Portfolio of Original Compositions

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For Stereo Fixed Media
Duration: 12 minutes

Different Streams I
For String Quartet and Electronics
Duration: 8 minutes

…On Perceiving The Enigma of Perspective…
For amplified Chamber Ensemble
Commissioned by the University of Manchester for Psappha
Duration: 16 minutes

Different Streams II
For Amplified Flute and 8-Channel Fixed Media
Written for Gavin Osborn
Duration: 19 minutes

ἀγωνία (agōnía)
For Amplified Violin and Stereo Fixed Media
Duration: 23 minutes

Total Duration: 78 min
Accompanying Scores

1) Different Streams I
2) …On Perceiving The Enigma of Perspective…
3) Different Streams II
4) ἀγωνία (agōnīā)

Accompanying Media

Audio CD 1

i) From The Dark Waters
ii) Different Streams I (Workshop recording)
iii) …On Perceiving The Enigma of Perspective… (live recording)
iv) Different Streams II (studio recording)

Audio CD 2

i) ἀγωνία (agōnīā) - Full recording
ii) ἀγωνία (agōnīā) - Fixed media only

Audio CD 3

Audio examples for Chapter 5 of the Commentary.
Each track number (1-14) corresponds to the audio example number given in this text.
Contents of USB flash drive

Commentary (PDF)

“Scores” Folder:

i) Different Streams I (PDF)
ii) …On Perceiving The Enigma of Perspective… (PDF)
iii) Different Streams II (PDF)
iv) ἀγωνία (agōnía) (PDF)

“Stereo Audio” Folder:

Audio Files (Stereo 24bit/96k):

i) From The Dark Waters
ii) Different Streams I (Workshop recording)
iii) …On Perceiving The Enigma of Perspective… (live recording)
iv) Different Streams II (studio recording)
v) ἀγωνία (agōnía) - Full recording
vi) ἀγωνία (agōnía) - Fixed media only

“Audio Examples” Folder:

i-xiv) Audio Files (Stereo 24bit/96k) corresponding to Audio Examples 1-14 in Chapter 5 of the Commentary.

“Different Streams I” Folder:

i) Max/MSP Performance Patch and associated audio files.
ii) Max/MSP Rehearsal Patch and associated audio files.

“Different Streams II” Folder:

i) Different Streams II – Fixed Media (8 channel interleaved 24bit/96k).
ii) Different Streams II – Solo & Fixed Media (8 channel interleaved 24bit/96k).
Abstract

It is my contention that the worlds of instrumental and electroacoustic music are essentially grounded in one basic reality – the physical properties of sound. If there is a divide, then it is based on compositional models and conventions. This is not to diminish the stylistic or technical differences between the two but rather to make the case for a focus on the core aspects of sound, in order to discover different ways of exploring various possible relationships between music for instrumental performer(s) and digital (electroacoustic) means.

My thesis stems from the argument that every sound has its own spectromorphology– its own inner life governed by envelope, spectral content, energy and internal pulsation. This leads architecturally to considering the relationship of micro- to macro- phenomena and provides the essential foundations for all the compositions in this portfolio.

Taking Pierre Schaeffer’s concept of the “sound object” as its starting point, my portfolio explores various forms of interaction between instrumental and electroacoustic techniques, methodologies and aesthetics, via a range of outcomes for fixed media, acoustic instruments, and combination of instruments with electroacoustic media.
Declaration

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Dedication

I would like to dedicate this PhD to my parents Jean and Stephen Garbett with thanks for all their love, support and encouragement over the years.

Gratitude is owed to my supervisors Professor Ricardo Climent and Professor David Berezan.

I would also like to give special thanks to the musicians I have worked with over the course of this research, especially Gavin Osborn, Savva Zverev, the members of the Quatuor Danel and Psappha.
Introduction

Part 1 - Overview

The term “sound object” (objet sonore) was coined by Pierre Schaeffer in the course of his experiments into musique concrete. His journal “In Search of a Concrete Music”\(^1\) made tentative steps towards the articulation of a new approach to working with sound which was ultimately detailed in his Treatise on Musical Objects\(^2\). This treatise was further explored by Michel Chion\(^3\) and developed by Lasse Thoresen\(^4\). The same concept was taken by James Tenney\(^5\) and evolved into a theory of “clangs”.

My research takes the concept of the “sound object” or “clang” as defined by those aforementioned writers as its starting point\(^6\), filtering it through the writings of Denis Smalley and Simon Emmerson, as well as concepts of interaction proposed by Flo Menezes and Mike Frengel and leads to my central question regarding the use of acoustic instruments within electroacoustic music:

*What happens if we take instruments (with knowledge of typology and morphological potentiality) and place them in a new context, whether an electroacoustic environment or a purely instrumental one – that seeks to avoid “symbolism” or traditional forms?*

This has led me to explore different approaches to typological organisation, musical morphology, spectral content, and interaction in a manner which is specific to each composition and shall be outlined in this commentary.

---

\(^1\) Pierre Schaeffer: A la recherché d’une musique concrète – Éditions du Seuil, 1952 (original publication).
\(^5\) James Tenney: Meta ↴ Hodos - Master’s Thesis (University of Illinois at Champaign-Urbana) 1961
\(^6\) My first piece of preparatory research for the PhD was a composition called *Electronic Study* (2009), applying a Schaefferian approach to recordings of a few household objects – as this was merely an etude I have not included it in the portfolio.
Fig. I.1 Research overview
Fig. I.1 displays an overview of my research progression from the starting point of the “sound object” through the principal focus of each piece and approach to interaction, leading to the compositional outcome.

The portfolio explores this through a range of research outcomes including works for fixed media (From the Dark Waters) amplified instrumental music (…On Perceiving The Enigma of Perspective…) and works for instruments and electroacoustic media (Different Streams I and II, ἄγωνία).

The outcomes of my research together with their subsidiary research questions and objectives may be outlined as follows:

1. **From The Dark Waters (2010-11) [12 minutes]**
   - *How can abstracted syntax combined with spectral content be used to structure a fixed-media composition?*
     - The spectral study of sound
     - The merging and abstracted syntax of natural sound (water) with instrumental sound (piano) and other noise-based percussive sounds via the digital processing of these sounds in the studio environment.
     - The exploration of abstract spaces within the stereo image.

2. **Different Streams I (2011) [8 minutes]**
   - *How can a pre-existing fixed-media composition be used to generate material for a new instrumentally-driven electroacoustic piece?*
   - *How can a typological analysis of material be applied to an instrumental/electroacoustic composition?*
     - The use of an aural score (From the Dark Waters) to generate instrumentally performed responses, followed by the analysis and typological organisation of these recordings as the starting point for the composition.
     - The application and control of performative parameters stemming from electroacoustic studio production.
3. ...On Perceiving the Enigma of Perspective... (2011) [16 minutes]

- How can a spectral and behavioural understanding of sound ("sound object") be applied to a purely instrumental work?

- The use of spectral and behavioural typologies of instrumental sound.
- The exploration of small-scale sound configurations.
- The use of timbral fusion and contrast.

4. Different Streams II (2011-12) [19 minutes]

- How can the continuous frequency spectrum be utilised in instrumental terms through microtones?

- The exploration of spectral space through extended instrumental techniques in the field of microtones.
- The transformation of flute and other sounds through digital processing.
- The expansion of the sonic image to 8 channels (‘surround’).
- The exploration of longer forms and structure.
- The morphological integration and interaction of flute and electronically processed sounds.

5. ἀγωνία (2017-18) [23 minutes]

- How can the ideas explored in previous compositions be further developed in a more integrated way while allowing for a more direct form of expression?

- To confront the issue of ‘historical/traditional’ instrumental writing in dialogue with digitally created morphologies.
- The exploration of spectral resonance, cross-synthesis and a range of studio techniques.
- To explore the micro-level morphologies of instrumental sounds as a means of creating gestures and textures through granular synthesis.
There are essentially three background currents running throughout the portfolio which may be summarised as follows: Defining/Organising Typologies, Exploration of Spectral Space, and Form/Architecture. The manner in which these operate in the various works is outlined in the table below and is discussed in much greater detail in the following commentary. The dominant force throughout, and which encompasses the three aforementioned strands is that of interaction. Interaction involves the relationship of instrumental/electroacoustic sounds, sonic interaction within a given context, as well as interaction with performers. The research also embraces a number of notational strategies for the instrumental parts that respond to the specific compositional challenges of a given work and these will also be explored and discussed.

<table>
<thead>
<tr>
<th>Typology</th>
<th>Spectral</th>
<th>Form/Architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>From The Dark Waters</strong></td>
<td>Contrasting of limited typologies. Sculpting gestures and morphological shapes.</td>
<td>Digital transformation of sounds. Designing spectral space.</td>
</tr>
<tr>
<td><strong>Different Streams I</strong></td>
<td>Analysis of recordings. Typological organisation of materials.</td>
<td>Instrumental techniques. Combination of live instruments and fixed media.</td>
</tr>
<tr>
<td><strong>...On Perceiving The Enigma of Perspective...</strong></td>
<td>Typological blending as well as juxtaposition.</td>
<td>Exploration of the spectral content of acoustic instruments heightened by amplification.</td>
</tr>
<tr>
<td><strong>Different Streams II</strong></td>
<td>Blending of flute sounds with electronic and water sounds.</td>
<td>Developing spectral content in electroacoustic music. Exploring discrete frequency steps and their resultant timbral qualities through microtonal writing.</td>
</tr>
</tbody>
</table>

Table 1 – Research areas
<table>
<thead>
<tr>
<th>Typology</th>
<th>Spectral</th>
<th>Form/Architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>ἀγωνία</td>
<td>Exploration of cross-synthesis, forms of resonance and texture.</td>
<td>Large-scale architecture in 5 segueing sections defined by material-type.</td>
</tr>
<tr>
<td></td>
<td>The exploration of spectra at both micro and macro levels.</td>
<td></td>
</tr>
<tr>
<td>Integration of harmonic/rhythmic instrumental writing with electroacoustic morphologies and energy transfer. The exploration of individual sounds through granular synthesis.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1 (continued)

Part 2: Bridging the Gap - The Meeting of Instrumental and Electroacoustic Techniques and Aesthetics

“As long as we stay with ordinary instruments and the usual symbolism, the formal and material development of music will necessarily be limited to combinations of instruments and combinations of notes.”[7]

With those words Pierre Schaeffer was provoking a discussion, one that was important at that stage of musical history and still resonates today. However I would argue that this precludes a whole range of uses of, and interaction with, traditional instruments and vocabulary. I believe all the instrumental writing in this portfolio stands in response to that statement, by asking the question stated in the opening of my introduction: of placing instrumental morphologies in a new context.

