spectromorphology', which refers to the 'temporal unfolding and shaping of sound spectra'; 'source-cause levels', a scheme that refers to the different ways in which we identify the (or with the) sounds that we hear; and 'transformational discourse', an approach to musical discourse whereby 'an identity [of a sound] is transformed while retaining significant vestiges of its roots.'[67] The notion of conventional timbre is repeatedly questioned throughout:

> Once split open, the timbre complex is not a package of distinctly separable parameters, but a field of interactive behaviour… under such conditions does not the concept of timbre become so general as to be meaningless?[68]

In this article, therefore, Smalley puts forward a very comprehensive theory for how spectromorphology – a term that is used as a more accurate or appropriate term than timbre – functions in both acoustic instrumental and electroacoustic music. Conversely, this theory can be extremely difficult to completely apprehend and appreciate at times, and too abstract to be fully applicable to everyday listening experiences. Moreover, the claim that

[65] Denis Smalley, 'Defining Timbre — Refining Timbre', *Contemporary Music Review* 10, no. 2 (1994): 36.

[66] Smalley, 36.

[67] Smalley, 37, 38–40, 43–44.

[68] Smalley, 40.

'composing with timbre' can only be fully pursued in acousmatic music is unsubstantiated – if carefully written for, instruments do not have to remain tied to their 'source-cause'.[69]

3.7: Conclusion

As this non-exhaustive review shows, timbre as a discursive term has come to represent a multifaceted, multidimensional phenomenon that has been theorised on and analysed across multiple literatures. There is a risk, as a result of this, that timbre becomes such an encompassing term that it starts to represent, as Chion puts it, a 'qualitative catchall'. I would argue that, despite this risk, a phenomenologically grounded conceptualisation of timbre may be useful at least for the purposes of exploring the role that timbre may play in the aesthetic disconnect between the acoustic and electronic forces in mixed electroacoustic music. This conceptualisation could be conceived on the basis of how listeners directly experience timbre both in the moment(s) of listening, and how they reflect upon the phenomenon and its effect on the music to which they have previously listened. Of all the approaches explored in this review, conceptual metaphor theory as applied to our experience of timbre appears to most closely build upon this phenomenologically grounded notion of the phenomenon, as it allows for the possibility of a kind of, albeit culturally situated, timbral analysis that uses descriptive and metaphorical language to convey the timbral devices employed in a musical work to the reader in a way that potentially allows said devices to be meaningfully understood.

[69] Smalley, 47.

Chapter 4: Contemporary approaches to the analysis of timbre in musical works

4.1: Introduction

Whilst the review on the concept of timbre in Chapter 3 focused on how the term has been discussed, defined, and utilised in the abstract as a musical element across various musical and non-musical disciplines, in this chapter I will be examining how timbre has been analysed – in terms of how it functions and how it is perceived – in musical works from a variety of genres and periods within the contemporary music analysis literature. This critical analysis will also introduce a wider discussion – which will inform my own approach for analysing timbre in mixed electroacoustic music in Chapter 5 – about how we might be able to analyse timbre in musical works without relying on methods that do not adequately represent how timbre is perceived by listeners or on timbral descriptions which conflate personal and subjective claims with those that explicitly result from the application of a theoretically grounded analytical framework.

The methodologies which contemporary timbral analyses employ can be split into two very broad strands, with each one sometimes used exclusively, and at other times used in some form of combination. Those that belong to the first strand tend to rely on the use of spectrograms or graphical representations of different acoustically measurable features of sound, in order to provide insight into the way timbre operates in a specific musical context. Those belonging to the other strand take issue with the use or exclusive use of spectrograms as a means of analysing timbre, instead relying on the use of descriptive metaphor-based language that often anchors itself in a specific non-musical theoretical approach and is often used in conjunction with novel graphical aids in order to assist understanding. This chapter is therefore split into three sections: first, I examine and critically review some examples of contemporary analyses which focus exclusively on the use of spectrograms or graphical representations of acoustic features of sound; secondly, I focus on analyses which use spectral graphical representations alongside a form of descriptive analysis; finally, I

examine those which eschew the use of spectral representations entirely in favour of descriptive analysis and novel graphical aids.

4.2: Analyses which focus on the use of spectrograms or spectral graphical representations

John Latartara – Analysis of *Tuit Mi Penser* (c. 1350) by Guillaume de Machaut[70]

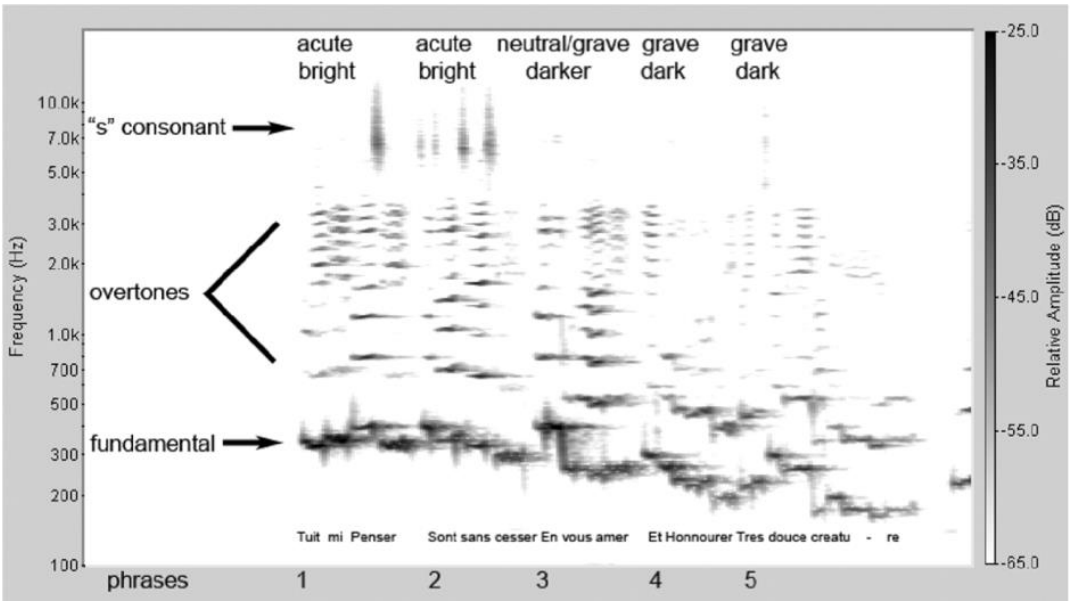


Figure 4.1: One of the spectrograms produced by John Latartara in his analysis of the refrain in *Tuit Mi Penser* (c. 1350) by Guillaume de Machaut.[71]

Latartara's central claim in his analysis of this fourteenth-century monophonic virelai is that it 'fuses the language sounds of the text with the pitch space of the melodic line', whereby he defines 'language sounds' to be the 'physical sound of the words themselves'.[72] He uses two methods to reach this conclusion: one tracks the structural pitch progressions in the work and is beyond the scope of this particular review; the other method, derived from

[70] John Latartara, 'Machaut's Monophonic Virelai *Tuit Mi Penser*: Intersections of Language Sound, Pitch Space, Performance, and Meaning', *Journal of Musicological Research* 27, no. 3 (2008): 226–53.

[71] Latartara, 239.

[72] Latartara, 227.

studies by Daniel Leech-Wilkinson and Robert Cogan, concerns the 'vocal sound analysis of both the text and a performance' using spectrograms.[73]

With the disclaimer that spectrograms 'do not show us what they hear' but do provide acoustic reasons for our perceptions, Latartara claims that the spectrogram depicts how the sounds in this refrain get 'darker' over time. He contends that the spectrogram shows the first two phrases as 'the brightest and the most intense, with strong upper partials extending to 3.5kHz', while also containing 'intense spectral activation in the 5-10kHz range' due to the vocalist's use of the 's' consonant. By the end of the fifth phrase, according to Latartara, the spectrum becomes its 'darkest' during the whole refrain due to it only containing 'three weak partials reaching 500Hz.'[74] Based on generic spectrographic analyses of different kinds of vowel sounds seen in the text for this work, Latartara then argues that the language sounds in the abstract also move from bright to dark during this section, and that in combination with analysis carried out using the aforementioned first method regarding the progression of pitch, sufficient evidence is provided for the claim that the language sounds and pitches are fused.[75]

Kai Siedenburg – Analysis of *Modulations for 33 Instruments* (1976-77) by Gérard Grisey[76]

Siedenburg argues in this analysis that the notion of 'convergence' can be used to describe what happens in the last section of Grisey's work, partly for reasons relating to texture and instrumentation, but also for reasons relating to timbre.

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[73] Latartara, 229; Cogan's work has often been criticised for overlooking the issue of 'perceptualisation' – see, for example, Nora Engebretsen, 'Minding the Gap: Conceptualizing "Perceptualized" Timbre in Music Analysis', *Leonardo Music Journal* 30 (2020): 14–17.

[74] Latartara, 'Machaut's Monophonic Virelai *Tuit Mi Penser*', 240.

[75] Latartara, 240–41.

[76] Kai Siedenburg, 'An Exploration of Real-Time Visualizations of Musical Timbre', in *Proceedings of the International Workshop on Learning Semantics of Audio Signals*, ed. Stephen Baumann et al. (Graz, Austria: LSAS, 2009), 17–30.

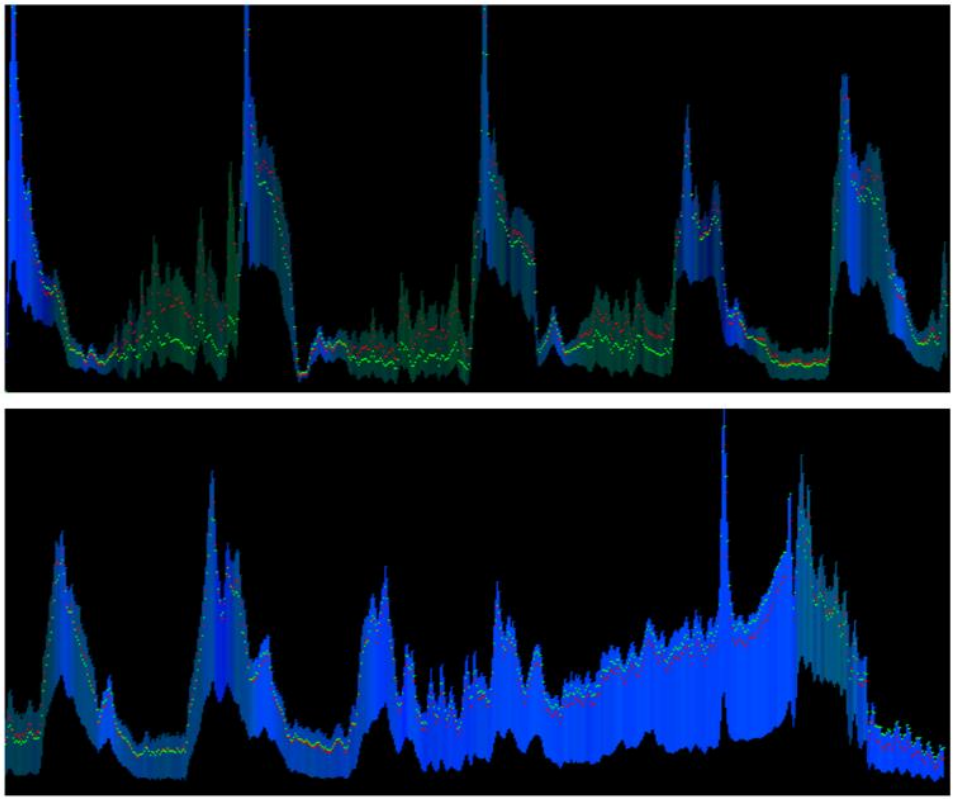


Figure 4.2: A 'River' visualisation, produced by Kai Siedenburg, depicting a section of Grisey's *Modulations for 33 Instruments* (1976-77).[77]

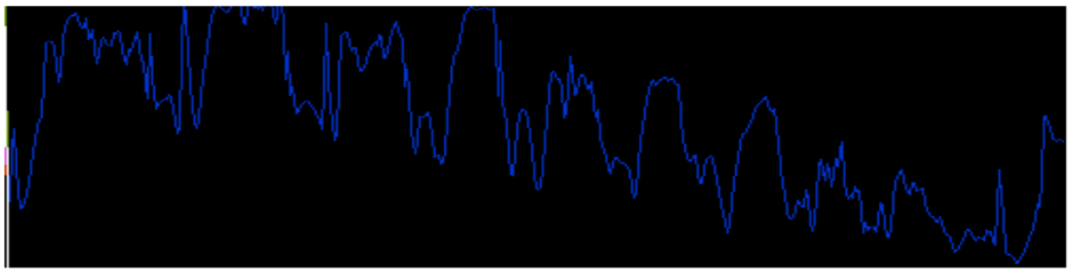


Figure 4.3: Another visualisation, produced by Kai Siedenburg, depicting what the author terms the 'Distance' values over time in Grisey's *Modulations for 33 Instruments* (1976-77).[78]

The visualisations depicted in Figures 4.2 and 4.3 were produced by Siedenburg in the object-based visual programming language *Max/MSP/Jitter*. Using this, Siedenburg built multiple connected patches (individual pieces of software) that can extract different

[77] Siedenburg, 26.

[78] Siedenburg, 26.

acoustic features from a recording in real-time and mathematically process these in order to then generate any number of graphics, each with customisable acoustic parameters and visual properties. In Figure 4.2, the visualisation tracks several acoustic correlates of timbre over time: the lower bound of the 'River' tracks the spectral centroid; the relative position of the red dots tracks the degree of noisiness; and the width of the 'River' indicates the spectral spread.[79] For Figure 4.3, the visualisation tracks the mathematically calculated distance between these various parameters over time.[80] According to Siedenburg, both visualisations – especially the latter, as the 'timbre distance' values reduce to zero by the end of the segment – provide confirmation that the string and wind sections are 'converging acoustically' in this section.[81] I would argue that this article is very persuasive in providing compelling acoustic evidence that supports a perceived metaphorical idea of what is happening in the work during this section. Siedenburg employs perceptually salient acoustic correlates of timbre to show the development of the timbral landscape, calculates a set of values that represents the empirical "distance" between these correlates, and represents both of these so cogently in his visualisations in a way that allows us as readers to clearly see, unlike in normal spectrograms, the evolution of these different parameters over time.

Steven Malloch – Analysis of two different recordings of *Jeux Vénitiens* (for orchestra, 1961) by Witold Lutoslawski[82]

After suggesting that using spectrograms for analysis is problematic because of its 'poor illustration of the complex data weighting and reduction that the human auditory system achieves', Malloch outlines a method for the analysis in this article that instead utilises 'techniques of timbre analysis based on psychoacoustic research' and employs what he

[79] Siedenburg, 26. The spectral centroid is an acoustic measure of where the spectral centre of mass is in a given snapshot of a particular sound. Noisiness refers to the inverse of the acoustic measure of spectral flatness – the degree to which a sound resembles a pure sine tone.

[80] Siedenburg, 22, 24.

[81] Siedenburg, 27.

[82] Stephen Malloch, 'An Exploration of Timbre Analysis: The Game of Sound in Two Performances of Jeux Vénitiens', *Musicae Scientiae* 8, no. 1 (2004): 53–81.

terms the 'psychoacoustic timbre measures of width, sharpness, and roughness' in order to create graphs that track these parameters over time in two different performances of this twentieth-century orchestral work.[83] The graphs in Figure 4.4 are partitioned into sections based on any sudden changes, which are shown with vertical lines that extend from the top to the bottom of the Y-axis, in any of the three parameters.

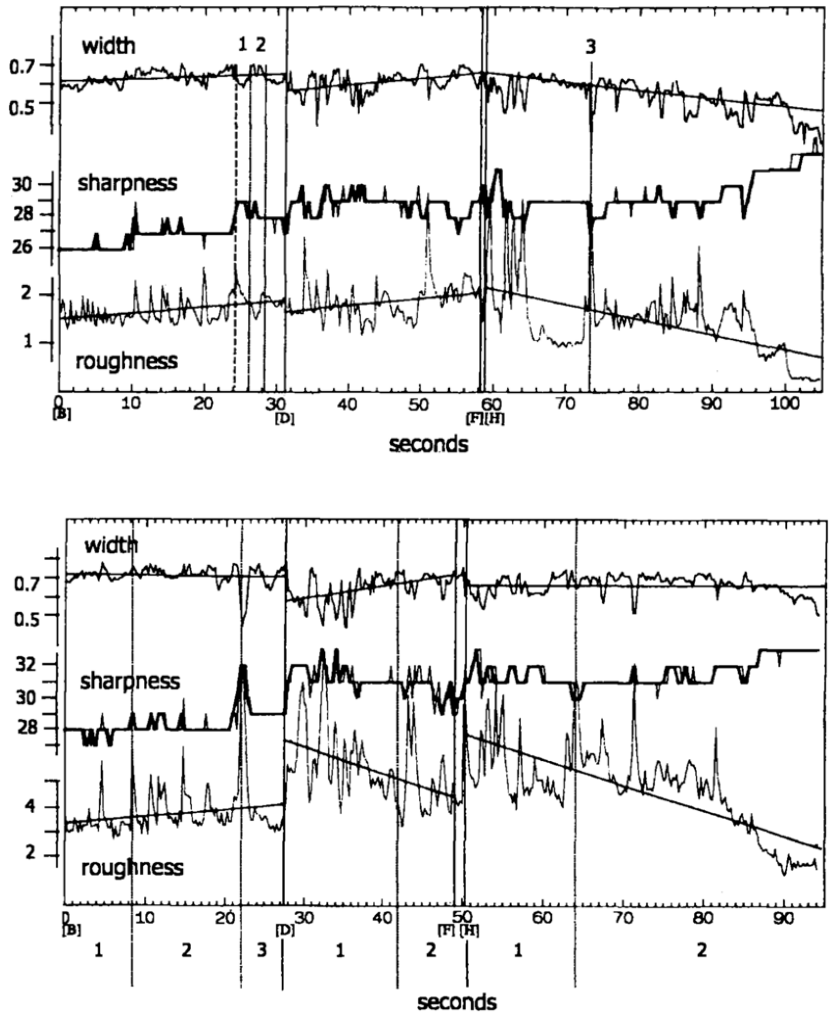


Figure 4.4: Steven Malloch's graphical depiction of three acoustic measures of timbre over time in two different performances of *Jeux Vénitiens* (1961) by Witold Lutoslawski.[84]

As a result of there being such a difference between the parameters' values in the two graphs, this analysis is valuable in shining a light onto the issue of analysing the timbres in

[83] Malloch, 64, 53.

[84] The X-axis on both graphs shows the time in seconds, while the Y-axis shows three different relativised scales for the acoustic parameters of width, sharpness, and roughness. Malloch, 76.

any work based on one recording. Malloch argues that 'recording style' must influence the way timbre functions in the two different recordings, and therefore questions whether there can ever be an archetypal performance that somehow represents 'the work', arguing that if such a performance were to exist, it could actually be 'psychoacoustically measured' and a meaningful timbral analysis of the work could be produced.[85]

On an entirely separate note, I would question whether width, sharpness, and roughness are perceptually salient parameters to use in light of more recent evidence which suggests that valid acoustic correlates of timbre, notwithstanding the issues regarding acoustic correlates already discussed in Chapter 3, are likely to include but are not limited to spectral centroid, the logarithm of the attack time, spectral flux, and spectral irregularity.[86]

4.3: Analyses which focus on the use of spectral representations in combination with other forms of descriptive analysis

Megan L. Lavengood – Analysis of different presets on the Yamaha DX7 synthesiser as used in several 1980s pop music songs, employing a combination of spectrograms and cultural analysis[87]

In this article, Lavengood presents a methodology that combines the use of spectrographic and what she terms 'cultural' analysis, and uses this method to analyse different examples of 1980s pop music and to make the case that Allan Moore's system of textural music layers, which include the beat, bass, melodic, and harmonic filler layers, should be augmented with

[85] Malloch, 71, 69.

[86] See, for example, Stephen McAdams and Bruno L. Giordano, 'The Perception of Musical Timbre', in *The Oxford Handbook of Music Psychology*, ed. Susan Hallam, Ian Cross, and Michael Thaut (New York: Oxford University Press, 2016), 113–24. McAdams and Giordano herein (115) define spectral flux as 'the degree of evolution of the spectral shape over a tone's duration', and spectral irregularity as 'the degree of jaggedness of the spectral shape', while describing the logarithm of the attack time as allowing for blown or bowed 'continuous' instruments to be distinguished from struck or plucked 'impulsive' instruments.

[87] Megan L. Lavengood, 'The Cultural Significance of Timbre Analysis: A Case Study in 1980s Pop Music, Texture, and Narrative', *Music Theory Online* 26, no. 3 (2020), https://mtosmt.org/issues/mto.20.26.3/mto.20.26.3.lavengood.php.

a new 'functional layer' called the 'novelty' layer.[88] For the purposes of the spectrogram analysis, Lavengood first outlines a descriptive vocabulary based upon the notion of 'markedness' as it is outlined by Robert S. Hatten, but which she defines as 'the significance given to difference often between two opposed terms'.[89] This vocabulary is presented as a list containing a total of ten oppositions of timbral attributes (e.g. bright/dark), each of which are grouped into three different spectral categories: sustain, attack, and pitch components. One term from each of these binaries is then assigned to each analysed sound based on contextual judgements made by Lavengood – for example, when deciding if a sound is considered to be bright or dark, she writes that 'my own decision for this article is to consider anything above 1100Hz bright and anything below dark'.[90] In order to determine which of these assigned attributes are marked or unmarked, the sounds are analysed in comparison to a sample of what Lavengood considers to be the 'prototypical pop music sound' – the clean electric guitar.[91] Lavengood claims that those attributes which conform to the prototypical guitar sound reinforce the norms of texture in '80s pop music, and so are unmarked attributes which correspond to one of Moore's four functional layers, while other attributes do not conform and so contribute to the newly defined novelty layer. With this methodology in hand, Lavengood analyses presets on the Yamaha DX7 synthesiser as they are used in several '80s pop hit singles.

[88] Lavengood, para. 0.3; Allan F. Moore, *Song Means: Analysing and Interpreting Recorded Popular Song* (Farnham, UK: Ashgate, 2012).

[89] Lavengood, 'The Cultural Significance of Timbre Analysis', para. 0.3; Robert S. Hatten, *Musical Meaning in Beethoven: Markedness, Correlation, and Interpretation* (Bloomington, IN: Indiana University Press, 1994).

[90] Lavengood, 'The Cultural Significance of Timbre Analysis', para. 1.9.

[91] Lavengood, para. 1.6.

– / + OPPOSITION	E. PIANO 1	HARMONICA	FLUTE 1	CALLIOPE
Spectral components - sustain				
bright / dark	+	+	+	+
pure / noisy	–	–	+	+
full / hollow	+	+	–	+
rich / sparse	+	–	+	+
beatless / beating	+	–	–	–
harmonic / inharmonic	–	–	+	+
Spectral components - attack				
percussive / legato	–	+	+	+
bright / dark	+	Ø	Ø	Ø
Pitch components				
low / high	Ø	Ø	Ø	Ø
steady / wavering	–	–	–	–

Figure 4.5: Table produced by Megan Lavengood showing the different spectral terms she assigns to each Yamaha DX7 preset as it is used in the song 'What's Love Got to Do with It' (1984) by Tina Turner.[92]

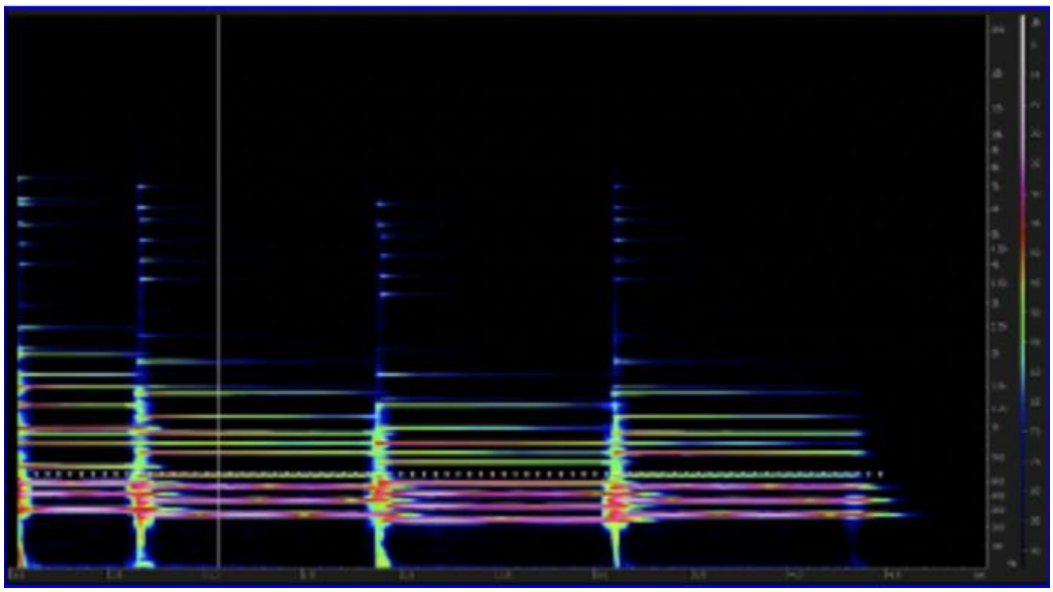


Figure 4.6: Thumbnail of a spectrogram video example produced by Megan Lavengood of the 'E. PIANO 1' preset on the Yamaha DX7 in 'What's Love Got to Do with It' (1984) by Tina Turner.[93]

The process by which sounds are designated as marked or unmarked is ultimately quite opaque, as attributes are assigned to timbres without justification or explicit reference to the spectrograms (which are instead used more as visual aids), or to the empirical

[92] A minus or plus marking means that the sound exhibits the former or the latter spectral component, respectively, on the left-hand side of the table. If a null sign is shown, the sound evokes neither component. Only a plus marking indicates that the attribute is marked. Lavengood, para. 2.5.

[93] Lavengood, para. 2.10.

parameters (e.g. the aforementioned bright/dark dividing line of 1100Hz) that might lead to such a categorisation. Furthermore, the spectral parameters used are all given equal weighting in this analysis, and no attention is given to which parameters, if any, might be (more) perceptually salient – a similar issue to the one discussed with respect to the Malloch analysis.

After her analysis of the various tracks, Lavengood groups twelve DX7 presets as belonging to either what she terms the core layer – one of the four pre-existing functional layers – or the novelty layer. She writes that the core sounds tend to be timbrally 'full, rich, and harmonic', whilst the novelty layer is 'much more diverse and thus difficult to generalise' but generally has more marked assigned attributes such as 'inharmonic and hollow'.[94] According to Lavengood then, because of the designations that each layer is more likely to exhibit, the purpose of a core layer is to promote blend, while the aim of the novelty layer is to do the exact opposite.[95] Why any of these features specifically enable or impair blending is not explained further. I would argue that another issue with this article is the lack of an explicated process by which each song is selected as well as the small number of songs chosen for the analysis, as it is perhaps questionable whether such a broad conclusion on the timbral functions of these different DX7 presets can be reached on the basis of this relatively small and arbitrarily chosen sample set.

Ben Ramsay – Analysis of 'Foil' (1994) by Autechre, using a combination of spectrograms and psychology-centred methodology[96]

In his analysis of the work 'Foil' (1994) by Autechre, Ramsay draws a distinction between subjective and objective descriptions of timbre in music analysis, basing his ideas on those of psychologist Ernst Schachtel, who differentiates between two types of perception: 'subjective', which pertains to emotions and feelings; and 'objective', which ignores what

[94] Lavengood, para. 2.21-2.23.

[95] Lavengood, para. 2.23.

[96] Ben Ramsay, 'Analysis of *Foil* by Autechre (from *Amber* (1994))', in *Expanding the Horizon of Electroacoustic Music Analysis*, ed. Simon Emmerson and Leigh Landy, 1st ed. (Cambridge University Press, 2016), 209–30.

Ramsay calls 'subjective distractions'.[97] Ramsay claims that if we map these two kinds of perception onto the sounds heard in the genre of electronica (the genre which pertains to this track), two different kinds of sound groups can be described: the 'subjective grouping' contains 'emotive, subjective content' that promotes a 'physical or emotional response in the listener'; the 'objective grouping' contains sounds that incorporate 'real-world objective references' and in which timbre performs a 'more pivotal role'.[98] What follows are some of Ramsay's descriptions of the subjective and objective sounds within this Autechre track:

Subjective descriptions

> From 4m 37s the track begins to fall apart and, from a subjective viewpoint, the listener might get the sense that the main elements of the piece are losing their power as they stutter and falter and appear to try, in vain, to cling on to life.[99]

Objective descriptions

> The use of delay and reverberation is widespread throughout the track and gives the sounds a sense of depth and sonic density…[100]

Later, Ramsay describes one specific timbre in the track, which he labels as the track's 'focal sound', as developing over time by way of the evolution of four acoustic timbral features that give the sound 'moment and meaning'; these parameters are loudness, spatial distance, spectral density, and 'cohesion', whereby cohesion is defined as the 'togetherness' of the sound.[101] The graphic in Figure 4.8 maps these four features, with Ramsay representing the evolution of these based on his own listening assessment and evaluation of the spectrogram.

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[97] Ramsay, 213; Ernest G. Schachtel, *Metamorphosis: On the Conflict of Human Development and the Development of Creativity* (New York: Basic Books, 1959).

[98] Ramsay, 'Analysis of *Foil* by Autechre (from *Amber* (1994))', 214.

[99] Ramsay, 216.

[100] Ramsay, 217.

[101] Ramsay, 219–20.

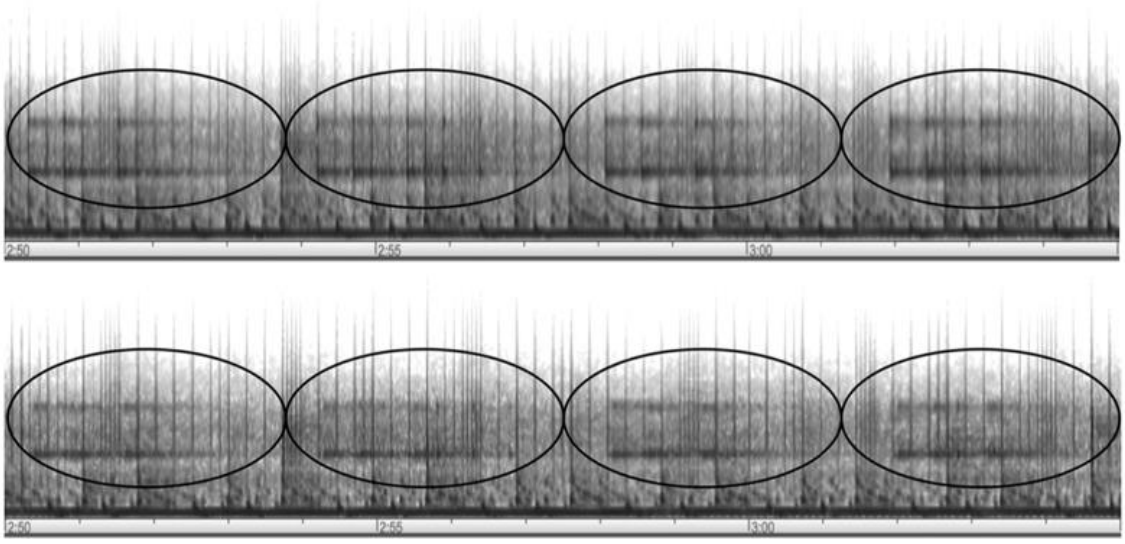


Figure 4.7: Spectrograms produced by Ben Ramsay of the left and right channels during one particular section of 'Foil' (1994) by Autechre.[102]

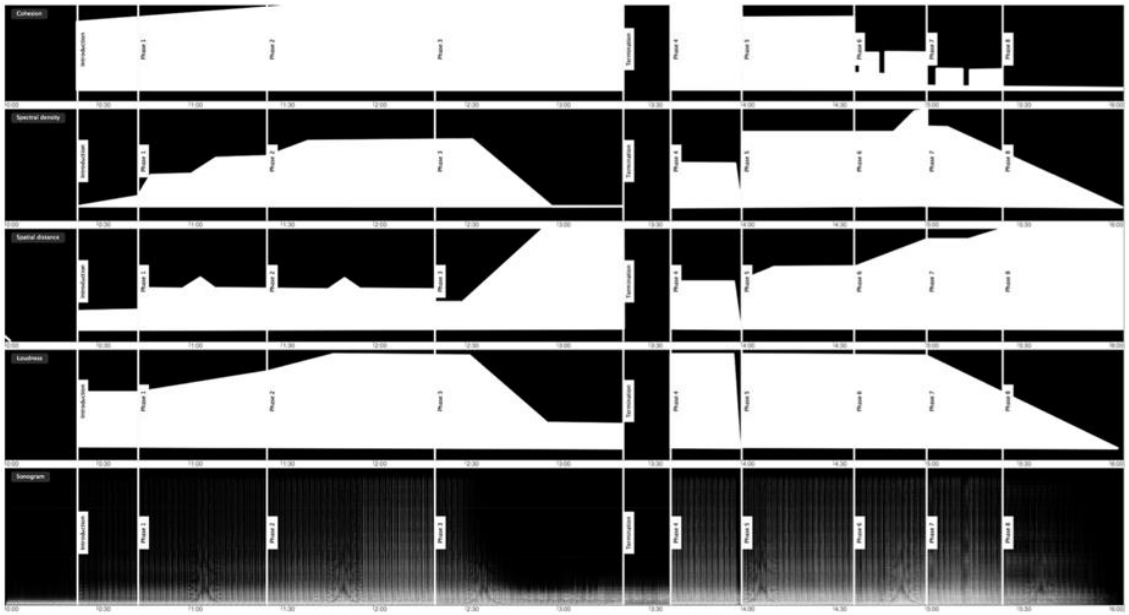


Figure 4.8: Spectrogram and graphical representations produced by Ben Ramsay, depicting the evolution of the four primary acoustic features of the 'focal sound' in 'Foil' (1994) by Autechre.[103]

[102] The spectrogram is claimed to show the difference between the two channels – the left purportedly has higher frequency content and more visible attack transients. Ramsay, 218.

[103] Ramsay, 224.

Although grounding a framework for the analysis of timbre in psychological concepts is an effective means by which to determine how timbre functions from the listener's perspective, I would argue that Ramsay does not theoretically ground his objective/subjective distinction in such a way so that it is clear how any given sound or description of said sound falls into either grouping. This leads to the sense that the article mostly contains descriptions from Ramsay's personal perspective, which at times includes exceedingly metaphorical and emotively affecting language – an example of this being where the drones and pads at the start of the track are solely described as 'suggesting an ominous and oppressive atmosphere.'[104] Moreover, the spectrograms and graphical representations do not serve to convince the reader that the descriptions and designations given in the article are backed up by any acoustically measurable evidence.

Simon Emmerson – Analysis of *Zellen-Linien* (for piano and live electronics, 2007) by Hans Tutschku, using a combination of spectrogram and score analysis[105]

Emmerson, in his article on *Zellen-Linien* (2007) by Hans Tutschku, begins by writing that the perspective of the listener will be the foundation of his analysis, as the work is more likely to have been heard than seen in its score form.[106] He then acknowledges the issue of trying to objectively describe the different timbres in any work when the writer cannot avoid, for example, their own piano-playing knowledge or their experience of exploring different piano sounds in the studio, but suggests that, nevertheless, he 'hope[s] to offer some signposts'.[107] A number of small excerpts from the two descriptive analyses follow:

[104] Ramsay, 215.

