A Practical Investigation of Expectation in Acousmatic Music

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Abstract

The experience of expectation within acousmatic music is regarded as problematic because the electronic mediation of sound permits and even encourages composers to combine and integrate sounds of widely varying origins that may carry equally divergent aesthetic implications. Because of this, the compositional management of expectation in acousmatic music presents many challenges beyond those found in Western tonal music where familiar musical grammar assists the listener in comprehending the tensions and implications that contribute to expectation.

Therefore, the purpose of this research is to investigate the nature of expectation within acousmatic music by means of a practice-based methodology.

The composition portfolio itself has led to two new frameworks being proposed. The first, acousmatic skip-diving, provides a method for the *ad hoc* evaluation of materials and their interactions in situations where large numbers of existing sound materials are available.

The second framework – sonic evidence – is based on some of the fundamental principles of forensic science and crime scene investigation. While not derived from my compositional practice, this reflection on the practical outcomes of the research is intended as a useful tool for the listener or musicologist to consider future development of events in a piece of music in terms of expectations aroused.

While this study was never intended to provide a definitive answer to the issues surrounding expectation in acousmatic music, it has further illuminated the challenges facing listeners when attempting to anticipate events within a work, and how composers may create moments of surprise within their music. Furthermore, the ideas explored within the dissertation provide important building blocks through which further examination of expectation within the genre may take place.

Acknowledgements

To my Mother and Father...

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List of Works

TITLE	YEAR	DURATION	MEDIUM
Mordicum	2013	06:55	8-channel fixed medium
Our Song	2013	11:35	Stereo fixed medium
Si0$_2$	2013	09:38	8-channel fixed medium
Sacred Voices	2014	09:13	Stereo fixed medium
Cyclic Motions	2014	07:43	16-channel fixed medium
Tout autour de la montagne	2014-15	09:24	Stereo fixed medium (originally conceived for loudspeaker dome/ 8-channel fixed medium)
Rift	2015	07:25	Stereo fixed medium

List of Audio Examples

Title	Work	Composer	Location in work	Duration (seconds)
Audio Example 1	*Powertools*	Moore	00:00-00:17	00:17
Audio Example 2	*Rift*	Rossiter	00:00-00:02	00:02
Audio Example 3	*…et ainsi de suite…*	Harrison	00:57-02:00	01:02
Audio Example 4	*Imago*	Wishart	00:00-00:37	00:36
Audio Example 5	*Points de fuite*	Dhomont	00:00-01:30	01:30
Audio Example 6	*Shortstuff*	Stollery	00:00-00:28	00:28
Audio Example 7	*Shortstuff*	Stollery	00:43-01:11	00:28
Audio Example 8	*Probe tones – Shortstuff*	Young	00:00-00:43	00:44
Audio Example 9	*Shortstuff*	Stollery	03:30-03:46	00:17
Audio Example 10	*Break*	Williams	00:00-00:08	00:08
Audio Example 11	*Tout autour de la montagne*	Rossiter	06:10-06:25	00:14
Audio Example 12	*Tout autour de la montagne*	Rossiter	06:56-07:18	00:22
Audio Example 13	*La disparition*	Calon	07:28-07:44	00:15
Audio Example 14	*Jeu*	Normandeau	12:11-13:49	01:37

USB 3.0 Drive Contents

Title	Name of file	Format
0.Thesis in Electronic form	PhD Thesis – Louise Rossiter	PDF
1. *Mordicum*	1.1 Mordicum_Stereo	.wav Audio (24bit/ 48000Hz)
	1.2 Mordicum_8_interleaved	.wav Audio (24bit/ 48000Hz) 8-channel, interleaved
	1.3 Mordicum_8_deinterleaved	.wav Audio (24bit/ 48000Hz) 8-channel, deinterleaved
2. *Our Song (我們的歌)*	2.1 Our_Song_Stereo	.wav Audio (24bit/ 48000Hz)
3. *Sacred Voices*	3.1 Sacred_ Voices_Stereo	.wav Audio (24bit/ 48000Hz)
4. *Si0$_2$*	4.1 Si02_stereo_binaural	.wav Audio (24bit/ 48000Hz)
	4.2 Si02_ 8_interleaved	.wav Audio (24bit/ 48000Hz) 8-channel, interleaved
	4.3 Si02_ 8_deinterleaved	.wav Audio (24bit/ 48000Hz) 8-channel, deinterleaved

5. *Cyclic Motions*	5.1 Cyclic Motions_ binaural	.wav Audio (24bit/ 48000Hz)
	5.2 Cyclic Motions_ 16_int	.wav Audio (24bit/ 48000Hz) 8-channel, interleaved
	5.3 Cyclic Motions_ 16_deint	.wav Audio (24bit/ 48000Hz) 8-channel, deinterleaved
6.*Tout autour de la montagne*	6.1 Tout autour de la montagne_Stereo	.wav Audio (24bit/ 48000Hz)
7. *Rift*	7.1 Rift_Stereo	.wav Audio (24bit/ 48000Hz)
8. Audio Examples	8.1 Audio Examples 1 -13	.wav Audio (24bit/ 48000Hz)
9. *Tout autour de la montagne* (DOME)	Folder containing Reaper file and software, Jack setup file, Zirkonium Software and instructions.	Software/ .wav Audio