---

Pierre Schaeffer’s theory of the “sound object” relied on its mechanical production being unseen. My pieces use these ideas despite the identification with the acoustic instruments by exploring the spectromorphological properties of individual sounds, gestures and textures in order to move the focus away from a historical formal context.

In one of the defining texts on Electroacoustic Music, Denis Smalley explains the role of human action: “A human agent produces spectromorphologies via the motion of gesture... to apply energy to a sounding body. A gesture is therefore an energy-motion trajectory which excites the sounding body, creating spectromorphological life.” These “spectromorphological consequences” are essentially an audible parallel to electronically generated or treated sound, or indeed naturally-occurring sounds. While he makes clear his arguments for an aesthetic of electroacoustic music, it may also be relevant to, and have potential applications within instrumental writing.

This is most notably the case in Different Streams I where the morphologies of live instrumental sound are dictated by the performative techniques and control over multiple simultaneous parameters, but is also present in each of the works involving instruments (for example the clearly apparent human agency at work in Different Streams II).

The first question at the beginning of my PhD was how to utilise many of the different aesthetics of instrumental and electroacoustic music and combine them with my own developing instrumental language to create something new. The question was how to integrate the knowledge gained from work in the studio to acoustic instruments and vice versa. It is from that genesis that issues of form and interaction arise.

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8 Denis Smalley—Spectromorphology: explaining sound-shapes
Organised Sound / Volume 2 / Issue 02 / August 1997, pp 107 – 126 (p.111)
Part 3 – The Importance of Material in Defining Each Composition

In this portfolio I have approached the compositional process from a number of different angles, and the decisions made at the outset can have a profound effect on the resultant piece. The journey from initial idea to final realisation relies on cohesion, both in terms of language and material. The aim throughout my research has been to unify:

caption

concept – material - methodology – realisation.

The pieces in this portfolio aim to bind the source material to the smaller-scale forms, larger-scale architecture and musical character. In other words, the material defines the formal, as well as conceptual aspects of the composition. For this portfolio I have focused on typologies of sound to provide the material irrespective of their sound-source.

**From The Dark Waters** employs a structure that is defined by its spectral and gestural content and material. The whole compositional methodology of *Different Streams I* was based on different ways of generating and interacting with materials, whose inherent contrasts are then articulated by its moment-form structure. In the purely instrumental context of ...*On Perceiving The Enigma of Perspective*... the typologically-defined material was used to create behavioural and discursive unity and conflict, as well as timbral fusion and contrast, within and between sound configurations.

The use of microtones in *Different Streams II* provided an essential element of the musical character while the use of a series was designed to provide continuity to the solo part. The typological definitions provide both continuity/juxtaposition and fusion/contrast.

The decision to use sounds derived from the same instrument(s) as the live parts in the fixed media of *Different Streams I, Different Streams II* and *ἀγωνία* was made to create fusion between the live instrumental music and electroacoustic elements.
Part 4 – Interaction

The manner in which interaction occurs in this portfolio is discussed in light of two primary articles – those of Flo Menezes9 and Mike Frengel10. Although other forms of interaction occur at different levels and indeed stages of the compositional process (such as Different Streams I) much of the analytical discussion in this commentary will utilize the terminology and conceptualization of these sources.

Menezes described a need to overcome the “sectarian character” of electroacoustic music drawn from the distinction of instrumental writing versus electroacoustic resources and provide a framework of interaction between the two, underpinned by Schoenberg’s “unifying” and “articulating” functions of harmony11. For my own mixed-media compositions I have chosen to work with fixed media “differed time” rather than “real time” processing and so the interactional context is defined by the relationship of live performer(s) to a fully predetermined sonic entity. Frengel defines a complex web of relationships between live and non-live sounds, proposing a “multidimensional framework” and this has also proved particularly important to my approach to this research.

---

10 Mike Frengel: A Multidimensional Approach to Relationships between Live and Non-live Sound Sources in Mixed Works – Organized Sound / Volume 15 / Issue 02 / August 2010, pp96-106
11 Arnold Schoenberg: Problems of Harmony (1934)
Chapter 1: From The Dark Waters (2010-2011)

*For Stereo Fixed Media (Duration: 12 minutes)*

### 1.1 Introduction

*From The Dark Waters* was the first result of time spent mastering the musical instrument that is the studio: from the selection and recording of sounds through their transformation to eventual compositional ordering. It is in many regards an exploration of Schaefferian\(^\text{12}\) \(^\text{13}\) concepts of sound-type and is a work built on the juxtaposition of sound objects to provide continual contrast between spectral occupancy, sonic density, internal rhythm, roughness of grain, modes of attack, acoustical space and so on, as well as Denis Smalley’s article on ‘Spectromorphology’.

The concept was to navigate the worlds of natural sound (water) and instrumental sound (piano) together with other percussive noise created through human engagement with a physical object (banging pans and suchlike) through electronic transformations thereof. It therefore operates on (and constantly shifts between) various perceptual planes ranging from the real-world (and indeed philosophical associations of water) to the completely abstract electronic sounds which produce their own vocabulary and discourse. The cumulative effect lies somewhere in the region of what Simon Emmerson determines as the “combination of aural and mimetic discourse: combination of abstract and abstracted syntax”\(^\text{14}\), although this is applied intuitively to varying degrees, rather than in a dogmatic way.

The perceptual instability is enhanced by the manner in which it toys with the idea of ‘source bonding’ “the intrinsic-to-extrinsic link, from inside the work to the sounding world outside... the *natural* tendency to relate sounds to supposed sources and causes, and to relate sounds to each other because they appear to have shared or

---

\(^{12}\) Pierre Schaeffer: *In Search of a Concrete Music*

\(^{13}\) More recently developed by Lasse Thoresen: *Spectromorphological Analysis of Sound Objects An adaptation of Pierre Schaeffer’s Typomorphology (2001/2004)* The Norwegian Academy of Music

\(^{14}\) Simon Emmerson: *The Relation of Language to Materials - The Language of Electroacoustic Music* p.31
associated origins.”

This identification of certain source sounds placed alongside others which clearly do not belong together naturally, creates an environment which shifts between and juxtaposes that which alludes to the real world and that which is totally artificial (abstracted syntax). The blurring of untreated water sounds and those which have undergone transformation aims to create a surreal, dream-like space, with often sudden changes in perspective. In general the three sets of sound sources behave in consistent ways: water provides texture and environment, as well as occasional punctuation; while the piano and percussive material is used to punctuate and interrupt. Ultimately the formal structure (described below) does not reach a resolution, rather it ‘evaporates’ along with the sounds themselves.

### 1.2 Material and Spectral Content as Architecture

The work is cast in four sections as shown below (Figure 1.1), although as can be seen the central section may be further split in half and there are transitional moments where one section segues into the next. The following spectrogram shows clearly the spectral differentiation between the sections. Indeed the spectral content plays a significant part in forming the architecture of the work, giving differentiated character to the various sections while utilising the same basic sound objects throughout.

Overall the piece follows a path of gradual opening out – allowing greater temporal distance between events and the expansion of spectral and perspectival/environmental space. The density of spectral activity in the second half of section two represents a highly approximate version of the ‘golden section’.

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15 Denis Smalley - Spectromorphology: explaining sound-shapes-Organised Sound / Volume 2 / Issue 02 / August 1997, p110

Fig. 1.1 From The Dark Waters - Spectrogram showing the sectional overview
Fig. 1.2 From The Dark Waters – Annotated spectrogram showing the opening section
Figure 1.2 shows an annotated spectrogram of the opening section up to 1’40”.

This section builds “out of the depths” so-to-speak, arising out of a low frequency cluster of “wind” sound (essentially unpitched noise) and “gurgling” water over which gradually pulsing air sounds fade in and out in clearly higher register. The first ‘Signal’ occurs between 26-29 seconds as an accelerando figure followed by two punctuating accents. This is followed almost immediately by the 2nd ‘Signal’ (a ‘splash’ sound) widening the spectral space which the 3rd ‘Signal’, through high frequency, somewhat metallic droplets significantly intensifies the fourfold widening of spectral expanse. Following the 3rd Signal the spectral content splits into clear frequency strands, in contrast to the rather hazier, less well defined occupancy elsewhere and pulsating ‘breath’-type sounds are taken over by the recurrent accelerando-figure and other percussive interjections. In other words, what began as a slow, irregular pulsation now becomes a more clearly delineated rhythmic entity which bounces between left and right channels: not only has the spectral/timbral distinction of sound become clearer but also its position within the stereo image.

This opening section plays out as a series of “reveals” as if pulling back a curtain to display a new form of material or typology. Each ‘Signal’ (a form of acute punctuation) brings about a change in sonic state (either in terms of frequency, density or typology of sound), for instance the 4th ‘Signal’ clearly alters the type of water/surface interaction – now a much more bass-heavy articulation of rapid dripping onto a hard plastic plane. This conjunction of material-type, spectral content and environmental space is a defining element of the composition as a whole.

The section beginning around 1’50 binds the spectral content and behavioural typology to space. Light drops (sounding like rain) open the section in wide spectral space (separated high and low frequencies with no mid-band) occupying a relatively wide space within the image (environmental distance) and with a staccato-like separation of granular onset. The lower to middle frequencies are taken over by a more complex morphology of “gurgling” water in a layer of continuous sound in much closer spatial proximity. The spectral density of a low piano cluster at 2’20 is matched by rushing water sounds of high frequency and greater noise content as well as percussive articulating gestures. The cumulative effect of the spectral, behavioural and spatial properties was intended to create a sense of oppression and claustrophobia in the listener.
At 6’00 the use of gesture and percussive attack familiar from the opening leads us to another change of sound state, and at 6’20 a similar technique brings about the starkest and most sudden contrast of environmental space in the whole piece. In the final section (highlighted as “4” in Fig.1.1) much clearer spectral bands emerge each driven by a specific sound, each different in its morphology and behaviour.

Throughout this piece there is clear separation of sonic strands and events in terms of Frengel’s nine axes with each sound retaining a clear identity and function. The inter-relationships between axes become much more complex in the remaining portfolio and *From The Dark Waters* represents the beginning of my research in this area.

1.3 Conclusions

By utilising a limited number of sound sources I have been able to focus on their properties in order to begin the development of an approach to typological organisation so fundamental to this portfolio. The particular application of spectra in the work lays the foundations for my research into micro-intervals in Different Streams II and ultimately the exploration of spectral resonance in ἀγωνία.