[105] Simon Emmerson, 'The Analysis of Live and Interactive Electroacoustic Music: Hans Tutschku – *Zellen-Linien* (2007)', in *Expanding the Horizon of Electroacoustic Music Analysis*, ed. Simon Emmerson and Leigh Landy (Cambridge: Cambridge University Press, 2016), 333–54.

[106] Emmerson, 333.

[107] Emmerson, 334.

> The use of subtle flange and phase transformation is sparing in this piece and focused in specific sections to create a dreamlike and "strange" quality to the sound.[108]
>
> In fact the added [electronic] layers do not resemble the piano itself spectrally in such a way – the timbres are more complex, often with a grainier noisier component.[109]

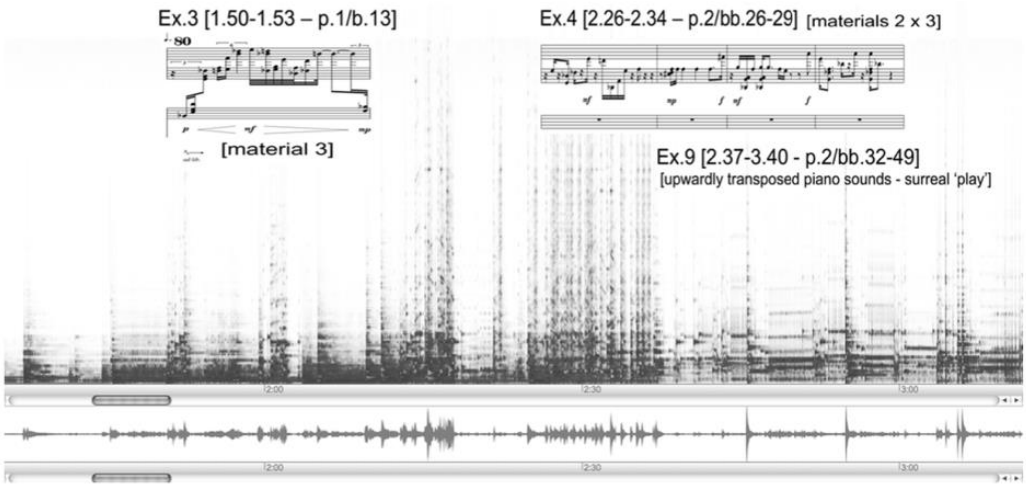


Figure 4.9: Graphic produced by Simon Emmerson featuring a waveform and spectrogram of a recording of *Zellen-Linien* (2007) by Hans Tutschku, along with score extracts and descriptive labels.[110]

On the whole, the acknowledgement of one of the fundamental issues with descriptive timbral analysis – namely that the writer's perspective will always influence the way timbre is perceived and described – is welcome. The analysis, however, makes much use of metaphors in aid of understanding, which is of course not an issue in and of itself but causes confusion when terms like 'strange' are given in quotation marks whilst the same is not done for terms like 'dreamlike'. Furthermore, Emmerson states that he is offering 'signposts' from his perspective but then uses the pronoun 'we' (e.g. 'we can hear how

[108] Emmerson, 339.

[109] Emmerson, 341.

[110] Example 4 is referred to in the descriptive analysis as a 'strung out gesture' which timbrally 'appears to absorb repeated note material'. Most of the other score examples are used to describe other musical factors, however. Emmerson, 336–37.

technology has allowed the composer to create an expanded or extended soundworld').[111] I would argue that Emmerson should frame the analysis as being from his own perspective, or otherwise there needs to be a more explicit theoretical basis for how he would move away from said perspective.

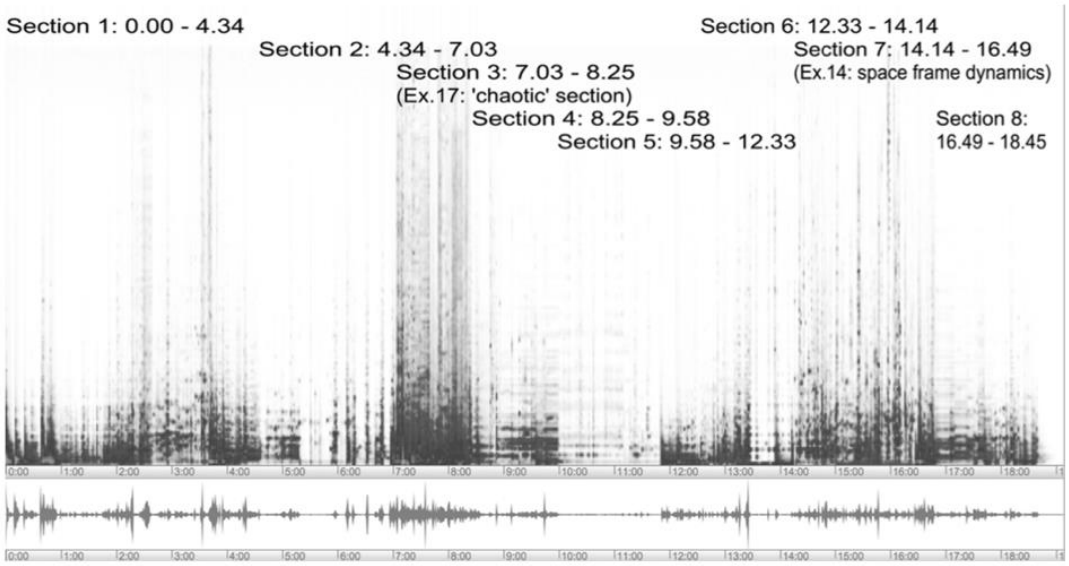


Figure 4.10: Another graphic produced by Simon Emmerson featuring a spectrogram and waveform of a recording of *Zellen-Linien* (2007) by Hans Tutschku, along with descriptive labels.[112]

4.4: Summary of analyses which make use of spectrograms or spectral graphical representations

In summarising the articles discussed thus far, spectrograms and graphical representations of certain spectral parameters can be useful tools for showing what a given timbre is spectrally composed of and for enabling a researcher to draw links between how a timbre is perceived intersubjectively and the objective acoustic data for that sound. However, what spectrograms cannot account for is how timbre as a percept extends beyond what objectively exists in the acoustic data. This issue has been much explicated in contemporary timbre scholarship, most notably by Cornelia Fales, who terms this issue as the problem of

[111] Emmerson, 353.

[112] Example 17 is later portrayed by Emmerson as featuring the piano aspiring to the 'condition of a vast metallophone', which is brought about through the 'addition of *noise*', described as '"sizzle" and denser grainy noise within the metallic sonority.' Emmerson, 352.

'perceptualisation' (previously discussed in Chapter 3) – a phenomenon that entails the cognitive ability to embellish the perception of a sound's timbre in a way that cannot be directly attributed to the acoustic features of said sound.[113] Furthermore, I would argue that neither spectrograms nor any of the graphic representations of acoustic spectral features that have been included in this chapter effectively communicate to the reader how timbre functions or has been used in a given work, as these forms of analysis are far removed from how timbre is actually experienced by the individual. I would also contend that these spectrograms and representations are not usually visually apprehensible and do not provide additional information in and of themselves beyond what has already been described in more detail by the analyst or can be easily perceived by the reader through listening. Simon Emmerson himself describes this apprehensibility issue well, writing that 'only the most experienced user' can extract any specific timbral details from a spectrogram, and even then, potentially only general features concerning 'overall sound shapes and trajectories, tessitura and loudness.'[114]

4.5: Analyses which focus on the use of descriptive analysis in combination with novel graphical aids

Each of the following three analyses employs contrasting graphical aids, although their descriptive sections share much in their form and content.

David K. Blake – Analysis of 'The King of Carrot Flowers, Part 1' (1998) by Neutral Milk Hotel[115]

With the assistance of Edward Casey's phenomenological work, Blake begins by making the case that 'timbre is subjectively experienced' and understood only from 'within a perceptual context', only when the listener is provided with 'particular orientations', and only in

[113] Fales, 'The Paradox of Timbre'.

[114] Simon Emmerson, 'Analysing Non-Score-Based Music', in *Noise as a Constructive Element in Music: Theoretical and Music-Analytical Perspectives*, ed. Mark Delaere, 1st ed. (London: Routledge, 2022), 114.

[115] David K. Blake, 'Timbre as Differentiation in Indie Music', *Music Theory Online* 18, no. 2 (2012), https://mtosmt.org/issues/mto.12.18.2/mto.12.18.2.blake.html.

comparison to other timbres within said perceptual context – not via 'absolute characteristics'.[116] The analysis in this article is therefore based on the idea that, in Blake's words, 'timbre is primarily understood through difference', a claim that is said to centre 'timbral ontology in embodied perception and projection.'[117] Blake also writes that he will use metaphorical adjectives as timbral descriptors in the analysis, as he argues that Casey's work lends legitimacy to his notion. Three different indie rock music tracks are then analysed by comparison to a typical 'mainstream rock' version of an electric guitar from an example track, to which Blake assigns four descriptive adjectives: full, distorted, digestible, and heterogenous.[118] I will focus on Blake's analysis of the Neutral Milk Hotel track in this chapter. A couple of examples of the descriptive analysis follow:

> The breathy timbre of the accordion seemingly morphs out of the deep, round vowel sound in Magnum's [the main vocalist's] exhalation…[119]

> The [guitar] sound is *full*, but not distorted. It is imminently *digestible* and warm, and the song evolves into a *heterogenous* timbral tapestry… as compared with mainstream expectations.[120]



Figure 4.11: Graphic produced by David Blake representing timbres and volumes of different forces over time in 'The King of Carrot Flowers, Part 1' (1998) by Neutral Milk Hotel.[121]

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[116] Blake, para. 4.5; Edward Casey, *Getting Back Into Place: Toward a Renewed Understanding of the Place-World* (Bloomington, IN: Indiana University Press, 1993).

[117] Blake, 'Timbre as Differentiation in Indie Music', para. 4.5.

[118] Blake, para. 4.7.

[119] Blake, para. 6.5.

[120] Blake, para. 6.6.

[121] The Y-axis here represents the volume of the forces; the X-axis represents time. Blake, para. 6.6.

In describing what the graphic in Figure 4.11 depicts, Blake writes that the 'warm and full' hues of the 'ruddy orange and browns' are used to represent the 'timbral colour' of the different instruments, and that the differences in colour are meant to show the differences between the timbres – for instance, the zanzithophone's bright orange is meant to highlight its sound's 'direct, pinched nature' in comparison with the 'more resonant, warmer brown' colour assigned to the guitar.[122] The transitions between colours are supposed to underscore the 'careful timbral transitions' featured in the song.[123]

The attempt to address the issues surrounding how to describe and analyse timbre by Blake is laudable, especially through the attempt to establish a phenomenological theoretical grounding so that metaphorical descriptive terminology can be contextually used to analyse timbre without the sense that the analysis starts to border on the personal and subjective. The contextual guitar comparisons are particularly successful in this regard. However, at times, this use of metaphor is stretched beyond credulity. For example, on the basis of interviews in which the main singer-songwriter of this track says that the album is based on his love for Anne Frank after having read her diary, Blake writes that the 'warm timbres', amongst other non-timbral factors, can be interpreted as being 'directed towards Anne Frank' and providing 'a haven to bring her back to life so that she may be loved.'[124] In addition, he contends that 'the use of long, breathy timbres may thus act as aural resuscitation, trying to imbue her ghost with the breath of life.'[125] Putting the insensitivity of making such an argument to one side, the validity of this claim – if it is to be anchored in Blake's theoretical grounding – is tenuous. As for the graphic used above, its novelty and simplicity are, in my opinion, successful in giving the reader a broad sense of the differences between the timbres. I would also argue however that, as the graphic is very generalised, it

[122] Blake, para. 6.6.

[123] Blake, para. 6.6.

[124] Blake, para. 6.8.

[125] Blake, para. 6.8.

neglects to give any further indication of the particular qualities of those timbres and how they interact with each other.

Jennifer P. Beavers – Analysis of Maurice Ravel's late works[126]

In this article, Beavers refers to the psychological literature on audio perception in order to develop what she calls her 'aurally based analytical approach'. She outlines two concepts from the literature that she uses for the purpose of her analysis: auditory streams, where a single instrument or several are perceived as belonging to one sound object; and auditory scenes, which in this context is used to refer to a particular musical event or series of events that capture a certain mood.[127] Two of the several works that Beavers analyses in a comparative fashion are Mussorgsky's solo piano work, *Pictures at an Exhibition* (1874), and Ravel's 1922 orchestral version of the same work. Select quotes from this analysis follow:

> In the piano version, we perceive a single auditory stream with the opening eighth notes…[128]

> The horns quietly enter underneath the previous instruments, creating the "magical effect", in which one timbre emerges out of another.[129]

> Here the mutes distort and distance the horns from the previous phrase and echo the magical effect with a [Standard] > [Color] transformation…[130]

In the last quote above, Beavers is referring to and expanding upon Randolph Johnson's 'SPC' model, which describes different categories of instruments and the normative

[126] Jennifer P. Beavers, 'Ravel's Sound: Timbre and Orchestration in His Late Works', *Music Theory Online* 27, no. 1 (2021), https://mtosmt.org/issues/mto.21.27.1/mto.21.27.1.beavers.html.

[127] Beavers, para. 2.3.

[128] Beavers, para. 3.3.

[129] Beavers, para. 3.3.

[130] Beavers, para. 3.3.

functions they play in Romantic-era symphonies based on the 'timbral and instrumental combination patterns' they exhibit.[131] Beavers writes about transformations between the 'Standard', 'Power', and 'Color' categories throughout the analysis, and in this example the horns, which would normally fall into the Power category as they exhibit loud dynamics, are categorised as Colour instruments in this particular section due to the use of the mutes. The Standard to Colour transformation refers to the strings and clarinets that dominate the texture before we hear the horns by themselves.

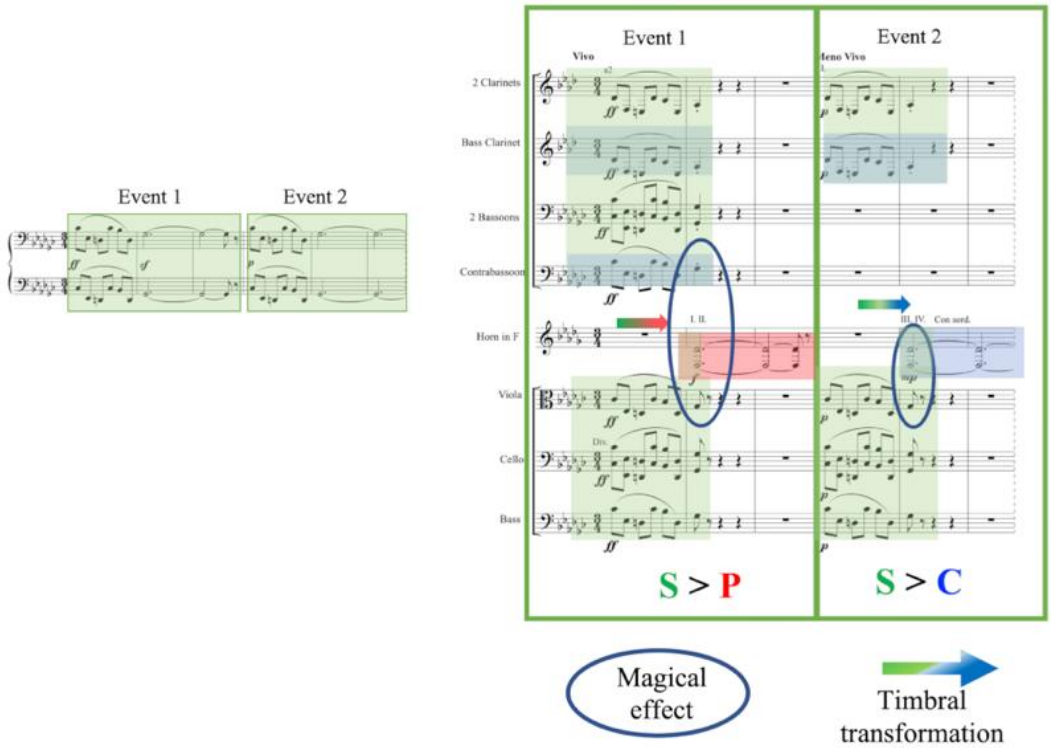


Figure 4.12: Graphic produced by Jennifer P. Beavers displaying score extracts from the original solo piano version of *Pictures at an Exhibition* (1874) by Mussorgsky and the orchestral arrangement by Ravel (1922), with analytical highlighting and markers added.[132]

In her subsequent analysis of Ravel's *Boléro* (1928), Beavers writes about the appearance of an 'illusory saxophone', claiming that when the flute and the muted trumpet enter together in the work for the first time, we perceive these two instruments as one, as if they

[131] Beavers, para. 2.5; Randolph Johnson, 'The Standard, Power, and Color Model of Instrument Combination in Romantic-Era Symphonic Works', *Empirical Musicology Review* 6, no. 1 (2011): 2–19.

[132] The horn analysis previously described is depicted in 'Event 2'. Beavers, 'Ravel's Sound', para. 3.3.

were a singular tenor saxophone – 'our perceptual apparatus hears these two instruments as one integrated stream due to the fused rhythms and octaves'.[133] Beavers cites music psychologist Stephen McAdams to support this by drawing attention to the 'perceptual grouping process that music psychologists refer to as "fusion"'.[134]

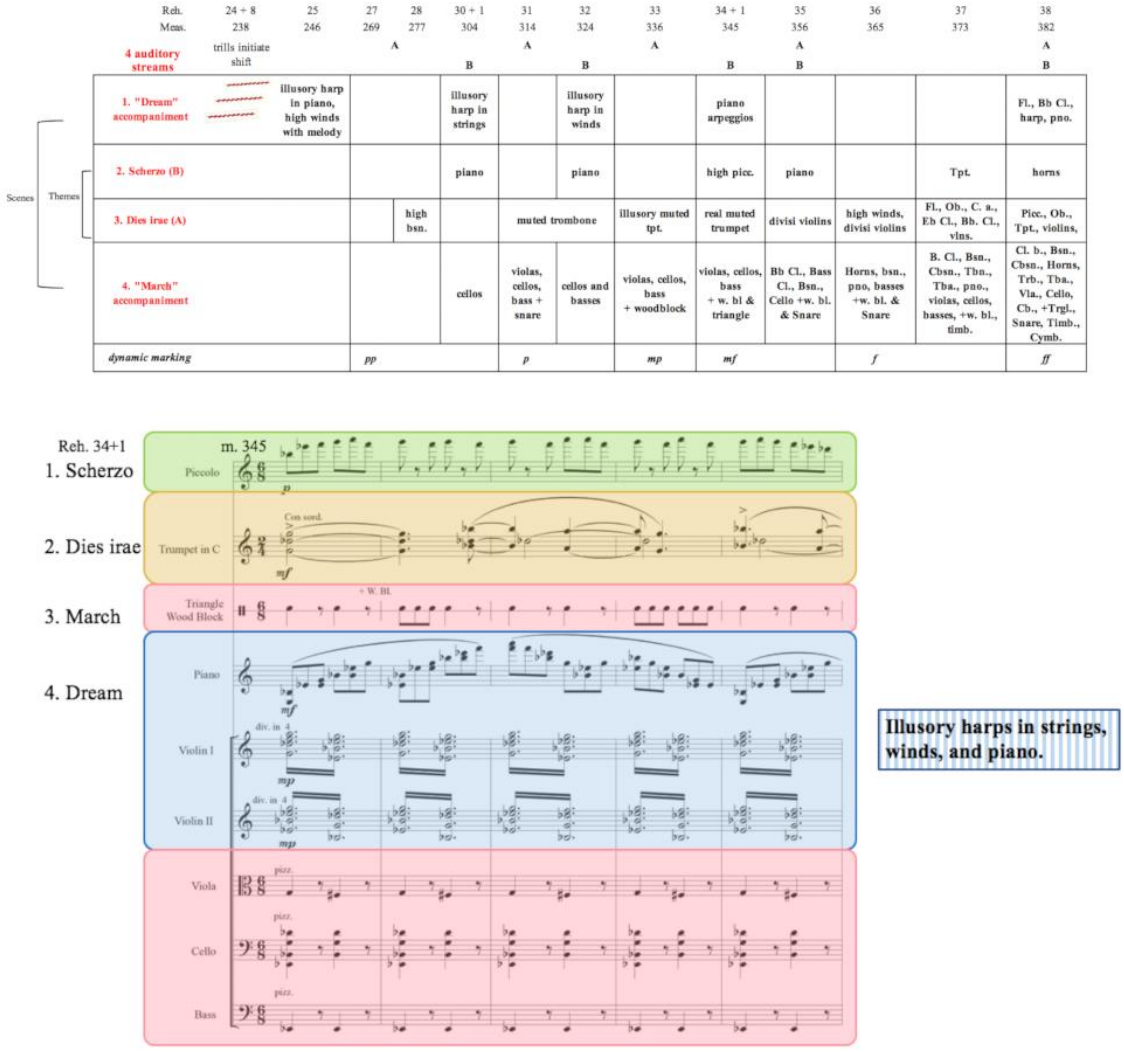


Figure 4.13: Graphic produced by Jennifer P. Beavers depicting her timbral analysis of Ravel's *Piano Concerto for the Left Hand* (1929-30).[135]

[133] Beavers, para. 4.5.

[134] Beavers, para. 2.4; Stephen McAdams, Philippe Depalle, and Eric Clarke, 'Analyzing Musical Sound', in *Empirical Musicology: Aims, Methods, Prospects*, ed. Eric Clarke and Nicholas Cook (New York: Oxford University Press, 2004), 157–96.

[135] Beavers uses a reduced score of the work for reference. Beavers, 'Ravel's Sound', para. 4.14.

In the final example I will highlight in this chapter, the graphic in Figure 4.13 is described by Beavers as showing one substantial auditory scene that contains four auditory streams, some of which use fusion in order to create 'illusory instruments'.[136] Beavers also claims that the 'blurred timbral make-up' of the piano, violins, and high winds produces a 'dream-like feel' which creates the perception of an 'illusory harp'.[137]

There is an impressive clarity with which these analyses are presented in their graphical forms and with which the visual extracts from the score are used to further elucidate the different kinds of timbral transformations and events taking place in Ravel's works. However, Beavers' borrowing of concepts from the music psychology literature, such as those concerning auditory streams/scenes and how timbre is otherwise perceived, including its potential for fusion, does not appear to justify the somewhat personalised nature of the analyses that follow, particularly with regards to the concept of 'illusory instruments', the appearance of the 'magical effect', and once again the use of the pronoun 'we' without providing any substantiation for the author's perception being shared more broadly.

4.6: Other analyses of note

Jean-Charles François – Analysis of Edgard Varèse's *Ionisation* (for 13 percussionists, 1929-31)[138]

While no explicit theoretical framework for this analysis is provided by François, I include it here due to its use of a novel graphical representation to show the different timbres at work in Varèse's composition. François makes two central claims in this article. The first is that the 'concept of instrumental identity', defined as 'the associative relationship between the nature of the instrument and the origin to which it refers', is extended to a 'point of extreme radicalisation' in *Ionisation* – he gives an example of how the military drum in the

[136] Beavers, para. 4.14.

[137] Beavers, para. 4.14.

[138] Jean-Charles François, 'Organization of Scattered Timbral Qualities: A Look at Edgard Varèse's Ionisation', *Perspectives of New Music* 29, no. 1 (1991): 48–79.

work is used to play what is perceived as a 'military march' from the listener's perspective.[139] The second claim is that the ensemble of instruments in the work begins as a 'gathering of multiple voices which talk together, but do not really listen to each other, until they suddenly intone as a collective chorus', and are 'welded into an abstract form', producing a 'new, complex sound object.'[140]

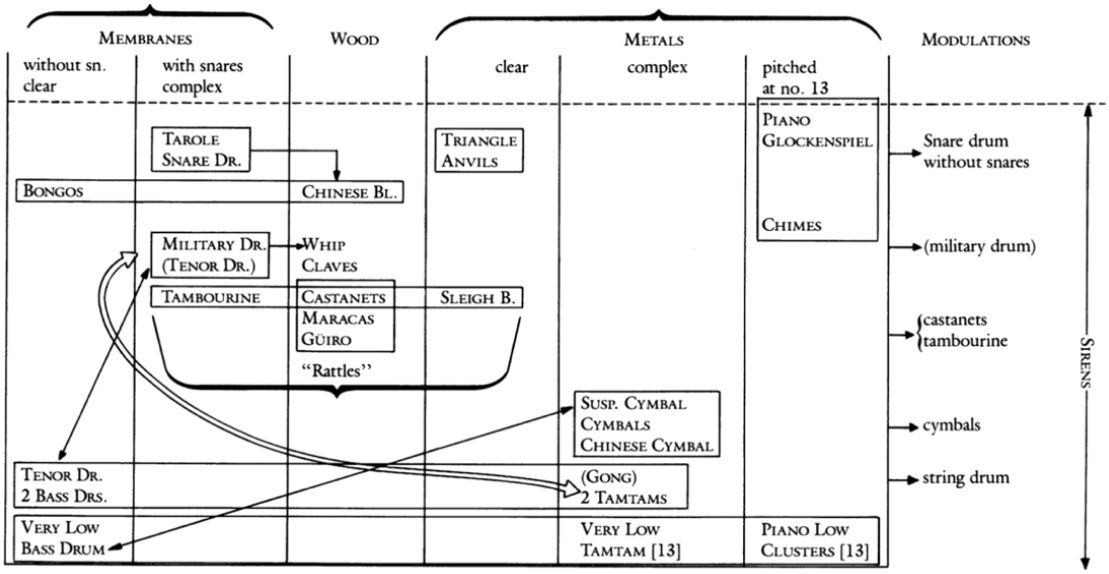


Figure 4.14: Graphical representation produced by Jean-Charles François of the timbral relationships between the various forces in *Ionisation* (1929-31), by Edgard Varèse.[141]

According to François, the map relates the instruments to each other by 'pitch, relative complexities of spectra, nature of the material of the instruments, modes of production, envelopes of sound, durations of resonance, and even association in the context of traditional orchestral practice (i.e. the relationship of the bass drum with the cymbals).'[142] Whilst the graphic concerns a lot more than just matters relating to timbre, there are some timbral parameters which are displayed uniquely here, of a kind I have not found anywhere else in the contemporary timbre analysis literature. As a result, it is possible to visually apprehend, in a clear and simple manner, the instrumental forces at work and how they

[139] François, 61.

[140] François, 61.

[141] François describes this map as containing a 'representation of all the instrumental connections that can be found' in the work. François, 69, 68.

[142] François, 68.

timbrally relate to each other – whether that be in terms of the spectral similarities they share, how they timbrally oppose each other, or in terms of how their sounds are physically produced.

Simon Emmerson – Analysis of his own electroacoustic work, *Memory Machine* (2010)[143]

This publication is included in this review as, although it does not fit into any of the previously outlined analytical categories, it does feature one of the most compelling graphical examples I have seen, in which the power of the *EAnalysis* software – first illustrated by Pierre Couprie – is clearly demonstrated.[144] Emmerson does not carry out any full analyses here, but rather discusses idealised forms into which we might transcribe non-score-based music in the future; the graphic in Figure 4.15 shows what one of these forms might look like.

I would argue that this graphic is particularly successful at showing the timbral forces at play in the work because it gives clear and succinct text labels, with implicit time stamps, of the different timbres that are entering and exiting the soundscape, and attached to these labels are intuitive graphical representations of these timbres that are a genuine attempt to imagine how a sound might transfer, in a synaesthetic sense, over into the abstract visual domain. It is worth noting however that this form of representation is most useful when it is of a work which has clearly demarcated timbres, as otherwise it might be possible to misleadingly represent different timbres as entirely separate from one another when they may not in fact be perceived this way by listeners. This plays into a broader concern that this kind of representation may risk oversimplifying the contents of what we hear – it could perhaps act as a very useful complementary tool but not act as a standalone form of analysis.

[143] Emmerson, 'Analysing Non-Score-Based Music', 107–24.

[144] Pierre Couprie, 'EAnalysis: Developing a Sound-Based Music Analytical Tool', in *Expanding the Horizon of Electroacoustic Music Analysis*, ed. Simon Emmerson and Leigh Landy (Cambridge: Cambridge University Press, 2016), 170–94.

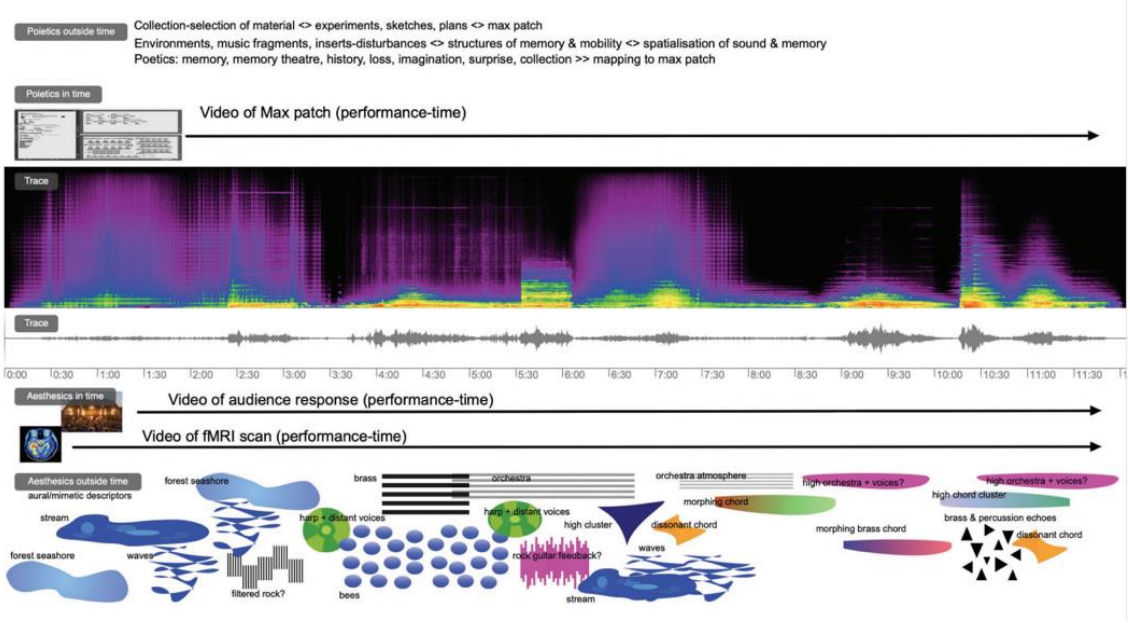


Figure 4.15: Graphic produced by Simon Emmerson featuring a spectrogram and waveform of his own work, *Memory Machine* (2010), alongside an EAnalysis graphical representation of the various timbres that can be heard in the work.[145]

4.7: Conclusion

This review of the analytical literature on timbre shows that timbre has been analysed within contemporary music analysis discourse using a variety of different methodologies and technologies, with a keen interest being taken in what was often an ignored musical element in analyses of the past. The use of spectrograms is still the most popular means by which to analyse timbre in musical works, although there is now more recognition that the use of spectrograms, at least by themselves, does not fully capture how timbre functions and is perceived by individual listeners. While the approaches that respond to this particular issue are broad, what they share is the attempt to analyse timbre descriptively in some sense, and to situate these descriptions within some kind of theoretical framework, whether that be one drawing from phenomenology, ethnography, sociology, psychology, or some combination of them all. I would argue that whilst some of these analyses – for example, the aforementioned Blake analysis – successfully manage to anchor their descriptions within these frameworks, many others do not; instead, the framework is often merely stipulated before the analysis proceeds in a manner that comes across as personal

[145] Emmerson, 'Analysing Non-Score-Based Music', 120.

or subjective. While it is entirely possible and potentially valuable, I would contend, for there to be analyses of timbre in musical works that use methodologies which situate the personal at the fore, it is problematic however to confuse subjective analysis with analysis that purports to anchor these claims in specific theoretical frameworks which are influenced by non-musical disciplines, especially when these subjective descriptions are presented as if they are in fact quasi-empirical claims couched in a framework derived from disciplines such as music psychology (for example, Beavers' claim of a shared perception of different 'illusory instruments' on the basis of the psychological concept of timbral fusion).

Some analysts also employ the use of graphical aids to assist with the understanding of the descriptive analyses. A number of these – for example, the aids used in the Beaver analysis – are very successful at representing the descriptive analysis in an intuitive visual form, and in a way that the reader can understand and relate to their own experience of the work. However, I would contend that many of these graphics could serve to better aid understanding by including more detail and by making them core features of the analyses themselves, rather than by only using them supplementarily.

As was shown in the review of the concept of timbre in Chapter 3, timbre is a complex multidimensional phenomenon that functions on multiple levels – the acoustic, perceptual, and semantic – and plays a fundamental role in our ability as listeners to perceive, interpret, understand, label, and intellectually and emotionally respond to what we hear. This complexity of timbre makes it extremely challenging to both define and – as I would argue this chapter has shown – to analyse, especially in musical works. To analyse timbre in a way that encompasses its full effects is to take into account all of these functional levels, all of which can be understood through a multiplicity of phenomenological, ethnographic, psychological, linguistic, sociological, and acoustical lenses, to name just a few. Furthermore, I would contend that this analysis has shown that falling back onto the use of subjective descriptions of timbre is difficult to avoid even when an extensive theoretical framework has been provided. In the following chapter of this thesis, I will set out my own theoretical framework for the purposes of exploring the role that timbre may play in the

oft-perceived aesthetic disconnect between acoustic and electronic forces in mixed electroacoustic works. I will argue that an intersubjective metaphor-based framework allows for the use of semantic descriptions of timbre that are based on commonly used culture-specific metaphors which are nonetheless deeply embodied and undergirded by sensory cross-domain mapping. I will contend that such a framework could prove valuable as a means of effectively analysing and subsequently communicating how this aesthetic disconnect could be bridged by composers, should they so wish.

Chapter 5: Compositional strategies for timbral blend in mixed electroacoustic music

5.1: Introduction

Within the discursive paradigm of electroacoustic music, one issue that composers have frequently confronted is the difficulty of producing works which feature both acoustic and electronic forces without some sense that there is an aesthetic disconnect between them. As seen in Chapter 2, recent literature has often attempted to tackle this disconnect by appealing to concerns relating to retaining or avoiding a sense of liveness and/or instrumentality, while the role that timbre may play in this issue has not been the subject of much discussion to date. The complex multidimensional nature of timbre, as explored in Chapter 3, makes it difficult to even define the term and how it functions in the first place, never mind to examine its aesthetic and compositional role in mixed electroacoustic music. Meanwhile, the multiplicity of available approaches to the analysis of the phenomenon in musical works, as examined in chapter 4, provides a small insight into how challenging it is to capture and articulate timbre's full effects on listeners. Any scholarship that attempts to study the role of timbre in this issue, therefore, should acknowledge this lack of consensus on what timbre is, how it operates, and how it should be analysed in a musical context.

To examine the role that timbre may play in this sense of disconnect, in this chapter I will conduct timbral analyses on three mixed electroacoustic compositions: 'Salt Canyons' from *The Inner Universe* (1983) by Priscilla McLean; *RAS* (2000, rev. 2011) by Natasha Barrett; and *Scirocco* (1983) by Maggi Payne. Using a theoretical framework that is based on Walther-Hansen's theory of sound as a perceptual combination of the 'sound-in-itself' and the sound's apparent source, Wallmark and Kendall's application of conceptual metaphor theory to timbre semantics, and Walther-Hansen's model of metaphorical descriptions for recorded sound, I analyse these works by defining and describing the timbral threads that can be delineated within them – using, where necessary, metaphorical language to aid in these descriptions. I also graphically represent the development and interplay of these

threads over time by way of a series of flowcharts. Through these analyses and subsequent discussion, I will establish the compositional strategies used to achieve timbral blend, and thus a bridging of the oft-perceived aesthetic disconnect, between the acoustic and electronic forces within each work individually as well as those shared across the works. Each analysis is also contextualised by an examination of relevant compositional preferences outlined by the composers under discussion in order to establish any influence that these might have had on the compositional strategies used for the purposes of timbral blend.