Introduction

The Oxford English Dictionary defines expectation as:

> a strong belief that something will happen or be the case. (OED, 2017)

However, expectation is an idea that is difficult to define in a manageable and meaningful way. It cannot be packed into a single definition. Still, because expectation plays an essential part in human experience, key agents in the forming of expectations such as fight and flight responses, schematic knowledge of the world, learning experience and memory all have important roles to play in our daily lives. To provide a hypothetical example:

Leicester City Football Club (LCFC) is on the cusp of sporting history. They are currently first place in the Barclay's Premier League, and after drawing with Manchester United the previous day, it becomes necessary for Chelsea Football Club to win or draw their game against Tottenham Hotspur for Leicester to become champions for the first time in the club's history. The situation is unprecedented. Bookmakers stand to lose hundreds of thousands of pounds because on the first day of the footballing season they placed 5000/1 odds on this occurring: the expectation was that LCFC would either be relegated or be near the bottom of the league table. The match begins, and millions are watching around the world anticipating the result. Meanwhile, statisticians are working hard to determine what power resources will be required to ensure that everyone can watch the game and to predict when spikes in demand for electricity will occur: for example, at half-time when people are most likely to boil their kettles. If the statisticians at the power company are correct in their estimates, there will be enough power for everybody and very little wasted electricity, thus maximizing efficiency. If, however, they are incorrect, there may be power cuts due to unprecedented demand, or a large loss of efficiency due to too much electricity being produced and much of it going to waste.

On this basic level, an expectation is what is believed to be the most likely eventuality in an uncertain situation. It can provoke a broad range of emotions – from disappointment when an expected event does not occur, to surprise when an entirely unexpected event takes place.

There is probably nothing more rewarding than experiencing emotions such as surprise, shock and *frisson* when engaging with music through listening, composition or

performance. Often there is a subconscious feeling that a particular event is going to occur. In such a situation, the listener engages with what they hear – whether this is a solo violin partita or a piece of acousmatic music. To form an expectation of a future event, they must put together pieces of a musical jigsaw puzzle[1]. Expectation constitutes an essential element of all musical experience and acts as an aperture to the emotions that we as listeners will experience through the act of listening.

The work of Gestalt psychologists (Koffka, 1935) has established that an understanding of expectation cannot be achieved through the perception of a single stimulus in isolation. Rather, it results from the grouping of stimuli into patterns and by examining the similarities and differences between them. Within Western tonal music, the essentials of a composer's musical language can be projected through interactions between melody, harmony, rhythm, tonality and timbre. Music unfolds through time; and part of a musical experience is in our anticipation of what form this unfolding will take.

Western tonal music possesses numerous elements that can steer listeners' expectations – for example, through the rising of the dynamic level as an orchestra gathers pace in a tutti section of a symphonic score until a climax is reached. The expectation that a work or a part of a work is approaching a conclusion, can also be encouraged through the function of cadential formulae as we anticipate the end of a phrase or landmark events throughout a work. Most significantly, the syntactical elements of tonality, for example the tonic implied and 'heard' before it is sounded in cadential structure, project important implications in shaping expectation in Western tonal music.

In contrast, acousmatic music possesses far fewer constraints, precisely because it embraces the creative use of recorded and processed sounds from any source. There are no limits as to what sounds can be utilized or how these sounds may be treated or manipulated. This employment of sound materials provides a tangible link to the real world and the potential to create surprise or tension through ambiguity and transformation of sounds. Despite some similarities with traditional ways of thinking about expectation in music, the complexity of resources in the genre introduces a risk that a composer's intentions when handling expectation may not be understood by the listener. As such, within this practice-based research project's dissertation, I attempt to show what I anticipate the listeners' expectations to be. However, I cannot guarantee

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[1] This is explored within my notion of *sonic evidence* in **Part Two** of this dissertation.

that my compositional intent will marry with what an audience understands from the music, precisely because each will bring with them a unique experience of listening.

Thus, the following research questions are explored within this dissertation:

What techniques of sound shaping and transformation are used in acousmatic music to create expectation?

What might stand in for the functions of tonality present in Western music?

What role does the relationship between sound and silence play in the way we form expectations?

How are expectations derived from prior experience of sound?

How do we build expectation through source recognition?

This dissertation explores a number of research questions, using both theoretical and practical approaches. **Part 1** introduces a context for the research questions and issues explored within this dissertation.

Part Two presents two tools I developed during my research. The first, *acousmatic skip-diving*, provides an insight into my application of Guy Reibel's notion of *séquence-jeu*[2] and the means by which I process sound materials within a composition. The second, *sonic evidence*, was developed *as a result* of the portfolio. It outlines a possible method of explaining how a *listener* may piece together sonic information to form expectations of future events in acousmatic music. It is not entirely complete at this stage as further research is required to work out its intricacies. Neither does it aim to encompass or surpass the conventions or tropes associated with traditional kinds of music or provide a way of addressing issues of expectation in *all* types of music.

The focus of this research project was primarily on the composition of the portfolio. The accompanying dissertation, therefore, elaborates on particular issues encountered throughout the compositional process.