The combination of Schaefferian sound object and Emmersonian syntax provided not only the theoretical foundations for my research, but also the point of entry into developing a personal compositional language, explored and expanded throughout this portfolio.
Chapter 2: Different Streams I

*For String Quartet and Electronics (Duration: 8 minutes)*

### 2.1 Methodology

Immediately following *From The Dark Waters, Different Streams I* developed as a response to that work and became the first of my portfolio pieces to be concerned primarily with sonic typology as a way into the compositional process and the relationship of instrumental to electroacoustic sound. This line runs through the remainder of the portfolio.

In my introduction I spoke of the importance of raw material to the compositional process and for this composition I used a methodology which would tie together the generation of material with the architectural organization of typologies, and the performers themselves.

Given the opportunity to write a piece for the Quatuor Danel to play in a University workshop I began by inviting the four members to come into the studio individually and record their own personal responses to *From The Dark Waters*. Listening to that piece on headphones I asked them to respond either by imitating what they heard or reacting against it, but always *without thinking*, as the aim was to achieve a completely unfiltered stream-of-conscious response. Although certain clichés emerged, the recording proved a fertile reservoir of materials with which to embark on the development of both fixed media electronics and live quartet writing.

The manner in which I engaged with the musicians produced an interactive compositional loop:

![Diagram](Fig 2.1 - Interaction with the Quatuor Danel)
It also produced a fascinating musical (non-verbal) dialogue since they responded to my electroacoustic music with purely acoustic instrumental sounds thus beginning a process of bringing together the two musical worlds into a genuine compositional hybrid.

After initial analysis of the individual players' recordings, I began to examine the four improvisations synchronised, questioning if there was a resultant structure that could be used as the basis for the new piece. Although this turned out not to be the case, certain types of gestures, textures and forms began to emerge. With this in mind, I edited the recordings into constituent elements and categorized them by typology. It was through this process that both the fixed media and live instrumental music was created. Fig.2.2 shows a diagram explaining the methodology, a process which stood in stark contrast to what was then my usual compositional approach which tended to emerge from an overall concept, and was generally through-composed.
Completed acoustic piece \textit{“Dark Waters”} (December 2010)

**Recording Session**
Danel Quartet Responses to playback of \textit{“From The Dark Waters”}

**Response 1**
Bouncing the four Danel Tracks simultaneously into 1 stereo wav file to make a ‘piece’

\textit{Version 1}: not mixed - balance as recorded.

\textit{Version 2}: Mixed by myself - slight ‘moulding’ of piece by adjusting the balance between instrumental parts (4 tracks).

**Response 2**
Further Analysis of Recordings

**Classification of Typologies**
Selection of samples which could be said to be representative of these recordings.

Creation of fixed media using these selected samples.

Development of fixed media - Process of further selection (focussing on further reduced number of samples) - Aiming for ever greater clarity of sound materials and their transformations.

Composition of music for Live Quartet. Integration of ideas between fixed media and live music.

Development of notational systems for live quartet music.

Can/Should this structure be used as a basis for new composition?

Decision - NO

Fig.2.2 Compositional Process for \textit{Different Streams I}
As the above flow chart shows, the analytical emphasis soon fell on the types of material, the typomorphology of individual sounds and gestures.

The fixed media part was thus composed by taking certain fragments of the recordings which were not only representative but also contained interesting compositional potential. I also brought back some of the original water recordings made in preparing *From The Dark Waters* and thus the instrumental recordings and their transformations were blended with the very sounds that inspired the earlier work.

The fixed media part was kept comparatively sparse in order to allow the live string quartet music to carry most of the musical argument, which was itself based on the material proposed by the quartet players in the recordings.
2.2 Defining Multiple Morphological Processes

Central to the work was the transference of electroacoustic studio techniques into the live instrumental arena, which meant exerting the kind of control over sonic morphologies one has in Digital Signal Processing to the instrumental writing. In actuality this presented a three-part challenge – both compositionally and performatively. Firstly, deciding which parameters could be transformed live through instrumental techniques. Secondly, creating a notation that could adequately describe these processes, and thirdly challenging the performers to enact these parallel but independently controlled and temporally separated, morphologies. The ways in which the various parameters of individual notes and gestures were defined follows thus:

- Variable speed of glissandi
- Variable rate of tremolo
- Specified rate of vibrato
- Variable rate of internal pulsation
- Dynamic envelopes
- Temporal fluctuations
- Alternating bow position on the strings – thereby varying the spectral content.

In Figure 2.3 below there are five elements at play. There are three constants – (i) the gesture: a frequency oscillation - a semitone trill between A natural (880 Hz) and B flat (c.932Hz) (ii) the indication to play it continually as a quasi-harmonic, and (iii) to use level 1 vibrato throughout. There are then two morphological transformations (variables) running in parallel but with temporal independence: (i) a constantly varying rate of tremolo between the two extremes of 0 and 10 (the widest range used in the piece) and (ii) a time-varying dynamic envelope.
Figure 2.4 shows a similar type of gesture as played by the viola (an oscillation – in the last example a relatively stable one but now varying wildly) but this time over a larger interval driven by the vibrato marking of level 4 (the highest level) whereby the vibrato no longer merely “colours” the core frequency but completely alters it vacillating between D sharp and F sharp (311Hz and 370Hz). However in this example there are three stated variables (i) a rate of tremolo which moves up and down within the range of 3 and 7 (ii) the actual rate of oscillation accelerating and slowing (indicated by the feather-beam graphic underneath the stave) and (iii) the constantly changing dynamic envelope.

Figure 2.5 becomes even more complex. There are essentially two halves to this example first a glissando from A 880hz to C 65.4hz ending with a harsh ‘snap’ (Bartok) pizzicato; second a sustained C natural. However these basic gestures are overlaid with a whole host of parametric variants. The glissando is punctuated by sudden accents (similar to amplitude modulation) on each of the string crossings while the speed of the glissando is changing throughout, shown by the wavy line on the upper stave. Throughout all this there is a massive rallentando of tremolo speed from 10 (the fastest possible) to 1, whilst the rate of vibrato increases from level 1 to level 2.
Once we arrive at what initially appears to be a stable frequency (the open C string) this actually proves to be anything but as the spectral content is manipulated by moving the bow backwards and forwards from the fingerboard to bridge, thus completely altering the nature of the overtones, in the manner of a time-varying filter. Whilst spectral transformation is in progress the pulsation created by the bow also changes, beginning at tremolo rate 1 accelerating first to level 3, then 8 and proceeding to vary between limits of 3 and 8. This is also further enlivened by irregular dynamic changes, with accents applied freely by the performer.

Figure 2.5 Different Streams I - page 1 of the score (example C)
2.3 Temporality, Structure and Interaction

_Different Streams I_ was conceived as an exploration of temporal strategies. For much of the piece my aim was to avoid metronomic time or clearly audible pulse, other than for the occasional contrasting passage. Rather than overall uniformity there are three time strategies: (i) the cuing of entries by time-code (ii) completely free-time passages (iii) tempi markings which nevertheless possess a degree of ambiguity by layering different sub-divisions (for instance moment 2). The work is composed on a sliding-scale, alternating between temporally independent layers and rhythmic unison.

It is cast in a Moment-Form structure consisting of 7 moments, or sections, largely corresponding to the rehearsal letters in the score. The concept of Moment-form was defined by Stockhausen\(^\text{17}\) as being sections of music where particular characteristics remain constant – a moment may begin or end abruptly or transition into another moment, and in Stockhausen’s works the order of moments are variable. In _Different Streams I_ the order of moments is fixed with each having a particular focus or set of techniques, which may be summarised thus:

<table>
<thead>
<tr>
<th>Moment/Section</th>
<th>Place in Score</th>
<th>Defining Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Start-B</td>
<td>Temporally independent layers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multiple morphologies</td>
</tr>
<tr>
<td>2</td>
<td>B-C</td>
<td>1st “Classical”(^\text{18}) moment – fast, rhythmically driven – 4:5:6:7 ratios vs. rhythmic unison</td>
</tr>
<tr>
<td>3</td>
<td>C-D</td>
<td>1st Ad lib. moment – free choice in ordering events</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temporally independent lines and events</td>
</tr>
<tr>
<td>4</td>
<td>D-E</td>
<td>Temporally independent lines vs. unison interjections</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Crescendo to…</td>
</tr>
<tr>
<td>5</td>
<td>E-F</td>
<td>Independent, time-varying glissandi relative to time-frames rather than metrical pulse.</td>
</tr>
<tr>
<td>6</td>
<td>F-G</td>
<td>2nd “Classical” moment – espressivo</td>
</tr>
<tr>
<td>7</td>
<td>G-End</td>
<td>2nd Ad lib. moment – free choice in ordering events</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Temporally independent lines and events</td>
</tr>
</tbody>
</table>

Table 2 – Moment form overview of _Different Streams I_

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\(^{17}\) *Texte zur Musik* Band 1 (1963)

\(^{18}\) By using the term “classical” I refer to the use of what may be termed ‘historically traditional’ string quartet writing, without any use of special techniques. These moments stand in contrast to the other five moments.
The moment-form structure allows each section to have clearly defined characteristics, which may be defined in terms of Frengel's multidimensional framework of axes. The typologically driven material of each moment clearly arises from Schaefferian principles - the concept of the sound object which I shall discuss in the following chapter. Suffice to say that each moment is driven by particular types of morphology and behaviour. Moment 1 is based on disparate discursive elements and typologies. While the live quartet retains general dominance (proportional axis) there is a high degree of sonic interaction (both between live parts and with the fixed media) in respect of timbral and behavioural axes.

Moment 2 clearly separates the live and fixed media elements with both sustaining independence on all axes since the quartet perform rhythmically driven material (alternating polyrhythmic and unison), thereby using periodicity in stark contrast to the aperiodic nature of Moment 1; and the fixed media is based on timbral material.

Moment 3 (omitted on the recording) allows the quartet to create interrelationships between the notated material in an ad libitum manner, where an element of chance determines the exact resultant forms and textures at any given point.

Moment 4 utilises the mobiles used in the previous moment in dialogue with the fixed media, which provides accented interjections as well as building texturally as a crescendo into Moment 5 at which point the live quartet and fixed media are proportionally balanced and have the most clearly differentiated material.

The fixed media is given a background environmental function in the final two Moments (6 and 7) with the live writing in Moment 7 harking back to Moments 1 and 3 and providing a sense of relative calm despite the lack of obvious or easy resolution.

Throughout the whole set of moments there is I believe an overarching form resulting from the progression of moments, the continuous presence of the fixed media and the fact that the whole work is to be played without pauses.