5.2: Theoretical framework for timbral analyses

Timbre as a perceptual combination of its source and its contents

The theoretical framework for these analyses is first based on a theory outlined by Walther-Hansen with respect to how sound is perceived when listening to music. Walther-Hansen presents two different conceptual theories of sound as an introduction: one contends that a sound can be heard without any perceptual reference to itself (heard as a 'sound-in-itself', as Walther-Hansen terms it), as theorised by Pierre Schaeffer and Roger Scruton; the other claims that a source is perceptually inseparable from its produced sound, outlined by others including Eric Clarke and Simon Emmerson.[146] Walther-Hansen proceeds to argue, developing on Andy Hamilton's perspective, that the 'metaphorical and literal dimensions' of a sound 'merge in experience and form a sound gestalt'.[147] In other words, we simultaneously perceive both the 'sound-in-itself' and the source from which the sound is derived when listening to music. I would agree with this conclusion but also wish to develop it further. I would contend that when what is heard is commensurate with our previously

[146] Walther-Hansen, *Making Sense of Recordings*, 55; Pierre Schaeffer, *Traité Des Objets Musicaux: Essai Interdisciplines* (Paris: Editions du Seuil, 1966); Roger Scruton, *The Aesthetics of Music* (Oxford: Clarendon Press, 1999); Roger Scruton, 'Sounds as Secondary Objects and Pure Events', in *Sounds and Perception: New Philosophical Essays*, ed. Matthew Nudds and Casey O'Callaghan (Oxford: Oxford University Press, 2009), 50–68; Eric Clarke, *Ways of Listening: An Ecological Approach to the Perception of Musical Meaning* (New York: Oxford University Press, 2005); Emmerson, *Living Electronic Music*.

[147] Andy Hamilton, 'The Sound of Music', in *Sounds and Perception: New Philosophical Essays*, ed. Matthew Nudds and Casey O'Callaghan (Oxford: Oxford University Press, 2009), 146–82; Walther-Hansen, *Making Sense of Recordings*, 57–58.

formed expectations of what particular sources sound like, then descriptions of what is perceived are more likely to enter the domain of source designation – e.g. "That sounded like a *piano*". When what is heard is not commensurate with these expectations or the sound's source is simply not identifiable, then descriptions are more likely to enter the metaphorical domain. Of course, it is also possible that both kinds of description will be utilised simultaneously, as described by Walther-Hansen, who uses the descriptive example of 'the guitar is *dry*.'[148] In this case though, I would argue that either the guitar's dryness is being specifically drawn attention to, or the guitar's dryness stands out as contrasting with the listener's experience of what they are used to a guitar sounding like.

This concept of timbre as a perceptual combination of the 'sound-in-itself' and its recognised source, and the perceptual flux between these two models, will inform the timbral analyses that follow. When a timbre is explicitly recognisable by its source or suggests a certain kind of source during listening, I will label it as such as that is what, I would argue, will also be most salient for other listeners. When a timbre's source is more ambiguous, requires further clarifying description, or when multiple timbres interact in some way which requires further description, then I will often employ the use of metaphor in order to aid with this. I will now outline the model of conceptual metaphor theory, as it applies to the semantics of timbre, that will undergird this use of metaphor in the timbral analyses.

Conceptual metaphor theory as applied to timbre semantics

The two other complementary theories that this theoretical framework is based on both apply Lakoff and Johnson's conceptual metaphor theory to our semantic description of sound in some regard: the first of these is by Wallmark and Kendall (already examined in

[148] Walther-Hansen, *Making Sense of Recordings*, 58.

Chapter 3), which applies the theory explicitly to the semantics of timbre; the second is by Walther-Hansen and applies the theory to the semantics of what he terms 'sound quality'.[149]

Conceptual metaphor theory is based on the hypothesis that the linguistic use of metaphor to describe what we perceive not only acts as a convenient and expressive form of socially constructed intersubjective communication, but is also a fundamental means by which we cognitively make sense of, represent, and embody our perceptions. As summarised by Wallmark and Kendall, we thus use metaphor to understand and describe 'abstract domains of human experience' by reference to 'concrete, embodied domains'; they use the metaphor 'happy is up' as their primary example of this, whereby phrases such as 'we had to cheer him up' and 'they were in high spirits' demonstrate the connection between the emotion of happiness and the 'bodily experience of upward physical orientation or motion'.[150] Crucially, as Walther-Hansen outlines, these metaphors 'emerge primarily from previous sensorimotor experiences'.[151] In other words, the existence of these cognitive metaphors predominantly reflect a basic physiological and psychological reality of human experience – while the exact linguistic format in which they emerge may vary, their abstract conceptual development is largely independent of sociocultural influence. The qualification provided here regarding any sociocultural influence is important to note. According to Walther-Hansen, what he terms 'cultural understanding' and 'learned concepts' do affect the format of these metaphors.[152]

As discussed briefly in Chapter 3, conceptual metaphor theory can be used to help explain why we resort to metaphor when attempting to articulate our perceptions of timbre. Wallmark and Kendall refer to two common metaphors used to describe timbre – 'sound is light' and 'sound is texture' – in order to demonstrate this. Both metaphors entail the understanding of one sensory domain, hearing, in the form of another: vision for the former

[149] Lakoff and Johnson, *Metaphors We Live By*; Wallmark and Kendall, 'Describing Sound: The Cognitive Linguistics of Timbre'; Walther-Hansen, *Making Sense of Recordings*.

[150] Wallmark and Kendall, 'Describing Sound: The Cognitive Linguistics of Timbre'.

[151] Walther-Hansen, *Making Sense of Recordings*, 3.

[152] Walther-Hansen, 3.

example; touch for the latter.[153] The linguistic deployment of metaphor to describe timbre, and sound more broadly, is so pervasive that we often do not even notice it: 'the sound was solid and round' and 'the sounds blended perfectly into the mix' are two examples that Walther-Hansen contributes.[154] On this basis, that the description of timbre by way of metaphor is not merely a matter of individual subjectivity but is rather a universal means by which we articulate our embodied experience of the phenomenon, Walther-Hansen argues that 'we can take control of the metaphors that are already working in the background of our cognitive system' for purposes such as using 'metaphors as tools for performing musical analyses'. Because there is no other means by which, for example, to refer to a sound's warmth without resorting to metaphor, the use of metaphor in analysis could shine a light on those features of a sound's timbre that would usually go unnoticed, according to Walther-Hansen.[155] I would argue that conceptual metaphor theory as applied to the semantics of timbre provides a potential basis for a kind of timbral analysis that, at least in part, relies on the use of descriptive metaphor.

Integrated theoretical framework of timbre-as-metaphor and timbre-as-source

As a result of the literature reviewed in Chapter 3, I concluded that, whilst timbre has come to represent, at least discursively, a multifaceted and multidimensional phenomenon, a phenomenologically grounded conceptualisation of timbre could be useful for the purposes of this thesis, as it can be conceived on the basis of how listeners directly experience timbre in the moment(s) of listening and how they reflect upon the phenomenon and its effect on the music to which they have previously listened. Based on the analyses examined in Chapter 4, I concluded that the analysis of spectrograms does not effectively represent how timbre is perceived by individual listeners, and that a successful alternative method of descriptive analysis should be one that is subject to a clearly established theoretical framework. A form of timbral analysis that grounds timbre phenomenologically as a

[153] Timbre semantics also seems to mainly rely on the use of synaesthetic cross-domain metaphor – see Wallmark and Kendall, 'Describing Sound: The Cognitive Linguistics of Timbre'.

[154] Walther-Hansen, *Making Sense of Recordings*, 52.

[155] Walther-Hansen, 7.

continuously shifting combination of its sources and its contents, and makes use of metaphor where necessary to describe its contents, has the potential to both reflect this phenomenological conceptualisation of timbre and be a kind of analysis that describes what is heard but is also grounded in a theoretical framework. I would argue that the primary benefit of an analysis of this form is that its grounding in our everyday perceptual and descriptive experiences of the phenomenon may allow for a more directly accessible understanding of how timbre functions in a musical work and how it can be manipulated for specific aesthetic purposes.

Methodological approach for metaphorical terminology used in timbral analyses

With this theoretical background in mind, the question then arises as to how such an analysis can be systematised so that the metaphorical timbral descriptions used are based on widely understood and used language rather than relying too much on one's own individual, subjective terminology. Walther-Hansen refers to this issue as learning to 'distinguish idiosyncratic terminology' from 'intersubjective (or more universal) terminology', in order to avoid discourses about 'sound quality' turning into 'semantic emptiness'.[156] The solution that Walther-Hansen attempts to provide for this entails an encyclopaedia of common metaphorical descriptions of sound, compiled through both computer-generated analyses of a substantial linguistic corpus of more than 50 million words from a variety of digitised literature about sound from 1942 to 2017, and qualitative human analyses of music-focused texts. These analyses result in a series of 15 pairs of opposing metaphors, including 'Balance/Unbalance', 'Clear/Blurred', and 'Wet/Dry'.[157] Some of these concepts relate to what Walther-Hansen terms 'ontological metaphors': basic metaphors which exist in the background of our cognition – for example, the 'Rough/Smooth' pair is derived from the 'Sound as Physical Objects' ontological metaphor.[158]

[156] Walther-Hansen, 16.

[157] Walther-Hansen, 84–88, 95–97, 124–26.

[158] Walther-Hansen, 113–14, 58–60.

As this encyclopaedia exemplifies the most comprehensive and substantiated attempt that I have found in the literature to incorporate commonly used metaphors to describe sound, I will use this series of metaphorical concepts – where possible – as the systematic underpinning for my use of metaphor in the upcoming timbral analyses, in order to ensure that each invoked metaphor is likely to be understood at least on an intersubjective basis.

Limitations of methodological approach

This methodological approach comes, of course, with its own issues that are worth discussing in brief. The first two issues pertain to the encyclopaedia and the methods involved in its creation. Firstly, the corpus created by Walther-Hansen is derived from – although it is not explicitly stated as such – English-language texts, and so it is thus likely that the encyclopaedia of metaphors derived from it does not fully reflect the complexities of the cross-cultural differences (and similarities) in how timbre is described.[159] This issue is, however, partly mitigated by the fact that, as Wallmark and Kendall point out, the differences between metaphors across languages are minimal on the whole.[160] The second issue pertains to a lack of information regarding the manual qualitative process that Walther-Hansen undertakes in order to transform the substantial computer-generated analyses of texts into the encyclopaedia that he presents; while a significant level of detail is given on the processes involved in the computer analyses, little is given on how the 15 pairs of metaphors are manually derived from these. Another issue concerns the concept of 'sound quality', to which Walther-Hansen ascribes the metaphors used throughout the encyclopaedia and the other chapters in his monograph. Sound quality, according to the author, is defined by what he describes as a combination of the 'distinctive features of sound' – 'dynamic contour, spectral content, spectral envelope, and pitch definition', citing

[159] Notwithstanding the previously discussed issues in Chapter 3 regarding empirical studies, one example of a cross-cultural difference that Kendall and Carterette point to is the use of sharpness (Schärfe) by German speakers to describe timbre, whereas English speakers are more likely to associate it with pitch/tuning – see Roger A. Kendall and Edward C. Carterette, 'Verbal Attributes of Simultaneous Wind Instrument Timbres: I. von Bismarck's Adjectives', *Music Perception: An Interdisciplinary Journal* 10, no. 4 (1993): 445–67.

[160] Wallmark and Kendall, 'Describing Sound: The Cognitive Linguistics of Timbre'.

William Moylan – and the 'historical and cultural context' which informs listeners' perceptions.[161] This wide-ranging concept results in the metaphors in the encyclopaedia sometimes pertaining to phenomena that extend beyond timbre – for example, one of the characteristics that Walther-Hansen ascribes to 'tight' sounds is that they have 'perfect timing and pitch'.[162] I would argue, however, that because much of what is encapsulated by 'sound quality' also pertains to the concept of timbre, this is not an issue of significant concern. The final issue is one of Walther-Hansen's own observations: because the analysed texts are not explicitly linked to the sounds being described within them, the encyclopaedia only allows for a generalised assimilation of common metaphors used to describe sound, and not for a connected assimilation of the sound qualities to which those descriptions are ascribed.[163] This means that this encyclopaedia does not help us to know, on a perceptual level, what the similarities are in sounds that are assigned the same or similar descriptions – we can only be guided on the semantic level according to what the textual analyses tell us. Despite this issue, I would argue that it is precisely because Walther-Hansen's analyses focus specifically on the semantics of timbre – taking into account such a substantial number of textual sources – that it serves as such a powerful resource. Notwithstanding these difficulties, I would contend that Walther-Hansen's encyclopaedia of metaphorical descriptors and its accompanying conceptual justification will still act as a valuable theoretical underpinning for the timbral analyses that follow.

Listening approach and perspectives

For the following timbral analyses, I adopt a phenomenological approach to listening from a perspective that acknowledges the experiences I have had, as a composer and a musician in a Western context, which all affect my perceptions and my analytical descriptions of those perceptions. I have access to the scores for the works during the listening process as helpful references, but I otherwise try to approach the analyses with as little external information

[161] Walther-Hansen, *Making Sense of Recordings*, 14–15; William Moylan, *The Art of Recording: The Creative Resources of Music Production and Audio* (New York: Van Nostrand Reinhold, 1992).

[162] Walther-Hansen, *Making Sense of Recordings*, 119.

[163] Walther-Hansen, 16.

as possible to avoid any undue preconceptions. As the purpose of these analyses is to establish common compositional strategies for achieving timbral blend between the acoustic and electronic forces within the works, I would contend that whilst it is not possible to avoid the inevitable issues of being a biased subject situated in a particular cultural and musical context, I can produce analytical findings that are useful – at the very least – to those who already share a similar context to mine, or who otherwise wish to understand and engage with this context.[164] Another issue in my active listening approach that I acknowledge is how listeners' perceptions can be affected by the context in which they listen and even the physical movements they make during listening – for example, Stephen S. Hudson argues that the headbanging of heavy metal listeners intensifies their experience of timbral heaviness.[165] The unavoidable limitations of a descriptive timbral analysis conducted by one individual demonstrate, once again, the phenomenon's ability to escape easy analytical capture. This does not mean, however, that these analyses cannot be of value within a particular context.

Choice of recordings and timbral perception of recordings

As already discussed in Chapter 4, Malloch also highlights the issue of analysing timbre in any work based on any one particular recording.[166] If 'recording style', as Malloch terms it, or any number of other parameters about a recording can influence the way timbre functions in two different recordings, it is possible to question whether there ever can be an archetypal performance that somehow represents 'the work'.[167] Walther-Hansen also discusses the differences in perception that arise when listening to recordings instead of

[164] This listening approach is similar to the one outlined by Simon Emmerson in his analysis of *Zellen-Linien* (2007) by Hans Tutschku, which was discussed previously in Chapter 4. Emmerson, 'The Analysis of Live and Interactive Electroacoustic Music'.

[165] Stephen S. Hudson, 'Bang Your Head: Construing Beat Through Familiar Drum Patterns in Metal Music', *Music Theory Spectrum* 44, no. 1 (2022): 121–40.

[166] Malloch, 'An Exploration of Timbre Analysis'.

[167] Malloch, 71, 69.

listening to live performances. The primary feature of listening to recordings entails removing a sound source's 'visual calling card', as Walther-Hansen calls it.[168]

Both of these issues are extremely challenging to surmount and have been the source of much discussion in the music analysis and electroacoustic literatures. For the purposes of these analyses, however, I would argue the following. Firstly, any recording that the composer endorses, by means of its publication, serves as a meaningful exemplification of their work and can act as a decisive source for the purposes of musical analysis, although it is important to acknowledge that no one performance or recording can ever act as the definitive "work". Secondly, I would argue that although a recording entails the removal of a sound's visual reference, it does not necessarily remove its perceptual reference to its source – this depends instead, as I argued for earlier, on the sound's timbral presentation and context. There is a complex interplay here therefore that is not exclusive to recordings but also takes place with live performances in which the visual reference is (normatively) present – a whole series of timbral, textural, spatial, presentational, and contextual factors determine an individual listener's likelihood of associating what they hear with the source from which it emits. Thus, not only is it not practical to conduct a detailed analysis of this kind through one hearing of a live performance of a work, but I would argue that a recording does not – when compared with a live performance – create a uniquely distinct perceptual experience that would require special considerations for the purposes of a timbral analysis.

Choice of works for analyses

The decision to analyse these three works in particular was informed by the following two considerations: a pre-analytical aesthetic evaluation of a whole series of mixed electroacoustic works from the last sixty years in order to establish which were, in my opinion, most successful in engendering timbral blend between their acoustic and electroacoustic forces; and which mixed works or composers' perspectives have otherwise not been the source of much analysis or discussion to date and thus could offer some

[168] Walther-Hansen, *Making Sense of Recordings*, 54.

hitherto unexplored approaches to the issue of timbral blend. I acknowledge that using this method to select works for analysis entails an inevitable degree of subjective aesthetic judgement. However, I would argue that unless one subjects a pre-analysis selection of this kind to something akin to a wider empirical selection process, this level of individual involvement is unavoidable.

Concept of timbral threads, timbral blend, and flowchart-type method for analyses

I introduce the concept of timbral threads for the purposes of these timbral analyses. A thread can be a sound or set of sounds, which occur either once, repeat a number of times, or sustain continuously for a given period, and that could reasonably be perceived as being produced by a single source. Importantly, the sound(s) in a single thread do not have to in actuality be produced by only one physical source – they need only be perceived by the listener as if they are originating from the same physical or imagined source, even if the nature of that source cannot be identified.[169] By deconstructing a work into its constituent timbral threads, I can delineate and describe its phenomenologically salient timbral forces, the development of those forces over time, the acoustic and/or electronic sounds that each thread comprises, and how the threads then interact with each other in order to engender timbral blend.

As it would be challenging to convey the development of these threads through description alone, I also introduce a flowchart-type method to graphically represent the analyses of the works. These flowcharts display the complete results of the analyses in their full form – showing and describing the beginning and end point(s) of each thread, its constituent timbral developments, and its timbral and temporal interplay with other threads. After each flowchart analysis, I summarise and discuss the threads and make broader observations about the compositional strategies used to create timbral blend in the work.

[169] See McAdams and Giordano, 'The Perception of Musical Timbre', 116–20, for more information on how listeners group different sounds according to their physical or imagined sources.

I also introduce the concept of timbral blend for the purposes of these analyses. Timbral blend is defined as the capacity of two or more physical sources to coalesce together in such a way so that the listener is not likely to determine that there is an aesthetic disconnect between them.

5.3: 'Salt Canyons' from *The Inner Universe* (1983) by Priscilla McLean

Overview of 'Salt Canyons'

'Salt Canyons', by American composer Priscilla McLean (b. 1942), lasts c. 7'52'' and forms part of a group of compositions titled *The Inner Universe* (1983) for solo piano or piano and tape.[170] The piano part requires ten physical objects to be either attached before or used to play the piano during the work – termed as 'preparations' in the score.[171] McLean, when writing what she says was intended to be 'a very electronic-sounding, atmospheric piece', imagined a 'surreal piano universe', consisting of a live pianist, piano sounds on tape manipulated using 'echo, delay, pitch sliding and shifting', and preparations on strings that are used to 'bridge the gap between [the] straight on-keys playing' and the altered piano recording.[172]

McLean's concept of 'imago-abstract' sound

McLean contrasts two different approaches to sound used in electroacoustic music: using abstract, non-referential sounds (e.g. purely synthesised material); and using environmental/instrumental sounds (either recorded or imitated through synthesis). She claims that there is widespread opinion that the former is 'inferior' due to its 'suspected

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[170] McLean, *The Inner Universe*, i; Beverly Grigsby, 'Women Composers of Electronic Music in the United States', in *The Musical Woman: An International Perspective*, ed. Judith Lang Zaimont, Catherine Overhauser, and Jane Gottlieb (Westport, Conn: Greenwood Press, 1984), 62; Barton & Priscilla McLean, 'The Inner Universe 5. Salt Canyons by Priscilla McLean', YouTube, 2017, https://www.youtube.com/watch?v=s2RBBP7VcFU&feature=youtu.be.

[171] Priscilla McLean, 'Salt Canyons', in *The Inner Universe* (New York: MLC Publications, 1983), 48–49.

[172] Priscilla McLean, *Hanging Off The Edge: Revelations of a Modern Troubadour* (New York: iUniverse, 2006), 169; Priscilla McLean, 'The Inner Universe (1983)', Priscilla McLean's Music, accessed 20 May 2019, https://bartprismclean.wixsite.com/priscillamclean/the-inner-universe-1983.

inability to form diverse and complex relationships', while the latter inevitably results in 'more varied responses' from listeners, similar to the responses that might be directed towards programme music.[173]

As a remedy for these issues, McLean proposes a third approach, which entails the use of what she terms 'imago-abstract' sound. This kind of sound refers to a timbre that is not entirely abstract/non-referential, but is also not a direct reference to or an unaltered sample of an environmental sound:

> The imago-abstract sound… can be capable of many levels of interrelation, according to its abstract qualities and also connotative meanings evoked by the degree of allusion to other sound images. The important thing is that this sound is unique in its *own* sense, and not a direct recognizable referent – it has a characteristic quality not unlike a motive or theme (and in fact may use these) with only vague reference to alluded sonic events.[174]

There is a real clarity with which McLean outlines this concept of sound. However, there are two discrepant claims that McLean makes which I will briefly discuss. Firstly, in her analysis of her own composition, *Dance of Dawn* (1974), McLean traces three 'imago-abstract' sounds as they recur and develop throughout the work, and notes the following as she does so: any variations and extensions on these sounds; any unchanged repetitions; and how the sounds relate to each other timbrally and gesturally. She claims that these sounds form as much of a part of the 'intrinsic structure of the work' and are as 'complex interrelationally' as the 'completely abstract sounds'; she does not, however, explain why the analysed sounds qualify as 'imago-abstract', even if it is possible to see how they may be intuitively deemed as such upon listening to the work.[175] The other discrepant claim, I would argue, is

[173] Priscilla McLean, 'Fire and Ice: A Query', *Perspectives of New Music* 16, no. 1 (1977): 205–7.

[174] McLean, 207.

[175] McLean, 208–10.

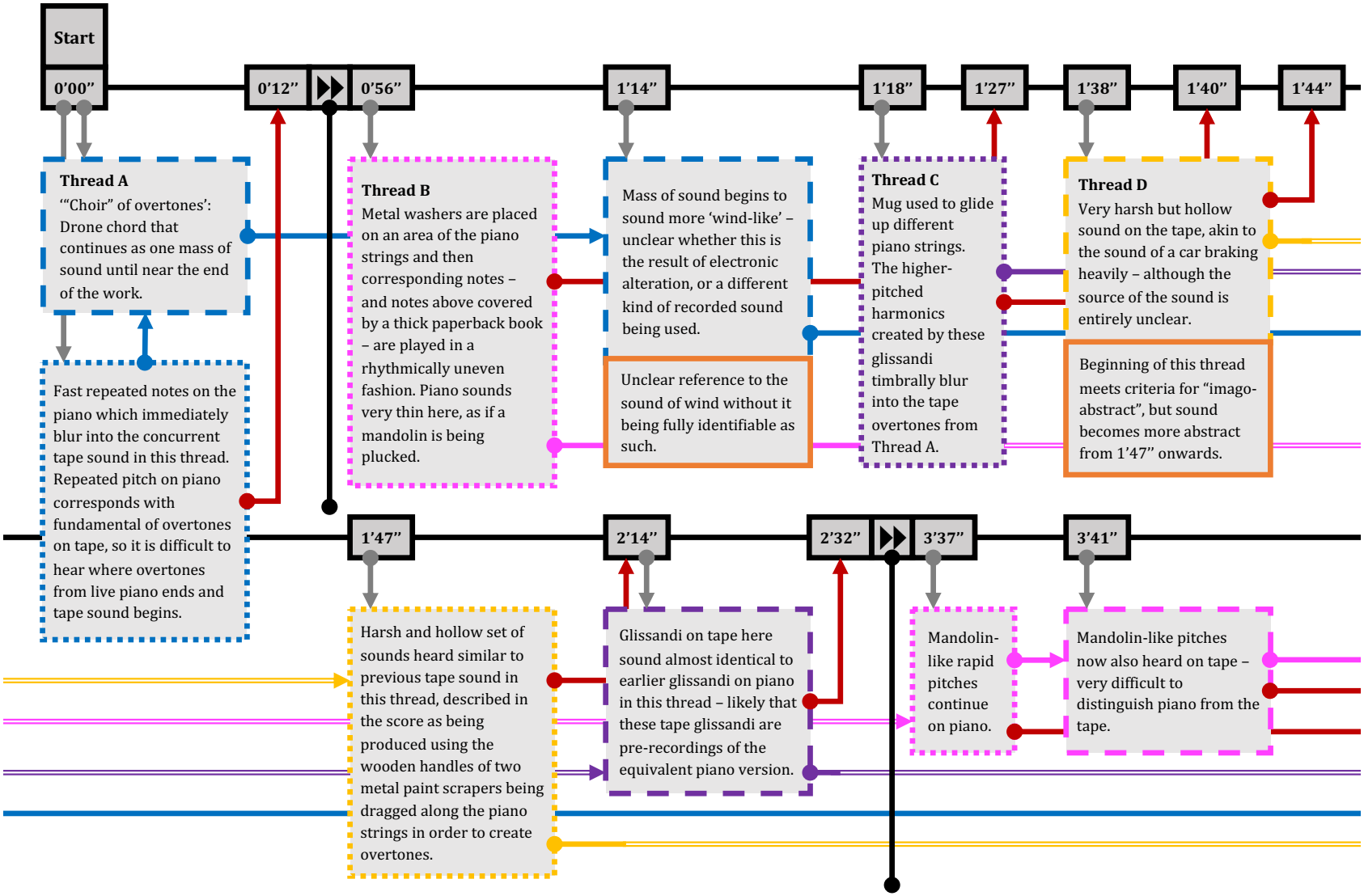
in her analysis of Luciano Berio's *Visage* (1961), in which McLean implies that the vocal sounds used are 'imago-abstract', even though these sounds clearly 'reference' a voice that has produced them.[176]

These criticisms aside, this concept of McLean's could help to suggest a possible contributor to this sense of an aesthetic disconnect between acoustic and electronic forces in mixed works. Namely, this lack of blend could be caused by a lack of integration between two different kinds of sounds which function in very different ways: referential (previously defined as acoustic) and non-referential (electronic). A solution to this could entail using 'imago-abstract' sounds to blur the distinction between these two forces. I will now present an analysis of McLean's work, in order to explore how it might be facilitating timbral blend between its acoustic and electroacoustic forces, while also examining how McLean's 'imago-abstract' concept might be aiding this blend.

Analysis of 'Salt Canyons'

As previously detailed, in this timbral analysis – represented in Figure 5.1 as a flowchart diagram – I break the composition down into timbral threads and explore how they develop over the course of the work. Not all sounds that feature in this work are discussed in the diagram – rather, I focus on those which are perceptually salient and relevant for the purposes of establishing compositional strategies used to engender timbral blend. As the score for this work uses time markings instead of traditional metre, the score timing is given in the flowchart if there is a discrepancy between the timing of a sound in the recording and the score.

[176] McLean, 207.


Start
0'00"
0'12"
0'56"
1'14"
1'18"
1'27"
1'38"
1'40"
1'44"
Thread A
'"Choir" of overtones': Drone chord that continues as one mass of sound until near the end of the work.
Fast repeated notes on the piano which immediately blur into the concurrent tape sound in this thread. Repeated pitch on piano corresponds with fundamental of overtones on tape, so it is difficult to hear where overtones from live piano ends and tape sound begins.
Thread B
Metal washers are placed on an area of the piano strings and then corresponding notes – and notes above covered by a thick paperback book – are played in a rhythmically uneven fashion. Piano sounds very thin here, as if a mandolin is being plucked.
Mass of sound begins to sound more 'wind-like' – unclear whether this is the result of electronic alteration, or a different kind of recorded sound being used.
Unclear reference to the sound of wind without it being fully identifiable as such.
Thread C
Mug used to glide up different piano strings. The higher-pitched harmonics created by these glissandi timbrally blur into the tape overtones from Thread A.
Thread D
Very harsh but hollow sound on the tape, akin to the sound of a car braking heavily – although the source of the sound is entirely unclear.
Beginning of this thread meets criteria for "imago-abstract", but sound becomes more abstract from 1'47" onwards.
1'47"
2'14"
2'32"
3'37"
3'41"
Harsh and hollow set of sounds heard similar to previous tape sound in this thread, described in the score as being produced using the wooden handles of two metal paint scrapers being dragged along the piano strings in order to create overtones.
Glissandi on tape here sound almost identical to earlier glissandi on piano in this thread – likely that these tape glissandi are pre-recordings of the equivalent piano version.
Mandolin-like rapid pitches continue on piano.
Mandolin-like pitches now also heard on tape – very difficult to distinguish piano from the tape.

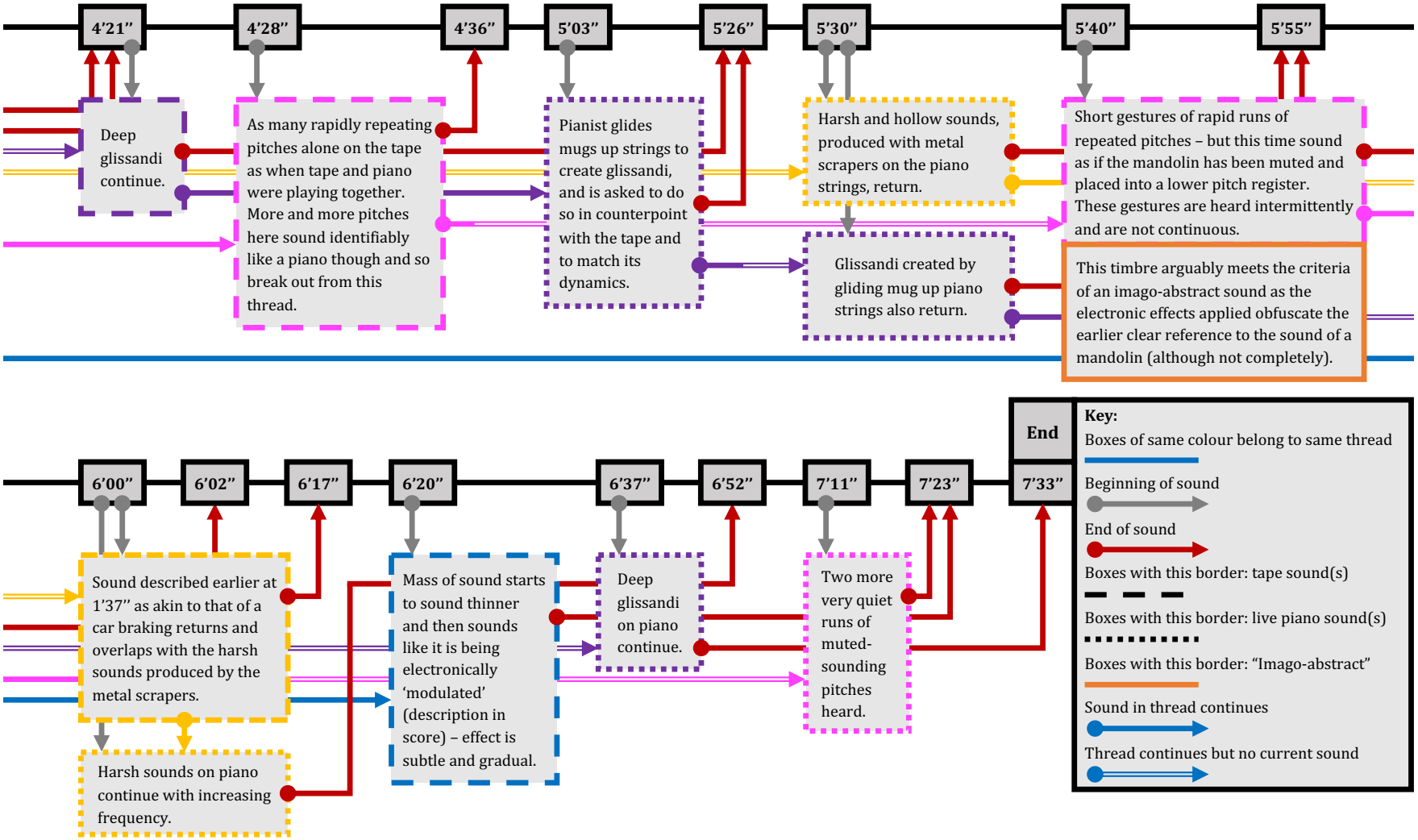


Figure 5.1: Timbral analysis of 'Salt Canyons' from *The Inner Universe* (1983) by Priscilla McLean.

Thread A

The sounds in this thread are grouped as such because they either sound like they are perhaps produced by the piano, or their sources are ambiguous upon listening but timbrally jump off from the initial piano-like sounds.[177] At 0'00'' in the recording, the brief fast repeated notes on the piano immediately blur into the '"choir" of overtones' (description given in the score) from the tape.[178] As the repeated pitch on the piano corresponds with the fundamental of the 'overtones' heard on the tape, it is difficult to hear where the overtones from the live piano ends and where the tape sound begins. This tape sound then continues as one mass of sound until near the end of the work, with some subtle timbral alterations beginning at two different points. At 1'14'', the mass begins to sound more 'wind-like', as helpfully described by McLean in the score – it is ambiguous whether this is the result of electronic alteration or a different kind of recorded sound being used.[179] At 6'20'', the mass starts to sound thinner and then sounds like it is possibly being electronically 'modulated' (McLean's description in score) in some respect, but the effect is so subtle and gradual that the exact nature and source of this modulation is ambiguous.[180]

Thread B

This thread begins at 0'56'' when, according to the score, metal washers are placed on an area of the piano strings and then the corresponding notes – as well as notes above whose strings are already covered by a thick paperback book – are played in a rhythmically uneven fashion.[181] The piano sounds very thin here, as if a mandolin is being plucked. Later, after repeated hearings of this timbre, the piano and tape play this mandolin-like sound together

[177] 'Jump off' – see the 'Sound as Animate Beings' ontological metaphor in Walther-Hansen, *Making Sense of Recordings*, 50–51.

[178] 'Blur' – see the 'Clear/Blurred' metaphor pair in Walther-Hansen, 95–97; McLean, 'Salt Canyons', 50.

[179] 'Mass' – see 'Sound as Physical Objects' ontological metaphor in Walther-Hansen, *Making Sense of Recordings*, 58–60; McLean, 'Salt Canyons', 52.

[180] 'Thinner' – see 'Fat/Thin' metaphor pair in Walther-Hansen, *Making Sense of Recordings*, 100–103; McLean, 'Salt Canyons', 61.