Part Three of the accompanying dissertation presents an analytical commentary on the portfolio offering interpretation of some instances of expectation within my works. In particular, it shows how I conceived the use of expectation and how I applied it in my practice. Of course, as mentioned above, my perception will not necessarily be the same as that of the listener. By providing an insight into the ways in which my listening

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[2] http://www.aecme.fr/définitions (accessed 10 December 2015).

and creative shaping of sound direct expectation, I offer a window to other practitioners and audiences of acousmatic music.

The notion of three-dimensional 'surround' space, as in multichannel composition, and the performance practice of acousmatic music through diffusion will not be discussed as these lie beyond the scope of the research. While I have a deep appreciation of the role of diffusion in the reinforcement and creation of expectation, my focus on sound materials is the salient aspect of this study. Although I view diffusion as the final part of the composition process, my expectations of the spatialisation of my pieces will undoubtedly vary from those of another performer. Thus, I suggest that diffusion is an aspect of stylistic interpretation that may provide a means for a spatial ontology for expectation rather than something contributing expectation on a level intrinsic to the work itself. Similarly, while I am interested in and have composed works in several spatial formats, these are not discussed in relation to expectation. Instead, I have chosen to focus on spectromorphological and referential aspects of sound as a planned constraint of this project.

Part 1:

1.0 Introduction

Despite the existence of a large body of work examining the notion of expectation in Western tonal music, very little attention has been paid to the role that it plays in acousmatic music. Research taking place in the fields of music psychology and electroacoustic music theory provides the fundamental starting point for an explanatory framework for expectation within acousmatic music. This investigation has provided the opportunity to evaluate some ideas from relevant literature. It offers a contextual frame around the creative studio practice – composition – which forms the major part of this practice-based research project.

1.1 ITPRA Theory of Expectation

David Huron's discourse on expectation (2006) is one of the most significant in the field of music psychology. Expectation plays a central role in our lives and is interwoven with biological and cultural factors (Huron, 2006: 3). The ability to form accurate expectations about future events has obvious benefits for a species. It is necessary for survival as it enables an organism to predict and avoid dangerous situations (which might lead to being eaten, for example). The 'feelings' most often associated with expectation are the emotional amplifiers of anticipation or surprise (Huron, 2006: 4). These emotional amplifiers encourage us to pursue behaviour with positive outcomes and avoid those with adverse ones. Huron (2006:7-8) notes that expectations evoke 'feeling states', which involve psychological and physiological changes. While some of these are automatic, unconscious responses, others require a conscious awareness and evaluation of an event. The emotional outcomes of these expectations can be grouped into positive and negative types and are, therefore, 'valenced'[3] (Huron, 2006: 7).

Huron proposes a psychological theory of expectation and applies this to music. The emotions created by expectation evolve from five distinct systems: *Imagination, Tension, Prediction, Reaction, and Appraisal* (ITPRA)*. ITPRA is an analysis of the time-course of events that may be either expected or unexpected, dealing with the psychological dimensions of expectation and how we as humans experience it. Huron

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[3] Valence is defined as: 'The positive or negative quality of emotions. (There are no neutral emotions.). (Huron, 2006: 422).

further groups these into pre-outcome responses and post-outcome responses (Huron, 2006: 15-16) **(Figure 1)**.
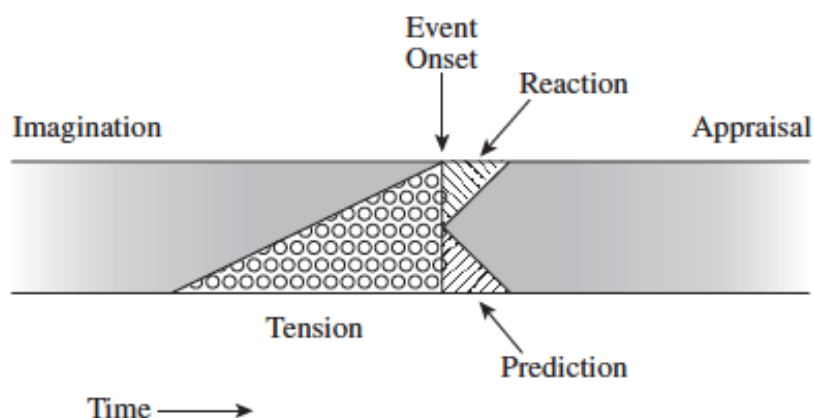
Figure 1: Schematic diagram of the time-course of the 'ITPRA' theory of expectation (Huron, 2006:17).