By using only two sets of sound sources for the fixed media part: the Quatuor Danel recordings and water, the entire piece engages in varying degrees of fusion and contrast between these elements and between the live quartet and fixed media. For example in the opening seconds the water and sustained chord in the fixed media are matched by the quasi-harmonic trill in the cello and col legno 2nd violin, while the 1st violin entry provides a parallel oscillation to the cello.

For much of the piece varying degrees of sonic difference arise from different playing techniques (both live and fixed media) and digital transformation of string sounds.
Despite the very different types of gesture used in Moment 5 a form of congruence arises from the fact the live players are using standard bowing techniques and the fixed media retains much of the characteristic string sounds (albeit with transpositions and chorus-type effect), driven by a relatively untreated rising, harmonically leading cello figure – this creates two parallel ensembles: a live one and an electronic one.

2.4 Conclusions

To have the Quatuor Danel reinterpret the material they originally proposed (now in the form of my composition) in the workshop completed the performer-composer-performer loop in a research outcome which may be further developed in the future.

The research methodology may be summarised as follows:

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Aural Score

Typological organisation of sounds - Producing moment-form architecture

Development of Performative Strategies
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By using my previous composition as an aural score to provoke instrumental responses from musicians, I began a process that not only displayed how a composition in one medium may be used as the genesis for a work in another medium, but also one that produced a wealth of interesting sonic material. The fundamental typological and behavioural characteristics of these recordings led me to produce a moment-form architecture which highlights the different forms of sonic gestures.

The recordings of the Quatuor Danel also displayed degrees of morphological subtlety and transformation that convinced me that it was possible to develop these performative elements as if they were parameters of electroacoustic music to be controlled in the studio, and have been detailed in this portfolio.

This experimental approach led directly to my reassessment of the ‘sound object’ in …On Perceiving The Enigma of Perspective… It also brought together areas of composition and performance into one combined process.
Chapter 3: …On Perceiving the Enigma of Perspective…

For Amplified Chamber Ensemble (Duration: 16 minutes)

3.1 Introduction

Having explored a structural approach to spectromorphology in From The Dark Waters and questioned the very nature of material and parametric performative strategies in Different Streams I, I decided for my next piece to focus on the very building blocks of music – individual sounds, within the context of an instrumental composition. When commissioned by the University to write a work for Psappha I returned to concepts of typology in order to research the Schaefferian concept of the object-sonore (sound object)\textsuperscript{19} and the dichotomy described by Schaeffer of escritura (notated music) versus electroacoustic resources and aesthetics.

Since the commission denied any use of electronics other than amplification, the research question arose of whether it was possible to take concepts of typology, morphology and behavioural functions into a purely instrumental arena (escritura) and indeed whether the idea of “sound objects” could have relevance.

In this work I set out to explore musical units with particular morphological or behavioural characteristics that would create their own context\textsuperscript{20}, and explore “…the clear distinction, dominant in Western music aesthetics of recent centuries, between potentially ‘musical’ material based on periodic (pitched) sounds and ‘non-musical’ aperiodic sounds (noise).”\textsuperscript{21} This approach then allows a range of relationships between sounds to emerge, together with fusion and contrast within the ensemble.

\textsuperscript{20} “Today, the sound material of music enjoys an autonomy never before accorded it….This liberation permits sound to create its own context” in a manner attributable to “a growing preoccupation with timbral independence.” George Rochberg- The Aesthetics of Survival: A Composer’s View of Twentieth-Century Music (Ed. William Bolcom) p.19
\textsuperscript{21} Simon Emmerson: The Relation of Language to materials (The Language of Electroacoustic Music, Ed. Emmerson Page 18)
3.2 Sound Objects = Clangs

At this point it is important to explain my definition of and approach to “sound objects”.

A “sound object” is a single sound or sound complex defined by and perceived in terms of its dominant characteristics. Essentially this boils down to what we now understand to be the spectromorphological properties of the sound, for example:

- The envelope of the sound; attack, decay, sustain, release.
- The spectral content (frequency partials) and their behaviour across the duration of the sound (stability, periodicity, clarity, individual dynamic envelopes etc.)
- The degree of harmonicity (an aspect of spectra which can be perceived as having clear frequency content or “noise”).
- The instrumentation and the degree to which it maintains the recognizable characteristics of the instrument.
- The energy-motion trajectory\(^{22}\) of the sound.

“Present musical knowledge is, in reality, only a sort of musical phonetics and the rules of a completely fabricated art. The study of musical structures hasn’t even been embarked upon, except for the study of what are quite improperly called “forms” (sonata, symphony, etc.), which are simply customary ways of packaging sound ensembles.”\(^{23}\)

For this work I avoided thinking in terms of larger structures initially and instead focused on small cells in order to allow small-scale forms to develop. Basing my approach to instrumental sound loosely around Thoresen’s\(^{24}\) essay I began by looking into the possible characteristics of an individual sound or sound-group in the manner outlined above. From this I developed units which would exploit such features, the central point of interest within a sound, together with an awareness of the time it takes a listener to perceive a sound, either through extension or repetition.

\(^{22}\) Denis Smalley - Spectromorphology: explaining sound-shapes - Organised Sound / Volume 2 / Issue 02 / August 1997, p.111

\(^{23}\) Pierre Schaeffer (translated by Christine North and John Dack) In Search of a Concrete Music p.133

\(^{24}\) Lasse Thoresen – Spectromorphological Analysis of Sound Objects (2004) Norwegian Academy of Music
Further research led me to James Tenney’s principle of ‘clangs’ proposed in his article Meta Hodos (1961) “any sound or sound-configuration that is perceived as a primary musical unit—a singular aural gestalt.” The importance of Tenney’s approach is to argue for a phenomenological view of music (whether instrumental or electronic), which, in distinct contrast to Schaeffer places focus on the “perceptual”, rather than the “operational” aspects of source material/process used in musique concrete.

I use the following application of clangs together with certain terminology:

Clang – an individual unit of sound – this may be a single instrument or combination of instruments in a synchronous gesture whose properties fuse together.

Fig. 3.1 Two examples of clangs: …On Perceiving The Enigma of Perspective…
– violin, bar 59

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25 James Tenney (Ed. Larry Polansky, Lauren Pratt, Robert Wannamaker, Michael Winter) - From Scratch (University of Illinois Press. 2015) p.33
26 Ibid. p35
Figure 3.1 shows two distinct clangs on a single instrument: the first one being a rapid unpitched bow stroke while the second is made up of 4 rapid iterations of a double-stopped col legno tapping which form a singular unit. Figure 3.2 shows a clang produced by flute (jet whistle), vibraphone and piano in which 3 instrumental timbres are fused together into a perceptual whole.

A clang may vary in one parameter, such as frequency while all other characteristics remain constant such as Figure 3.3, or over a longer duration such as the violin at bars 150-155.
The same is true of the rate of impulses:

I shall use the term ‘clang-cell’ to distinguish a particular kind of sound-configuration - a gesture which contains a number of impulses within a limited time-frame, yet has an overall set of defining characteristics in terms of harmonic or rhythmic shape, envelope and level of energy/motion, for example the piano at bar 62.

A clang may be sustained or extended through repetition – either in its original state, or varied in some parameter.

I use the term ‘clang-phrase’ to describe a passage in which defining characteristics are maintained and in essence a larger clang evolves over a longer time-frame. These shall be described further in the next section.
3.3 Clang morphology, Interaction and the Importance of ‘Timbre’

It is easy to imagine a short, single sound such as figure 3.1(A) as a clang, but what of a longer phrase lasting several seconds? I have already stated that every sound has its own morphology and one aspect of this is its time-varying spectra. If we slow down such frequency variations this can become a musical phrase such as the flute in bars 135 and 137 (fig.3.6) which essentially takes a glissando covering less than a tone and splits it into eleven individual microtonal steps. Each bar is an object created by flute, clarinet and violin as a time-varying spectra – in essence an elongation of what may happen in less than a second – over a period of approximately 6 and 9 seconds respectively. The half-tone (spectrally restricted and breathy) clarinet is matched by violin (artificial) harmonic to provide the relatively stable harmonic backdrop while the flute plays a sequence of descending microtones, (each with subtly changing timbres).

Fig.3.6 …On Perceiving The Enigma of Perspective – flute, clarinet and vibraphone, bars 135-137

The flute in bars 54-55 and 57-58 represents clangs which are shaped over time through varying rate of impulse (accelerando-rallentando) and dynamic envelope.

Between bars 20 and 25 the cello part contains a clang whose precise morphologies are left to the performer (fig.3.7). In this instance the random variations in pitch cover the whole range of the instrument, so its intervallic contour is very much open to chance (the randomized extension of time-varying spectra) – however the nature of the gesture, its timbre, overall dynamic level and clear functional difference separates it from the other instruments in this passage.
The clarinet/flute passage in bars 17-20 presents a clang phrase. This is a phrase which retains consistent characteristics throughout and forms a musical object.

This is important for three reasons: while each individual flute or clarinet phrase may represent a clang in itself (if temporally separated) the two instruments rhythmically interlock to create one overall clang-phrase. This interlocking assumes a singular character through timbre-matching, meaning that the flute playing flautando essentially 'imitates' the clarinet half-tone/toneless technique. In both instances the playing techniques are used to filter the spectral content to produce as seamless a transition as possible between the instruments.

This leads into my use of performative techniques to adjust the parameters of instrumental sound that may be collectively called 'timbre'. This takes us back to the opening paragraphs of this chapter in which I listed parameters such as spectra, harmonicity, envelope etc. These performative techniques arise from an awareness of sound developed in the electroacoustic studio.

A much used example of fusion is to match breathy/toneless bass clarinet sounds with strings playing tremolo sul pont - sul tasto, emphasising the sound of the bow rather than the pitch of a given note:
A different way in which these types of timbre are used can be seen in bars 51-58 (Figure 3.9) where essentially white noise is used to seemingly ‘evaporate’ the pitch centred material at the end of that section.

![Figure 3.9](image)

Fig.3.9 …*On Perceiving The Enigma of Perspective*… - clarinet and violin, bars 51-54

Page 3 of the score presents a number of very different clangs. Bar 11 juxtaposes two clangs at the extremes of harmonicity. The downbeat combines piano clusters (modified in their sound by the preparations which add percussive noise elements), a jet whistle on the flute (essentially unpitched, dominated by rush of air) and rapidly alternating chords in the vibraphone. The resonance of the attack is contrasted with a single E natural, a considerable reduction in spectral content, repeated on piano.

From letter F in the score the piano (with books or blocks of wood on the strings) is matched by tongue-blocked flute and string pizzicati all of which have the effect of a band-pass filter, with emphasis on the attack portion of the sound which becomes more percussive in the use of col legno and fingerboard ‘slaps’. The latter two also have a profound effect on the spectral content of the notated pitches – col legno proving a highly filtered, narrow bandwidth at the upper end of frequencies and hits to fingerboard dense, resonant clusters as all the strings vibrate together with the body of the instrument.