[181] McLean, 'Salt Canyons', 51.

from 3’41’’, creating a set of rapidly repeating interweaving pitches where it becomes extremely challenging to distinguish the piano from the tape.[182] Some of the pitches on the piano here are unprepared, and so timbrally break out from this thread. At 5’40’’, similar gestures of rapid runs of repeated pitches are heard from the tape, but this time they sound possibly like a timbral development on what is heard before – as if the mandolin has been muted and placed into a lower pitch register.[183]

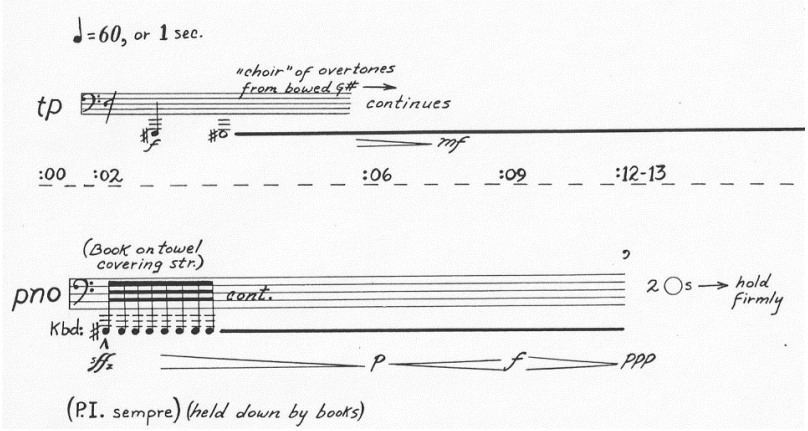


Figure 5.2: Beginning of Thread A in 'Salt Canyons', from the score of *The Inner Universe* (1983) by Priscilla McLean.[184]

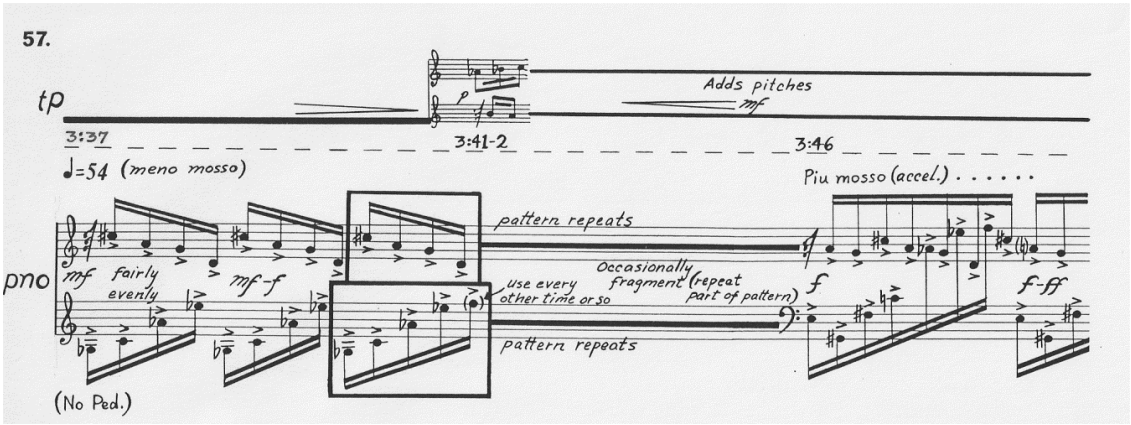


Figure 5.3: Mandolin-like sound in Thread B from 3’37’’ onwards in 'Salt Canyons'.[185]

[182] McLean, 57.

[183] McLean, 61.

[184] McLean, 50.

[185] McLean, 57.

Thread C

Beginning from 1’18’’, according to the score, a mug is used to glide up different piano strings.[186] The timbre created by this gliding sounds almost identical to the glissandi heard on the tape from 2’14’’ and 4’21’’ onwards – it is likely that the tape glissandi are pre-recordings of the equivalent piano glissandi.[187] From 5’03’’ the piano and tape feature these glissandi simultaneously, as if to blur any acoustic/electronic distinction further.[188] At some points, including at 1’18’’, the higher-pitched harmonics created by the piano glissandi also timbrally blur into the tape overtones from Thread A.[189]

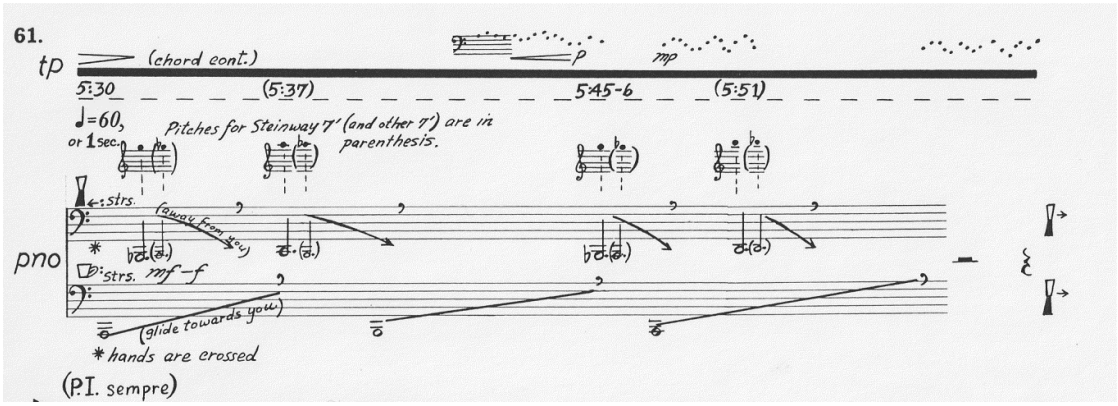


Figure 5.4: Glissandi in Thread C and muted mandolin-like sound in Thread B from 5’30’’ onwards in 'Salt Canyons'.[190]

Thread D

This thread begins, at 1’38’’, with a very harsh but hollow sound on the tape, akin to the sound of a car braking heavily – although the source of the sound is entirely unclear.[191] At 1’47’’, a similarly harsh and hollow set of sounds is heard, described in the score as being produced using the wooden handles of two metal paint scrapers being dragged along the

[186] McLean, 52.

[187] McLean, 54, 59.

[188] McLean, 60.

[189] McLean, 52.

[190] McLean, 61.

[191] ‘Harsh’ – akin to the ‘Rough/Smooth’ metaphor pair in Walther-Hansen, *Making Sense of Recordings*, 113–14; ‘Hollow’ – see ‘Full/Hollow’ metaphor pair in Walther-Hansen, 103–5; McLean, ‘Salt Canyons’, 53.

piano strings in order to create overtone pitches.[192] The harshness, hollowness, and similar high pitches emitting from these sounds lead to the perception that they emerge from the same source.

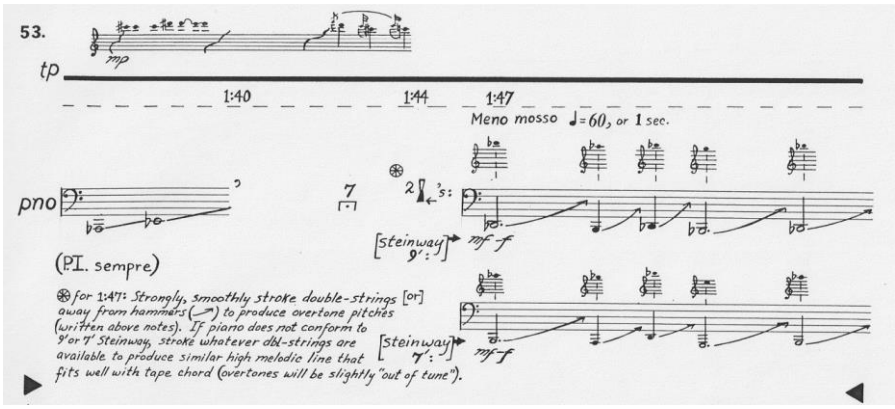


Figure 5.5: Beginning of Thread D in 'Salt Canyons'.[193]

Observations based on analysis of 'Salt Canyons'

From this analysis, I would argue that McLean engenders timbral blend in 'Salt Canyons' primarily by combining live piano sounds whose timbres bring the sound's sources into doubt with two types of tape sound: the first of which entails the use of unaltered or slightly manipulated recordings of sounds that are often very timbrally similar to some of the live piano sounds heard either at the same time or at some point previously in the work, which contributes to the difficulty of being able to determine the exact source(s) of different timbres for large sections of the work; the second category includes those sounds that were unlikely to have been pre-recordings of the piano, but still sound timbrally similar enough to nearby piano sounds so that the two forces still blend (e.g. the harsh car-crashing sound on the tape in combination with the harsh overtone pitches produced with the metal paint scrapers on the piano).

I would also contend that the 'imago-abstract' concept of finding a middle ground between referential and non-referential sounds is not synonymous with the idea of blending the

[192] McLean, 'Salt Canyons', 53.

[193] McLean, 53.

distinction between acoustic and electronic forces in mixed works. This work is successful in achieving the latter despite the extensive use of referential sounds. While there are several sounds in this composition that arguably do meet the 'imago-abstract' criteria, all of these are still heard in at least a partially referential context, which thus endangers their ambiguity of origin when later heard in their 'imago-abstract' form.

5.4: *RAS* (2000, rev. 2011) by Natasha Barrett

Overview of *RAS*

British composer Natasha Barrett (b. 1972) has, according to her own writings, spent several years during her compositional career looking at potential methods of arranging sounds produced by acoustic sources using similar processes to those which create those sounds in the first place.[194] The results of these investigations have manifested in several of her compositions, but the work in focus in this thesis is *RAS* (2000, rev. 2011). In this work, according to Barrett, its 'self-organised system' grows into a 'complex critical state' – achieved by taking computer-generated simulations of avalanches and mapping the data from these to the scoring of the percussion parts, and then combining these with the 'concrète sound of the electroacoustic parts.'[195] Lasting c. 9'31'', the work is written for 'percussion quartet, electroacoustic sound and live electronics'.[196]

The percussion used includes a concert bass drum, timpani, low tom, rototom, large cymbal, small Javanese gong, small bowl, large buffalo bell, and a MIDI drum pad. Additionally, the performers play a quarter each of a percussion 'matrix' that sits in the middle of the four performers which, according to the score, consists of a '10x10 square of small objects…

[194] Patricia L. Dirks, 'Natasha Barrett: Trade Winds', *Computer Music Journal* 34, no. 1 (2010): 114–15; Natasha Barrett and Karen Mair, '*Aftershock*: A Science–Art Collaboration through Sonification', *Organised Sound* 19, no. 1 (2014): 4.

[195] Natasha Barrett, 'Instruments & Live Electronics', Natasha Barrett's website, accessed 28 August 2019, http://www.natashabarrett.org/live_electronics.html; Performance notes in Barrett, *RAS*.

[196] Puls & Ning Trio, *RAS*, Works by Barrett, Hagen, Buene, Aagaard-Nilsen, Apollyon (Euridice Turn Left As, 2004), https://open.spotify.com/track/2crzeBbvoRnX0DA6fDysEu?si=_Hp3RKhlRy2LfaBCiURIOw; Barrett, 'Instruments & Live Electronics'.

made from glass, metal, clay, plastic, and wood'.[197] The electroacoustic sound and live electronics are spatialised across eight loudspeakers, with two speakers apiece sitting either side of each performer. Four condenser microphones are used to capture the matrix (none are used for the other instruments) – this captured sound is fed both to the computer to be processed and unaltered to the loudspeakers for amplification purposes. *Max/MSP* is used to process the captured sound. An instruction in the score states that the unaltered amplified sound and the electronically altered sound must be equally balanced in its output volume.[198]

Barrett's concept of 'sound-world realism'

Barrett writes about what she terms as a 'sound-world realism' frame of reference within acousmatic music, whereby a frame of reference is defined as the 'prototypical relationships amongst different sounds'.[199] A prototypical relationship is defined as an emergent property of two dissimilar sounds that retain the same kind of relationship over time despite other sounds being added to the music.[200] For Barrett, the 'realism' frame of reference exists on a continuum. A sense of 'maximum realism' exists when a 'real' sound, which is defined as a sound 'produced by a resonating body or volume of air' with 'attention to small details', is in a 'familiar' space, which is a space that exhibits qualities of a 'real-world space' or a 'non-real-world space' – the latter of which becomes familiar through associations produced within the music itself.[201] Conversely, a state of 'minimum realism' is achieved when real and 'synthetic' sounds – the latter of which are defined by their perceptual absence of any indicators of real sounds and commonly produced through computer synthesis – are used together in a familiar space in order to create a 'maximum conflict of information.'[202] Finally,

[197] Performance notes in Barrett, *RAS*.

[198] Performance notes in Barrett, *RAS*.

[199] Natasha Barrett, 'Structuring Processes in Electroacoustic Composition' (PhD thesis, City University London, 1997), 34, 31, http://openaccess.city.ac.uk/7468/.

[200] Barrett, 30–31.

[201] Barrett, 34–36.

[202] Barrett, 34–35.

in between these extremes are real or synthetic sounds in 'unfamiliar' spaces, and synthetic sounds in familiar spaces; the former exhibits more realism than the latter.[203] Barrett's use of space as a concept here refers to a 'virtual' space, created through the application of reverb, delay, EQ, and other effects.[204]

This 'sound-world realism' concept of Barrett's is intuitive to understand and provides a useful model of how the perception of a work might change depending on how different kinds of sound and spaces interact.[205] This model could also be instructive because it may illuminate, at least in part, why there is an oft-perceived aesthetic disconnect in mixed electroacoustic works. Perhaps the level of timbral blend is at its minimum when the criteria for a frame of minimum realism are met (i.e. when real and synthetic sounds are used together in a familiar space), but sounds which are used together in spaces that perceptually increase the sense of realism are likely to also engender a higher degree of timbral blend. I will now carry out a timbral analysis of *RAS* in order to explore how Barrett facilitates the timbral blend of its acoustic and electronic forces, and in which ways the composer's 'sound-world realism' concept may aid this blend.

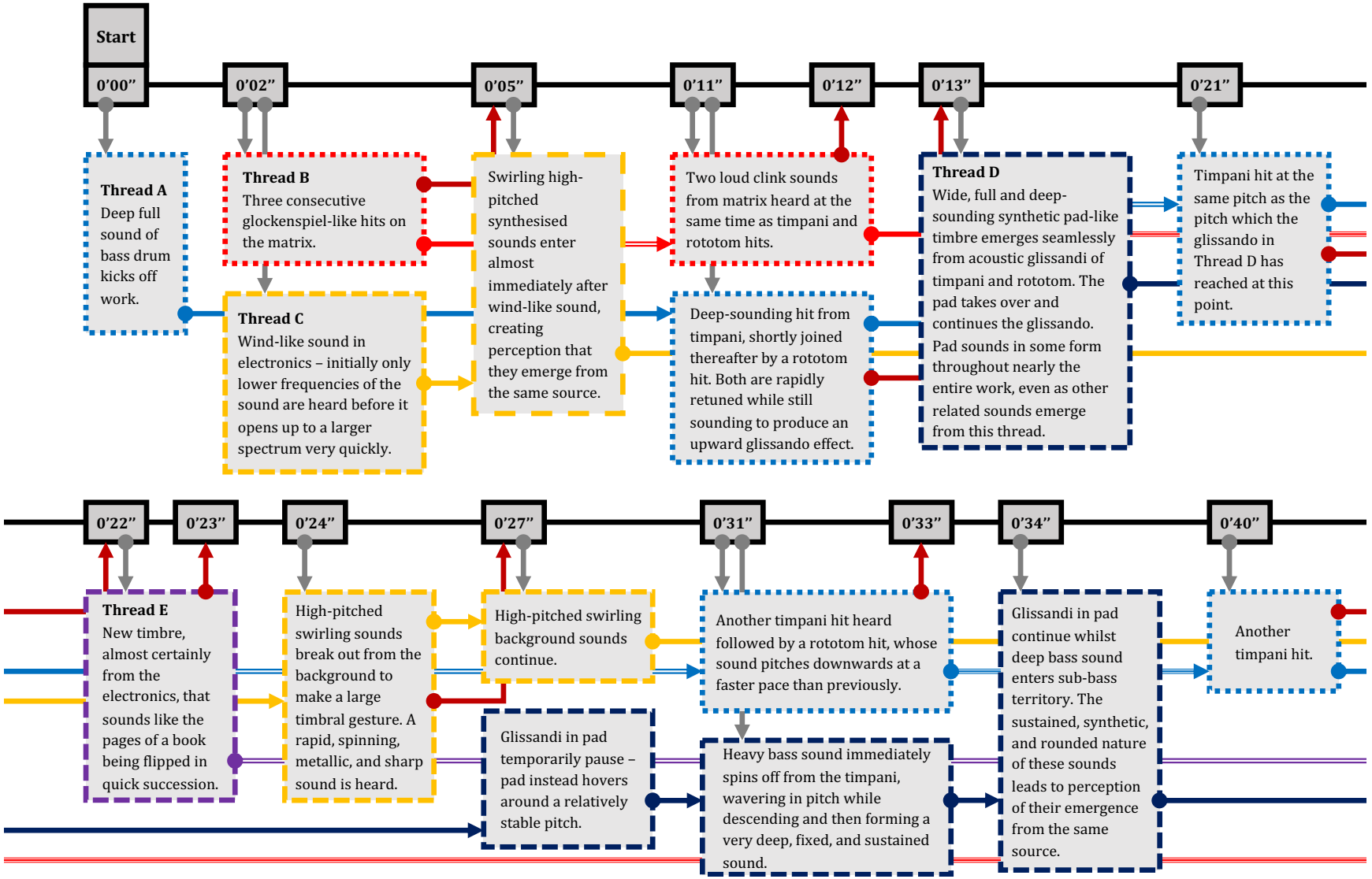
Analysis of *RAS*

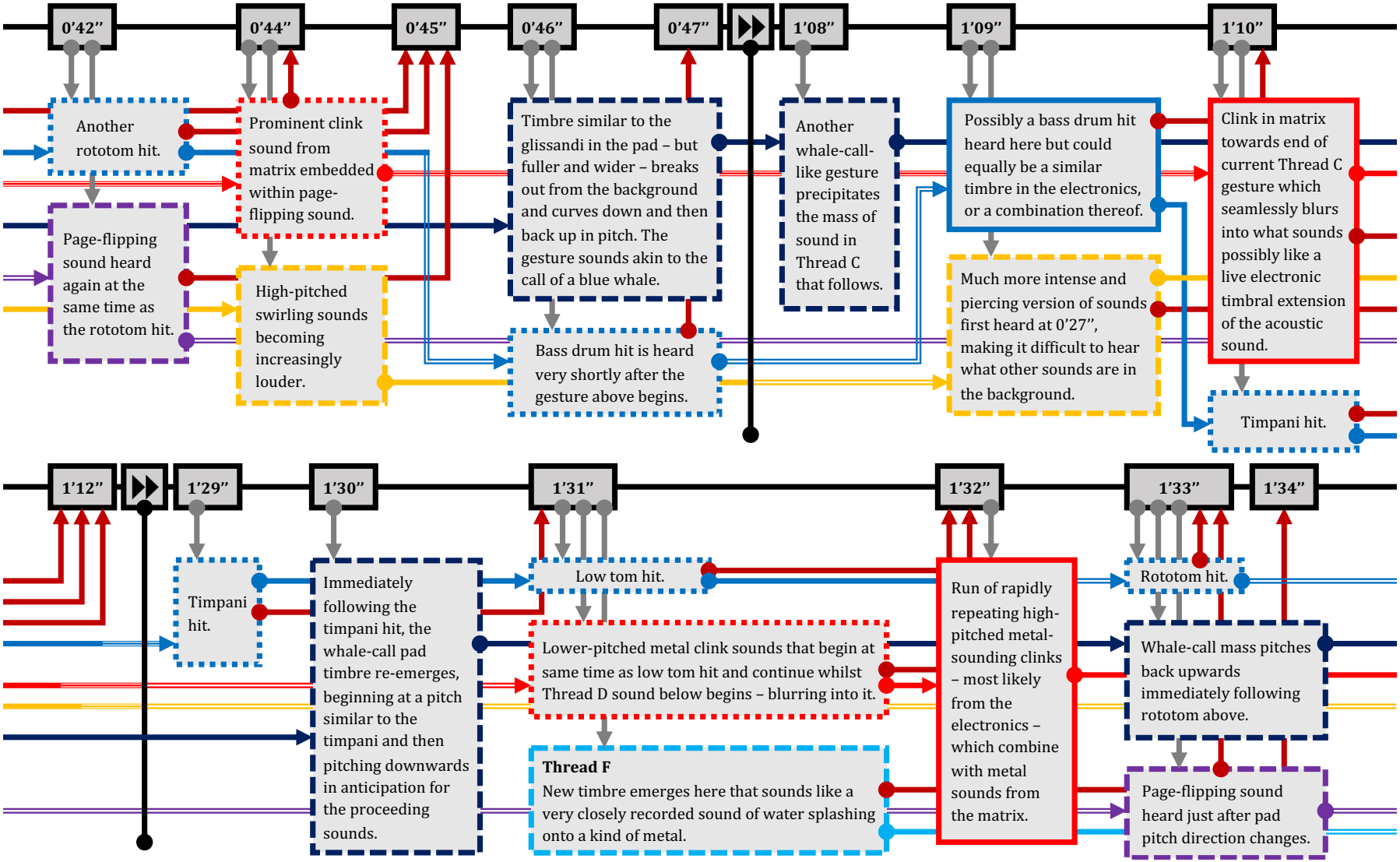
For this analysis, all timings given in the flowchart relate to the sounds as they occur in the referenced recording for this work.

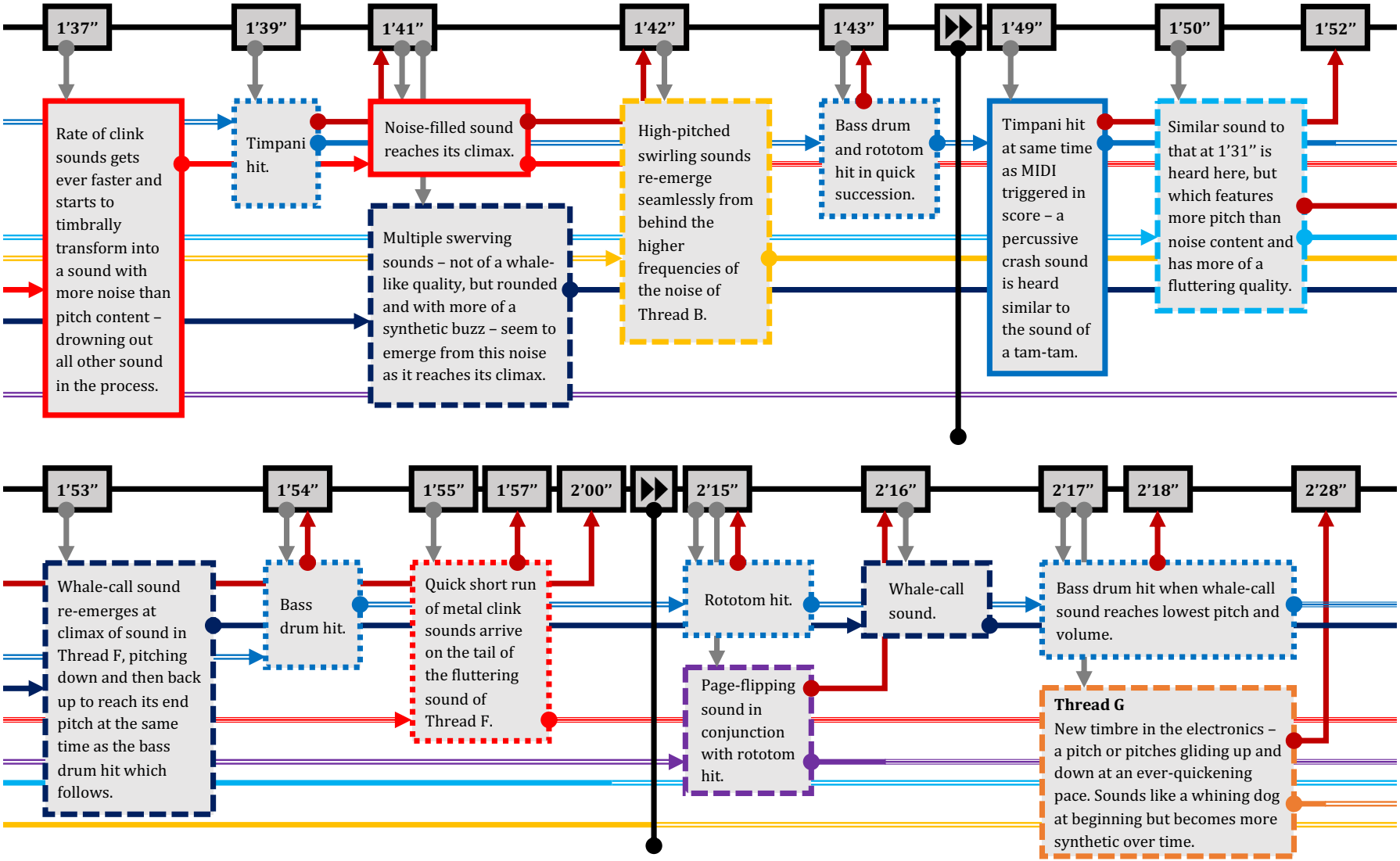
[203] Barrett, 36.

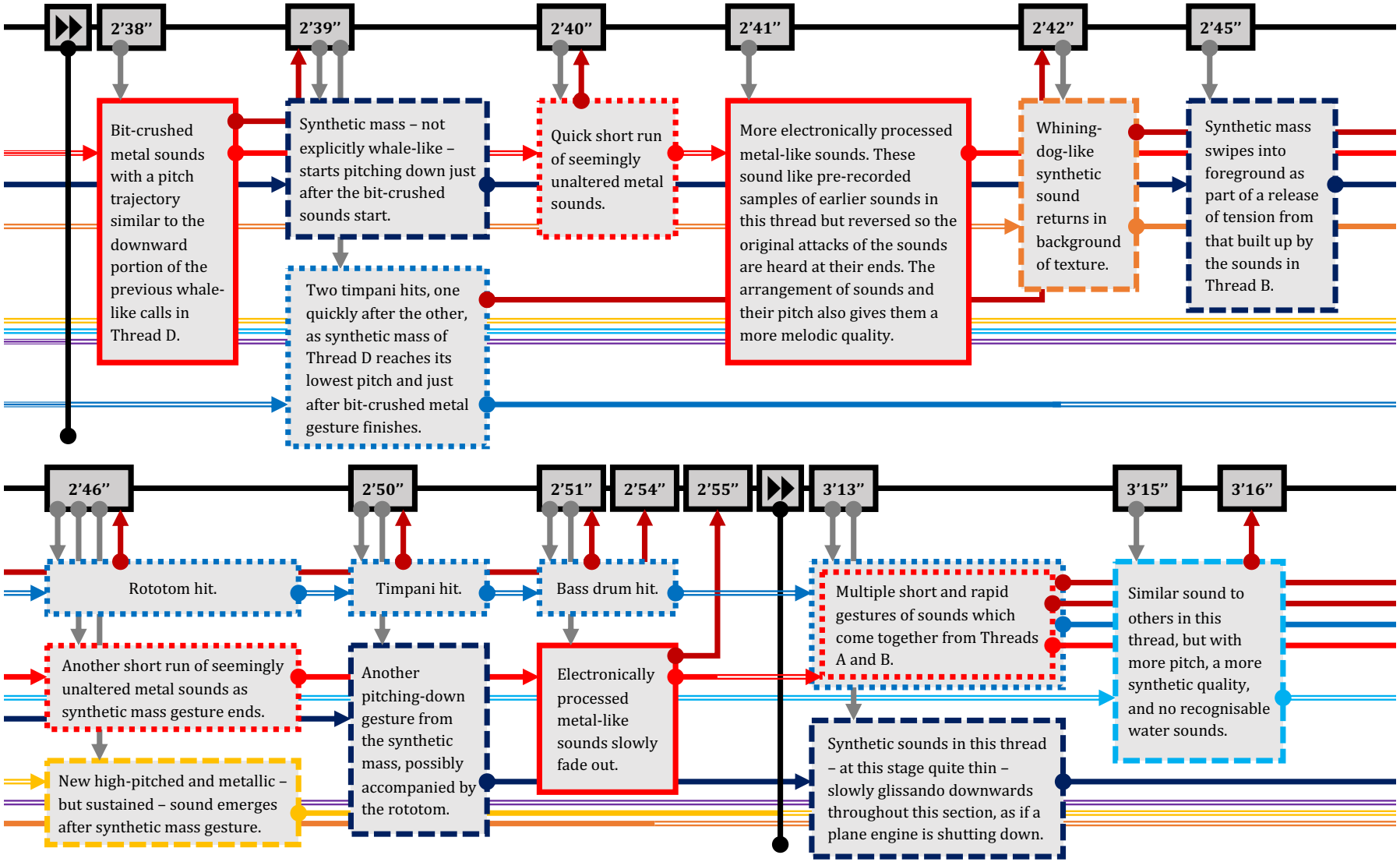
[204] Barrett, 35.

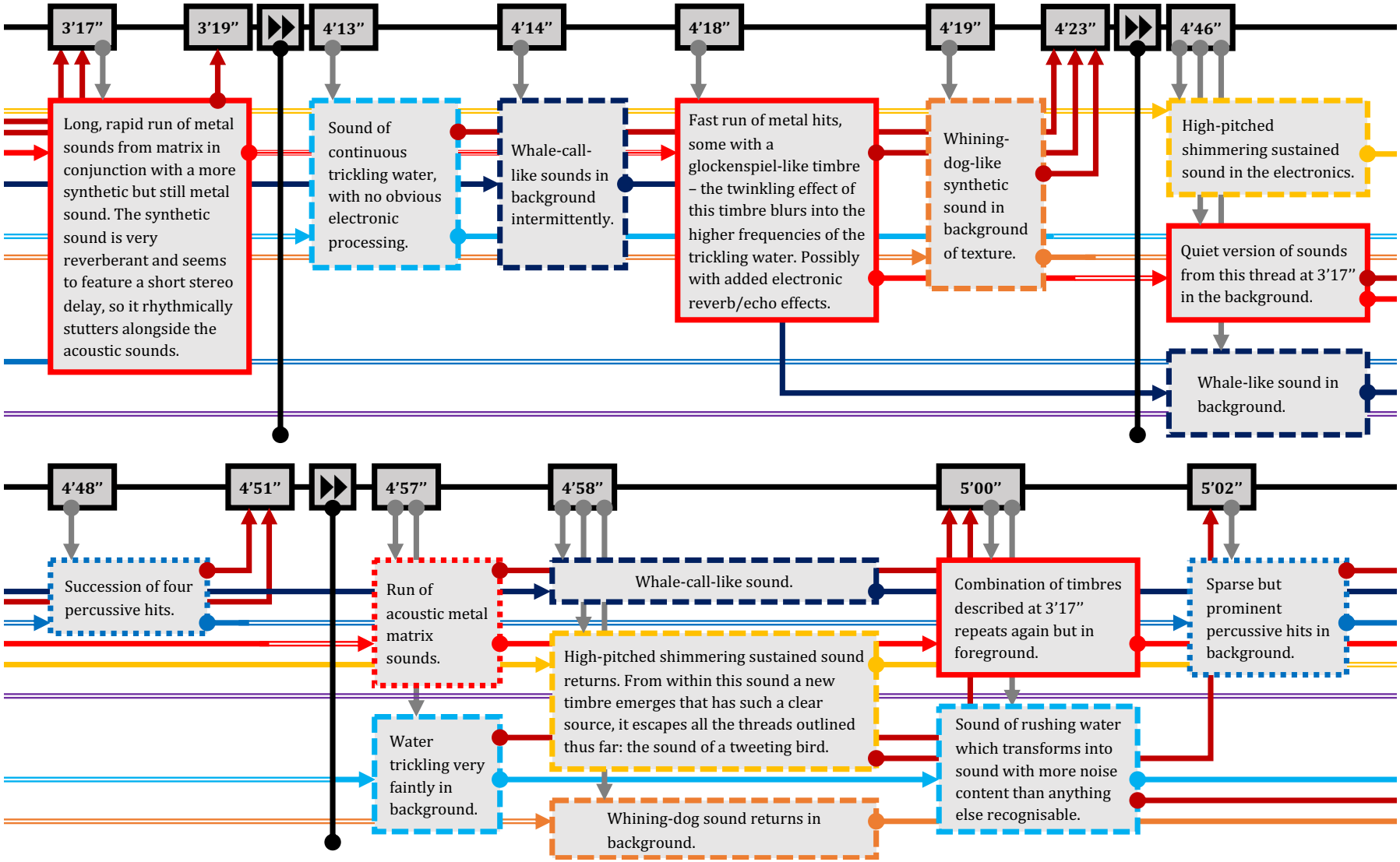
[205] However, it would have been more helpful if the concept had been effectively applied in the context of an example work. When Barrett does invoke the concept in reference to her own composition, *Little Animals* (1997), by claiming that the work exhibits 'maximum realism', there is a lack of clarity over exactly how this frame of reference applies. While she refers to and gives examples of the visual and acoustic juxtaposition implied by the use of sounds that have 'clear allusive implication' with those which have 'nonattributable sound materials', there is no explicit application of the 'sound-world realism' framework in both of the texts in which Barrett analyses the compositional structures that underlie the work. See Barrett, 'Structuring Processes in Electroacoustic Composition', 36, 75–78; Natasha Barrett, 'Little Animals: Compositional Structuring Processes', *Computer Music Journal* 23, no. 2 (1999): 11–12.