The individual assesses his or her criteria of prediction; positive feelings are triggered when the prediction is correct and negative feelings when the prediction is incorrect or the actual outcome surprising. At the same time a defensive reaction response is activated, the purpose of which is to assume a worst-case scenario. Finally, the appraisal response provides an assessment of the situation and takes into account additional elements such as social factors that will affect future expectations.[4]

Huron intends ITPRA to be applied primarily within the context of Western tonal music and valorises this to each scale degree (Huron, 2006: 144 -147). As such he suggests that ITPRA is a cognitive as opposed to a conscious process. A question then arises as to the ways in which ITPRA can be applied to the genre of acousmatic music. I would argue that the effect of the shaping of gesture over time within acousmatic music is relatable to the five stages of ITPRA. This can be exemplified through an analysis of the opening section of Adrian Moore's acousmatic work *Power Tools* (2004) **[Audio Example 1: 00:00 - 00:17]**. The first sound of the work is a powerful, reverberant attack (00:00-00:06), which fills up the lower and middle frequencies of the spectral space. This attack and its subsequent continuity in time trigger the *imagination* of a physical causality. The decay of the momentous attack also implies the presence of significant energy within the sound itself, leading to the creation of *tension* as its

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[4] A real-life application of ITPRA is summarised in Daniel Goldschmidt's *YouTube* video. Goldschmidt demonstrates ITPRA through the process of playing with his dog, Brady, and a tennis ball. https://www.youtube.com/watch?v=gJwYOkE4kE4 [accessed 22 May 2016].

relatively static decay becomes more dynamic and granular in nature (00:06-00:13). The accelerando, crescendo and upward trajectory of pitched material at this point may lead the listener to a *prediction* of both *when* and *what* will occur to release the tension within the work. It would be reasonable to expect the climax of the phrase at 00:13 to function as an anacrusis to an attack related to that heard at the beginning of the work. However, the release of tension is delayed as the anacrusis rapidly gives way, revealing granular material reminiscent of that heard after the decay of the first gesture of the work. The *reaction* response will occur at this point and is likely to be that of a surprise for the listener, along with an *appraisal* of the event and its relationship to the development of the work occurring over a longer timescale.[5]

1.2 Tendency and Expectation

Meyer (1994) describes 'tendency', or what MacCurdy terms 'instinct' (MacCurdy, 1925: 475) as 'a pattern reaction that operates, or tends to operate, when activated, in an automatic way' (Meyer in Aiello et al, 1994: 22).[6] A 'pattern reaction' is a set or series of simultaneous responses which become part of a response to a stimulus, and is ordered on both temporal and structural levels. A tendency to respond may occur on either a conscious or an unconscious level and will gradually become less conscious as it develops into more of an automatic response. A conscious response is likely where there is an obstruction of some kind (Meyer in Aiello et al, 1994: 22), which inhibits the completion of the reaction pattern. These conscious and unconscious tendencies are often referred to as 'expectations' (Meyer in Aiello et al, 1994: 23).

When we listen to a piece of music, we may expect a particular event to occur. For example, in Western music of the classical period we would expect to hear cadential formulae which can delineate phrase structures. The events that we come to expect as listeners are driven by our knowledge of the stylistic norms of a particular genre of music. Similarly, our expectations may be non-specific, in that we expect a particular event to occur but are uncertain as to how exactly this expectation will be fulfilled. Likewise, if appropriate musical stimuli such as the relationship between different components of a piece (melody and harmony, for example) are unclear, then the listener will experience some degree of uncertainty. This can be manipulated in a creative manner by the composer to create *suspense*—described by Meyer as

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[5] This is also heard in my work *SiO$_2$* which is discussed in more depth in **section 3.3**.
[6] For McCurdy, the term 'instinct' includes learned habit responses (Meyer in Aiello et al, 1994: 36).

'essentially a product of ignorance as to the future course of events' (Meyer in Aiello et al, 1994: 25). This 'ignorance' can arise through a sequence of events that offer many possible outcomes, or because the events that have unfolded in the piece so far are difficult to use as the basis for forming expectations. In a traditional harmonic context this could happen, for instance, where the decay of an extended sound implies closure, but is contradicted by an implication that the chord carried in that sound needs to resolve.

Huron describes three types of response that may arise from an incorrect expectation[7]. The first of these is a *delay* of expectation, occurring in situations where a listener's expectation is eventually fulfilled and uncertainty associated with this is short-lived. The second possibility is that a listener has applied an *incorrect* expectation to a particular passage in a piece of music, which brings about *reappraisal* to ensure that the correct schema is used. The final possibility is that the listener's predicted events *fail completely.* In this situation, the listening experience might be unpleasant with the listener being unable to apply or resolve conflicting schemata[8] to the events occurring at any given time in the piece of music. However, with repeated exposure to a stimulus or the characteristics of a particular style, a listener will develop schemata that allow for more appropriate expectations to be formed in future listening experiences.

1.3 Memory

Memory is crucial to the way we form expectations in a listening experience, through recall of past events and by learning what the range of possibilities are for future ones. The memory of sound consists of three primary forms: echoic memory[9], short-term memory (STM) and long-term memory (LTM)[10]. Each function across a different time scale which Snyder (2000) refers to as levels of musical experience. These timescales are loosely related to three time levels of musical organisation described by Snyder as: 'level of event fusion,' 'melodic and rhythmic level,' and the 'formal level' (Snyder, 2000:

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[7]http://csml.som.ohiostate.edu/Music829D/Notes/Expectation.html#Realized,%20Thwarted,%20Reverse,%20and%20Paradoxical%20Expectations (accessed 18/4/2015).
[8] Schemata are defined by Snyder (2000) as:
[…] organized sets of memories about sequences of events or physical scenes and their temporal and spatial characteristics, which are built up as we notice regularities in the environment (Snyder, 2000: 95 - 96). The role of schemata in expectation is discussed further in **section 1.4.**
[9] Echoic memory forms the first process of Snyder's *Memory Model* (Snyder, 2000: 4 – 5). For this practice-based research project, only short-term memory and long-term memory are discussed in detail.
[10] Long-term memory is also known as *semantic memory* (see Huron, 2006: 224).