It is precisely because of this kind of spectral-filtering, that when, at Letter O all performers utilise the full harmonic spectra of the instruments (made all the wider by the use of piccolo and bass clarinet) which have been, for the most part altered or masked in some way up to this point that the nature of the music is completely changed – from something brittle, at times dark, fragmentary, and with instrumental distinctions blurred – to a sudden burst of harmonic colour.
In Bars 36-39 (Figure 3.10) the playing techniques of flute, clarinet, piano and violin are matched to provide timbrally unified punctuation-like gestures over the cello’s *sul pont* moto perpetuo. The wavy red lines indicate timbral blending and the flute/clarinet gesture is reminiscent of the old fashioned “reverse-tape” effect by having an elongated onset with the attack coming at the end, emphasised by the violinist hitting the fingerboard. This gesture (bar 37) is then compressed in the following bar before the clarinet breaks out of its single pitch into a melodic contour while maintaining the same method of sound production. All instruments use playing techniques to reduce the level of harmonicity and increase the level of ‘noise’ – in other words distorting the central pitches.

![Fig.3.10 On Perceiving The Enigma of Perspective – bars 36-39 [annotated]](image)

The first two bars of letter G (figure 3.11) provide a rare moment of complete ensemble unison, both rhythmically (unified periodicity) and in terms of the instrumental timbres deployed. The piano and cello form one pairing at the lower frequency range and the flute (key slaps), vibraphone (using the wood of the beaters), and violin (col legno battuto, with all four strings stopped at the top of the fingerboard) another higher pitched group:
3.4 Organising clangs

Having defined individual clangs, clang-cells and clang phrases, the sections of the work are based on the following organizational principles:

- Sequences of individual clangs or clang-cells.
- The extension and layering of clangs.
- The construction of ‘clang-masses’ (described below) that are perceived in terms of overall shape/density rather than constituent elements.

Every boxed notational cell, together with the piano writing in the first five bars represents a clang or group of closely related (varied repetition) clangs. Apart from the piano clusters which clearly act as temporal markers (punctuation) the functionality of all other sounds, is simply to contribute elements to an overall mass. However because of the ad libitum placement of each clang it is possible for resultant, complex clang-forms to occur by chance from the particular combination of constituent elements. This is an example of a ‘variable’ mass – two examples of what may be termed ‘fixed’ masses occur in bars 29-30 and bars 162 (3rd beat) – 164 (to end of beat 1). In these examples the clang mass is created by the ensemble in
summation – the listener perceives the rhythmic/spectral shape of the gesture rather than each individual note within it: these are examples of larger-scale clangs in the Tennian sense. By separating objects through the rest of the piece not only do their characteristics become clearer but they begin to take on functional roles in the musical discourse.

An example of extension and layering occurs between rehearsal marks [I] and [J] in the score. The main focus of attention may be drawn to the vibraphone since it is the most resonant instrument at this moment playing tremolo chords with sustain pedal depressed for each one, and with the duration of each chord allowing both the placement of pitches and the timbre to be appreciated.

The second layer contains violin and cello harmonics. The third layer is made up of clarinet multiphonics which are the most unstable sounds in this example, their spectromorphology is unpredictable – the sounding partials can vary together with the amplitude of individual partials, indeed the whole timbre can change. Multiphonics will always be the instrumental sound which takes the longest for a listener to perceive, and therefore requires a reasonable duration.

These layers are punctuated by a flute gesture which is essentially noise-based: a complex sound dominated by the sound of air rushing. This flute gesture uses repetition not only to provide an articulating function to the music but also for the properties of the sound to be recognized since a single staccato impulse could not register in any meaningful way.

The timbral blending of string harmonics (both natural and artificial) with clarinet multiphonics, provide a form of time-suspension (no obvious pulsation, regular or otherwise) against the sonic ‘fragility’ of the clarinet. The slow pace here allows the listener to really hear the vertical plane (frequency spectrum) with all its irregularities coming from the multiphonics. The accelerando-rallentando flute punctuations provide a somewhat eerie typological contrast whilst serving to reinforce the somewhat vague temporal flow.
From sections built on fragmentary gestures (rehearsal letters F-G), to those in which the ensemble becomes unified in the behaviour (rehearsal letters G-H) to the highly complex, irregular and unpredictable (Bar 1 up to letter A), the piece aims to avoid conventional concepts of structure, and what has been described by Lachenmann as “syntactical blueprints”\(^27\) - focusing instead on the perception of sound configurations at any given point.

The whole section from A to F is concerned with juxtaposition of vertical lines and counterpoint with more fragmentary gestures.

At Letter F there is a profound change from the layering up of textures (most complex up to A, but continuing through the next section) to the isolation of gestures, each one clearly defined in its sonic characteristics and behaviour, whilst also being spectrally and timbrally altered in some way from its ‘natural’ or ‘traditional’ instrumental state.

Many (though not all) of the passages tend to avoid a sense of onward structural propulsion as they are primarily concerned with their own internal configurations, this is not a music of easy resolution. Even where there is propulsion at the onset of the final section, signalled by the piano bass thuds and cello glissando\(^28\), as the sounds appear to be pulled downwards by gravity, dissolving clear frequency into noise, it still leaves a question mark over its resolution. It is a piece devised to question the degree of autonomy and relations of clangs, together with our perception of temporality and of form.


\(^{28}\)The cello glissandi complete with the detuning of the C string represents the pitch-time paradigm described by Stockhausen in "... wie die Zeit vergeht ..." (1957) (...how time passes... Die Reihe Vol.3 [prefigured by Henry Cowell and traced back as far as 1853 by David Lewin to Moritz Hauptmann’s “Die Natur der Harmonik und Metrik”] and much critiqued since; whereby slowing the rate of vibrations we move from the pitch domain to rhythm (individual impulses). In practice this also leads to other noise elements sounding caused by the creaking peg, thus the passage from periodicity (pitch) to aperiodicity (noise) is complete.
3.5 Amplification and Space

In his article “Space-form and the acousmatic image” Denis Smalley explores and defines numerous manifestations of space, from a compositional and listening perspective, in both electronic and instrumental music. …On Perceiving The Enigma of Perspective… uses many of these within its compositional argument.

It blends ‘gestural space’ (“the intimate space of individual performer and instrument”) and ‘ensemble space’ (“the personal and social space among performers”, “within which individual gestural spaces are nested”) with ‘microphone space’. In this work all the instruments are closely and individually amplified in order to emancipate sound from the normal restrictions of hearing within an auditorium, given the distance between performers and audience.

The title of the piece reflects its inspiration from the concept of manipulating and reinventing perspective in the visual arts, notably Escher and Hockney, and the creation of alternative realities, as well as the phantasmagorical imaginings of the surrealists. The idea is one of no absolute and that perspective exists in our perception – therefore enigmatic and malleable. At play here is an alternative sonic reality not defined purely by the instrumental means of production, but rather enhanced by amplification to give equal dynamic value to all sounds, from the quietest possible (for example the string players rubbing the body of the instrument or lightly sliding the bow between the scroll and the end of the fingerboard, stopped with the hand) to the loudest piano attack.

3.6 Conclusions

The use of amplification to emancipate the instrumental sounds is symbolic of my research in this piece – by using the Schaefferian ‘sound object’ and Tennian ‘clang’ principle I have sought to question the forms and architecture of an instrumental composition. My methodology therefore has shown a possible means of emancipating individual sound configurations from historical lattice-based designs.

Denis Smalley – Space-form and the acousmatic image-Organised Sound / Volume 12 / Issue 01 / April 2007 pp.35-58

IBID p.41

IBID p.42

However, by “equal dynamic value” I do not mean uniform amplitude levels, rather the capacity for all sounds to be heard clearly, no matter what their properties may be.

Discussed in Chapter 5
Chapter 4: Different Streams II (2011-12)

For Solo Flute and 8-Channel Electronic Music (Duration: 19 minutes)

4.1 Introduction

Following Different Streams I, this is the second piece to have developed out of my acousmatic work From The Dark Waters.

While From The Dark Waters was built on larger sections based on spectral content, it also began an investigation into typologies of sound. In Different Streams I I created moment-forms out of typologies, whereas On Perceiving The Enigma of Perspective... focused on individual sound-configuration or clangs. By the time I began composing Different Streams II I felt the need to combine gestural shapes with a return to an investigation into harmonic spectra, in order to create a larger-form work. With a growing awareness of the potential for using pitches outside the tempered chromatic scale I wanted to research the area of microtonality, and given the opportunity to work with flautist Gavin Osborn, this proved to be an ideal project for both the instrument and performer.

4.2 Title, Aims and Typologies

Whilst indicating the use of water sounds, the title also refers to:

- The juxtaposition and interweaving of different characteristic musical lines.
- The establishment and interrelation of different typologies of sonic material (incorporating the full range of instrumental playing techniques).
- The deployment of contrasting spatial strategies.
- The use of various approaches to the frequency continuum.
- The interaction of solo instrument with electroacoustic media.

My intention was to create a work that employed (more or less) all available sounds from the instrument as well as those of the performer.
Instrumental Sounds:

- ‘Traditional’ playing (in the Western ‘classical’ sense).
- Microtones.
- Key clicks (various types).
- Breath sounds through the instrument.
- Tongue Pizzicato.
- Tongue Rams.
- Harmonics.
- Glissandi.
- Flutter-tonguing.
- Multiphonics.
- Air rushes over the mouthpiece.
- Throat Buzzing.

Vocal Sounds:

- Breath sounds (inhaling and exhaling).
- Tongue clicks.
- Lip ‘popping’.
- “Sshh” sounds.
- Phonetic air-based sounds.

The only vocal sounds I chose not to include were speech, and sung tones (or hummed tones) since the latter would vary wildly from one performer to the next depending on whether they were male or female, and their vocal range.

In addition to this I created material that could be grouped into classifiable typologies based on rhythm, pitch (wide/narrow bands or large interval leaps), the use of articulation, etc. These were then merged with the various typologies of other sounds based on ‘extended techniques’ resulting in a variety of different phrase structures – some of which explore one particular technique, while others employ a wide range of typologies which are nevertheless linked by certain characteristics (such as the nature of attack, duration of sound, the element of noise, and so on).
4.3 Investigating Microtones

While many approaches are based on mathematical ratios\textsuperscript{34}, or else tied to the natural harmonic series such as French Spectralist composers such as Tristan Murail and Gerard Grisey or at the more extreme end of Spectralism, Horatiu Radulescu, the approach that particularly interested me for this piece, given its instrumental scoring, was that used in the solo instrumental music of Karlheinz Stockhausen, especially the numerous works for flute and basset horn which stem from the \textit{Licht} cycle. The approach used here is based on melodic contour – an extreme form of “ultrachromaticism”\textsuperscript{35}. Two pieces of particular interest to me were \textit{Yspilon} and \textit{Xi}.