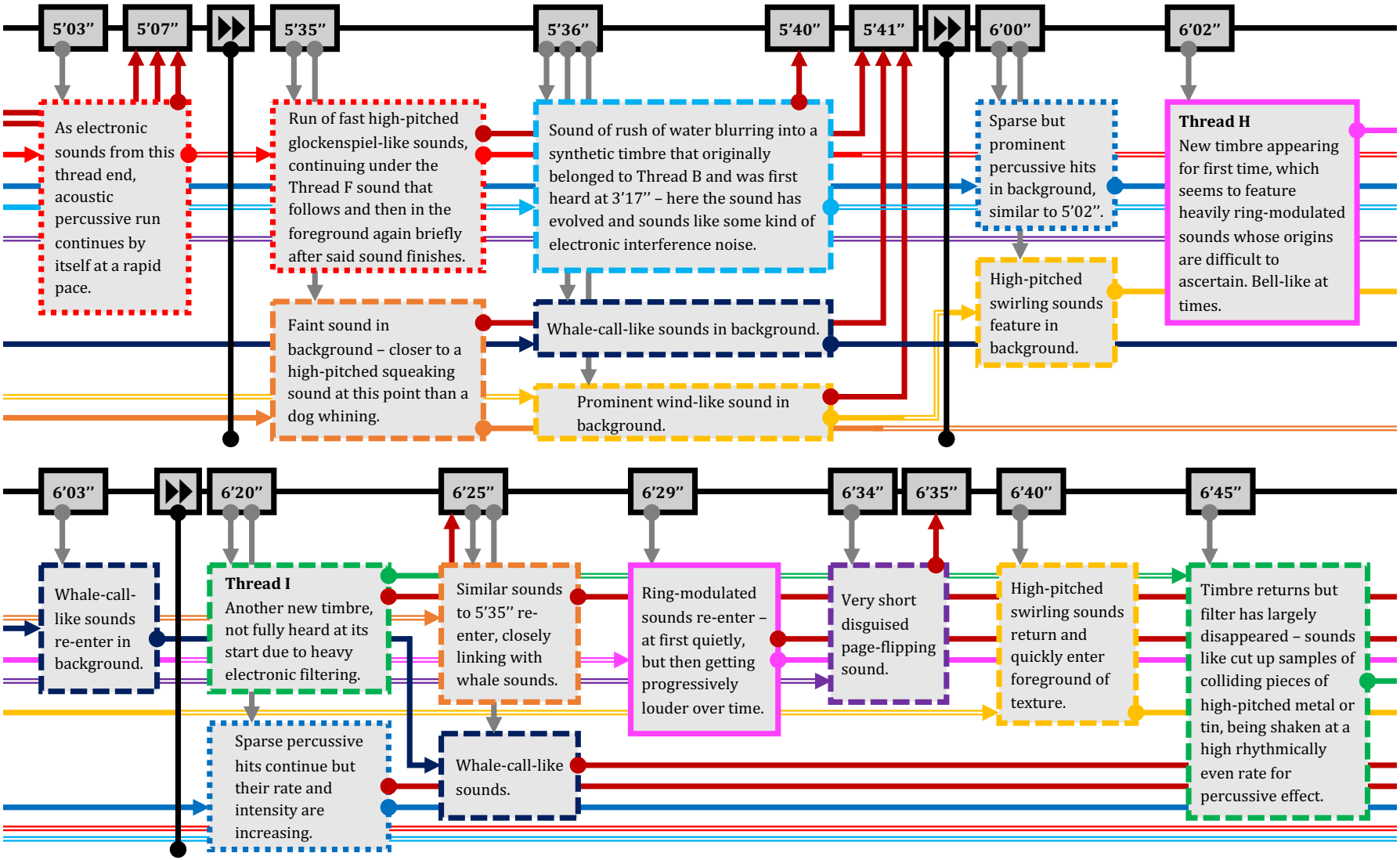

Start
0'00"
0'02"
0'05"
0'11"
0'12"
0'13"
0'21"
Thread A
Deep full sound of bass drum kicks off work.
Thread B
Three consecutive glockenspiel-like hits on the matrix.
Thread C
Wind-like sound in electronics – initially only lower frequencies of the sound are heard before it opens up to a larger spectrum very quickly.
Swirling high-pitched synthesised sounds enter almost immediately after wind-like sound, creating perception that they emerge from the same source.
Two loud clink sounds from matrix heard at the same time as timpani and rototom hits.
Deep-sounding hit from timpani, shortly joined thereafter by a rototom hit. Both are rapidly retuned while still sounding to produce an upward glissando effect.
Thread D
Wide, full and deep-sounding synthetic pad-like timbre emerges seamlessly from acoustic glissandi of timpani and rototom. The pad takes over and continues the glissando. Pad sounds in some form throughout nearly the entire work, even as other related sounds emerge from this thread.
Timpani hit at the same pitch as the pitch which the glissando in Thread D has reached at this point.
0'22"
0'23"
0'24"
0'27"
0'31"
0'33"
0'34"
0'40"
Thread E
New timbre, almost certainly from the electronics, that sounds like the pages of a book being flipped in quick succession.
High-pitched swirling sounds break out from the background to make a large timbral gesture. A rapid, spinning, metallic, and sharp sound is heard.
High-pitched swirling background sounds continue.
Glissandi in pad temporarily pause – pad instead hovers around a relatively stable pitch.
Another timpani hit heard followed by a rototom hit, whose sound pitches downwards at a faster pace than previously.
Heavy bass sound immediately spins off from the timpani, wavering in pitch while descending and then forming a very deep, fixed, and sustained sound.
Glissandi in pad continue whilst deep bass sound enters sub-bass territory. The sustained, synthetic, and rounded nature of these sounds leads to perception of their emergence from the same source.
Another timpani hit.

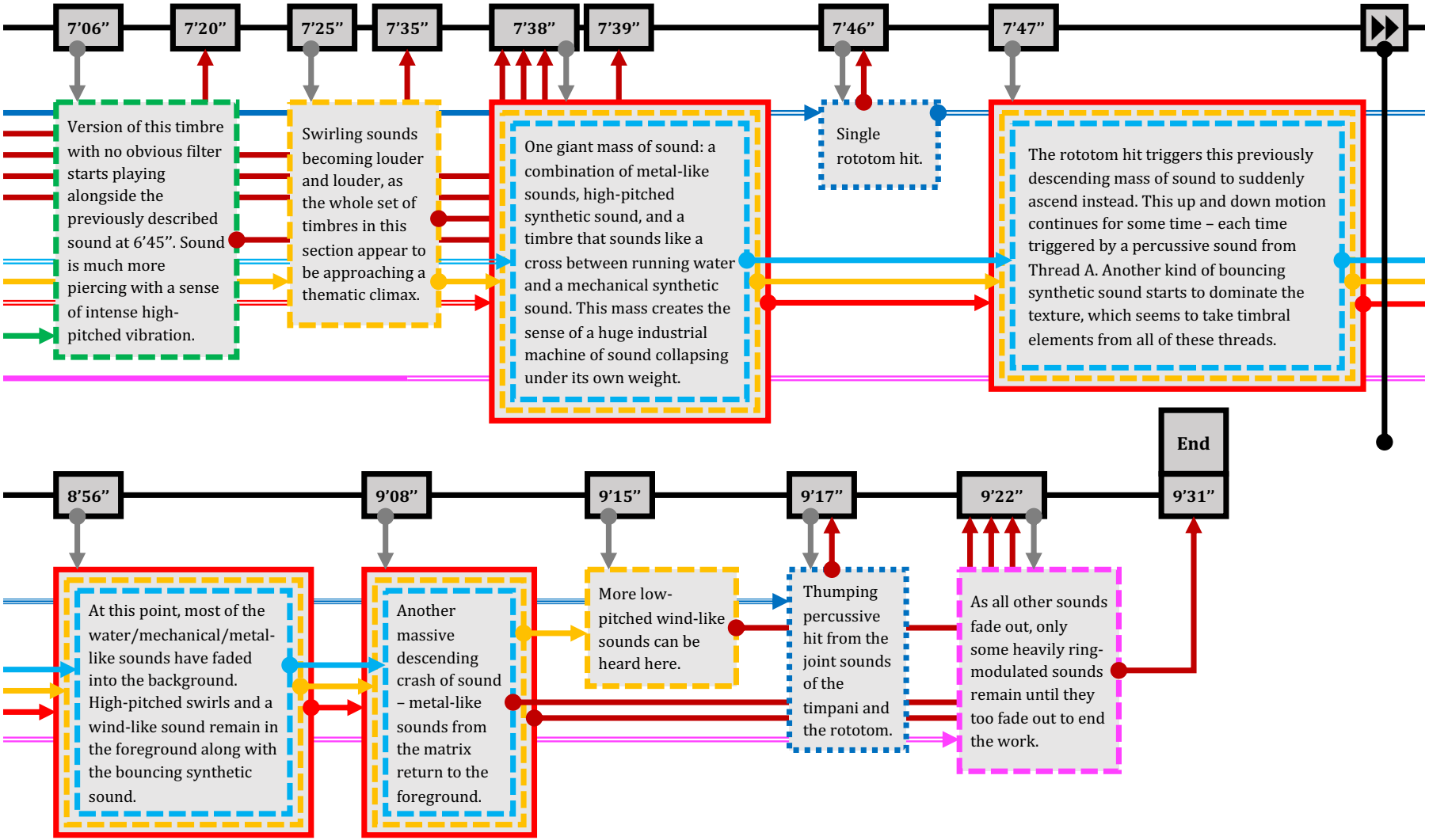

0'42"
0'44"
0'45"
0'46"
0'47"
1'08"
1'09"
1'10"
Another rototom hit.
Prominent clink sound from matrix embedded within page-flipping sound.
Timbre similar to the glissandi in the pad – but fuller and wider – breaks out from the background and curves down and then back up in pitch. The gesture sounds akin to the call of a blue whale.
Another whale-call-like gesture precipitates the mass of sound in Thread C that follows.
Possibly a bass drum hit heard here but could equally be a similar timbre in the electronics, or a combination thereof.
Clink in matrix towards end of current Thread C gesture which seamlessly blurs into what sounds possibly like a live electronic timbral extension of the acoustic sound.
Page-flipping sound heard again at the same time as the rototom hit.
High-pitched swirling sounds becoming increasingly louder.
Bass drum hit is heard very shortly after the gesture above begins.
Much more intense and piercing version of sounds first heard at 0'27", making it difficult to hear what other sounds are in the background.
Timpani hit.
1'12"
1'29"
1'30"
1'31"
1'32"
1'33"
1'34"
Timpani hit.
Immediately following the timpani hit, the whale-call pad timbre re-emerges, beginning at a pitch similar to the timpani and then pitching downwards in anticipation for the proceeding sounds.
Low tom hit.
Lower-pitched metal clink sounds that begin at same time as low tom hit and continue whilst Thread D sound below begins – blurring into it.
Thread F
New timbre emerges here that sounds like a very closely recorded sound of water splashing onto a kind of metal.
Run of rapidly repeating high-pitched metal-sounding clinks – most likely from the electronics – which combine with metal sounds from the matrix.
Rototom hit.
Whale-call mass pitches back upwards immediately following rototom above.
Page-flipping sound heard just after pad pitch direction changes.


1'37"
1'39"
1'41"
1'42"
1'43"
1'49"
1'50"
1'52"
Rate of clink sounds gets ever faster and starts to timbrally transform into a sound with more noise than pitch content – drowning out all other sound in the process.
Timpani hit.
Noise-filled sound reaches its climax.
Multiple swerving sounds – not of a whale-like quality, but rounded and with more of a synthetic buzz – seem to emerge from this noise as it reaches its climax.
High-pitched swirling sounds re-emerge seamlessly from behind the higher frequencies of the noise of Thread B.
Bass drum and rototom hit in quick succession.
Timpani hit at same time as MIDI triggered in score – a percussive crash sound is heard similar to the sound of a tam-tam.
Similar sound to that at 1'31" is heard here, but which features more pitch than noise content and has more of a fluttering quality.
1'53"
1'54"
1'55"
1'57"
2'00"
2'15"
2'16"
2'17"
2'18"
2'28"
Whale-call sound re-emerges at climax of sound in Thread F, pitching down and then back up to reach its end pitch at the same time as the bass drum hit which follows.
Bass drum hit.
Quick short run of metal clink sounds arrive on the tail of the fluttering sound of Thread F.
Rototom hit.
Whale-call sound.
Bass drum hit when whale-call sound reaches lowest pitch and volume.
Page-flipping sound in conjunction with rototom hit.
Thread G
New timbre in the electronics – a pitch or pitches gliding up and down at an ever-quickening pace. Sounds like a whining dog at beginning but becomes more synthetic over time.


2'38"
2'39"
2'40"
2'41"
2'42"
2'45"
Bit-crushed metal sounds with a pitch trajectory similar to the downward portion of the previous whale-like calls in Thread D.
Synthetic mass – not explicitly whale-like – starts pitching down just after the bit-crushed sounds start.
Quick short run of seemingly unaltered metal sounds.
More electronically processed metal-like sounds. These sound like pre-recorded samples of earlier sounds in this thread but reversed so the original attacks of the sounds are heard at their ends. The arrangement of sounds and their pitch also gives them a more melodic quality.
Whining-dog-like synthetic sound returns in background of texture.
Synthetic mass swipes into foreground as part of a release of tension from that built up by the sounds in Thread B.
Two timpani hits, one quickly after the other, as synthetic mass of Thread D reaches its lowest pitch and just after bit-crushed metal gesture finishes.
2'46"
2'50"
2'51"
2'54"
2'55"
3'13"
3'15"
3'16"
Rototom hit.
Timpani hit.
Bass drum hit.
Multiple short and rapid gestures of sounds which come together from Threads A and B.
Similar sound to others in this thread, but with more pitch, a more synthetic quality, and no recognisable water sounds.
Another short run of seemingly unaltered metal sounds as synthetic mass gesture ends.
Another pitching-down gesture from the synthetic mass, possibly accompanied by the rototom.
Electronically processed metal-like sounds slowly fade out.
Synthetic sounds in this thread – at this stage quite thin – slowly glissando downwards throughout this section, as if a plane engine is shutting down.
New high-pitched and metallic – but sustained – sound emerges after synthetic mass gesture.


3'17"
3'19"
4'13"
4'14"
4'18"
4'19"
4'23"
4'46"
Long, rapid run of metal sounds from matrix in conjunction with a more synthetic but still metal sound. The synthetic sound is very reverberant and seems to feature a short stereo delay, so it rhythmically stutters alongside the acoustic sounds.
Sound of continuous trickling water, with no obvious electronic processing.
Whale-call-like sounds in background intermittently.
Fast run of metal hits, some with a glockenspiel-like timbre – the twinkling effect of this timbre blurs into the higher frequencies of the trickling water. Possibly with added electronic reverb/echo effects.
Whining-dog-like synthetic sound in background of texture.
High-pitched shimmering sustained sound in the electronics.
Quiet version of sounds from this thread at 3'17" in the background.
Whale-like sound in background.
4'48"
4'51"
4'57"
4'58"
5'00"
5'02"
Succession of four percussive hits.
Run of acoustic metal matrix sounds.
Whale-call-like sound.
Combination of timbres described at 3'17" repeats again but in foreground.
Sparse but prominent percussive hits in background.
High-pitched shimmering sustained sound returns. From within this sound a new timbre emerges that has such a clear source, it escapes all the threads outlined thus far: the sound of a tweeting bird.
Water trickling very faintly in background.
Sound of rushing water which transforms into sound with more noise content than anything else recognisable.
Whining-dog sound returns in background.


5'03"
5'07"
5'35"
5'36"
5'40"
5'41"
6'00"
6'02"
As electronic sounds from this thread end, acoustic percussive run continues by itself at a rapid pace.
Run of fast high-pitched glockenspiel-like sounds, continuing under the Thread F sound that follows and then in the foreground again briefly after said sound finishes.
Sound of rush of water blurring into a synthetic timbre that originally belonged to Thread B and was first heard at 3'17" – here the sound has evolved and sounds like some kind of electronic interference noise.
Sparse but prominent percussive hits in background, similar to 5'02".
Thread H
New timbre appearing for first time, which seems to feature heavily ring-modulated sounds whose origins are difficult to ascertain. Bell-like at times.
Faint sound in background – closer to a high-pitched squeaking sound at this point than a dog whining.
Whale-call-like sounds in background.
High-pitched swirling sounds feature in background.
Prominent wind-like sound in background.
6'03"
6'20"
6'25"
6'29"
6'34"
6'35"
6'40"
6'45"
Whale-call-like sounds re-enter in background.
Thread I
Another new timbre, not fully heard at its start due to heavy electronic filtering.
Similar sounds to 5'35" re-enter, closely linking with whale sounds.
Ring-modulated sounds re-enter – at first quietly, but then getting progressively louder over time.
Very short disguised page-flipping sound.
High-pitched swirling sounds return and quickly enter foreground of texture.
Timbre returns but filter has largely disappeared – sounds like cut up samples of colliding pieces of high-pitched metal or tin, being shaken at a high rhythmically even rate for percussive effect.
Sparse percussive hits continue but their rate and intensity are increasing.
Whale-call-like sounds.


7'06"
7'20"
7'25"
7'35"
7'38"
7'39"
7'46"
7'47"
Version of this timbre with no obvious filter starts playing alongside the previously described sound at 6'45". Sound is much more piercing with a sense of intense high-pitched vibration.
Swirling sounds becoming louder and louder, as the whole set of timbres in this section appear to be approaching a thematic climax.
One giant mass of sound: a combination of metal-like sounds, high-pitched synthetic sound, and a timbre that sounds like a cross between running water and a mechanical synthetic sound. This mass creates the sense of a huge industrial machine of sound collapsing under its own weight.
Single rototom hit.
The rototom hit triggers this previously descending mass of sound to suddenly ascend instead. This up and down motion continues for some time – each time triggered by a percussive sound from Thread A. Another kind of bouncing synthetic sound starts to dominate the texture, which seems to take timbral elements from all of these threads.
End
8'56"
9'08"
9'15"
9'17"
9'22"
9'31"
At this point, most of the water/mechanical/metal-like sounds have faded into the background. High-pitched swirls and a wind-like sound remain in the foreground along with the bouncing synthetic sound.
Another massive descending crash of sound – metal-like sounds from the matrix return to the foreground.
More low-pitched wind-like sounds can be heard here.
Thumping percussive hit from the joint sounds of the timpani and the rototom.
As all other sounds fade out, only some heavily ring-modulated sounds remain until they too fade out to end the work.

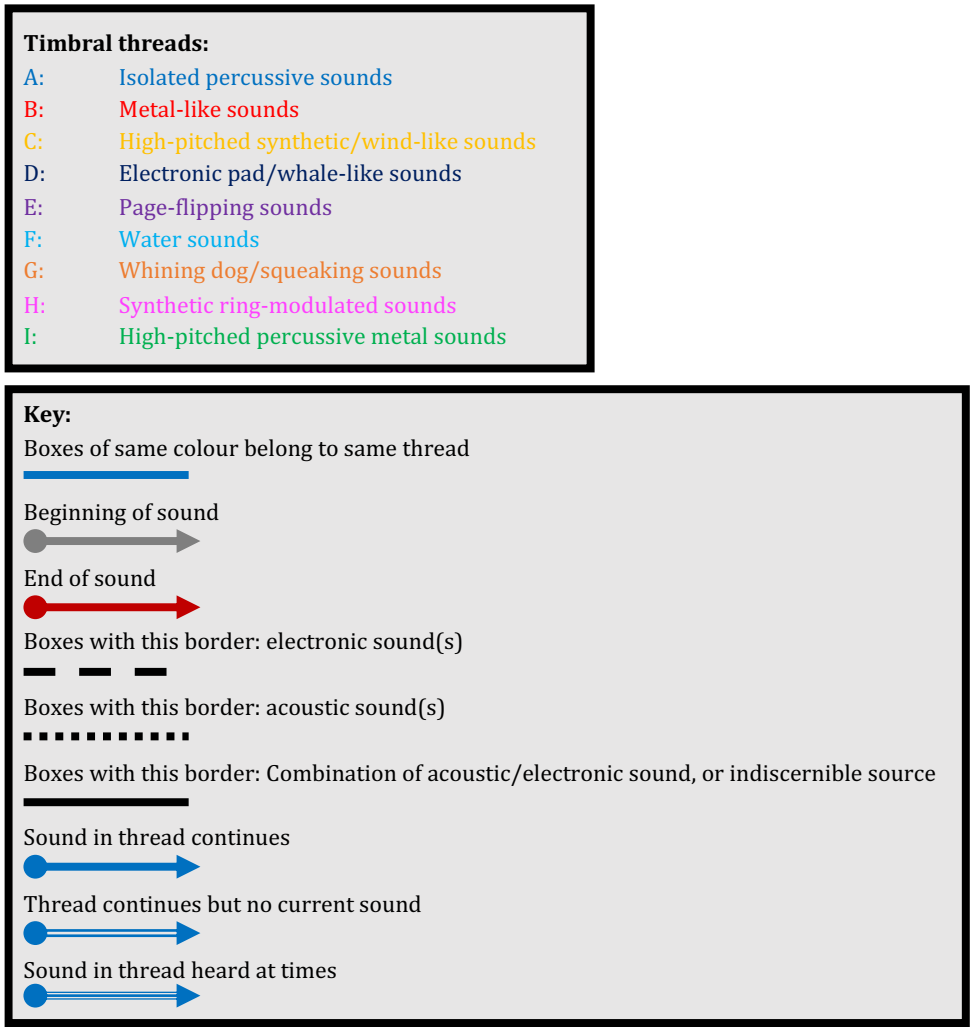


Figure 5.6: Timbral analysis of *RAS* (2000, rev. 2011) by Natasha Barrett.

Thread A

This thread mostly features isolated and short acoustic sounds (e.g. timpani, rototom, bass drum hits) that all sound like they emerge from a unified percussive source. These sounds nearly always precipitate much longer and denser expanses of sound from other threads, acting almost as timbral springboards.[206]



Figure 5.7: Timpani/rototom glissandi from Thread A at the beginning of the score of *RAS* (2000, rev. 2011) by Natasha Barrett.[207]

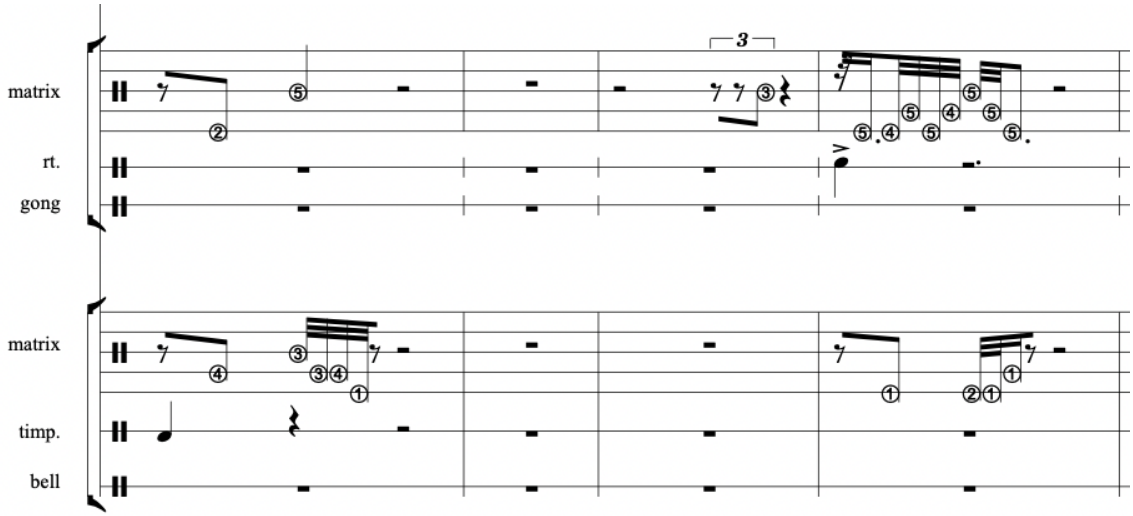


Figure 5.8: Examples of sounds from Thread A triggering sounds in Thread B from 2'38'' onwards in *RAS*.[208]

[206] 'Isolated' – related to the idea of sounds in a 'Sound Container', see Walther-Hansen, *Making Sense of Recordings*, 60–62; 'Short' and 'Longer' – appeals to 'Sound as Physical Objects' metaphor, see Walther-Hansen, 58–60; 'Denser' – synonymous with the 'Full/Hollow' metaphor pair, see Walther-Hansen, 103–5; 'Springboards' – also appeals to 'Sound as Physical Objects' metaphor as well as, indirectly, the 'Sound As Animate Beings' metaphor due to the implied sense of the sounds jumping off from the springboards, see Walther-Hansen, 58–60, 50–51.

[207] Barrett, *RAS*, 1; Puls & Ning Trio, *RAS*, from 0:10 onwards.

[208] Barrett, *RAS*, 5; Puls & Ning Trio, *RAS*, from 2:38 onwards.

Thread B

A large amount of timbral evolution takes place within this thread, but all the sounds appear to emerge from the same imagined source because of their metal-like timbres. The thread commences at the very beginning of the work with sparse glockenspiel-like sounds from the matrix. These sparse sounds from the matrix continue intermittently, embedded amongst other threads, until 1'32'' in the recording, when a run of high-pitched metal-sounding clinks – most likely from the electronics – combine with the matrix sounds and both start to timbrally transform through the introduction of noise into the sound. The runs of fast metal clinks, from an ambiguous combination of the electronics and the matrix, continue at various points (e.g. 2'38'', 2'41'', 3'17'', 4'18'', 5'00''). Some of the metal-like sounds during these runs take on a more bit-crushed or otherwise synthetic tone – presumably through electronic manipulation. There is often a sense that the deep percussive sounds from Thread A set off the metal-sounding runs in Thread B due to their temporal arrangement and the repetition of such gestures.

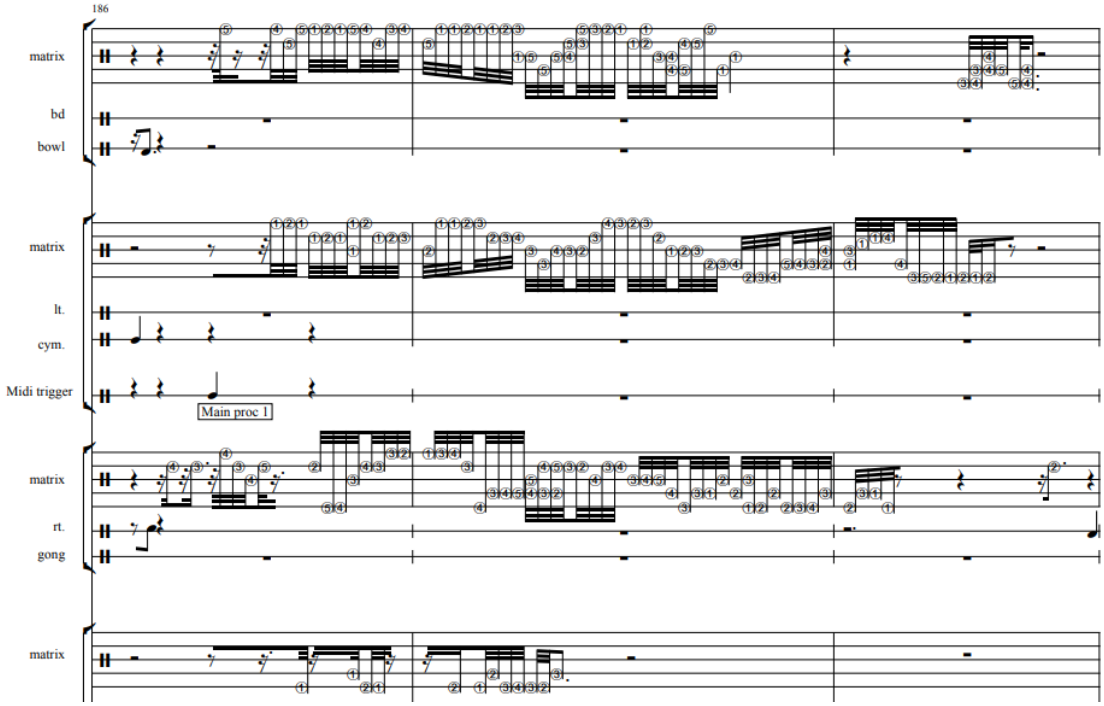


Figure 5.9: Thread B metal-like sounds in matrix from 7'38'' onwards in *RAS*.[209]

[209] Barrett, *RAS*, 17; Puls & Ning Trio, *RAS*, from 7:38 onwards.

Thread C

This very intricate and complex thread of sound in the electronics runs throughout most of the work, and can be characterised as mainly featuring high-pitched wind-like sounds and high-pitched swirling synthetic sound. The thread begins at 0'02'', where the lower frequencies of a wind-like sound are heard, before it then quickly opens up to a larger spectrum.[210] The sounds in this thread then break out occasionally from the background to make larger timbral gestures. Examples of this can be seen at 1'09'', where a rapidly spinning, metallic, sharp, and piercing sound can be heard, and at 4'46'', where a high-pitched shimmering sound can be heard.[211]

Thread D

A wide, full and often deep-sounding synthetic pad-like timbre from the electronics forms this thread, which begins initially as a timbral expansion of the timpani and rototom glissandi at 0'13'': the acoustic glissandi morph imperceptibly into this pad-like sound while the glissandi trajectory continues.[212] It is clear though that the timbres in Threads A and D emerge from different sources, even if they often gesturally interact and timbrally fuse at several points during the work. A further example of this interaction can be seen at 0'31'', in which a timpani hit is immediately followed by a rapidly detuned rototom hit that creates a downward glissando which blends seamlessly into a sustained bass-heavy synthetic sound.[213]

[210] 'Opens up' – see 'Open/Closed' metaphor pair in Walther-Hansen, *Making Sense of Recordings*, 108–10.

[211] 'Spinning', 'Metallic', 'Piercing', 'Shimmering' – 'Sound as Physical Objects' ontological metaphor, see Walther-Hansen, 58–60; 'Sharp' – see 'Dark/Bright' metaphor pair in Walther-Hansen, 98–100.

[212] 'Synthetic' – see 'Organic/Synthetic' metaphor pair in Walther-Hansen, *Making Sense of Recordings*, 110–12; 'Morph' – see 'Sound Morphing' ontological metaphor in Walther-Hansen, 63.

[213] 'Heavy' – see 'Heavy/Light' metaphor pair in Walther-Hansen, *Making Sense of Recordings*, 105–7.

Thread E

This thread features a timbre, most likely from the electronics, that sounds like the pages of a book being flipped in quick succession – whether this is a recording of such a sound, or an entirely synthesised sound is not possible to ascertain. Example occurrences of this sound include at 0'22'' and 0'42''.

Thread F

This thread consists of a recurring timbre in the electronics that initially sounds, at 1'31'', like a very closely recorded sound of water splashing onto a kind of metal.[214] A similar sound then repeats at 1'50'', but which features more pitch than noise content, and has more of a fluttering quality to it – it is possible that this sound is an electronically manipulated version of the recorded sample that comes before it.[215] This timbre appears at a number of other points during the work, including at 5'36'', where a sound akin to that of water trickling – first heard in its seemingly unaltered state at 4'13'' – suddenly and radically transforms into a more synthetic timbre that sounds more like the bygone sound of interference noise from speakers with mobile phones in their vicinity.

Thread G

This thread features a sound, almost certainly in the electronics, that glissandos up and down at varying rates and has a timbre that sounds at times almost like a whining dog, but also at times a combination of something possibly synthetic or of some kind of rubbery object being made to squeak. Example occurrences of this sound include at 2'17'' and 6'20''.

Thread H

This thread does not appear until much later in the work (from 6'02''), and seems to feature heavily ring-modulated sounds of some kind, whose origin is challenging to determine due

[214] 'Sound of water splashing' – 'Sound as Liquids' ontological metaphor in Walther-Hansen, 62.

[215] 'Fluttering' – 'Sound as Animate Beings' ontological metaphor in Walther-Hansen, 51.

to the level of electronic manipulation. They trigger close to live bell sounds in the acoustic domain, so it is possible that it is these that are used as the source for the ring modulation.

Thread I

The final thread in this analysis features a timbre in the electronics that, when heard fully (around 7'06'' onwards), sounds like colliding pieces of high-pitched metal being shaken at an (inhumanly) high rhythmically even rate for percussive effect. It takes some time for this sound to be heard in full though, as it is initially heavily electronically filtered.

Observations based on analysis of *RAS*

As a result of this analysis, I would first argue that there are two kinds of sound which dominate this work. The first of these consists of purely acoustic percussion sounds which have an ill-defined source beyond their "percussive" origin. I would argue that the exact origins of these sounds are ambiguous because the very large number of objects or instruments that can be used for percussion purposes leads to a considerable range of timbral possibilities. Moreover, the electronic manipulation of some of these sounds at times puts their sources in further doubt. The second kind of sound which dominates this work consists of electronic sounds that appear to have at least some kind of real-world origin and are used for percussive effect. The majority of these seem to have electronic effects added in some regard, but these are either subtle (and are heard in tandem with timbrally similar or complementary acoustic sounds), or when they are heavily altered, they are embedded within a busy textural and timbral context. Any timbres whose origins sound synthetic in some regard – the third kind of sound in this work – either timbrally spin off or spread out from acoustic or electronic percussive sounds, or feature in an otherwise dense texture of sound.

The combination of these three kinds of sound is one of the two primary compositional strategies used to create timbral blend between the acoustic and electronic forces in this work. By using sounds that constantly play with the timbral boundaries between acoustic percussive sounds, real-world electronic sounds used for percussive effect, and synthesised

sound, Barrett creates a soundworld where it is extremely challenging to ascertain where the acoustic forces end and the electronic forces begin.

The other strategy used to ensure timbral blend entails the use of very clear musical gestures that provide a means for connecting and blending consecutive sounds. These gestures often begin with one or two simultaneous acoustic percussion hits, before exploding into a series of acoustic and electronic sounds. The use of these gestures also develops structurally, so that similar gestures repeat over time but become more timbrally extravagant as they do so. This integration of the use of gestures and structural development of these thus enhances the sense of timbral blend in the work.

Returning to Barrett's 'sound-world realism' model, the vast majority of the sounds used in the work have a real origin, as they are intricate and detailed, and sound like they are being produced by resonating bodies. The space in which these sounds are situated is initially unfamiliar, as what I hear is something I would argue is not likely to be heard in the real world. However, as this space remains timbrally similar throughout the work, it becomes – by Barrett's definition – a non-real-world space over time (one which becomes familiar through the composition's own internal associations). Thus, the combination of real sounds and a space that becomes familiar over time results in an increase of the perception of realism over the course of the work. Looking at this work through Barrett's lens, therefore, may afford a tangible insight into how a sense of timbral blend is constructed in mixed works.

5.5: *Scirocco* (1983) by Maggi Payne

Overview of *Scirocco*

Scirocco (1983), lasting ca. 10'19'', is written by American composer Maggi Payne (b. 1945) for flute, digital delay, and pre-recorded tape.[216] According to Payne, the flautist plays

[216] Maggi Payne, 'Selected Program Notes', Maggi Payne's website, accessed 31 July 2019, https://sites.google.com/site/maggipayne/educationawards2; Maggi Payne, *Scirocco*, Crystal (Lovely Music, Ltd., 1991); Maggi Payne, 'Maggi's Long and Winding Bio', Maggi Payne's website, accessed 31 July 2019, https://sites.google.com/site/maggipayne/maggi%27slongandwindingbio;

multiphonics, whistle tones, and uses humming to create 'complex timbres', while the tape consists exclusively of 'up to 36 layers' of digitally delayed flute sounds, for which the flautist requires a 'high quality condenser microphone, … white noise generator, sine and square wave oscillator(s), and output level control for the total attenuation of [the] flute signal.'[217]

Payne's predilection for instrumental and environmental sounds

Whilst Payne has not outlined any particular aesthetic conceptualisations of sound that are relevant to this thesis, she has made several published statements in which she talks about instrumental or environmental attributes of sound that appeal to her in some regard. For example, Payne describes to Sabine Feisst how the 'vastness' and 'drama' of the deserts in the southwest of the United States pervade much of her work, perhaps in part because all sounds become 'enormously magnified' in these kinds of environments.[218] Separately, in a dialogue with Yeji Kim, the composer articulates that her love of acoustic instruments is at least in part driven by the fact that a note is 'never absolutely perfectly held' due to the instabilities of timbre, loudness, and pitch that are inherent in the sounds these instruments produce.[219] This fondness for these types of sound also appears to be partly influenced by Payne's primary instrument: the flute. According to Payne, the timbres and sounds she chooses to use in her work are often similar to what her flute produces, selecting timbres which resemble 'pitched wind and low roars' and have a 'sense of the breath' and the 'phrase'.[220]

Elsewhere, in an interview with Heather Dewey-Hagborg, the composer – while not explicitly referring to environmental or instrumental sounds – professes that she loves to

Tara Rodgers, *Pink Noises: Women on Electronic Music and Sound* (Durham, NC: Duke University Press, 2010), 63.

[217] Payne, 'Selected Program Notes'; Payne, as cited in Yeji Kim, 'Hybridity in Flute Music of Four Contemporary Composers' (PhD thesis, Bowling Green State University, 2012), 37–38.

[218] Payne, as cited in Sabine Feisst, 'The American Southwest as Muse: Maggi Payne's Sonic Desertscapes', *Contemporary Music Review* 35, no. 3 (2016): 325.

[219] Payne, as cited in Kim, 'Hybridity in Flute Music of Four Contemporary Composers', 120.

[220] Payne, as cited in Kim, 114.

capture sounds with the intention of exposing details that would have otherwise been imperceptible.[221] Relatedly, in her own writings, Payne explains that she likes to extend the limitations of sounds so that their sources become unintelligible – while still retaining a partial resemblance to what might be heard in the 'real world'.[222] Payne's tendency to use these kinds of sounds is further elucidated by her reply to a question in one interview on the Kalvos & Damian new music radio programme, in which she is asked why she uses electronics to express something natural. She responds:

> But the origin is electroacoustic, the origin is real sound which you hear, you know? It's electronically processed, but it's natural.[223]

Further reinforcing these timbral preferences, much of the reception of Payne's works, including on *Scirocco*, notes the use or influence of environmental sounds. For example, Sabine Feisst writes about how Payne evokes 'fierce natural phenomena' in *Scirocco*, while Richard Kadrey, Elizabeth Hinkle-Turner, and John Rockwell all use environmental metaphors (e.g. 'rainforest', 'virtual windstorm', and 'ominous roaring') to describe the same work.[224]

Payne's stated compositional preferences and the reception of her works perhaps suggest that using environmental and instrumental sounds together – both of which have a tendency to be unstable and lend themselves to a large degree of potential fluctuation across several musical parameters – could be one compositional method through which timbral

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[221] Payne, as cited in Heather Dewey-Hagborg, 'Maggi Payne', Girrl, 2011, http://girrlfeaturedartistsmaggiepayne.blogspot.com/.