3). Expectation can be formed from the binding of events sharing similar properties such as pitch, overtone structure and rhythmic patterns. These trigger a part of long-term memory activated by the recall of similar events which have previously taken place. Long-term memory handles events occurring on a time-scale lying beyond the range of short-term memory (STM). Events separated by less than three to five seconds are likely to be grouped together as STM and are perceived instantaneously as recollections of an event. Consequently, when listening to a piece of music in its entirety, any awareness of relationships between different sections of a work occurs through recall from long-term memory.[11]

In contrast to long-term memories, which are formed over a lengthy period and are long-lasting, short-term memory addresses the very recent past and events occurring on a much shorter time-scale. Typically, short-term memory lasts between three and five seconds depending on the complexity of the material being recalled (Snyder, 2000: 5). Short-term memory is also crucial to the integration of events over time, forming a primary pathway by which we can comprehend sequences of events. This notion of recall of sound is important when we are dealing with a kind of music that does not follow the hierarchical organisational patterns of tonal music.

There are limitations to short-term memory. In comparison with long-term memory, the capacity of short-term memory regarding both time and information is very limited. Previous research (Snyder, 2000: 50) has established that, on average, short-term memory contains a limit of seven different elements. Snyder also notes that a profound implication of this is also the length of time for both an average spoken sentence and a normative musical phrase. Within STM, recent experience is available as highly activated memory, which can be reinforced through rehearsal or repetition of the event.

From a normative cultural perspective, exposure to music based on shared materials and organising principles leads to their reinforcement through common musical practice. These can include defined instrumental identities, discrete pitch and proportional durations (such as described in Wishart's 'lattices' (Wishart, 1996: 23)), and the syntactical relationships that exist between them—for example, the tension and resolutions generated by dominant to tonic harmonic motion, or by the extended appoggiaturas of late romantic music. In electroacoustic music, many of these features of sonic organisation are absent because of a lack of the seemingly 'natural' hierarchy of materials as witnessed in tonal music. The memorability of the heavily processed

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[11] Many forms of long-term memory and nomenclature are not discussed within the context of the dissertation. Further information can be found in Snyder (2001): 69 – 79.

sounds often heard in acousmatic music is also questionable.[12] A sound will be harder to recall if the musical language or sound world is unfamiliar. In this situation repeated listening will be necessary so that a wider context for connections and interrelations may be established. As a result of this their role in forming a cohesive musical argument may be weakened. An example of this weakening effect can be heard in Pete Stollery's *Shortstuff* (1993), which is discussed in detail in **section 1.14.**

1.4 Schemata

Schemata[13] enable the listener to form ideas about the way sounds behave through their temporal and spatial characteristics, which in turn allow us to experience and contextualise situations and scenarios meaningfully. The ability to relate our ideas to something whose affordances are known and understood can provide a basis for forming connections to something that has already been heard. The unconscious functioning of schemata allows us to experience something without requiring us to continuously evaluate the detail and the meaning of that experience (Snyder, 2000: 95-6). The selection of the schema appropriate to the situation is a requirement of comprehension for the listener and typically occurs within milliseconds of an auditory stimulus. The speed with which a listener can move from one schema to another, which Huron (2006: 210-11) calls *schema switching*, is relevant to the abundance of new, unfamiliar sound materials so often present in acousmatic music. In this situation, it is necessary for the listener to identify cues rapidly to form a context for what is being heard at any particular moment, and to assist in building expectations for future events. To this end, Huron highlights the inherent nature of the search for a more appropriate schema should the expected one not occur (Huron, 2005: 211). An innate ability to form schemata that are tailored to particular situations is central to our musical experience and provides a foundation for differentiation between styles, cultures and genres of music.

While Huron (2006: 204) places emphasis on pitch, there are questions as to what intrinsic features of acousmatic music form schemata, given that the genre as a whole comprises a range of sound materials much broader than conventional instrumental and vocal music, which are based primarily on pitch and quantised duration.

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[12] In a recent interview at Colyer – Fergusson Hall, University of Kent (21 May 2016) Denis Smalley commented that, when working on a piece, he finds it difficult to mentally recall the materials and sonic organisation he has created while away from the studio and that direct exposure to the sounds is necessary to develop ideas and creative continuity (Personal communication with John Young, 8 July 2016).
[13] See Snyder, 2000: 95-6.