Although still essentially using discrete steps, the concept of exploring the frequency continuum in instrumental music is something for which the flute is ideally suited. The process began by researching available intervals and fingerings. I then gave this information to the flautist Gavin Osborn, and in Studio 3 at Novars we recorded some 208 individual microtonal pitches between B\textsubscript{4} and G\#\textsubscript{5} plus the relevant tempered pitches.

The purpose of these recordings was to gain some insight into the characteristics of the various microtones and begin to imagine how they could be explored in the composition. Whilst, according to some sources\textsuperscript{36}, there are over 40,000 theoretical fingerings/frequencies for the flute, there is also a fairly wide gulf between what is theoretically possible and can be achieved under the egis of scientific research (under particular acoustic conditions – and not accounting for perceptual/psychoacoustic issues) – and what can realistically be employed in the course of a musical performance. Whilst these specific pitches may be achieved individually (if sometimes by using incredibly uncomfortable fingerings) a clear, logical strategy must be employed in order to facilitate the smooth passage from one pitch (and fingering) to the next in the context of a composition.

\textsuperscript{34} For instance using Meantone, Just Intonation, or other indigenous tuning systems.
\textsuperscript{35} This was a term used by Wyschnegradsky, according to Julia Werrntz \cite{Werrntz2001}.
\textsuperscript{36} “The Virtual Flute” \url{http://flute.fingerings.info}
It is also possible that while certain tones will work effectively on some instrumental models, they may not work on others. Therefore, I felt it was important to provide a degree of flexibility to the performer in order for them to explore ways of making the piece ‘work’ on their instrument.

I therefore developed a notational strategy which allowed me to indicate the number of micro-intervals between tempered pitches and indicate their approximate distance from each other, whilst at the same time allowing for slight differences in the choice and acoustical nature of the precise resultant frequencies from one player (indeed performance) to the next. The notational strategy consequently employed is detailed in the preface to the score.

4.4 Increasing the number of Pitches

The complete set of microtones together with their fingerings is shown below. Upward arrows indicate pitches that are slightly raised from the preceding note and “N” above a pitch indicates standard tempered frequency and fingering. It is worth noting that the fingerings displayed were devised by Gavin Osborn to work within the particular melodic context in which they occur.
Fig. 4.1 *Different Streams II* - Extension of the flute’s pitch range and increasing the number of pitches available
Number of regular notes in flute range B-B♭ = 36
Total number of pitches shown here through extended techniques = 130

(Fig. 4.1 continued)
4.5 The Solo Part

In order to provide continuity through a larger time-span I decide to use a note series (fig. 4.2) and the variation of melodic or gestural cells throughout.

The Series

![Graph showing the series](image)

Fig.4.2 Different Streams II –The Series

The live instrumental writing is based upon the typological classification and ordering of melodic/harmonic/rhythmic material in the same way as other works in this portfolio apply such strategies to broader sonic materials. All the principle elements of the piece are laid out in their simplest form in the opening of the flute part (Letter A). The entire work is based on this material (together with the series) in the form of juxtapositions, expansions (for example bar 16 expanded in bars 78-85) and reconstructions of these basic harmonic, rhythmic and gestural motifs.

The work begins from the narrowest frequency bands with each sound limited in its overtones due to the use of key clicks and tongue pizzicato – with wider bands (blown normally) pitches introduced gradually in the first 15 bars. As soon as more “traditional” playing takes over at letter C we are immediately placed into the realm of microtones.

The 18-note row is played in full at letter C with microtonal step-wise frequencies between the tempered pitches, whilst the row (minus micro-intervals) is heard asynchronously in the fixed media.
The series can be heard at various points, for example bars 54-62 (fig. 4.4), 96-101 (with repetitions) (fig.4.5), 129-134 (pitches 1-14) (fig.4.6)
In Bars 45-52 two approaches to frequency come together with the Western tempered chromatic scale combined with microtones in between. This is enhanced in the fixed media by the creation of a frequency “wedge” steadily increasing in dissonance as the frequency band widens from top to bottom yet the internal distance between frequencies reduces. This is a technique found often in the early works of Penderecki\textsuperscript{37}, though here the spectrum is controlled electronically.

Examples of shapes used to expand or contract the harmonic/spectral content can be seen below. Penderecki (in instrumental terms using adjacent chromatic notes and quarter-tones) used them frequently in 1960s to early 1970s and I have used them throughout my electroacoustic music.

\textsuperscript{37} For example \textit{Threnody for the Victims of Hiroshima}: Figs.10-20 (study score – Edition Eulenburg ETP3008), \textit{Magnificat}: opening of Movement III “et Misericordia eius…” pages 45, 46 and Fig.2a on page 49 – Movement VII “Gloria” Fig.15 page 93 (study score – Edition Schott 6646)
Gradual broadening of spectral content:

Fig. 4.7 Shape 1: Broadening spectral content

Gradual reduction of spectral content:

Fig. 4.8 Shape 2: Reducing spectral content

Fig. 4.9 Shape 3: Varying spectral content

Fig. 4.10 Shape 4: Varying spectral content with glissando

These shapes can be layered or used in various ways and differing combinations.

In Bar 71 we have another form of spectral ‘wedge’ (described above) though here it is entirely acoustic – by specifying the keys to begin the gesture the frequency is as clear as it can be (given the method of production) however this clarity is obscured by the increase in keys pressed and the percussive (noise) aspects, thereby reducing harmonicity.

In Bars 118-121 Quarter-tones act as a bridge between the tempered scale and microtonal scales heard at letter C forming the relationship of Tempered-scale/Chromaticism → Quarter Tones → Micro-Intervals (of varying frequency-width).
At letter M (144) the repeated alternation of Tongue Pizzicato and Flutter-tonguing highlight these opposing characteristics of playing, while the occasional, aperiodic Flutter-tonguing becomes a larger gesture in the second bar. This is emphasized and made more extreme by the sound of “wind rushing” in the fixed media – a clearly related, yet transformed sound. The second bar of this example includes an example of the most directly related material to playing technique whereby the Flutter-tonguing (rapid reiteration/attack impulse) matches the speed of frequency alternation.

![Fig. 4.11 Different Streams II (bars 144-145)](image)

From letter O I developed further expansions/deconstruction/reconstructions of Page 1.

From letter Q I employed a process of gradually ‘thinning-out’ the harmonic/spectral complexity matched by an increasingly sparser density of sound. This is highlighted by the separation of pitched material into clearly ‘high’ and ‘low’. The gradual dissolution of the music is reminiscent of the conclusion of From The Dark Waters where the sound conceptually “evaporates”.
4.6 Interaction with Fixed Media

As described by Menezes and Frengel, there are many potential forms of interaction. For *Different Streams II* I grouped meeting-points into 5 principle categories which I shall outline below.

Direct Contact

The performer is synchronous with the fixed media in their gesture, whether or not they share similar spectromorphological properties, they have the same attack impulse. This can be seen in the following examples where the fixed media adds resonance to the pitches performed by the soloist.

Fig.4.12 *Different Streams II* (bar 127 - excerpt)

Fig.4.13 *Different Streams II* (bar 159 - excerpt)

Fig.4.14 *Different Streams II* (bars 162-163)
Direct Shadowing

The fixed media synchronously expands notes played live by the soloist, as if “growing out” of the live music. There are a number of moments where a form of “chorus” effect occurs:

This becomes more precise and pronounced in the following example.
Gestural interaction
This is essentially a “call and response” type of interaction in which similar material is presented by the soloist and the fixed media in some form of conversational relationship. Bars 73-76 show this through the gestural shapes and behaviour of the granulated sounds in the fixed media set against the soloist.

Fig.4.18 Different Streams II (bars 73-76)

Similarly-voiced Polyphony
In such cases similar sounds are present in both the live part and the fixed media. This produces a “doubt state” in which the listener can no longer distinguish between sounds performed live and those produced by electroacoustic means.

Throughout this work much of the fixed media is based on sounds stemming from the solo instrument which are pre-recorded and given varying amounts of processing. Where the material is in its most ‘natural’ state this can be used to blur the distinction between voices. The passage from bar 136 (L) is one such example of this. In bar 211 the electroacoustic flute sounds prefigure the live part which enters in the following bar. This is a direct form of temporal displacement, something which is used to far more complex effect in the fragmentation of the soloist's material for example bars 82-85 and bars 132-142.

At the other end of the spectrum is total separation. Here the soloist and fixed media are clearly separated on the axis proposed by Frengel. In such instances both have different musical arguments, behaviour etc. – both may be competing for dominance or the fixed media may be very much in the background (for example where the score indicates “ambience”).
4.7 The Performer’s relationship with Space

The layout of speakers in performance is as follows:

![Speaker Diagram]

Fig.4.19 Different Streams II – layout of speakers

The amplified sound of the soloist should be projected through speakers A and B at the front of the stage. There is then a ring of eight speakers – one for each of the corresponding channels in the fixed media playback. This represents the most basic system, where additional speakers are available (as in the MANTIS performances) then I diffused the 8 channel image over additional “rings” of speakers for example those set on the floor and ceiling as well as a distant ring.

The overall ‘structure’ of the piece is one of variation and transformation, and the concept of a ‘journey’ through various acoustic spaces. This is achieved through varying amounts of processing of different sound materials to produce a constantly shifting scale between relatively untreated sounds to those with a far greater timbral distance from the instrumental protagonist. This relationship of performer and fixed media leads us into issues of spatial differentiation, together with the use of different ‘sound-spaces’ arising from spectral occupancy, spatial positioning, acoustic properties, the nature of sonic events and so forth.

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38 If the soloist’s amplified sound is not projected through the front two speakers (A & B), it may be projected through speakers 1 and 2 in the ring of eight.
One sound that is directly developed from performer-based sound is that of breath which becomes “wind”-like and pans around the 8 channels. Another sound is granulated key-clicks whose gestural shape is matched by the movement in space. Material that I consider to be of more “ambient” nature – spectral washes of sound that provide a background to the soloist also open out the space by employing a greater sense of environmental distance.

The main forms of spatialization are as follows:

- Temporally short directional gestures.
- Sounds coming from multiple channels simultaneously.
- Rotational movement linked to sonic typologies.
- ‘Free-floating’ counterpoint(s).
- Fragmented and multi-directional gestures (including granulation).