[222] Payne, 'Maggi's Long and Winding Bio'.

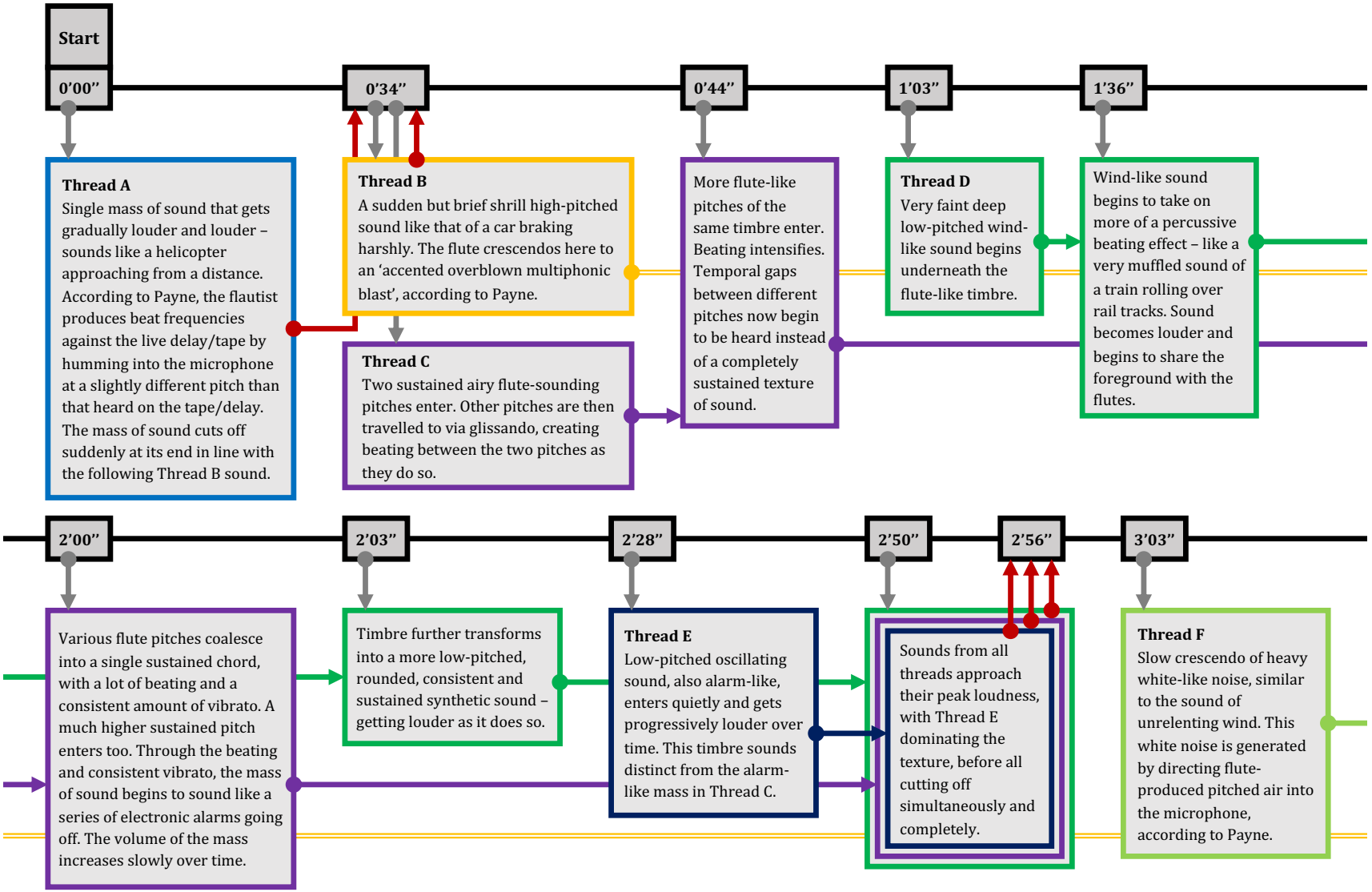
[223] Kalvos & Damian, 'Interview with Maggi Payne', eContact!, accessed 26 July 2019, https://econtact.ca/10_2/PayneMa_KD.html.

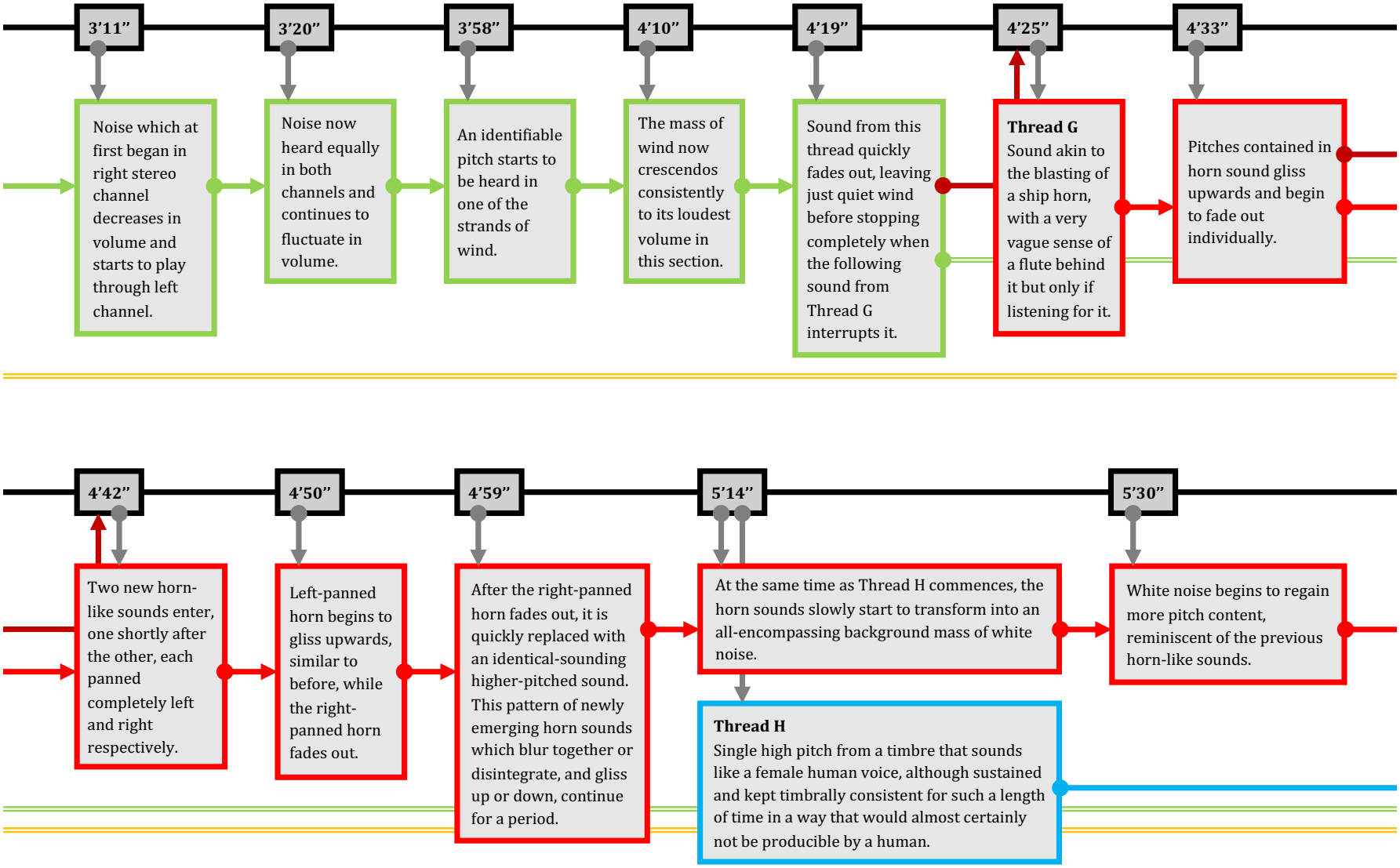
[224] Sabine Feisst, 'Negotiating Nature and Music through Technology: Ecological Reflections in the Works of Maggi Payne and Laurie Spiegel', in *Current Directions in Ecomusicology: Music, Culture, Nature*, ed. Aaron S. Allen and Kevin Dawe (New York: Routledge, 2015), 249; Richard Kadrey, as cited in Maggi Payne, 'Selected Reviews', Maggi Payne's website, accessed 17 September 2019, https://sites.google.com/site/maggipayne/selectedreview; Elizabeth Hinkle-Turner, *Women Composers and Music Technology in the United States* (Aldershot: Ashgate, 2006), 86; John Rockwell, 'Maggi Payne's Version Of California Music', *The New York Times*, 27 April 1986.

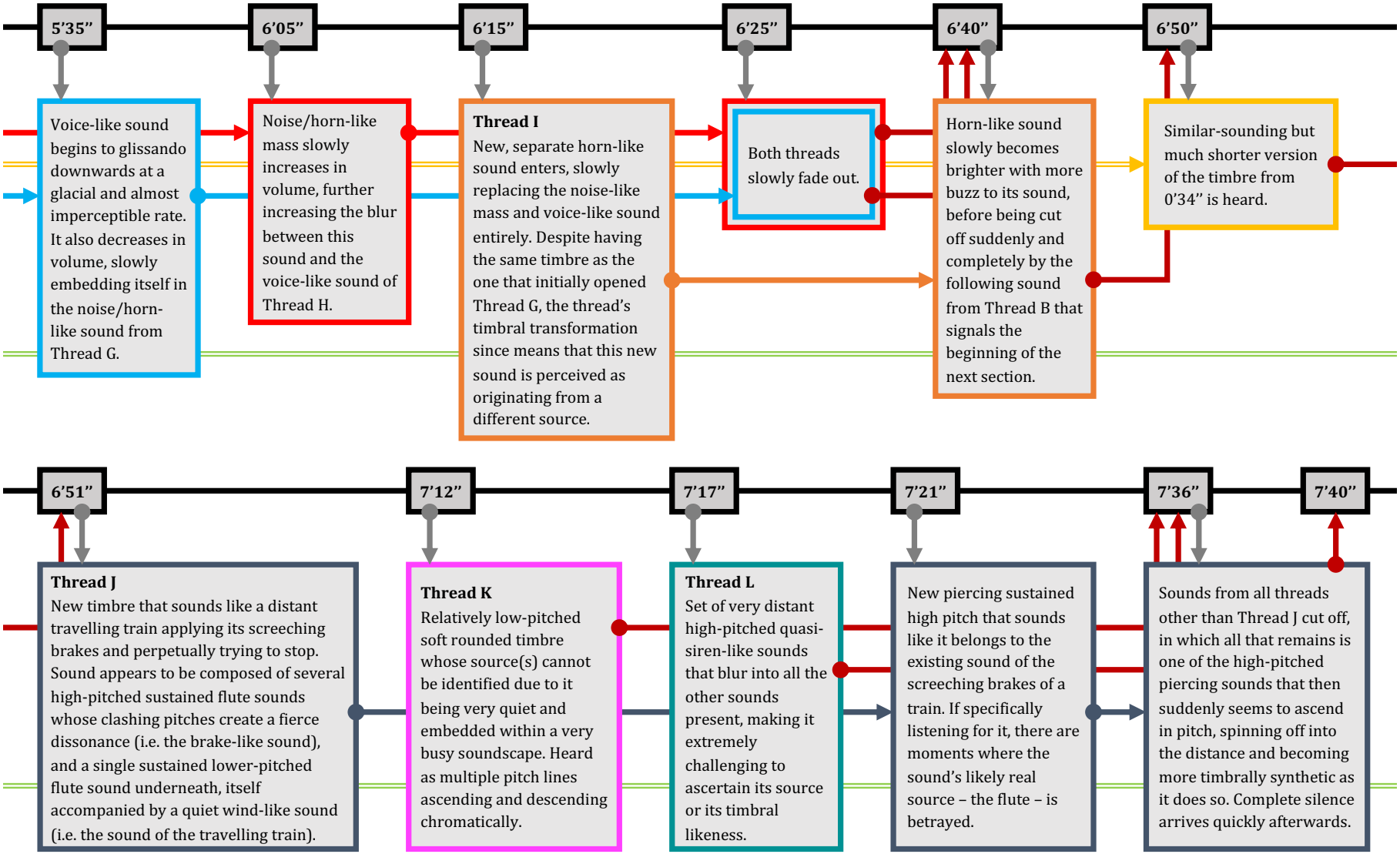
blend is achieved between acoustic and electronic sounds in mixed electroacoustic works. I will now conduct a timbral analysis of *Scirocco* in order to examine how the work facilitates timbral blend, and in what ways Payne's preference for environmental/instrumental sounds might aid this blend.

Analysis of *Scirocco*

For this analysis, all timings given in the flowchart relate to the sounds as they occur in the referenced recording for this work. Furthermore, as all the threads during this work appear to consist of a continual perceptually inseparable combination of acoustic and electronic sound, I do not attempt to label any given sound in a thread as originating from one kind of source or the other. Unlike the previous analysed works, *Scirocco* consists of clearly delineated sections without much overlap of timbral threads between them; I therefore summarise the analysis below the flowchart diagram by dividing the work into these specific sections and describing the threads within them.


Start
0'00"
0'34"
0'44"
1'03"
1'36"
Thread A
Single mass of sound that gets gradually louder and louder – sounds like a helicopter approaching from a distance. According to Payne, the flautist produces beat frequencies against the live delay/tape by humming into the microphone at a slightly different pitch than that heard on the tape/delay. The mass of sound cuts off suddenly at its end in line with the following Thread B sound.
Thread B
A sudden but brief shrill high-pitched sound like that of a car braking harshly. The flute crescendos here to an 'accented overblown multiphonic blast', according to Payne.
Thread C
Two sustained airy flute-sounding pitches enter. Other pitches are then travelled to via glissando, creating beating between the two pitches as they do so.
More flute-like pitches of the same timbre enter. Beating intensifies. Temporal gaps between different pitches now begin to be heard instead of a completely sustained texture of sound.
Thread D
Very faint deep low-pitched wind-like sound begins underneath the flute-like timbre.
Wind-like sound begins to take on more of a percussive beating effect – like a very muffled sound of a train rolling over rail tracks. Sound becomes louder and begins to share the foreground with the flutes.
2'00"
2'03"
2'28"
2'50"
2'56"
3'03"
Various flute pitches coalesce into a single sustained chord, with a lot of beating and a consistent amount of vibrato. A much higher sustained pitch enters too. Through the beating and consistent vibrato, the mass of sound begins to sound like a series of electronic alarms going off. The volume of the mass increases slowly over time.
Timbre further transforms into a more low-pitched, rounded, consistent and sustained synthetic sound – getting louder as it does so.
Thread E
Low-pitched oscillating sound, also alarm-like, enters quietly and gets progressively louder over time. This timbre sounds distinct from the alarm-like mass in Thread C.
Sounds from all threads approach their peak loudness, with Thread E dominating the texture, before all cutting off simultaneously and completely.
Thread F
Slow crescendo of heavy white-like noise, similar to the sound of unrelenting wind. This white noise is generated by directing flute-produced pitched air into the microphone, according to Payne.


3'11"
3'20"
3'58"
4'10"
4'19"
4'25"
4'33"
Noise which at first began in right stereo channel decreases in volume and starts to play through left channel.
Noise now heard equally in both channels and continues to fluctuate in volume.
An identifiable pitch starts to be heard in one of the strands of wind.
The mass of wind now crescendos consistently to its loudest volume in this section.
Sound from this thread quickly fades out, leaving just quiet wind before stopping completely when the following sound from Thread G interrupts it.
Thread G
Sound akin to the blasting of a ship horn, with a very vague sense of a flute behind it but only if listening for it.
Pitches contained in horn sound gliss upwards and begin to fade out individually.
4'42"
4'50"
4'59"
5'14"
5'30"
Two new horn-like sounds enter, one shortly after the other, each panned completely left and right respectively.
Left-panned horn begins to gliss upwards, similar to before, while the right-panned horn fades out.
After the right-panned horn fades out, it is quickly replaced with an identical-sounding higher-pitched sound. This pattern of newly emerging horn sounds which blur together or disintegrate, and gliss up or down, continue for a period.
At the same time as Thread H commences, the horn sounds slowly start to transform into an all-encompassing background mass of white noise.
White noise begins to regain more pitch content, reminiscent of the previous horn-like sounds.
Thread H
Single high pitch from a timbre that sounds like a female human voice, although sustained and kept timbrally consistent for such a length of time in a way that would almost certainly not be producible by a human.


5'35"
6'05"
6'15"
6'25"
6'40"
6'50"
Voice-like sound begins to glissando downwards at a glacial and almost imperceptible rate. It also decreases in volume, slowly embedding itself in the noise/horn-like sound from Thread G.
Noise/horn-like mass slowly increases in volume, further increasing the blur between this sound and the voice-like sound of Thread H.
Thread I
New, separate horn-like sound enters, slowly replacing the noise-like mass and voice-like sound entirely. Despite having the same timbre as the one that initially opened Thread G, the thread's timbral transformation since means that this new sound is perceived as originating from a different source.
Both threads slowly fade out.
Horn-like sound slowly becomes brighter with more buzz to its sound, before being cut off suddenly and completely by the following sound from Thread B that signals the beginning of the next section.
Similar-sounding but much shorter version of the timbre from 0'34" is heard.
6'51"
7'12"
7'17"
7'21"
7'36"
7'40"
Thread J
New timbre that sounds like a distant travelling train applying its screeching brakes and perpetually trying to stop. Sound appears to be composed of several high-pitched sustained flute sounds whose clashing pitches create a fierce dissonance (i.e. the brake-like sound), and a single sustained lower-pitched flute sound underneath, itself accompanied by a quiet wind-like sound (i.e. the sound of the travelling train).
Thread K
Relatively low-pitched soft rounded timbre whose source(s) cannot be identified due to it being very quiet and embedded within a very busy soundscape. Heard as multiple pitch lines ascending and descending chromatically.
Thread L
Set of very distant high-pitched quasi-siren-like sounds that blur into all the other sounds present, making it extremely challenging to ascertain its source or its timbral likeness.
New piercing sustained high pitch that sounds like it belongs to the existing sound of the screeching brakes of a train. If specifically listening for it, there are moments where the sound's likely real source – the flute – is betrayed.
Sounds from all threads other than Thread J cut off, in which all that remains is one of the high-pitched piercing sounds that then suddenly seems to ascend in pitch, spinning off into the distance and becoming more timbrally synthetic as it does so. Complete silence arrives quickly afterwards.

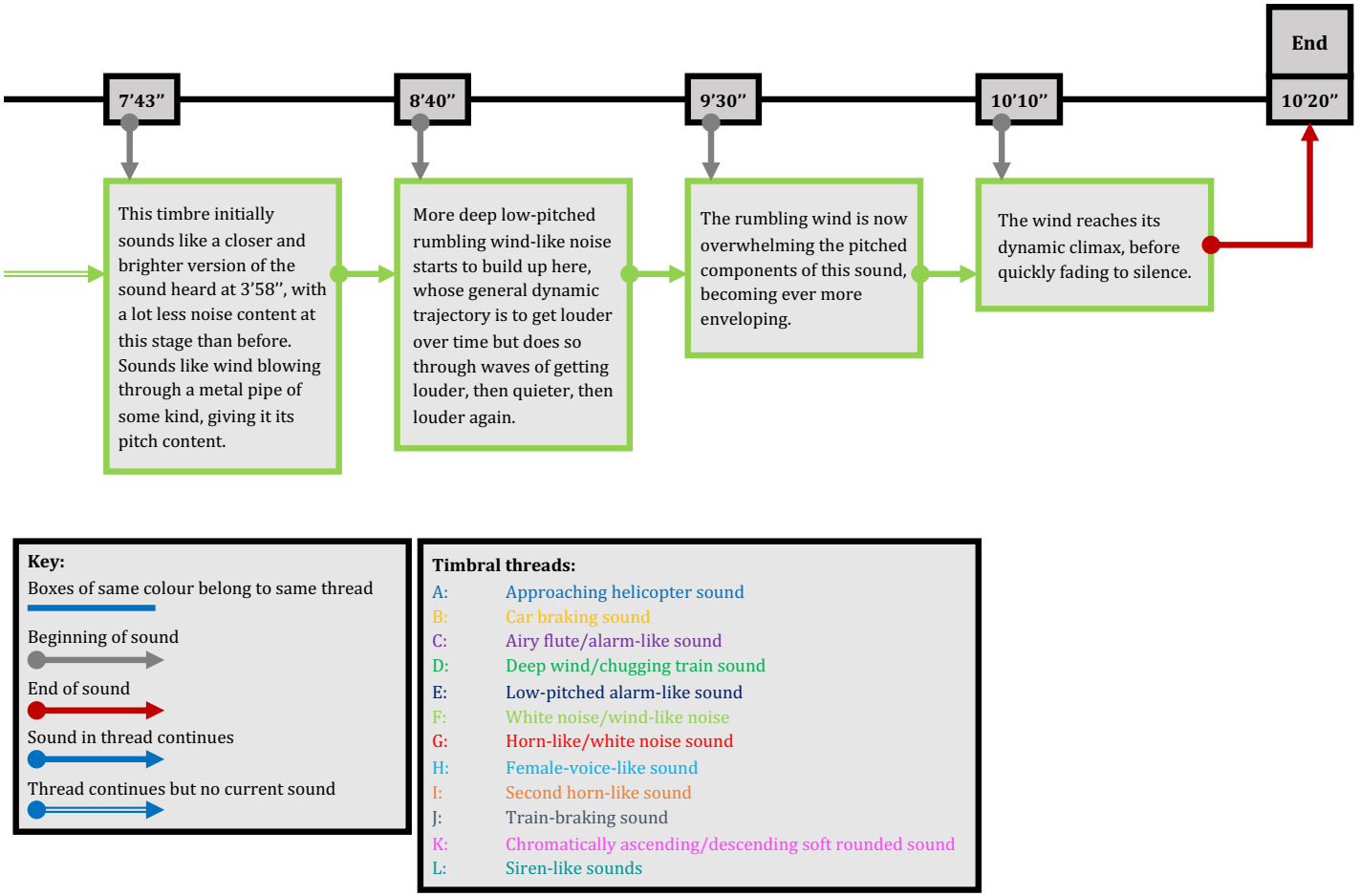


Figure 5.10: Timbral analysis of *Scirocco* (1983) by Maggi Payne.[225]

[225] Maggi Payne, personal correspondence, 6 September 2019.

0’00’’-0’34’’

The work begins very quietly with a single mass of sound (Thread A) which does not sound like a flute at all, but rather like a helicopter approaching from the distance. This sound gets gradually louder until what Payne describes as an ‘accented overblown multiphonic’ on the flute (Thread B) – but which sounds more like a car braking harshly – signals the change of the section.[226] Both of the threads in this section are more likely to be recognised as originating from the environment than an instrument.

0’34’’-2’00’’

The beginning of this section features sustained airy flute-sounding pitches (Thread C), although it is impossible to ascertain which of these pitches is being produced by the live flute. A deep low-pitched wind-like sound enters underneath Thread C at 1’03’’ (Thread D), before it takes on a more percussive beating effect at 1’36’’ – like the sound of a train rolling over rail tracks.

2’00’’-3’03’’

Here, the various flute pitches from Thread C coalesce into a single sustained chord. The sustained and relatively unchanging nature of the chord in this thread makes the flutes lose their identity. The timbre in Thread D further transforms into a lower-pitched synthetic sound, while a new alarm-like low-pitched sound enters at 2’28’’ (Thread E). All sounds suddenly cut off at 2’56’’.

3’03’’-4’25’’

A complete change of timbral soundworld takes place in this section, with just one new timbral thread featuring (Thread F). A slow crescendo of white-like noise, similar to the sound of an unrelenting wind, persists in various forms throughout the section – with more pitch heard in one of the strands of wind from 3’58’’.

[226] Payne, personal correspondence.

4’25’’-6’50’’

Two kinds of sound dominate this section: one akin to the sounding of a ship’s horn, which slowly transforms over time to include more white noise (Thread G); and a high-pitched monophonic tone from a voice-like timbre (Thread H) that slowly glissandos downwards and embeds itself into Thread G over time.

6’50’’-7’43’’

This section begins with a complex timbre that sounds like a distant train travelling at speed perpetually applying its screeching brakes (Thread J). At 7’21’’, a new piercing high pitch enters that sounds like it belongs to the existing timbre of the train’s screeching brakes – but when specifically listening for it, it is possible to identify the source of the sound as a flute, whether live or electronically delayed.

7’43’’-10’22’’

Here, there is a near-identical soundworld to 3’58’’ onwards. Thread F returns with a dominating wind-like sound, which slowly crescendos to a peak at 10’10’’.

Observations based on analysis of *Scirocco*

From this analysis, I would contend that there are two primary compositional approaches used to create timbral blend in this composition. The first involves transforming the sound of the flute entirely by creating timbres using the digital delay and tape that result in a real-world soundscape where no identifiable flute can be heard at all. The second entails using the flute in the delay and tape with no perceptible electronic manipulation so that it is challenging to distinguish the live flute from the flutes that feature in the electronics. Another strategy which reinforces these approaches is to separate many of the sections with a period of silence, in order to wipe the perceptual palette clear and prepare the listener for a new kind of timbral landscape in the subsequent section. One exception to the aforementioned strategies is in the sections in which these two kinds of timbres (real-world and instrumental) overlap. In these sections, however, there is either a gradual timbral

transformation between the two, or the real-world sounds used may have a timbral likeness to them that suggests a particular source, but this likeness is never clear enough to enable any certainty over said source.

I would argue that Payne's preference for environmental and instrumental sounds do influence the facilitation of timbral blend, as nearly all the timbres that the composer uses in this work suggest an instrumental or environmental origin. However, the temporal separation of most of the environmental and instrumental sounds in the work possibly indicates that Payne avoids combining them at the same time too explicitly, for fear of timbral blend being disrupted. This suggests that while the use of one type of sound at any one time is likely to ensure timbral blend, using two or more concurrently may risk the continuity of said blend.

5.6: Discussion of timbral analyses

Although the timbral landscapes that feature in these three compositions and the espoused aesthetic philosophies of the works' composers differ greatly, the analyses in this chapter show that, across all the works, there are a number of shared compositional strategies that engender a sense of timbral blend between the acoustic and electronic forces within them. I will now split these strategies into those which are used to influence the timbres of the acoustic forces and those which are used to influence the timbres of the electronic forces in the works.

Compositional strategies for acoustic forces

A majority of the acoustic sounds in these compositions have sources that are either likely identifiable but not with complete certainty, unrecognisable even when heard in isolation, or would be recognisable if not for the fact that they are disguised in some way within the prevailing texture. This suggests that a lack of source recognition potentially enables a larger variety of timbral possibilities for the purposes of timbral blend in mixed works. If the origin of an acoustic sound is completely unidentifiable, then that sound has a larger potential to be used alongside any electronic sound and for the combination thereof to still

retain a sense of timbral blend. If the origin of a sound is identifiable but not with complete certainty, then this potential is smaller, but this type of sound still allows for more blended combinations than a sound whose origin is likely to be immediately recognised.

Compositional strategies for electronic forces

Most of the electronic sounds in these works are one of two kinds: pre-recorded or electronically delayed live acoustic sounds – of which nearly all are of the kind described in the previous paragraph – that are otherwise subject to either no or minimal apparent electronic effects; or pre-recorded sounds of a seeming real-world origin that are subject to different levels of perceptible electronic manipulation depending on the context. Passages that feature real-world timbres with little or no electronic effects, which thus are likely to have at least semi-recognisable sources, do not simultaneously feature any recognisable acoustic sounds at all. These kinds of passages are often arrived at via very gradual timbral evolutions from passages that feature no real-world timbres. When real-world timbres with a noticeable number of electronic effects are used, they tend to be transformed so that their sources become ambiguous, and often start to sound more like the acoustic sounds they accompany. Importantly, there are very few timbres across the three works which clearly sound synthesised. These strategies suggest that, similar to those used to determine the acoustic sounds, the less recognisable an electronic sound's source is, the more potential that sound has to blend with its acoustic counterpart.

Influence of composers' aesthetic philosophies

I would argue, based on these analyses, that Barrett's 'sound-world realism' concept plays an important role in all three compositions. As has already been established, *RAS* features a sense of 'maximum realism' over time, but so does, I would contend, 'Salt Canyons' and *Scirocco*. Both feature, nearly exclusively, what could be deemed as 'real' sounds, in 'spaces' that are made 'familiar' over time. One difference that distinguishes the latter work is that rather than there being one space which becomes familiar over the course of the whole work, Payne instead establishes a different space in each section which all attain familiarity

very quickly due to there being only one kind of sound (environmental or instrumental) per section. Payne's near-exclusive use of environmental and instrumental sounds also mirrors the compositional choices of Barrett and McLean for their works; as already mentioned, there are very few synthesised sounds in any of the works. Furthermore, all of the composers – not just Payne – avoid using clearly identifiable instrumental and environmental sounds together at the same time.

Conclusion

The compositional strategies used to ensure timbral blend in these works are multifarious. Nevertheless, there are a small number of strategies which, I would argue, can be assimilated into one unifying strategy that is utilised across all of the works: timbres, whether they are acoustic or electronic, whose sources are challenging to identify, are more likely to blend with each other. Equally, I would also note that the means used to make these timbres challenging to identify in these works are manifold. Furthermore, even though this particular strategy is shared across these three compositions, it does not mean that strategies which are unique to individual works are any less important or useful. As these analyses have shown, any composer will always require a wide and tailored set of strategies if they wish to engender a sense of timbral blend between the acoustic and electronic forces in their mixed electroacoustic works.

Chapter 6: Conclusion

6.1: Introduction

In this thesis, I have explored the role that timbre may play in the oft-perceived aesthetic disconnect between the acoustic and electronic forces in mixed electroacoustic works. By conducting a series of descriptive and graphical timbral analyses on a set of mixed works, using an analytical framework that conceptualises timbre as a phenomenologically ever-shifting combination of its sources and its contents, and that makes use of culturally situated intersubjective metaphor to describe said contents, I have established common compositional strategies utilised in these works to achieve timbral blend, and thus to bridge this aesthetic disconnect. By contextualising these analyses through an examination of relevant compositional aesthetic preferences outlined by the composers of the analysed works, I have also considered what influence these preferences have had on the strategies used for timbral blend. In this concluding chapter, I discuss the findings from the analyses and their possible implications for the oft-perceived aesthetic disconnect, and explore how future research might incorporate and develop further means to conceptualise and analyse timbre in mixed electroacoustic works.

6.2: Discussion of findings from timbral analyses

As a result of the timbral analyses in this thesis, I argued that the most common compositional strategy utilised across the three analysed works to engender timbral blend entailed the utilisation of timbres whose sources are challenging to identify. If we were then to assume the opposite, that combinations of sources whose timbres are clearly identifiable lead to a lack of blend, it is worth speculating briefly on how this proposition may relate to the aesthetic disconnect in mixed works on which composers have often remarked. As reviewed in Chapter 2, concerns relating to liveness have often been the source of contemporary discussion when attempting to address this disconnect. Although issues relating to liveness are, of course, salient and worth considering, perhaps our aesthetic judgements in this regard are also influenced by the interplay between our timbral

perceptions and our culturally situated intersubjective descriptions of these. If a sense of aesthetic disconnect in mixed works is contributed to by utilising sources compositionally whose timbres are clearly identifiable, perhaps this is because doing so leads to a perceptual and/or aesthetic dissonance connected to the historical context with which at least some are likely to associate those identifiable timbres. As a simplified example: if, hypothetically, we hear a clearly identifiable piano in conjunction with a sawtooth-wave synth sound together, this sense of dissonance might reach its maximum – the timbre of the piano is what many, in a current Western context, grew up to perhaps associate primarily with a pre-electronic timbral landscape; the timbre of the synthesiser is what many perhaps grew up to associate primarily with twentieth- and twenty-first-century popular music genres.[227] If, however, we were to hear a clarinet in conjunction with a sine-wave synth, the attachment of these instruments to their contexts might loosen – precisely because their timbral similarities (rounded, smooth and constant) create doubt about the sources of what we are hearing, leading to a sense of timbral blend – and thus this sense of dissonance, or disconnect, is then perhaps at its minimum, or bridged.[228] I would speculate that it is this culturally embedded influence on our timbral perceptions that at least contributes therefore to this oft-perceived sense of aesthetic disconnect in mixed works.[229]

[227] Isabella van Elferen explores how timbre specifies genre, as part of a wider discussion regarding timbre's paradoxical phenomenology, in 'Drastic Allure: Timbre Between the Sublime and the Grain', *Contemporary Music Review* 36, no. 6 (2017): 614–32; Also see Steve Waksman, 'Crossing the Electronic Divide: Guitars, Synthesizers, and the Shifting Sound Field of Fusion', in *The Relentless Pursuit of Tone: Timbre in Popular Music*, ed. Robert Fink, Melinda Latour, and Zachary Wallmark (New York, N.Y: Oxford University Press, 2018), 256, in which Waksman observes that a particular timbre's perceived lack of belonging to a genre can affect musical decision-making, using the synthesiser's perceived 'otherness' when introduced into the hard rock and heavy metal genres as an example.

[228] 'Rounded' and 'Smooth' both relate to the same 'Rough/Smooth' metaphor pair in Walther-Hansen, *Making Sense of Recordings*, 113–14.

[229] It is important to emphasise that this hypothesis relies on a very specific cultural context, and equally implies that if one were to have had their first experiences of the piano and the synthesiser through mixed electroacoustic music, then perhaps no aesthetic disconnect relating to timbre would be formed. This would also be the case if one were to have first experienced both instruments via, for example, jazz music – where it is of course extremely common to hear both feature.

6.3: Future research

It is also worth briefly discussing what avenues of future research could be pursued in response to these analyses, their findings, and the theoretical framework introduced in this thesis. Firstly, a framework which attempts to further systematise the use of metaphor could be of value for the purposes of future timbre analyses. Stephen S. Hudson, for example, in his review of Walther-Hansen's monograph, has already attempted to develop on the author's work by proposing networks of related metaphors in order to more firmly establish the cognitive connections and distinctions between them.[230] Secondly, a set of analyses on a wider selection of mixed works could provide further common compositional strategies used for timbral blend and enable a wider series of aesthetic concerns of composers to be taken into account. This would also allow for a consideration of composers' technological concerns.[231] A systematised means by which to select works for analysis could also prove valuable – perhaps this could entail an empirical study of participants' perception of blend across a set of works.[232] A cross-referential analysis of different recordings of the same work could also help to allay previously discussed concerns regarding what constitutes 'the work' in a given context. Finally, one aspect of timbre that further research could consider is that of vocal timbre and its functioning in mixed works, concerns of which were almost entirely omitted from this thesis due to the level of additional complexity that the human voice's timbral features and the perception thereof would have introduced.[233]

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[230] Stephen S. Hudson, 'Review of Making Sense of Recordings: How Cognitive Processing of Recorded Sound Works', *Intégral* 35 (2022): 103–8.

[231] For an example of how technological and pragmatic concerns can affect the composition of mixed works, see Pierre Alexandre Tremblay, 'Pragmatic Considerations in Mixed Music: A Case Study of La Rage', in *Proceedings of the International Computer Music Conference*, 2006, 527–30.