The unifying effect of the cognitive constraints of tonality are beneficial to a composer, both because of the ways in which notes are grouped into scales, and also the means by which they are expressed harmonically and melodically. Because of this, there is often the implication[14] that these notes will lead towards a particular goal such as a modulation in key or a cadence. In general, musical tension can be created by material which in some way gives a sense of leaning or pulling towards a particular outcome. The inclusion of a note with a low probability of occurrence (what Huron describes as an 'oddball note' (Huron, 2006: 312-314)) has the effect of creating uncertainty. While the 'when' of the event may have been predicted correctly, the 'what' may be incorrect.[15]

The opening motif of Scarlatti's Keyboard Sonata in G minor (also known as the 'Cat Fugue'), provides an example of the moment-to-moment basis that Huron refers to in *Sweet Anticipation* (Huron, 2006: 101-129) and the implications that arise from this **(Figure 2)**.
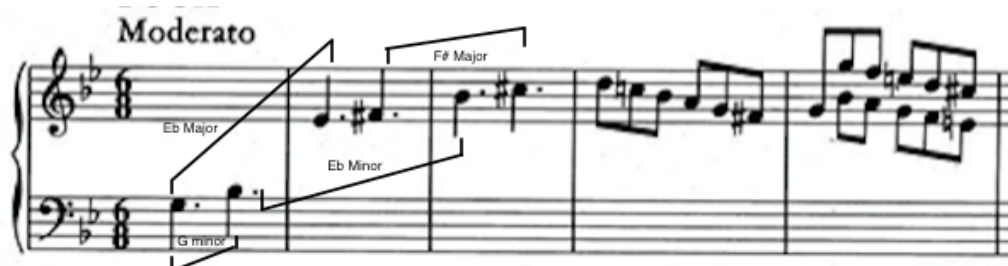
Figure 2: Opening five bars of Scarlatti keyboard *Sonata in G minor*.

The first two notes of the work suggest an arpeggio of G minor. Therefore, the expectation would be that a 'D' be heard next, as this would form the tonic triad of the stated key. Rather, the composer creates unexpected tension and tonal ambiguity by inserting an E-flat on the first beat of the second bar to create an E-flat major triad, followed by an F-sharp in the second half of the bar to produce the effect of an E-flat

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[14] Implication and its role within musical expectation have been examined in detail by several scholars in the field (see Meyer, 1956, 1973; Jackendoff, 1991; Schellenberg, 1997; Huron, 2001; and Ockelford, 2006). Meyer (1956) discusses the notion of implication and Huron's (2001) position is primarily an extension of this, with the core idea that our response to music and the consequences of these reactions are derived directly from real-world scenarios experienced on a daily basis.

[15] As David Cope suggests, the legacy of tonal music consists of key, consonance (relaxation) and dissonance (tension) and, hierarchical relationships (Cope, 1997: 12). The notion of note, tonality and hierarchy has a potential for ambiguity and for connections to be made by the listener, which can be incorrect. An example of this is heard in the introduction to the first movement of Haydn's Symphony No. 99 where pivot chords lead in unexpected directions and create tension and surprise.

minor triad with the subsequent B-flat and C-sharp completing the F-sharp major triad. The resulting tonal ambiguity creates tension for the listener because no consistent pattern of directed tonal motion is offered, and only settles across bars four and five when more normative tonal clarity is reached.

With respect to the more open sound world of acousmatic music however, Smalley's idea of surrogacy (Smalley, 1986, 1997) provides an example of applied schemata and a meaningful way of qualitatively describing the blurred boundaries between recognisable sounds, and less identifiable sounds in acousmatic music. By acknowledging the potential for sound to evoke correlation with its means of production, composers may have a method by which to call upon a listener's intuitive knowledge of sound production, and this may be a factor in facilitating the memorability of complex, digitally processed sound events. Surrogacy can also be considered on a transformative scale, with a listener being more likely to recall transformations to or from a particular sound. By connecting schemata with a transformed sound, immediate associations with a particular memory may be made. For example, the opening gesture of my work *Rift* (2015) **[Audio Example 2: 00:00 - 00:02]** could be associated with the key clicks of a saxophone should a listener be familiar with those particular sounds. It does not matter that the opening gesture is not constructed from saxophone key clicks but rather the sounds of heavily processed shattering glass and ceramics. Such an association made by the listener is based on memory recall of prior musical experience and could cause confusion, or add tension to the work as the sound is heard in a different context from that which would normally be expected.

1.5 Anticipation and predictability

Huron defines four ways by which musical events can be made to be more predictable, these being *schematic predictability, dynamic predictability, veridical familiarity* and *conscious predictability* (Huron, 2006: 240):

Schematic predictability occurs where music is put together in such a way that it conforms to an existing schema likely to be brought to the listening experience by the listener. Huron uses the example of Western-enculturated listeners expecting a dominant seventh chord to be most often followed by a tonic chord. When *dynamic predictability* is present, the music is constructed so that work-specific expectations are summoned. The use of motifs by a composer are an example of dynamic predictability because the listener might expect these to be developed or repeated throughout the

piece. *Veridical familiarity* occurs when listeners hear a work many times. Inevitably, the music will become more predictable as the listener draws upon their prior listening experience of the same work and begins to anticipate any events that may otherwise have been less inherently predictable. *Conscious predictability* can be present where the music is organised in such a manner that a listener can deduce what future musical events may occur as the piece progresses. Huron highlights the example of expecting a musical variation to revert to the major key after shifting to the minor.

1.6 Surprise

Musical surprise is created when something other than the expected occurs. Composers (and performers) can achieve this through many means. Huron (2006: 268) describes musical surprise as a kind of 'gremlin' being let loose on a musical score. This appears to be accurate given that a surprise will initially evoke a 'negative'[16] response due to the listener's expectation not being met. [17] While composers may deliberately want to include moments of surprise by making events less predictable, I would suggest they may also want to create a feeling of unease or discomfort so that the events in the piece are not anticipated.