When composing works for soloist and electroacoustic media I tend to imagine it in a very human-dramatic way, by placing the performer in a virtual world – a sonic environment in which they have to navigate and interact with sound and space. The opening up to rehearsal letter C is designed both to lay out the sonic material and create a situation where the soloist appears to be cautiously beginning to explore and make sense of this new space. There are moments of repose and others, for example bars 144-146 where the performer appears to have to use greater physical exertion to overcome the electroacoustic sounds that surround them. Although the soloist is clearly fixed in space, the electroacoustic sounds stemming from the flute move around all 8 channels and surround the audience, creating an interesting relationship between our perception of where the sounds ought to emanate from and where they actually come from.

I have mentioned breath sound becoming “wind”-like but it also provides a reminder of the human performer at the heart of the piece and in bar 195 provides a rare moment of intimacy.
4.8 Conclusions

Through this composition I have shown how the frequency spectrum may be traversed through micro-intervals in a way that may be blended with the spectral content of electroacoustic sounds. Progressing on from all the previous works in this portfolio, *Different Streams II* shows how typologically-driven material can be combined with a note-series and be organised in a fluid way which comprehensively explores not only the possibilities within the material itself, but also various forms of interaction with electroacoustic media.

Owing to the exploration of spectral space and typological organisation, this work engages in a discourse between instrumental performer and fixed media, which is further expanded through the use of multichannel spatial strategies.
Chapter 5: ἀγωνία (agníā) (2017-18)

For Amplified Violin and Stereo Fixed Media (Duration: 23 minutes)

5.1 Introduction

ἀγωνία represents the culmination of my research and brings together many of the concepts I have explored in the previous compositions: spectral architecture, sound-objects/clangs, and modes of interaction. It also marks a return to elements of tradition in terms of writing for an acoustic instrument. As a former violinist I felt a need to confront the historically-based forms of harmonic and rhythmic writing together with the types of gesture so characteristic of the classical repertoire of the instrument and integrate these elements with the electroacoustic language I have developed throughout my years of research. I chose to avoid, for the most part, “extended” techniques - instead focusing on the possible relationships between melodic or rhythmic material and electroacoustic morphologies.

In doing so, I have been forced to confront not only the Schaefferian opposition of escritura to electroacoustic music, but also the paradigms Trevor Wishart\(^39\) has eloquently described as lattices versus evolving morphologies.

Wishart shows the pitch-time relationship in its discrete steps (Fig. 5.1)\(^40\) as opposed to an “evolving timbre-stream” (Fig.5.2)\(^41\) of morphologies possible via electroacoustic means.

\[\text{Fig.5.1 Wishart: “Music on a two-dimensional lattice (schematic representation)”}\]

\(^40\) Ibid p.25
\(^41\) Ibid p.27
These schematics show distinct differences between “notes” (of relatively fixed frequency and timbre) existing in defined temporal units (semiquaver, quaver etc.) whose properties remain consistent (irrespective of their ordering or musical ‘style’), and morphologies which may alter gradually over time, splitting into streams and be shaped in a myriad of different ways.

It is clearly the case than any composition for instrument(s) and electroacoustic media must navigate this relationship and the works in this portfolio have all approached this challenge in different ways, however by focusing on the melodic, rhythmic and expressive qualities of the violin these contrasting elements are brought into sharper relief.

5.2 Sound Sources

Whereas Different Streams II utilises harmonic and gestural counterpoint stemming from the pre-recorded solo line, there is no such use of the live violin part in ἀγωνία. Instead I chose to focus on certain typologies of violin sound as the basis for gestures and textures. I performed and recorded these myself and they include:

- Single harmonics.
- Individual pizzicati.
- Col legno gestures (battuto and tratto).
- Tapping the body of the instrument.
- Wiping the instrument with a duster.
- Different individual bow strokes of varying pressure.
- Short improvised gestures (for example the arpeggiated gesture heard in the introduction).

In addition to these violin sounds I have also included some sounds which I already had in my archive of recorded material.
These are:

- Fragments of cello recordings, performed by Guy Danel\(^\text{42}\) in the preparation of *Different Streams I* (harmonics sul pont, pizzicati, col legno battuto, knocking the body of the instrument, a short gesture of extremely harsh bow pressure).
- Some individual notes played on the harp by Rebecca McIlroy\(^\text{43}\) (used in the section from Rehearsal letter I)
- Recordings of a tam tam and suspended cymbal.

Additional Sounds recorded specifically for this composition were:

- Stainless steel egg cups struck together.
- Pyrex bowls of different size struck to produce a ringing tone.
- The metal shelf of an oven rapidly scraped guiro-like with a fork handle (heard at the climax of the work – the end of Section IV).

### 5.3 Resonance, Cross-synthesis and the Shaping of Sound

The introduction (approximately one minute of fixed media alone) provides a good example of some of the techniques used throughout the piece in terms of shaping essentially noise-based sound.

The essential starting point was the sound of rubbing a duster over the instrument [audio example 1 – completely untreated original recording]. This was submitted to a freeze-frame in MaxMSP (essentially pausing the sample and sustaining the spectra) and played through a series of overlaid, time-varying resonant frequencies in Cecilia resulting in certain pitches emerging and receding as controlled by dynamic envelopes. This sound was cross-synthesised with violin harmonics producing a completely new hybrid timbre. This process was repeated numerous times and the final mix contains a combination of several such layers. These layers were also processed through time-varying filters which gradually alter the spectral content (occupancy, range and density in an effect of ‘opening’ and ‘closing’ parts of the

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\(^{42}\) Recorded in Studio 3 of Novars, University of Manchester; late 2010-early 2011

\(^{43}\) Recorded in Studio 3 of Novars, University of Manchester; 29th July 2015
spectra in a manner similar to a brass player’s mute). The effect of spectral motion is enhanced by panning within the stereo image.

From the centre of the audio image emerge sustained harmonic sounds (the sound of a Pyrex bowl cross-synthesised with a violin harmonic). This provides contrast in terms of its stable spectra, which is reinforced by its static spatial positioning.

The result of this can be heard in audio example 2.

Into this is placed a clang which may appear to a listener somewhat detached from the other material. This is an improvised arpeggiated figure on the violin, heard in its original sonic state (except for some minor EQ treatment). This isolated figure returns at various points in the work becoming more integrated into the rest of the material, as the fixed media begins to encompass more sounds of distinct (string) origin.

The only other sound is that of col legno tapping of which there are only four iterations of a four-impulse gesture.

Fig.5.3 (audio example 3) displays a spectrogram of the opening section up to 1’35” annotated as follows:

A (together with the horizontal white lines) shows the stable frequencies (largely occupying the lower to mid bands until 0’50” where they also begin to occupy the upper band).

B (boxed area) shows the more diffuse time-varying spectra which encompasses the whole spectrum but is most active in the higher frequencies.

C Indicates the first entry of col legno taps – notable both for their attack (the only sound so far in the piece to have an audible onset) and extremely wide spectra.

D shows the sustained frequencies of bowl/harmonic sound.

E indicates the entry of arpeggiated violin sample.

The dotted white lines show some examples of the spectral motion created by filtering.
Fig. 5.3 ἀγωνία - Annotated spectrogram showing the opening section up to 1’35”
Important examples of cross-synthesis occurring elsewhere in the composition stem from the sound of rubbing with the duster. In Section IV (Rehearsal letter P) samples of col legno battuto that have been subjected to granulation are cross-synthesised with the duster-sound. The difference between this example and that of the opening section is that the full envelope, spectral motion and irregular pulsation of the duster-sound are maintained, rather than sustained by a freeze-frame. This process gives the texture and sound quality of the col legno-derived granulation a shape derived from the duster-sound. This can be heard in audio example 4 and in the context of the full fixed media in audio example 5.

Audio example 6 illustrates how this same sample (duster) has been cross-synthesised with a sample of a suspended cymbal. This can be heard in its full context in audio example 7.

Occurring within the fixed media at Rehearsal letter Q is a cross synthesis between the same cymbal sound and a granulated texture drawn from the combination of violin and harp sounds. An extract of this is given in audio example 8.

The section from 14'40" layers different forms of granular synthesis which may be heard separately in audio examples 9-11.

Audio example 9 contains four samples of the more inharmonic, irregular and varied granulation. Audio example 10 contains three samples of clearer central frequencies. Audio example 11 contains the 3 samples of the most rhythmic elements with the final two the least processed and therefore most clearly identifiable as violin sounds. Audio example 12 contains the complete fixed media of this section.

Fig.5.4 shows spectrograms of these samples showing the contrasting levels of energy across the frequency spectra, with each one having its own very distinct shaping.
Fig.5.4 áγωνια - Spectrograms of audio examples 9 - 11
Not only do these layers contain clear differences in spectral occupancy and behaviour, they are also characterised by different degrees of harmonicity, density, internal pulsation and grain-type.

The onset, sustain and decay of each grain may be likened to different forms of violin playing: pizzicato, different forms of col legno, different types and pressure of bow strokes. The length of grain and intervals of entry, not to mention number of grains per second and stochastic algorithms used will all produce very different forms of sound-mass, from those with clearly articulated grains to those which fuse together into more continuous tones. Audio example 9(D) combines two distinct granular layers with the higher band preserving characteristics of col legno battuto in rapid pulsation while a lower frequency band fuses grains together into a continuous tone.

In considering the grain of these sounds it is interesting to compare a completely untreated sample of extreme bow pressure on cello, with extremely rough grain and pulsation, this can be heard on Audio example 13 and is used in this same form in the piece (Audio example 12 at 0’07”) and binds together different uses of grain – one, gestural and untreated, the other textural and the result of synthesis.