[232] See, for example, Vinoo Alluri and Petri Toiviainen, 'Exploring Perceptual and Acoustical Correlates of Polyphonic Timbre', *Music Perception* 27, no. 3 (2010): 223–42 in which the authors play short samples of Indian popular music to the study participants and ask them to rate the degree to which the presented timbral descriptors accord with what they are hearing.

[233] See Kate Heidemann, 'A System for Describing Vocal Timbre in Popular Song', *Music Theory Online* 22, no. 1 (2016), https://mtosmt.org/issues/mto.16.22.1/mto.16.22.1.heidemann.html, for a well-developed examination of vocal timbre and the development of a 'perceptual-based system' for analysing it.

6.4: Concluding remarks

Through this thesis, I have presented a phenomenological metaphor-based framework for the analysis of timbre and established common compositional approaches for enabling timbral blend in mixed electroacoustic works. I have concluded that the most common prevailing approach in the analysed works entails the utilisation of timbres whose sources are difficult for the listener to identify. This thesis has therefore shown one practicable method by which we can communicate how timbre functions in music and how we can manipulate timbre for specific musical purposes in composition. Timbre's complexity may make its contents and effects challenging to access and assess, but its fundamental role in shaping our experience of music continues to make that challenge, in my opinion, a rewarding and worthwhile pursuit.

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Prefaces to Portfolio of Original Compositions

Matt Collins

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List of Attached Files

Unmeasured (2019) for large ensemble and live electronics – c. 4'30''-6'

Score:	Unmeasured – Score.pdf
Recording:	Unmeasured – Recording.wav
Max/MSP patch for live electronics:	Unmeasured – Patch.zip

Fog (2019) for trombone and electronics – c. 6'

Score:	Fog – Score.pdf
Recording:	Fog – Recording.wav

Kopf (2020) for ensemble – c. 9'

Score:	Kopf – Score.pdf
Recording:	Kopf – Recording.wav

Antecedent (2020-21) for solo piano – c. 26'

Score:	Antecedent – Score.pdf
Recording:	Antecedent – Recording.wav

Degradation (2023) for string quartet and live electronics – c. 12'30''

Score:	Degradation – Score.pdf
Recording:	Degradation – Recording.wav
Max/MSP patch for live electronics:	Degradation – Patch.zip

Introduction to the Prefaces

Introduction

In the prefaces that follow, I aim to provide an overview of the explorations, intentions and motivations behind each composition in the *Portfolio of Original Compositions* which accompanies this document, along with commentary on other aspects of each work – such as its score or electronics – that may require explanation. In this introduction to the prefaces, I first briefly outline the form of my compositional practice in more personal and general terms. I then establish the metaphorical concepts concerning timbre that I utilise in the prefaces, drawing from the theoretical framework that I established in the preceding thesis portion of this submission, and I briefly outline how the compositional exploration of these notions of timbre are shared across or between individual works. Finally, I reflect on the compositional features that distinguish the works from each other, and how a comprehensive written account of a composition's sum and substance can never quite encapsulate its intended results and the motivations behind its writing.

Compositional practice

The works in this portfolio reflect both a consistency and a development in my compositional practice over the course of this doctorate. This consistency is displayed in these works predominantly through how I tend to foster musical development within them, and my compositional choices concerning harmony. Drawing from minimalist and post-minimalist influences, all the works rely on at least some use of melodic cells or harmonic 'units' that are subsequently modified in some regard – through extension, compression, reversion, inversion or otherwise – or repeated in different musical contexts. These cells or units are then usually situated in a tonal or quasi-tonal harmonic context that also draws from minimalist influences, but also from jazz, funk, and other classical music influences more broadly. This is not to say that my music is completely diatonic without exception – large sections of the second and third movements of *Antecedent* operate completely outside any intended tonal context, for example. I also draw extensively from post-tonal harmony,

as will become clear in the 'Influences' sections in the prefaces. The consistent predisposition towards a more-tonal-than-atonal compositional world, however, is clear.

The most notable development in my compositional practice in this portfolio concerns the use of timbre in the works. I have used timbre as a compositional device for a number of years now, and have been particularly interested in the timbral relationship between the acoustic and electronic forces in mixed electroacoustic music, as the preceding thesis in this document shows. Whilst it is important to note that many aspects separate the compositions in this portfolio, my engagement with timbre and its musical effects becomes perhaps one of my primary compositional interests across all of these works. The compositional and metaphorical language I develop to engage with and respond to timbre in this portfolio is therefore the main focus of the prefaces to these compositions.

Phenomenology of timbre, metaphors of timbre

Connections with *Compositional Strategies for Timbral Blend in Mixed Electroacoustic Music*

The portfolio and thesis that comprise this submission were completed primarily as independent forms of research. In these prefaces, however, I utilise and extend upon concepts from the theoretical framework that I develop in the thesis in order to explicate the various timbral concepts at work in the compositions. In Chapter 5.2 of the thesis, I develop on the work of Walther-Hansen, and Wallmark and Kendall, in order to establish a framework that conceptualises timbre as a phenomenologically ever-shifting combination of its sources and its contents, and that makes use of culturally situated intersubjective metaphor to describe said contents.[1] This framework enables, I would argue, the establishment of metaphorical concepts relating to timbre that can be used to describe the functioning of timbre in musical works from a phenomenological perspective. Using this

[1] Mads Walther-Hansen, *Making Sense of Recordings: How Cognitive Processing of Recorded Sound Works* (New York: Oxford University Press, 2020); Zachary Wallmark and Roger A. Kendall, 'Describing Sound: The Cognitive Linguistics of Timbre', in *The Oxford Handbook of Timbre*, ed. Emily I. Dolan and Alexander Rehding (New York: Oxford University Press, 2018).

framework therefore, I employ the following concepts for these descriptive purposes in the prefaces: timbral blend, timbral extremes, timbral objects, and timbral space. These concepts best illuminate the ways in which I worked with timbre during the compositional process for this portfolio. A short outline of these concepts and their use in the compositions follows.

Metaphorical concepts of timbre

Timbral blend

I first conceived and defined timbral blend in Chapter 5.2 of the thesis portion of this document as the capacity of two or more physical sources to coalesce together in such a way so that the listener is not likely to determine that there is an aesthetic disconnect between them. Issues of timbral blend are explored in the works that feature electronics in this portfolio: *Unmeasured*, *Fog*, and *Degradation*.

Timbral extremes

The effects of employing timbral extremes, which I define here as the utilisation of the playable limits or pitch extremes of an instrument, are examined in *Unmeasured* and *Antecedent*. With respect to pitch extremes, this idea can be seen through the metaphorical lens of the 'Dark/Bright' metaphor pair in Walther-Hansen's encyclopaedia of common descriptions of sound: the former likely to feature a 'large amount of low-frequency content', and the latter a 'large amount of high-frequency content'.[2] Experimenting with the playable limits of an instrument may afford the perception of its timbre as a 'sound-in-itself', as Walther-Hansen terms it, which I explore in the preface to *Unmeasured*.[3]

Timbral objects

Forming a work's ensemble into a timbral object or a shape which tends towards one is investigated in *Kopf* and *Degradation*. Referring to the concept of a timbral object, or 'sound

[2] Walther-Hansen, *Making Sense of Recordings*, 98–100.

[3] Walther-Hansen, 55–57.

object', is imbued with a variety of potential historical meanings. I intend to use it here in the metaphorical sense as described by Walther-Hansen, who claims that the sound object is an ontological metaphor in its own right – see Chapter 5.2 in the thesis portion of this document for an explanation of this kind of metaphor.[4]

Timbral space

I base the notion of timbral space as it is used in these prefaces on Walther-Hansen's 'Sound Container' ontological metaphor, which enables a conceptualisation of timbre that can occupy and move between different portions of space and different dimensions of space, and can attribute global characteristics to the space itself based on the timbres that act within it.[5]

This concept is explored in all five compositions, although the exact manifestation of this exploration differs between each work: in *Unmeasured*, I observe the effects of the timbral space being overtaken by the acoustic forces; in *Fog*, I argue that the timbral space adheres to Natasha Barrett's criteria for a 'maximum realism' frame of reference (a concept first explored in Chapter 5.4 of the preceding thesis); in *Kopf* and *Antecedent*, I explore the timbral space made available by the absence of electronics; and finally, in *Degradation*, I distinguish between notions of vertical and horizontal timbral space as a means of analysing the motivations behind particular timbral choices for the electronics in different sections of the work.

Distinguishing features and aims

Although I have discussed the common compositional features and aims in detail that unite these works in the portfolio, there are also those that distinguish them. Some of these are explored in further detail in the prefaces, including the exploration of boundaries between genres in *Kopf*, and the interactions between the different roles as a composer that I purposely inhabit in *Antecedent*. One other major distinction I would note is what I would

[4] Walther-Hansen, 52–54.

[5] Walther-Hansen, 60–62.

term the expressive affect of the works. This distinction is challenging to capture in words. Metaphor becomes necessary once again: the floating but purposeful music in *Unmeasured*; the range of senses from excitable, anticipatory, to melancholy in *Fog*; the energy, anxiety, and yearning in *Kopf*; the trepidation, chaos, and anger in *Antecedent;* the despair, hopelessness and surrender in *Degradation*. Whilst these portrayals give an insight into these affective differences, they also highlight a problem with any attempted descriptive account of a composition's features and its effects. As noted in the introduction, the following prefaces are the result of an effort to provide an overview of the explorations, intentions, and motivations behind each composition in this portfolio. However, it is only through direct engagement with the works themselves, with the prefaces as a guide, that the outcomes of this compositional research can be fully apprehended.

Unmeasured (2019)

for large ensemble and live electronics – variable, c. 4’30’’-6’

Attached files

Score:	Unmeasured – Score.pdf
Recording:	Unmeasured – Recording.wav
Max/MSP patch for live electronics:	Unmeasured – Patch.zip

Background

The large ensemble in this composition consists of flute (doubling on piccolo), oboe, clarinet, bassoon, horn, trumpet, trombone, vibraphone, piano, and a five-piece string section. The live electronics were created using the object-based visual programming language Max/MSP and are heard through a set of stereo loudspeakers positioned either side of the ensemble in the auditorium. The work was composed for the Oxford-based Ensemble ISIS, and premiered at the Faculty of Music in Oxford on 31st January 2019 as part of a composition workshop run by the group. The attached recording is from a stereo room microphone capture of the live instruments and electronics projected through speakers in this workshop performance.

Live electronics

The live electronics in this work are set up to allow for the live sound of most of the acoustic instruments to be captured using on-instrument microphones. The live audio is manipulated in the attached Max/MSP patch primarily using a series of differing digital delays and pitch transposition effects, before these processed sounds are played back through the loudspeakers in real time. Once the patch is set up, it can run for a whole performance of the work without any user input as the processing parameters remain the same throughout the work.

In the patch, the unprocessed audio is assembled into three separate channel groups: woodwind; brass, vibraphone and piano (BVP henceforth); and strings. Each channel

group's audio has its own set of effects applied. All groups are first sent through their own stereo delay processes: 29ms, 15ms, and 25ms delay time are applied to the left channels and 29ms, 15ms, and 27ms to the right channels of the woodwind, BVP, and strings groups respectively; 99% feedback is applied to all three left channels, 99% to the right channel of the wind group, and 97% to the right channels of the BVP and string groups. A user-defined mix of each group's unprocessed and delayed audio (determined with the aim of not creating too much delay feedback in the individual concert space) is then sent through its own multiband dynamic compressor. From here, copies of the delayed audio from the woodwind and strings groups are sent through a series of frequency-shifter objects: the left and right channels of the wind group are transposed up 1200 and 2400 cents respectively; only the left channel of the strings group is transposed, namely down by 2400 cents.

The delayed audio and separately transposed audio from all three groups – now five audio streams in total – is then fed through signal multiplier objects that smoothen any changes in loudness based on a continuous smoothened loudness value of the original unprocessed audio for each group.[6] Finally, the combined processed audio is sent to a reverb object named *Rev3* – adapted from *Pure Data* by Mitch Turner – whose output volume can be mixed separately from the dry processed audio signal.[7] The unprocessed mix of the channel groups can also be amplified separately if necessary for balance. A simplified diagram of the patch signal flow is displayed in Figure 1 below.

[6] The volume smoother in this patch utilises the *Analyzer* object, originally developed by Tristan Jehan. The Apple-silicon-compatible version of this object used in this patch was sourced from Volker Böhm: 'Downloads | Volker Böhm', Volker Böhm's website, accessed 1 January 2024, https://vboehm.net/downloads/; The original author's object can be found here: Tristan Jehan, 'Tristan Jehan's Max/MSP Stuff', Tristan Jehan's website, accessed 1 January 2024, https://web.media.mit.edu/~tristan/maxmsp.html.

[7] This object was originally sourced from the 'Tools' section of Cycling '74's online forum: 'Tool: Rev3~ | Cycling '74', accessed 1 January 2024, https://cycling74.com/tools/turner-rev3. At the time of writing, the link to this download is sadly broken, possibly because this portion of the site is no longer maintained.

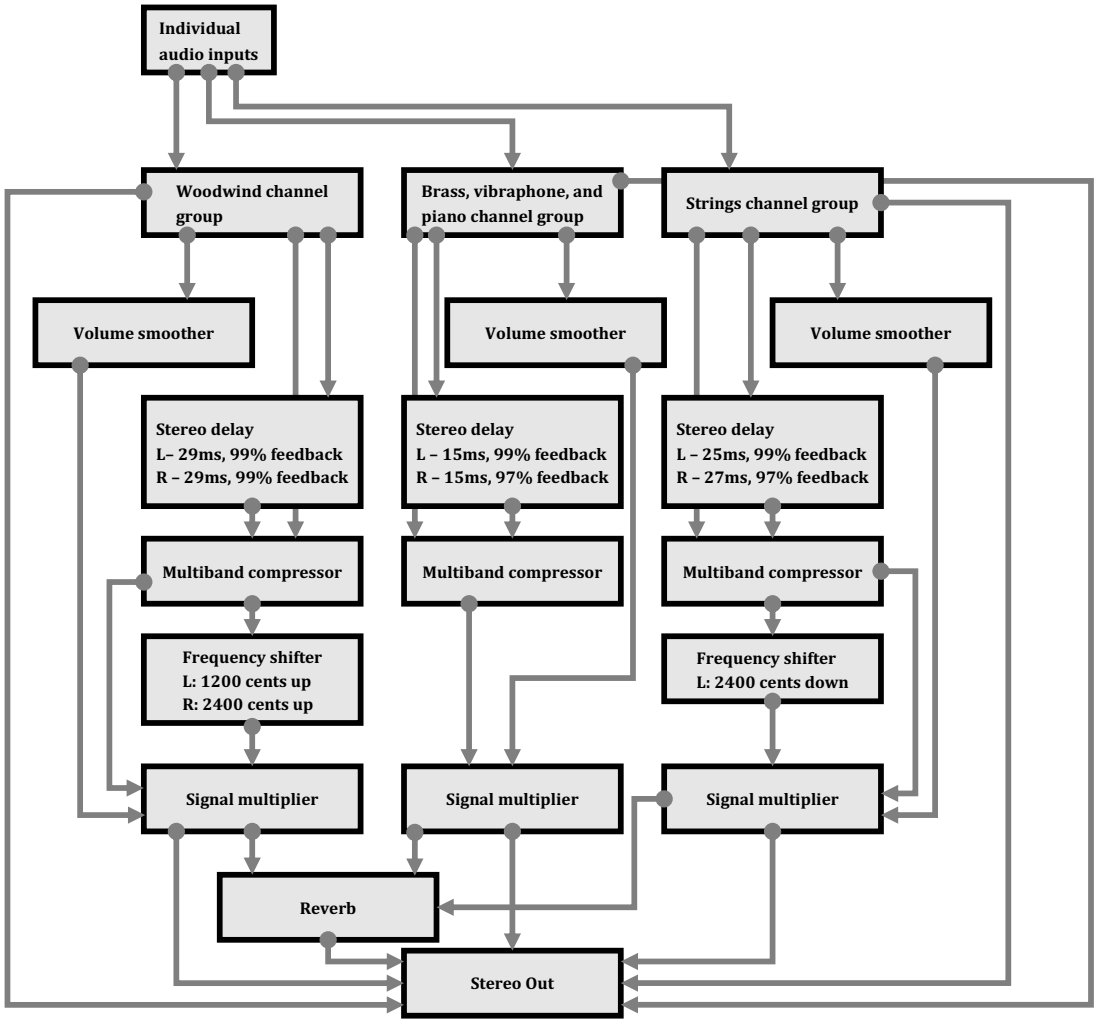


Figure 1: Simplified Max/MSP patch flowchart for *Unmeasured* (2019).

Score

The opening three pages of the score require a significant amount of creative input from the conductor of the performance. This section lacks a defined metre and instead asks the conductor to cue in different groups of performers at specified cue points, the exact timings of which are determined by other musical events taking place in the score. For example, at cue mark 1 at the beginning of the work, the conductor cues the woodwind players, who then each play one note independently for as long as one breath will allow them to play; when the conductor determines that the bassoon player has reached their loudest volume during this held note, cue mark 2 asks the conductor to cue the string players, who then also play their notes independently. The '1B', '2B', '3B', and '4B' markings in this section refer to

the number of breaths or bow strokes a player should use for a given note. Players using a bow aim to make a note last for as long as possible within the number of strokes indicated. The '(-)' markings in the score represent the silence that players should hold if they reach the end of their notes in a given section before their next cue point is triggered. From the second half of page three onwards, a more conventional metred section commences.

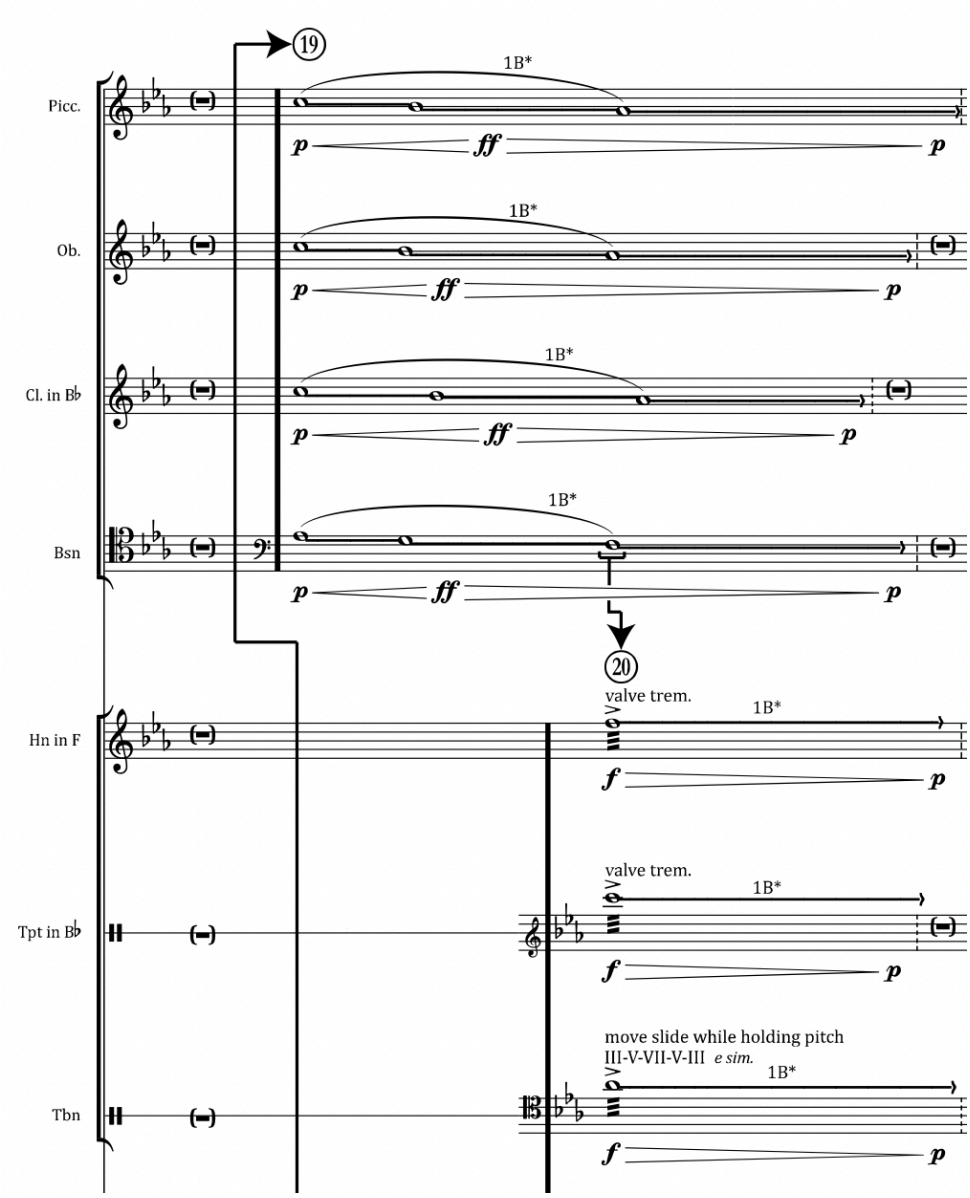


Figure 2: Example of independent cue points in opening section of the score of *Unmeasured* (2019).[8]

[8] In this example, when the bassoon begins to play its third note within cue point 19, the conductor should then cue the brass section to start playing their notes within cue point 20.

Discussion

Juxtaposition of timbral extremes and timbral blend through timbral unfamiliarity

One of my primary compositional intentions in this work was to examine whether a sense of timbral blend would emerge between its acoustic and electroacoustic forces if the acoustic instruments in the ensemble are made to produce less timbrally recognisable sounds and if these are then further manipulated using the live electronics. The acoustic instruments are thus played using a variety of timbre-modifying instrumental techniques in order to produce their unfamiliar timbres: the woodwind players often use flutter-tonguing and play key trills; the brass players use double bass bows on the rim of their bells at the beginning of the work to produce shrill high-pitched sounds, before playing valve tremolos later on; and the string instruments alternate at the start of the work between bowing over the fingerboard (*sul tasto*), bowing normally, and bowing near the bridge (*sul ponticello*), while playing rapid tremolos in the metred section. Utilising the theoretical framework I outlined in the thesis portion of this document (Chapter 5.2), this compositional approach could be seen, I contend, as one that attempts to foster a tendency towards the perception of the timbres in the works as sounds in themselves (instead of the timbres being identified according to their sources), and thus requiring a greater degree of metaphorical description for the timbres to be semantically captured.

Another aspect of instrumental timbre I explore in this composition is the idea of a juxtaposition of timbral extremes and how this might affect the output heard from the electronics. This concept is implemented in the work as follows: firstly, the instruments play at their respective highest or lowest reasonably playable pitches at the start, then slowly move towards each other and reach pitch unison by the end; secondly, every instrument begins the piece using one of the aforementioned extended techniques, but as the piece progresses, fewer and fewer techniques are employed; finally, the work begins unmetred and rhythmically open before slowly moving towards using more rhythmic material, with all instruments being in rhythmic unison by the end.

I would make two observations from the timbral results of these compositional explorations in this work. The use of extended instrumental techniques to create timbres that act as direct sources for the live electronics works well – I would contend – in contributing to a sense of timbral blend, although perhaps the acoustic sounds heard at times are so stark and enveloping that the relatively timbrally static electronics become drowned out as a result. This also links to the idea of providing the electronics more timbral space to be heard, through simple solutions such as having a greater number of temporal pauses in the acoustic forces – an idea which I develop on in *Degradation*, later in this portfolio. With respect to the use of timbral extremes, I would argue that this compositional strategy produces a timbrally stimulating result in which the electronics transition between two timbral roles over the course of the work: acting from timbrally within the acoustic forces at the beginning due to the timbral extremes exhibited by the acoustic instruments; by the end of the work, this role is reversed, with the electronics acting as timbrally outside the acoustic forces.

Influences

Particulars of certain works including Gérard Grisey's *Partiels* (for 18 musicians, 1976) and *Periodes* (for seven instruments, 1974) had a notable influence on this composition, including the switching between unmetred time and metred notation in both works, the use of horizontal lines attached to notes in the scores to indicate sustained pitches, and the spectrally broad timbral landscape at the beginning of *Partiels*.[9] Works such as Luciano Berio's *Sequenza V* (for trombone solo, 1966) and *Sequenza X* (for trumpet and piano resonance, 1984) were also a source of influence on the extended techniques used for the brass instruments in this composition.[10] The gradual evolution to an active, fluctuating texture from a static, unchanging texture in Tristan Murail's *Ethers* (for flute and five

[9] Gérard Grisey, *Partiels: pour 18 musiciens* (Milan: Ricordi, 1976); Gérard Grisey, *Periodes: per setti strumenti* (Milan: Ricordi, 1974).

[10] Luciano Berio, *Sequenza V: for trombone solo* (London: Universal Edition, 1968); Luciano Berio, *Sequenza X: per tromba in do (e risonanze di pianoforte)* (Milan: Universal Edition, 1984).

instruments, 1978) also served as an influence on my own textural transitions in this work.[11]

Technical requirements

The patch for the live electronics in this work has been tested in Max 8 on a Mac computer with Apple Silicon in both native mode and Rosetta mode. The attached patch is bundled with the two required external objects (*Analyzer* and *Rev3*). Further documentation of the requirements for a performance of this work can be found in the attached score and patch files.

[11] Tristan Murail, *Ethers: pour flûte et 5 instruments* (Paris: Editions Musicales Transatlantiques, 1978); Julian Anderson describes how Murail achieves this transition in the middle section of *Ethers*, namely by compressing 'a substantial 40-second sequence of spectral evolution first into apoggiaturas, then into rapid unison chords, and finally into a texture of tremolos and fluttertonguing' – see Julian Anderson and Tristan Murail, 'In Harmony. Julian Anderson Introduces the Music and Ideas of Tristan Murail', *The Musical Times* 134, no. 1804 (1993): 322.

Fog (2019)

for trombone and electronics – c. 6’

Attached files

Score: Fog – Score.pdf

Recording: Fog – Recording.wav

Background

This composition is written for solo trombone and electronics. The electronics take the form of a pre-produced audio file (made in the digital audio workstations Cubase and Ableton), which is played on a pair of stereo loudspeakers placed either side of the trombone player during the performance. The trombone itself is not subject to any electronics treatment, although it may be amplified for the purpose of balance between the instrument and the electronics. The composition was written for trombonist Sebastiaan Kemner and premiered at Modern Art Oxford on 2nd May 2019 as part of an event titled *The Art of Noises III*, which was organised by the Electronic Music Practice Research Group (EMPRES) based at Oxford University’s Faculty of Music. The attached recording is a combined mix, containing the on-instrument microphone capture of the live performance at this event and the electronics track added in post.

Electronics

The electronics in this work consist of a combination of my own treated vocal samples and two Moog Sub 37 analogue synthesiser tracks, both of which combine to create chords – often microtonal in nature. The vocal samples consist of the long ‘u’ vowel sound sung at different pitches and are shaped, using an ADSR envelope and a low-pass filter with a high resonance and a volume-modulated cut-off frequency, in order to give them a buzzing, more synthetic quality. The synthesiser sounds consist primarily of an initially high-pitched timbre, with a significant degree of noise added, and a much cleaner low-pitched timbre – both of which have a manually modulated cut-off filter applied throughout the recording.

About a quarter of the way into the work (bar 52), the former timbre joins the latter in pitch unison, giving the sense of a single timbral line for the remainder of the recording. Through the modulation of the filter, additional resonance, and overdrive, amongst other effects, the sound from the Moog becomes more and more intense over time. Both the vocal samples and the Moog are triggered in the recording using MIDI output from the score.

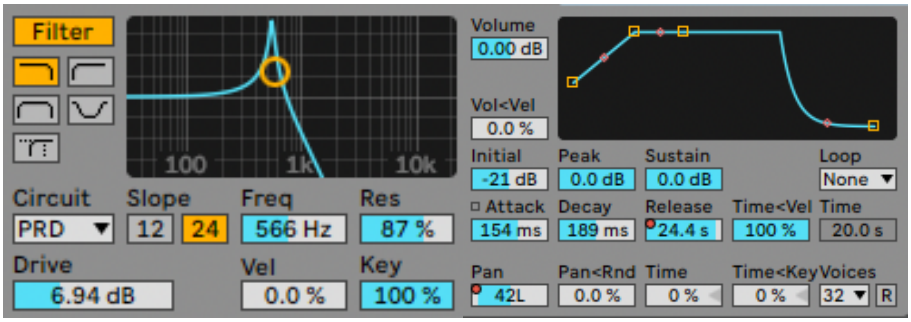


Figure 3: Filter and ADSR envelope applied to one of the vocal samples in Ableton in the electronics of *Fog* (2019).

Score and performance

This work imposes some particularly demanding requirements on the trombonist, who must use a set of in-ear monitors to listen to their chosen reference track during a performance in order to stay in sync with the electronics, all of which include a metronome click to help with this. Not only is this reference track used to stay in sync, but it is also likely to be used to tune the requested microtonal pitches on the trombone against the microtonally comparable pitches in the electronics. Three types of microtonal pitch are used in the work: quarter-tone sharp, quarter-tone flat, and three-quarter-tone sharp. If, for example at bar 12 (0'29'' in the attached recording), a quarter-tone sharp chord features in the electronics, a comparable quarter-tone sharp pitch is requested from the trombonist. The score shows all of the salient notes heard in the electronics on two separate staves (one for the synth, the other for the vocal samples) below the trombone part as a reference for the performer.

During bars 144-148 (3'37'' onwards), the trombonist is asked to modulate their embouchure by mouthing the different vowel sounds indicated above the trombone stave,

which are signified using phonemes from the International Phonetic Alphabet: [ɑ] as in *ah* in the word *car*; and [i] as in *ee* in the word *seen*.

From bar 155 onwards (4'09''), the electronics fade out and the performer plays unaccompanied without a click.

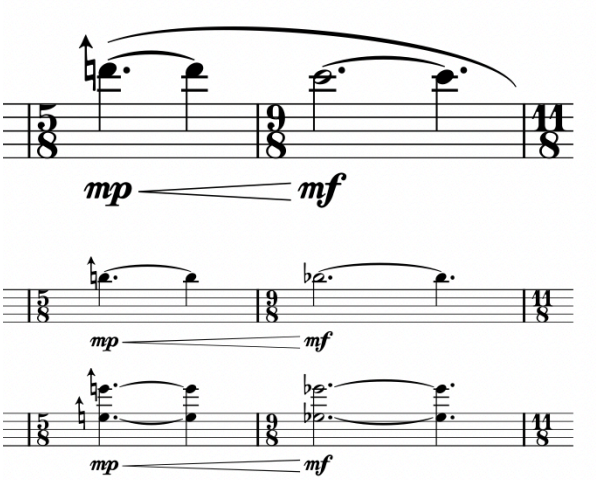


Figure 4: Bars 12 and 13 in the score of *Fog* (2019).

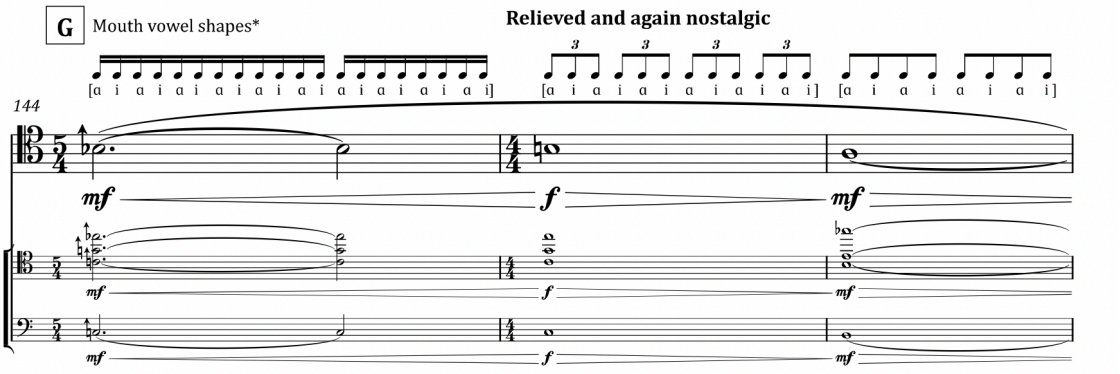


Figure 5: Bars 144-146 in the score of *Fog* (2019), where the trombonist is asked to mouth the indicated vowel shapes.

Discussion

Timbral blend through approximation and extension

In this work, I examine what kind of timbral blend (or lack thereof) might result from having the trombone play with a likely familiar and recognisable timbre whilst taking advantage of the precision afforded by pre-produced audio to timbrally approximate or extend upon the

trombone's sound. As a result, the trombone performs no special instrumental effects and plays within an idiomatic pitch range for most of the work, while the electronics are curated as follows: the synthesiser wave forms are chosen to closely resemble the buzz of the trombone's sound; the cut-off filter of the synth is modulated to imitate the similar timbral effect heard on the trombone when it gets louder or quieter; and the varying degree of static noise heard is added to extend upon the subtle non-pitched air components that can sometimes be heard from the trombone. To further timbrally blur the instruments, they are also in rhythmic unison for much of the piece. The microtonal language employed in the work is also deliberately chosen to further add to the timbral strangeness of the electronics.

I would contend that the result of these compositional choices is a close-knit timbral relationship between the two forces, but one that feels constantly under strain, in part due to the performative difficulty of maintaining temporal proximity to the electronics. In anticipation of this potential strain, the writing of the work is structurally organised so that the tension is slowly increased along several musical parameters over time, reaching a climax from bar 144 (3'37'') where the trombone's full timbral identity is revealed through the gradual timbral disentanglement of the two forces and the eventual termination of the electronics entirely. The microtonality in the ending solo section is also rendered, I would argue, suddenly somehow harmonically ordinary. With reference to Natasha Barrett's 'sound-realism model', discussed in Chapter 5.4 of the thesis portion of this submission, I would argue that this work gradually establishes the criteria for a 'maximum realism' frame of reference over time, in which 'real' sounds – in this case, the resonating bodies of the trombone and the synthesiser that attempts to imitate/extend upon the trombone, both with their 'attention to small details' – situate themselves in a timbral space that becomes familiar through the associations produced within the music itself: a 'non-real-world space', as Barrett terms it.[12]

[12] Natasha Barrett, 'Structuring Processes in Electroacoustic Composition' (PhD thesis, City University London, 1997), 30–36, http://openaccess.city.ac.uk/7468/.

Source of harmonic material

The harmonic material for this work is partly derived– although subsequently significantly transformed – from the third movement of *Suite in D Minor, HWV 437* by George Frideric Handel. Figure 6 below shows a simplified version of the basic harmonic material – without any microtonal inflection – of *Fog*, in which the blue-highlighted notes indicate those that feature in the corresponding chord in the first eight bars of the *Sarabande*, whilst the orange-indicated notes indicate those that I have added to the material.[13]



Figure 6: Simplified version of the core harmonic material used in *Fog* (2019).

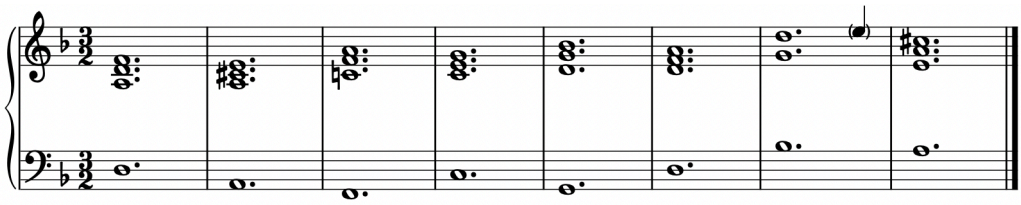


Figure 7: Simplified chord progression in the opening bars of the third movement in *Suite in D Minor, HWV 437* by George Frideric Handel.