As with anticipation, there are four ways in which musical events can cause surprise through violation of the of the listener's predicted event. The first three, *schematic surprise, dynamic surprise, and veridical surprise* occur on an unconscious level and so the listener does not need to think about them actively:

> 1. *Schematic surprise*: Here the music is constructed so that it violates some existing schema that listeners have brought to the listening experience.
>
> 2. *Dynamic surprise:* Here the music is constructed so that the work itself will set up some work-specific expectation that is then violated.
>
> 3. *Veridical surprise:* Surprises can also be evoked by violating a listener's existing knowledge of a given musical work. Such violations may arise, for example, through performance error, misquotation, or intentional parody (Huron, 2006: 269).

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[16] In this context 'negative' (Huron, 2006: 358-360) refers to the instinctive human 'reaction response' to surprise (fight or flight) before any subsequent emotions are triggered.
[17] Types of musical surprise are discussed in detail in Huron (2006: 269-304).

Schematic surprise, dynamic surprise and *veridical surprise* do not require the listener to think consciously about the music,. The fourth type of surprise – *conscious surprise* – calls upon the listener to reflect and form conscious expectations of what might happen next in the work and occurs when a listener familiar with a particular genre of music forms an expectation about a future event that is then proved to be incorrect (Huron, 2006: 270).

Both the fulfilment and the negation of expectations are valuable to the musical listening experience. This is because a listener engages in the process of listening with a forward-moving anticipation of what may happen, based upon schematic processes, knowledge of style, culture and memory of musical events that have already unfolded within the work.

1.7 Issues in acousmatic music

Acousmatic music, facilitated by the mediation of recording, presents a broad range of sound materials which can be associated with situations applicable to our daily lives through schemata. The freedom to record any sound poses problems for the comprehension of future events and therefore expectations within the genre. For example, if we hear a bird outside our window and then hear it in a piece of acousmatic music, what do we construe from this and what mental resources do we use to form an interpretation of the music and its significance in real life? Is it our prior musical experience? Cultural background? Survival instinct? How do fundamental elements of acousmatic music such as source recognition, spectromorphological shaping, and sound transformation affect this? Do we hear recorded birdsong, wind noise and a C major arpeggio on a piano as inhabiting the same 'world' in acousmatic music or do we, in fact, separate them into competing, blended or simply incompatible 'realities'? The fact that any sound can form a part of an acousmatic piece, therefore, poses a challenge—an issue highlighted by Denis Smalley's examination of what he defines as *space form:*

> Understanding the transmodal potential of acousmatic
> perception leads us to a more comprehensive view of what
> space-form might be. Space-form in acousmatic music is an
> aesthetically created 'environment' which structures transmodal
> perceptual contingencies through source-bondings and
> spectromorphological relations. Further, it integrates attributes
> particular to musical culture and tradition (like pitch and rhythm,
> for example). Acousmatic space-form inhabits domains
> somewhere between space as lived and enacted, and the

> spaces afforded through spectromorphological contemplation—
> by the perceived and imagined configurations of spectral and
> perspectival space (Smalley, 2007: 40-41).

In music, we form expectations when we hear a familiar chord, melody, harmony or sound. In acousmatic music, in particular, we may anticipate future events when we hear familiar sounds of recognisable objects, and construct meaning from the possible consequences of the actions by which they are manipulated. There exists a what we might call a 'sonic geography' in acousmatic music which establishes a 'substance' of where we are or what we are confronted with within a work through the consideration of the spectromorphological[18] and referential domains of acousmatic music. For example, we may be faced with noisy, grainy or transparent pitched sounds all of which may or may not move in time and in ways that, by way of a vicarious sense of physicality, we infer future directions. There is, therefore, an essential bifurcation of listening between spectromorphological and referential sound. This is reflected in Schaeffer's (1966) terms ordinary/specialised listening and natural/cultural listening as part of his seminal *Quatre Écoutes.* The goal of this was the valorisation of sound objects in an 'abstract' manner[19]:

> Ordinary listening goes immediately to the causality of the
> sound, its origins as well as its meaning… specialised listening
> concentrates on a particular manner of listening (Chion, 2009:
> 25).

Natural listening is concerned with source identification of a particular sound while cultural listening is related to its aesthetic context or attribution of aesthetic value. The way listening is focused can, therefore, evoke different expectations of sounds heard and the sounds themselves may tend to encourage one kind of listening or another. Consider, for example, the following imaginary scenario which takes place in St Pancras Station in London where each 'element' provides a 'hook' to different schema-based understandings for the listener[20]. As a place, it contains sounds that will identify it as a station such as the hustle and bustle of people moving luggage and trains arriving and leaving. It is likely that one will hear sounds identifying St Pancras itself such as platform announcements. As we move forward onto the escalators and into the main concourse, we would expect the sounds of the station to overwhelm us.