Fig 5.5 illustrates how I have explored similarities between types of violin playing and approaches to granular synthesis, from degrees of harmonicity to the temporal spacing and shape of grains. This illustration is not intended to be fully comprehensive and there are infinite stages, overlaps, and variables in any such scale. This is particularly the case when considering the number of variables involved in granular synthesis. However it does point to some key, generalised typologies used in the piece.
**Scale of harmonicity**

<table>
<thead>
<tr>
<th>Clear Pitch</th>
<th>No Clear Pitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonics</td>
<td>Extreme bow pressure—sul pont</td>
</tr>
<tr>
<td>Arco normal</td>
<td>Other noise-based sounds such as knocking body of instrument, or wiping instrument</td>
</tr>
<tr>
<td>Sustained bow strokes—even pressure</td>
<td>Maximum range of frequencies producing multiple side-bands</td>
</tr>
<tr>
<td>Trills (frequency oscillation but smooth grain)</td>
<td>Greatest speed and number of grains</td>
</tr>
<tr>
<td>Sustained frequency tremolo</td>
<td></td>
</tr>
<tr>
<td>Pizzicato</td>
<td></td>
</tr>
<tr>
<td>Short durations of arco with changing pitch (eg. rapid semiquavers)</td>
<td></td>
</tr>
<tr>
<td>Col legno tratto</td>
<td></td>
</tr>
<tr>
<td>Arco sul pont (light pressure)</td>
<td></td>
</tr>
<tr>
<td>Col legno battuto</td>
<td></td>
</tr>
</tbody>
</table>

**Scale of grain separation (of same or extremely limited frequency band)**

<table>
<thead>
<tr>
<th>Temporally separated</th>
<th>Uniform entry/duration of grains</th>
<th>Overlapping grains</th>
<th>Overlapping grains of long duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain envelope</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>or:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Similar to:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual pizzicato/col legno</td>
<td>Regular pulsation eg.</td>
<td>Tremolo</td>
<td>Sustained tones</td>
</tr>
</tbody>
</table>

Fig.5.5 Violin to granular synthesis comparison chart
5.4 Spectral Shaping

In chapter 1 I have described an approach to spectral architecture and in this work the spectra is controlled to shape, contrast and provide the essential character to the various sections of the fixed media.

The following spectrogram (Fig.5.6) clearly shows the use of sustained horizontal bands against highly diffuse ‘cloud’-like spectra in the opening of the work. This use of spectral occupancy and behaviour is brought into sharp focus when compared with the spectrogram in Fig.5.7 displaying Section IV with its predominantly vertical column-like spectra.

Fig.5.6 áγωνία - Spectrogram of the opening section up to 2’20”
Fig. 5.7 ἀγωνία - Spectrogram of section 4

Fig. 5.8 ἀγωνία - Spectrogram of the fixed media 6'09" – 8'32", with timings which refer to audio example 14
Audio example 14, shown in Fig 5.8 brings together an important intersection between gesture and the use of spectral space. It represents one of the major punctuation marks in the fixed media which brings together not only intensity of volume but also spectral energy. The onset of the sound-complex builds to a peak at 0'11 releasing energy across the entire frequency spectrum, as the level of force dissipates, so the cluster of frequencies disperse into strands which traverse the spectrum lattice-like as the amplitude steadily decreases. From 0'59" the lower half of the frequency spectrum is taken over by sustained frequencies shifting focus from the vertical to the horizontal axis.

5.5 Typology, Structure and Interaction

The five sections of the composition are broadly-speaking defined by the type of material contained within both the solo line and the fixed media.

In the first section the fixed media takes a background role for the most part while the soloist performs relatively long phrases. The solo line is concerned with the gradual onset and sustain of sound matched by dynamic contours which fade in and out the phrases (for example bars 63-66).

Section 2 places greater emphasis on sharp attacks (for example bar 99) where the violin entry is reinforced by the fixed media. The solo part explores a far broader range of articulation and performative techniques with a greater emphasis on short gestures, especially bars 155-173. This approach is also applied to the fixed media utilizing a greater range of sound-types. It is here that granulation first comes to the fore as well as sounds containing sharp attack and rapid (almost instant) decay such as pizzicato and col legno (relatively untreated) which share similarities with the particles created through granular techniques. This fixed media pizzicato and col legno passage (Rehearsal letter K) also marks a clear separation from the soloist by providing a contrasting gestural counterpoint and independence on the axes proposed by Frengel.

In sections 3 and 5 the fixed media recedes to the background with no gestural interaction with the soloist, whose part is extremely limited in its range of performative techniques and most intimate in its expression.
Section 5 behaves essentially as a ‘moto perpetuo’ focusing on the accumulation and transfer of energy between the soloist and fixed media defined by dense, complex textures.

The dynamic scope and content of the fixed media ranges from providing a spectral backdrop to the soloist, through textures and gestures which provide support or moments of timbral and rhythmic interaction through to instances of extreme amplitude which either interrupt, completely obliterate the solo line (bars 138–139 – 9’50") or terminate the solo as at the very end of section 4.

A point of complete fusion occurs in bars 285-286 where the violin harmonics are merged with those in the fixed media to produce one unified sound.

### 5.6 Title and Recording

ἀγωνίᾱ (agōniā) in Ancient Greek comes from ἀγών (agón).

I (genitive ἀγωνίας) first declension.

It has various meanings which represent different aspects of the piece both stylistically, performatively and psychologically:

- contest, struggle for victory
- gymnastic exercise
- (of the mind) agony, anguish

The solo violin part was performed by RNCM student Savva Zverev and recorded over two 3-hour sessions in Studio 3, Novars on Thursday 1st March and Monday 5th March 2018, engineered by myself. I edited, mixed, and mastered the full recording between March and May 2018.
5.7 Conclusions

ἀγωνία shows how granular synthesis techniques can be used to mirror the typologies of sound so characteristic of the various performative techniques on a particular instrument. In this case I chose the violin, however the same principle may be applied to other instruments (or indeed non-instrumental sounds). The work thus displays how the shared origins of instrumental and electroacoustic sounds may be fused together through their basic DNA. My exploration of spectra, which began in From The Dark Waters has expanded throughout this portfolio and I believe this work shows extensive development in this aspect of my research. By exploring the typologies of violin sound in this composition I have examined the dichotomy of lattice-based models and electroacoustic morphologies in a way which focuses on shared properties of sound as a unifying function, as well as the vehicle for dramatic discourse.

Ultimately the work fuses together the strands of research outlined in my introduction. By developing the compositional strategies detailed in this commentary I have reached a point where it has been possible to re-engage with more historically-based models of instrumental composition to produce a work which melds technical rigour and an expressive musical argument.
Conclusion

By taking the fundamental aspects of individual sounds (their spectromorphology) as the starting point for my research I have explored a wide range of vocabulary, techniques and applications which have been documented in this portfolio of compositions and commentary.

As stated in my abstract, I believe there are shared origins for instrumental and electroacoustic music (or indeed any form of musical expression) which, if fully utilised, may transcend genre. However this can only be done by appreciating the intrinsic properties of sound and I hope, through the course of my research and varied outcomes, to have shown some of the compositional ways in which this may be achieved. My portfolio has explored various ways in which the aesthetics and practices of acoustic instrumental music and technology may be brought together, compared, contrasted or even fused.

Through the implementation of a number of different strategies I believe I have been able to produce compositions of distinctive character by unifying the elements of compositional process: concept, material, methodology and realisation. By working with flautist Gavin Osborn I have been able to explore microtones, and use the recording of the solo part to show how this may be integrated into electroacoustic media to provide a range of transformations and interactions. While my work with the Quatuor Danel led me to explore a range of sonic outcomes I could not have predicted at the outset.

I believe my portfolio exhibits a number of ways in which the typology and spectral content of sounds may be used in the organisation of a musical work, from spectral content defining the sections of a work (From The Dark Waters) to the arrangement of typologies to produce a moment-form structure (Different Streams I). They may be used in avoidance of conventional form by focusing on smaller-scale sound configurations (…On Perceiving The Enigma of Perspective…) through to the use of variation and electroacoustic morphologies in Different Streams II and the direct confrontation of lattice-based instrumental composition with electroacoustic media in
ἀγωνία brought together through the fusion of their shared sonic DNA, as explored through granular synthesis.

The relationship between instrumental and electroacoustic elements has indeed proved to be a wholly reciprocal one. Beginning with a fixed media piece (*From The Dark Waters*) combining a range of sounds (natural/instrumental/electronically treated) I have been able to show how such an outcome may be used as the starting point for a second piece by extracting responses from instrumentalists (Quatuor Danel). The typological analysis of instrumental sound in that composition led directly to *Different Streams II* and *...On Perceiving The Enigma of Perspective...*. By focusing on spectral content in *From The Dark Waters* I was then able to question the application of the frequency spectrum to a solo instrument, by exploring microintervals on the flute (*Different Streams II*) and finally to the micro- and macro-application of spectra (largely derived from instrumental samples) in ἀγωνία.

In taking the concept of the ‘sound object’ or ‘clang’ as the basis for my research I have discovered different applications within both instrumental writing and electroacoustic media which exploit the varied spectromorphological content of source material in order to produce an original body of work which I hope will challenge listeners and be of some significance in the field.

My portfolio has addressed questions of interaction, not only in a literal sense of performer to fixed media but in terms of interaction between sonic materials (whether containing similar or contrasting properties) as well as the interaction of composer and performers in the process of generating and responding to material.

By presenting these scores, recordings and analyses which show how the theoretical impetus for the compositions has been realised in practice, I propose these strategies as templates which may be applicable to a wide variety of musical situations, irrespective of the material contained within or the compositional style.
I firmly intend to build upon this research in the future and in presenting this portfolio I hope to generate further discussion among composers, performers and musicologists, in order to further explore and develop new relationships between performers and electroacoustic media. I believe such hybridisation will continue to expand the possibilities for new music.
Appendix: Performances

1. From The Dark Waters (2010-11) [12 minutes]
   *Acousmatic – Stereo*
   Premiere: June 10th 2011 - MANTIS Festival,
   Cosmo Rodewald Concert Hall, University of Manchester

2. Different Streams I (2011) [8 minutes]
   *String Quartet and fixed media electronic music – Stereo*
   Workshop performance: Quatuor Danel
   March 10th 2011,
   Cosmo Rodewald Concert Hall, University of Manchester

3. …On Perceiving the Enigma of Perspective… (2011) [16 minutes]
   *For amplified Chamber Ensemble – 6 players*
   (flute/piccolo - clarinet/bass clarinet – violin – cello – vibraphone – piano)
   Commissioned by the University of Manchester for Psappha
   First Performance: Psappha - January 27th 2012 -
   Cosmo Rodewald Concert Hall, University of Manchester.

4. Different Streams II (2011-12) [19 minutes]
   *For Amplified Flute and 8-channel electronic music*
   Written for Gavin Osborn
   Premiere: Gavin Osborn (flute) Andrew Garbett (sound diffusion)
   October 27th 2012 – MANTIS Festival, John Thaw Studio Theatre, University of Manchester

   Second Performance: Gavin Osborn (flute) Andrew Garbett (sound diffusion)
   - April 3rd 2014 - Salford Sonic Fusion Festival, University of Salford, Media City, Salford.
   Third Performance: Brittney Balkcom (flute) - 25th September 2015 -
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Helmut Lachenmann: III. Streichquartett "Grido" [Breitkopf & Härtel]
Krzysztof Penderecki: Magnificat [Schott]
Krzysztof Penderecki: Threnody for the victims of Hiroshima (Eulenberg)
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