Influences

Two influences on the microtonal language in this work include *Étude pour les trilles et la precision des nuances* (for solo trombone, 2015/16) by Kevin Juillerat and *Adventures in Tuning* (for two trombones, 2015) by Roland Moser, both of which were discovered in *The Techniques of Trombone Playing* by Mike Svoboda and Michel Roth (trans. Jon Roskilly) – an excellent resource that was recommended by Sebastiaan Kemner, from which much of the

[13] George Frideric Handel, '*Suite in D Minor, HWV 437*', in *G. F. Händel's Werke*, ed. Friedrich Chrysander, vol. 2 (Leipzig: Deutsche Händelgesellschaft, 1858), 81–83, https://imslp.org/wiki/Special:ReverseLookup/402661.

logistics of microtonal writing and embouchure manipulation for the trombone deployed in this work was learned.[14]

Another influence on the close-fitting acoustic-electroacoustic timbral relationship in this work includes Joseph Michaels' *Assembly Line* (for two soprano saxophones and playback, 2014).[15] In *Assembly Line*, Michaels also takes advantage of the potential to make use of noise-based or noise-inflected timbres in his electronics when combining these with wind instruments (e.g. 0'55'' onwards in the referenced video score) – otherwise, the synthesised timbres at times are very closely approximated to the sounds of the saxes, to the point where there is no telling where the saxes timbres' end and the electronics begin (e.g. 3'51'' onwards).[16] The timbral strangeness engendered by the use of microtonality in the work was also an inspiration for the similar compositional approach I take in this composition.

[14] Kevin Juillerat, *Étude pour les trilles et la precision des nuances* (Kassel: Bärenreiter, 2017); Roland Moser, *Adventures in Tuning* (Kassel: Bärenreiter, 2017); Mike Svoboda and Michel Roth, *The Techniques of Trombone Playing*, trans. Jon Roskilly (Kassel: Bärenreiter, 2017).

[15] Joseph Michaels, 'Assembly Line [w/ Score]', YouTube, accessed 20 October 2018, https://www.youtube.com/watch?v=HSOIRwxJxjw.

[16] Michaels.

Kopf (2020)

for ensemble – c. 9’

Attached files

Score:	Kopf – Score.pdf
Recording:	Kopf – Recording.wav

Background

The small ensemble in this work features a flute, clarinet, piano, violin, and cello. During the writing process, I had originally intended for this composition to feature live electronics of some form, but due to the constraints imposed by the Covid-19 pandemic during this period, this unfortunately became unfeasible to realise, and so was instead written to be a solely instrumental work.[17] The composition was written for the CHROMA ensemble and premiered at the Jacqueline du Pré Music Building in Oxford on 15th October 2020 as part of a composition workshop run by the group. The attached recording is of this performance in the workshop, featuring a combined mix of a stereo room microphone capture and air microphones capturing the instruments from a close range.

Discussion

Timbral object within timbral space

For this work, I specifically wanted to avoid favouring one instrument over another in terms of how they are treated texturally, melodically, and timbrally. As a result, heterophonic or polyphonic textures persist throughout, each instrument is nearly always playing some kind of melodic material and lies within pitch ranges that do not make any particular line stand out, and none of the instruments employ any extended instrumental techniques that would

[17] On a personal note, as this composition was written during the first few months of the pandemic in 2020, I believe the work takes on – both intentionally and unintentionally – a sense of narrativisation that I believe provides a non-articulable insight into my state of mind during those extremely surreal, upsetting, and disturbing times.

make them timbrally protrude. I would argue that what is thus realised in this work is the assimilation of the ensemble into its own complex quasi-timbral object for large sections of the work, sounding simultaneously as one and yet continually breaking out from itself with melodic or timbral fragments that in some sense manage to escape from its main body.[18]

One of the consequences of a lack of an electronic presence in this work is a wider exploration of the timbral space made available by its absence. This can be seen most clearly in the re-use and re-combination of different material in different pitch registers to explore the timbral effects of doing so. For example, bars 12-51 (0'32'' onwards) in the opening section, which oscillate between the low and high pitch registers of the different instruments, are re-used between bars 169-227 (7'18'') in the final section of the work, with shrill high-pitched punctuations of material taken from bars 69-84 (3'18''). Another example can be seen in the re-use of the harmonic material from bars 85-91 (3'58'', also used in numerous other places) in a modified form in bars 159-167 (6'55''); in its original appearance, the material is heard in the middle-high sections of the instruments' ranges, but appears in a much more comfortable and relaxed portion of their ranges in the latter appearance. By creating these different timbral spaces in the work with the utilisation of similar compositional material, I expose (at least partially) the effects that timbre specifically has on the likely musical effect of said material. One could argue that the warm and full timbral space in bars 159-167 contributes to the sense of relief and resolution that the music evokes here, whilst the shrill and bright timbral space in bars 85-91 adds further to the music's building up of tension and despair. This idea of timbral space being opened up by an absence of electronics is explored further in *Antecedent*.

[18] I would also import an additional sense of meaning to 'object' in my use of it here: containing 'expectation, closure, opening', as Tristan Murail articulates in Rozalie Hirs, 'Interview with Tristan Murail', in *Contemporary Compositional Techniques and OpenMusic*, ed. Rozalie Hirs and Bob Gilmore (Paris/Sampzon: IRCAM/Delatour, 2007), 11.



Figure 8: Bars 14-15 in the score of *Kopf* (2020) – re-used in bars 173 and 175 in Figure 10 below.



Figure 9: Bars 68-70 in the score of *Kopf* (2020) – fragments from bar 70 are used in bars 172 and 174 in Figure 10 below.



Figure 10: Bars 172-175 in the score of *Kopf* (2020), made up of fragments from the indicated bars in Figures 8 and 9.

Genre subversion

Another theme that I explore in this composition is the timbral boundaries that normatively separate classical music from other musical genres, whether they be jazz, popular music, or others. The work is developed within a contemporary classical timbral (and social) context, but utilises a range of jazz and funk stylistic influences in order to challenge the generic presumptions that one might make about the work based on its timbral make-up.[19] The core harmonic material for the work is derived from the song 'Uh Uh' from the album *Drunk*

[19] I empathise here with the case for genre subversion that Christopher Ballatine makes in 'Against Populism: Music, Classification, Genre', *Twentieth-Century Music* 17, no. 2 (2020): 247–67. 'Genre transgressions seek to create spaces that might welcome those whose identities are different... [they] explicitly create common ground' (263). Further research on the perception of timbral authenticity as it relates to genre can be found in Steve Waksman, 'Crossing the Electronic Divide: Guitars, Synthesizers, and the Shifting Sound Field of Fusion', in *The Relentless Pursuit of Tone: Timbre in Popular Music*, ed. Robert Fink, Melinda Latour, and Zachary Wallmark (New York, N.Y: Oxford University Press, 2018), 253–76.

(2017) by the genre-defying jazz/funk/R&B composer and musician Thundercat, whilst the improvisatory-like melodic material and the groove-like rhythmic syncopation in the central section of the piece (bars 53-168, 2'30'') further allude to these non-classical influences.[20]

Influences

Other influences on this work include: the first movement of Steve Reich's *Radio Rewrite* (for ensemble, 2012), in which the composer re-uses material from music by the band Radiohead to slowly build up a series of rhythmically intertwining groove-based cells that form a heterogenous texture without any particular instrument dominating; the contrapuntal opening of the final movement of *Octet for Wind Instruments* (1922-23) by Igor Stravinsky, which influenced the opening of the central section of *Kopf* (bars 53-168); and Moondog's 'Symphonique #3 (Ode to Venus)' (1969), whose slow textural build-up of melancholy and despair through an intertwining rotation of repeating yet shifting melodic cells across the different instruments was an influence on a similar build-up of repeating and unstable interacting cells in the latter parts of the central section of *Kopf*.[21]

[20] Thundercat, 'Uh Uh', *Drunk* (Brainfeeder, 2017).

[21] Steve Reich, *Radio Rewrite* (New York: Boosey & Hawkes (Hendon Music), 2012); Igor Stravinsky, *Octet for Wind Instruments* (1922–1923; repr., London: Boosey & Hawkes, 1952); Moondog, 'Symphonique #3 (Ode to Venus)', in *Moondog* (CBS, 1969).

Antecedent (2020-21)

for solo piano – c. 26’

Attached files

Score: Antecedent – Score.pdf

Recording: Antecedent – Recording.wav

Background

This composition of three movements, for solo piano, was written for pianist David Palmer and was recorded at the Jacqueline du Pré Music Building (JdP) in Oxford over the course of 4th-6th August 2021. These recording sessions were conducted by Harris Ferguson at the JdP and I assisted with the process remotely due to the constraints imposed by the Covid-19 pandemic. Similarly to *Kopf*, I had intended originally for this work to feature live electronics of some kind, but due to the pandemic, it is presented as an instrumental work.

Discussion

Timbral versatility, timbral unity

A particular advantage of working with the piano as a solo instrument in composition is the combination (and juxtaposition) of its timbral versatility and its instrumental timbral unity – an instrument whose textural, dynamic, and pitch ranges permit it a plethora of timbral possibilities, and yet an instrument whose timbre is easily recognisable in most listening contexts. One of the primary compositional intentions in this work therefore is the exploration of this timbral versatility. There is also overlap here with two concepts of timbre explored previously in this portfolio: the idea of timbral space, more of which is made available by the absence of electronics (similar to *Kopf*); and the concept of timbral extremes (similar to *Unmeasured*). This exploration is in action in a multitude of senses across the whole work.

Examples of the timbral extremes of the piano being explored include: the juxtaposition between the extremely high-pitched sequence in bars 169-175 (5’49’’ onwards) of the first movement and the ever-deepening sequence with similar melodic material that immediately follows in bars 178-185 (6’02’’); the intensely loud high-pitched extremes explored in the second movement, in examples such as the rapid repeating set of notes in bars 31-37 (8’43’’), or the harsh repeated chords in bars 67-71 (10’31’’); the extremes of both ends of the piano being utilised simultaneously in multiple places, most noticeably in bars 242-244 (27’52’’) of the third movement.

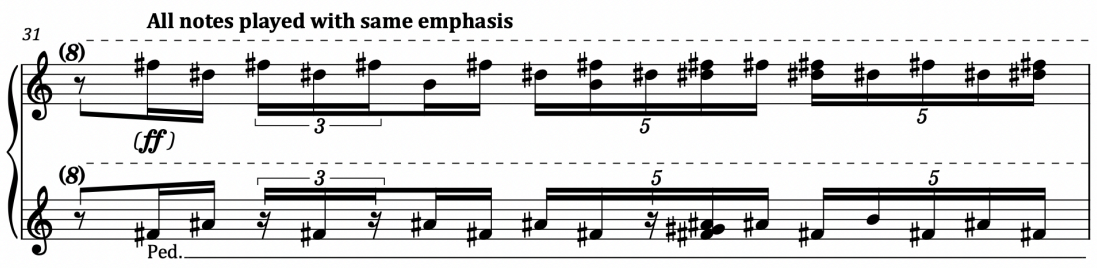


Figure 11: Timbral extremes in bar 31 of the second movement in the score of *Antecedent* (2020-21).

Notable examples of the investigation of the timbral space of the piano more generally include: the chordal sequence in bars 156-167 (5’21’’) of the first movement, within a fairly constrained timbral space, being repeated and elaborated upon across a much larger timbral space in bars 186-202 (6’14’’); the sparse loud percussive punctuations of notes in bars 56-64 (10’02’’) of the second movement situated in between the preceding swirling repeated notes and chords in the upper register and the dense chordal gestures that follow; the continuous and rotational switching of timbral spaces throughout the third movement, with the different spaces slowly being filled as more notes are introduced and the pace of the music quickens; and the contrast between the filling up of the timbral space afforded by the sustain pedal and opening up of the space when it is not used, explored throughout the whole work.



Figure 12: Different timbral spaces being explored in the first movement in the score of *Antecedent* (2020-21) – bars 156-160 repeated in bars 186-170 in a much lower range.

As a result of this exploration of timbral space and extremes on the piano, I would contend that one of the interesting timbral contrasts is how the utilisation of less timbral space leads to a higher perceptual sense of the piano in its instrumental timbral sense, while the maximisation of used timbral space leads to a higher perception of the 'sound-in-itself', as Walther-Hansen terms it.[22] Smaller timbral details are heard when individual pitches are given the space to stand alone, whilst with a mass of timbre a higher sense of impenetrability builds through the use of dense chordal textures. I would argue that this contrast persists regardless of the timbral extremes (or lack thereof) used.

Composer, improviser, programmer

In this work, I also examine the boundaries and interactions between the different roles I inhabit during the compositional process: myself as an improviser, myself as a composer, and myself as a musician in the twenty-first century who is reliant on notation software to

[22] Walther-Hansen, *Making Sense of Recordings*, 55–57.

realise my compositional ideas in a format that other musicians can interpret.[23] Each movement in this work is thus the result of an explicit compositional engagement with each of these roles. The first movement is derived from an audio recording that I took whilst improvising at the piano, which I then transcribed loosely into the score-writing software Dorico, with great creative liberty taken during this process. The second movement is the result of an improvised recording of a different kind, namely a MIDI recording that I made on my digital piano directly into Dorico, which I then extensively edited to make the score legible and so that I could insert my own subsequent compositional ideas (see Figure 13 below for the original unedited MIDI output). Finally, the third movement was composed through a combination of a procedural method and playing around with compositional ideas in Dorico without any form of improvisatory input (see Figures 14, 15, 16, and 17 below for examples of this compositional approach).

By deliberately reflecting on these usually unconscious identities that I occupy as a composer, and by restricting myself to the creative possibilities afforded by each of them, I discovered that the music which results can differ greatly. In the first and second movements, I was able to create a much more – compared to writing without the use of improvisation – rhythmically, temporally, and structurally free musical landscape, although I was also confronted with the difficulty of making the rhythmic ideas conform to the limitations of traditional Western notation. This difficulty became particularly challenging for the first movement, as I had to transcribe these ideas onto a completely blank canvas by ear, whereas with the second movement, I at least had the MIDI output from the recording to work with on my computer screen. For the third movement, the procedural nature of the compositional process led to what I perceive to be a satisfying musical result that is structurally disciplined and rewarding. However, this same process also meant that I could

[23] With respect to what distinguishes improvisation from composition, I am fond of the definitions that Richard Barrett gives: composition is 'any kind of musical creative process or the results thereof'; improvisation is a 'method of composition', and typifies the 'spontaneous element in musical perfomance'. See Richard Barrett, 'From Experimentation to Construction', in *Experimental Encounters in Music and Beyond*, ed. Kathleen Coessens (Leuven, Belgium: Leuven University Press, 2018), 141.

not inject any ideas of a more improvisatory quality, which may have allowed for some creative loosening of the music's rigidity in places.



Figure 13: Unedited MIDI output from a recording of an improvisation on a digital piano for the second movement of *Antecedent.*[24]

[24] The bars here correspond with those on the first page of the movement on the attached finished score (p. 15).



Figure 14: Bars 107-115 of the third movement in the score of *Antecedent* (2020-21), with note names added to the noteheads for ease of comprehension.[25]

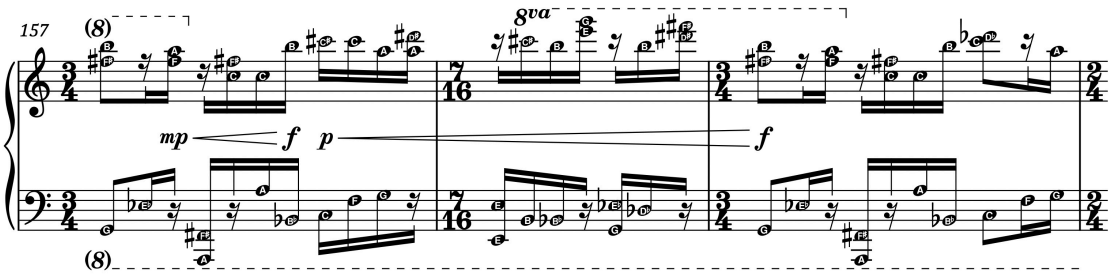


Figure 15: Bars 157-159 in the third movement in the score of *Antecedent* (2020-21).[26]

[25] Here, bars 107-109 show the full sequence of pitches that have slowly built up over the previous few minutes. The first transformational procedure begins in bar 110: each semiquaver beyond the first F# in bar 110 moves back one semiquaver beat, shortening the third bar of the sequence in the process; this process repeats itself a number of times and subsequently expands its procedural scope further – the results of which can be seen in the figures below.

[26] In this example, if notes run out of available space to occupy when moving back a semiquaver, they begin to form chords instead. In this section, once a three-note chord is formed, it lengthens to a quaver and no further subsequent notes are added to it.

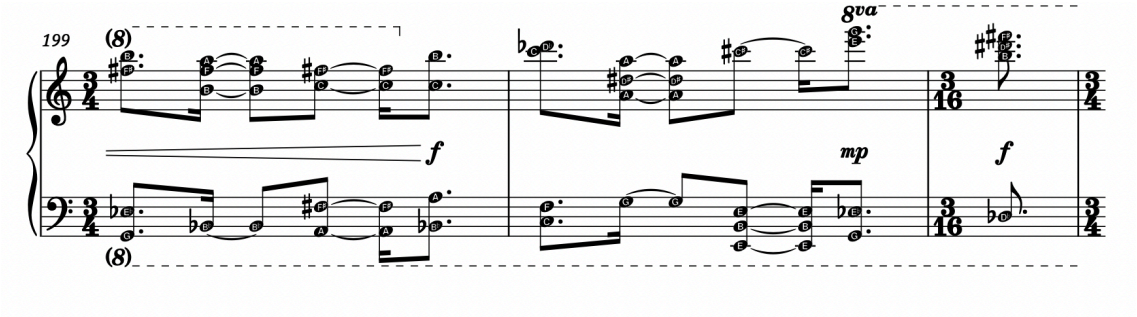


Figure 16: Bars 199-201 in the third movement in the score of *Antecedent* (2020-21).[27]

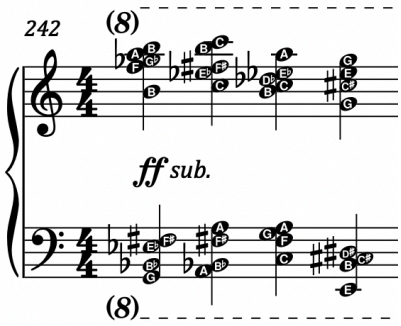


Figure 17: Bar 242 in the third movement in the score of *Antecedent* (2020-21).[28]

Influences

Influences of note on this composition include: the use of timbral extremes on the piano in *The Arching Path* (for solo piano, 2016) by Christopher Cerrone; the opening sequence of rapid semiquavers in the first movement of *Partita, Op. 2* (for solo piano, 1958) by Arvo Pärt, which influenced the build-up of semiquavers in the third movement of *Antecedent*; and the warm but questioning chordal sequences and wandering melodies in the third movement of the same work by Pärt, which influenced the sequence in bars 156-167 of the first movement and bars 117-163 of the second movement in *Antecedent*. More generally, a whole list of György Ligeti's compositions for piano could be named here as influences, but

[27] In this example, the result of every note in the original sequence being subsumed into its own four-note chord can be seen. The first G-E♭-F#-B chord in bar 199 comprises the first four notes of the full sequence in bar 107 (figure 14), for example.

[28] The final result of the procedure can be seen here – nine-note chords. The G, B♭, E♭, F#, B, F, G♭, A, B that comprise the first chord correspond to the first eight distinct notes in the original sequence (with the exception of the B♭ – a post-procedural manual addition).

notable works include: *Études for Piano, No. 13* and *No. 14* (1988-94); and *Musica ricercata, No. 8* and *No. 10* (1951-53).[29]

[29] György Ligeti, *Études pour piano*, vol. 2 (Mainz: Schott Music, 1998); György Ligeti, *Musica ricercata* (Mainz: Schott Music, 1995).

Degradation (2023)

for string quartet and live electronics – c. 12’30’’

Attached files

Score:	Degradation – Score.pdf
Recording:	Degradation – Recording.wav
Max/MSP patch for live electronics:	Degradation – Patch.zip

Background

This composition is written for string quartet and live electronics. The live electronics were created using the object-based visual programming language Max/MSP and are heard through a set of stereo loudspeakers placed either side of the ensemble in the auditorium. The work was written for the Castalian String Quartet and premiered at the Faculty of Music in Oxford on 3rd March 2023 as part of a workshop run by the group. The attached recording is a combined mix of the live capture of the instruments from this workshop performance using on-instrument microphones, and the live electronics which were recorded in Max in post using this performance as its input.

Live electronics

The live electronics in this work are set up, similarly to *Unmeasured*, to allow for the live sound of all the acoustic instruments to be captured using on-instrument microphones during a performance. The live audio is manipulated in real time in the attached Max/MSP patch using a series of spectral shimmer and, at times, spectral granulation effects, before these processed sounds are played back through the loudspeakers. Once the patch is set up and activated for a performance, it can run – assuming it functions as intended – without any required user input.

In the patch, the unprocessed audio from the live strings is first panned to different points in the stereo space and subsequently grouped into one stereo audio channel. After this channel is sent through an audio gate to remove any unwanted noises before processing,

copies of the audio are each fed into four separate *Spectral Shimmer* objects and a *Grain Streamer* object (both developed by Michael Norris).[30] The precise settings of these effects and the degree to which they can be heard are programmed to change automatically over time as a performance progresses. This automation is driven by the *Antescofo* object in the patch (developed by Arshia Cont et al. at *IRCAM*), which also receives a copy of the unprocessed audio, and then tracks the performers' position in the score based on the live audio it receives.[31] Using Max's *pattrstorage* object, the patch is set up to then receive the current detected bar number from Antescofo and perform two actions: interpolate between or immediately trigger stored presets that change the parameters of Norris' spectral effects; and interpolate between different values in audio crossfader objects (part of the *Auzzie* package developed by John Gibson) that determine the mix of the different effects. After the audio is sent through these various effects and faders, the processed mix is sent through a dynamic compressor (part of the *Upshot* package developed by Benjamin Van Esser), a customisable EQ (also part of Gibson's *Auzzie* package), and then a copy of this audio along with the original unprocessed stereo mix is sent to a reverb object (also part of Van Esser's *Upshot* package).[32] A mix of the unprocessed, dry processed, and reverb-processed signals can then be determined.

A simplified diagram of the audio signal and data flow is displayed in Figure 18 below. A full list of instructions for using the patch is displayed in its top level, and extensive documentation of its inner workings can be found across the whole patch and its constituent sub-patches.

[30] Michael Norris, 'Soundmagic Spectral', Michael Norris' website, accessed 6 January 2024, https://www.michaelnorris.info/software/soundmagic-spectral.

[31] 'Antescofo', IRCAM Forum, accessed 8 January 2024, https://forum.ircam.fr/projects/detail/antescofo/.

[32] John Gibson, 'Auzzie', Center for Electronic & Computer Music – Indiana University Bloomington, accessed 6 January 2024, https://cecm.indiana.edu/auzzie/; Benjamin Van Esser, 'Upshot', GitHub, accessed 6 January 2024, https://github.com/benjaminvanesser/upshot.

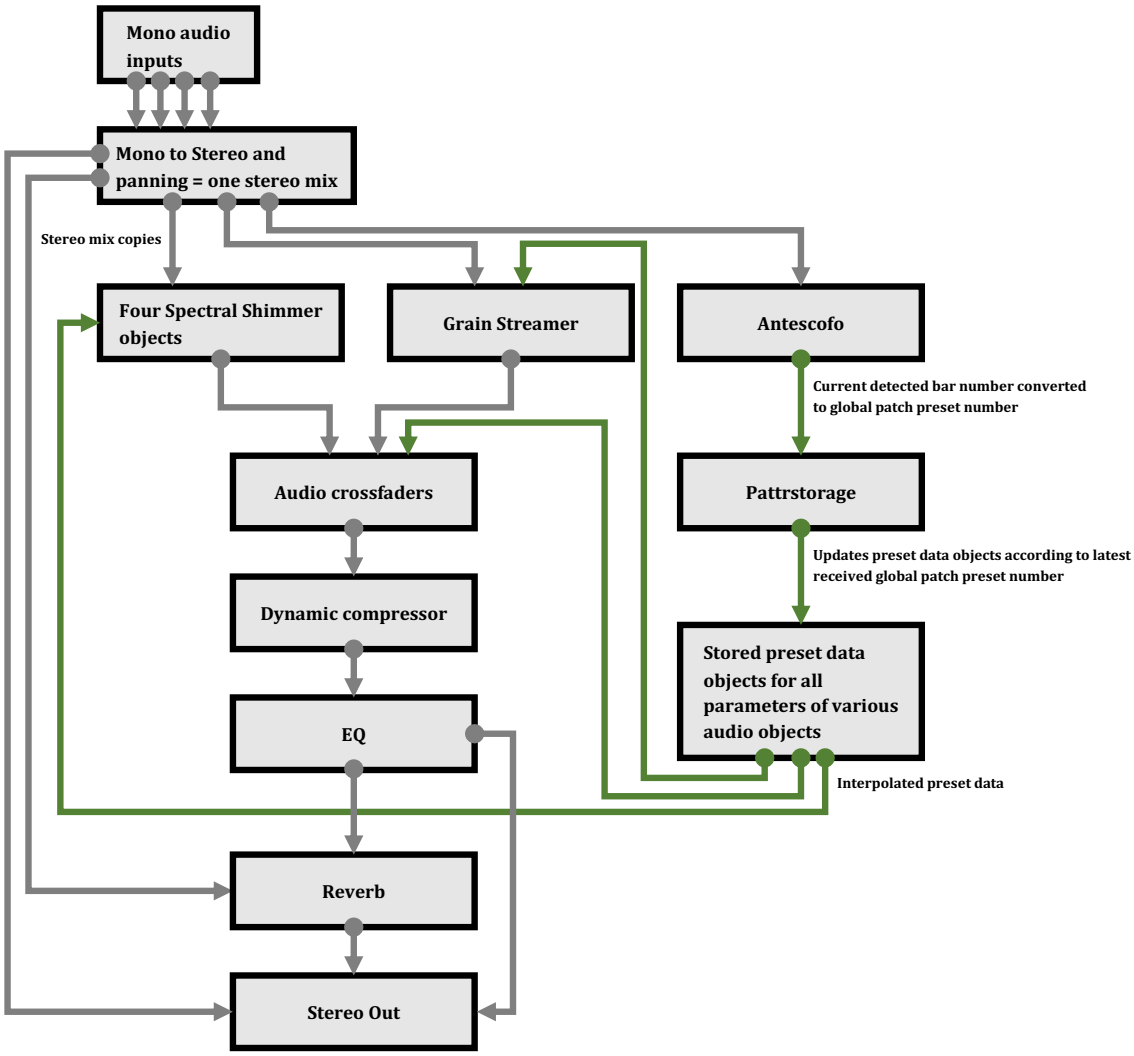


Figure 18: Simplified Max/MSP patch diagram for *Degradation* (2023). Green arrows indicate a data signal; grey arrows indicate an audio signal.

Discussion

Timbral proportionality, blend, blur, space

In writing this work, one of my compositional aims was for the electronic forces to sound timbrally proportionate to the current given state of the acoustic forces during a live performance. This idea of proportionality certainly engages notions of timbral blend, but also encapsulates the aim that the electronics should be timbrally reactive and responsive to both the musical material and the live acoustic signal they receive.[33] This composition

[33] Perhaps the metaphor in Walther-Hansen's work to which this idea of proportionality most closely applies is the 'Balance' metaphor – see *Making Sense of Recordings*, 84–88.

also develops on two compositional strategies from previous works in this portfolio, which were originally deployed for the purposes of exploring what degree of timbral blend may result from their use: the live electronic manipulation of the acoustic forces, as utilised in *Unmeasured*; and the use of rhythmic unison between different forces, as used in *Fog*.

In the preface to *Unmeasured*, I remark on the static nature of the electronics and the risk of their being sonically drowned out because of the at-times stark acoustic timbres. The choice therefore to use the spectral shimmer, grain streamer, and score-following objects in the Max/MSP patch in this work is in part a response to these observations. The use of presets for the effects and real-time interpolation between those presets based on score-following allows for – I would contend – a set of electronic sounds that are tailored to the musical context of the moment. For example, the first preset for the spectral shimmer object used at the beginning of the work adds a very subtle timbral effect to the strings and can hardly be heard, but as the interpolation to the second preset commences from bar 2, the shimmer effect begins to open up and is significantly more bright and noticeable by the time the interpolation is complete at bar 35 (1'23'' in the attached recording); this change of timbre is partly a result of the electronics responding to the denser texture and louder dynamics in the strings, but is predominantly a consequence of the change in the effects' parameters (in this case, an increase in the shimmer's FFT size) – deliberately chosen as such to reflect the musical progression. This change in parameters can be heard especially at the tail end of the section in bars 33 and 34 (1'17''), where the strings are nearly as quiet as they are in the opening bars, allowing for a direct comparison in the electronics' timbres.

As the example just given suggests, the primary compositional aim in the opening sections of the work (bars 1-132) with respect to the relationship between the strings and electronics is to maintain a high degree of both timbral blend and timbral blur between them.[34] In fact, the aim of engendering timbral blend also persists throughout the entire work. The intended level of blur, however, shifts repeatedly to reflect the changing musical

[34] 'Blur' here alludes to the 'Clear/Blurred' metaphor pair in Walther-Hansen, 95–97.

context. In the middle sections, a climactic and loud release of tension is heard in the strings in bars 133-149 (5'28''), which is followed by an energetic viola solo section from bar 151 (5'50'') and then all strings playing together in rhythmic and pitch-class unison from bar 177 (6'20''). In the electronics here, the noisy and muddy grain effects are heard for the first and only time in bars 133-150, whilst the spectral shimmer effects slowly become more piercing, shrill and shimmering – remaining so until the end of these middle sections. This shift in the electronics is a further reflection of the compositional aim of continuous timbral proportionality. The electronics here still sound like they are musically responding to the received live acoustic signal, but the transformation in the musical material's energy brings with it a change in the electronics' timbral role: from one of forming a timbral object with the strings to becoming a timbral object in its own right.

In the closing sections of the work (bars 252-end, 7'55''), the musical material in the strings is structurally and rhythmically identical to the opening sections, but the harmony and melodic direction of the material has completely transformed, creating a more dissonant, sombre, and melancholic feel. This also means that the pitch range which the strings occupy during these sections is significantly narrower in comparison. The timbral relationship between the acoustic and electroacoustic forces, meanwhile, changes once again. As a response to the subdued material in the strings, the electronics take on a role that appears as an ambiguous midpoint between the two roles they have played thus far. They feature warm shimmer effects, but with much more noticeable high-pitched shimmer than in the opening sections, and no grain sounds. A degree of timbral blur thus resumes, but a degree of timbral independence also remains. One example of unambiguous timbral convergence in these sections, however, is in bars 322-326 (10'59''), where the use of *sul ponticelllo* in the strings creates a harsh and shrill timbre that blurs seamlessly into the electronics. In bar 356 (12'24''), the high-pitched shimmer disappears, leaving a timbral warmth similar – if not slightly expanded upon – to that found in the opening sections. The electronics begin to dissipate thenceforth, fading out entirely by bar 399 (14'20''); the strings' use of *sul tasto* here however may lead the listener to assume that the electronics are still present due to

the timbral strangeness created by the combination of this instrumental technique and the repeated *pianissimo* semiquavers on the same pitch.

I make these long-form observations of the shifting timbral roles that the electronics play in this composition as a means of articulating how this work – successfully in my view – navigates the timbral relationships it seeks to create between the acoustic and electronic forces: of proportionality, of blur, and of blend. One final observation I would make in this section relates to the notion of timbral space as I explored it in *Unmeasured*, where I remarked that a greater number of temporal pauses in the acoustic forces might allow more space for the electronics to be heard. This is a strategy that I deploy in *Degradation*, but I would note that during the middle sections, these temporal pauses are largely absent. Perhaps this is why I decided to make the electronics so shrill and fierce here, so that they would still be able to play a noticeable timbral role via the greater occupation of what one might call *vertical* timbral space, as opposed to the greater *horizontal* timbral space they occupy in the other sections.

Influences

A major influence on this work was the first movement of Beethoven's *String Quartet No. 14 in C-Sharp Minor, Op. 131* (1826), which rotates around and moves outwards from a single fugal subject and has an expressive musical language that is evocative of absolute despair and hopelessness.[35] Another more general influence was the sombre, yet meditative and later hopeful mood conveyed in 'Dark/Light 2' from *On Behalf of Nature* (2016) by Meredith Monk.[36] Finally, a substantial influence on the acoustic-electroacoustic timbral relationship in this composition was Cort Lippe's *Music for Tuba and Computer* (2008), whose live

[35] Richard Ormesher provides a comprehensive analysis of this fugue in 'Beethoven's Instrumental Fugal Style: An Investigation of Tonal and Thematic Characteristics in the Late-Period Fugues.' (PhD thesis, University of Sheffield, 1989); Ludwig van Beethoven, 'String Quartet in C-Sharp Minor, Op. 131', in *Complete String Quartets* (Breitkopf und Härtel, 1863; New York: Dover Publications, 1970), 119–58, https://imslp.org/wiki/Special:ReverseLookup/4768.

[36] Meredith Monk, 'Dark/Light 2', in *On Behalf of Nature* (Germany: ECM Records, 2016).

electronics maintain a fully reactive and responsive dialogue with the tuba throughout the work.[37]

Technical requirements

The patch for the live electronics in this work has been tested in Max 8 on a Mac computer with Apple Silicon, although it will only run in Rosetta mode due to *Antescofo* being currently incompatible with Silicon architecture. The attached patch is bundled with some of the required external objects (Gibson's *Auzzie* package, Van Esser's *Upshot* package, and IRCAM's *Antescofo*). Norris' *Soundmagic Spectral* package, which contains the *Spectral Shimmer* and *Grain Streamer* objects, must be downloaded and installed before the patch can run.[38] Further documentation of the requirements for a performance of this work can be found in the attached patch and score files.

[37] The score, programme notes and a recording of the work can be found here: 'Cort Lippe Compositions', Cort Lippe's website, accessed 4 January 2024, http://www.cortlippe.com/compositions.html.

[38] Norris, 'Soundmagic Spectral', https://www.michaelnorris.info/software/soundmagic-spectral.

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Performances and recordings

All recordings were recorded and produced by the author unless otherwise indicated.

Unmeasured (2019) for large ensemble and live electronics – c. 4'30-6'

Recorded at the Faculty of Music, Oxford, on 31st January 2019.

Performed by Ensemble ISIS, conducted by John Traill, as part of a composition workshop.

Fog (2019) for trombone and electronics – c. 6'

Recorded at Modern Art Oxford on 2nd May 2019.

Performed by Sebastiaan Kemner as part of an event titled *The Art of Noises III*, organised by the Electronic Music Practice Research Group (EMPRES) based at Oxford University's Faculty of Music.

Kopf (2020) for ensemble – c. 9'

Recorded at the Jacqueline du Pré Music Building, Oxford, on 15th October 2020.

Performed by CHROMA as part of a composition workshop.

Antecedent (2020-21) for solo piano – c. 26'

Recorded by Harris Ferguson at the Jacqueline du Pré Music Building, Oxford, between 4th-6th August 2021. Recording produced by the author.

Performed by David Palmer as part of a series of recording sessions funded by the University of Oxford Music Faculty's *Graduate Research Award* scheme.

Degradation (2023) for string quartet and live electronics – c. 12'30''

Recorded at the Faculty of Music, Oxford, on 3rd March 2023.

Performed by the Castalian String Quartet as part of a composition workshop.