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[18] Spectromorphology is discussed in **section 1.10.**
[19] Schaeffer's seminal *Traité des objets musicaux* provides a theoretical framework for the identification and classification of the morphological properties of sound within acousmatic music. See the translation by John Dack and Christine North (forthcoming).
[20] Such a discussion took place concerning *Tout autour de la montagne* (2014/15) which is included in this portfolio. It is precisely these listening expectations which influenced some of my compositional decisions when revising the work. See later discussion in **section 3.7**.

However, we are surprised when we hear a chord emanating from one of the on-site pianos, immediately drawing our awareness to a distinct musical identity. We may listen to a chord progression of C major moving to G major and ask ourselves whether we hear a tonic to dominant progression. Within this context, on the basis of register, voicing and texture we may relate this chord progression to piano pieces we know; do we hear a work of Schubert for example? We will, therefore, begin to anticipate and form expectations of future events based on a culturally acquired understanding of harmonic progressions and our prior listening experience of Schubert's music. However, we may also notice that the onsite piano being played by a member of the public is out of tune and begin to form other expectations. Will we still hear Schubert or will we only hear out of tune chords? Will these out of tune chords create beat frequencies that attract the ear, or will we make an assumption about the physical nature of the piano, such as it being in good condition or dilapidated? These chord progressions provide a formal association with aesthetic experience because the piano is heard playing outside its normal context.

The brief analysis of a scenario such as this demonstrates the virtual creative space outlined by Smalley's (2007) acousmatic space-form, in which any sound can occur. For example, the first encounter with the piano is very unexpected. However, once this is understood and regarded as a 'normal' part of the environment, we begin to appreciate that the complex fabric of the soundscape itself is made up of many discrete kinds of sounds that stimulate different types of listening expectations.

Acousmatic music does not share directly the harmonic and metrical rhythm based grammar associated with Western tonal music. Instead, there may be vestiges of a tonal grammar through clear or harmonic progressions through musical quotations,[21] or through the way that pitch and harmony are presented within a work. As a result, a broader holistic view of its ontology is necessary.[22] This poses a problem as, in one sense, there is present an ontology driven by the listening context supported by electronic media which can project sound sources calling upon various types of schemata. For example, it will require the listener to draw upon the affordances of what we understand as real-world sounds or non-real world sounds.

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[21] These ideas are demonstrated within my compositional portfolio. *Our Song* uses a musical reference to the traditional Scottish work *Auld Lang Syne*, and *Tout autour de la montagne* possesses a tonal grammar throughout ...*Sur le trottoir…,* a movement where there is a clear harmonic progression. Both of these works are discussed in more detail in **sections 3.5 and 3.7.**
[22] The holism of musical ontology is an issue in musicology generally and is discussed in Clarke's ecological work *Ways of Listening* (2005).

1.8 Sound sources

Any sound, regardless of its source, can be thought of as a carrier of sonic information about a possible physical origin [source] and a generative energy [cause]. These 'messages' reflect the interaction between the sounding body and the energy applied to it to create sound, and potentially about the living context in which a sound might be expected to exist. Wishart's notion of *sonic landscape,* which he describes as 'the source from which we imagine the sounds to come' (Wishart, 1986: 43), provides one way of codifying associations that may be heard by listeners and acknowledging the impact these can have on anticipation of future events. Wishart argues that sonic landscapes projected to an audience via loudspeakers allow for the construction of virtual acoustic spaces:

> […] In our common experience, we are often more aware of the source of a sound than not, and studies of behaviour and aural physiology would suggest that our mental apparatus is pre-disposed to allocate sounds to their sources (Wishart, 1986: 41).

Wishart also suggests that a zone of possibilities both expected and unexpected is made available through the creation of an acousmatic virtual ontology. Within this, he evaluates the musical potential of source recognition concerning the language often heard within Western tonal music. This alludes to musical devices including pitch, tonality, rhythm, and harmony which provide a way of directing a listener's focus away from the recognition of a sound source and onto the formalised aspects of musical language. Wishart develops his principle of landscape with the help of conceptual scenarios, suggesting that a listener will begin to perceive a different sonic landscape through the gradual substitution of recognisable sound sources such as bird song with a variety of incongruous sound objects. While the characteristics of the objects remain realistic in the sense that the listener will still perceive the acoustic constancy of a particular place (a forest for example), the sound sources within the place will necessitate an imaginary resolution. A consequence of these codifications of listening is the potential for us as listeners to form expectations about the flow of events in a piece of music by evoking schemata **(see section 1.4)** drawn from real-world situations.

A usefully systematic extension of these ideas is found in Simon Emmerson's development of a means of identifying different forms of interaction between sonic messages through the creation of a 'language grid' (Emmerson, 1986: 24), which provides a typology for combinations of syntax and discourse within a work. The

language grid considers the presence or absence of mimesis, which distinguishes the type of discourse and the kind of syntax being deployed. The dual approach of discourse and syntax recognises the possibility for an awareness of a hybrid between both mimetic and aural discourse, and abstract and abstracted syntax. Through this, we have a means of examining the materials and musical languages implemented in acousmatic music and a tool for evaluating the way source recognition itself can influence expectation.

An example of relationships existing between discourse and syntax can be found in Jonty Harrison's *…et ainsi de suite…* (1992) and Trevor Wishart's *Imago* (2002) which make for a compelling comparative analysis as the composers use the same sound source of drinking glasses (the initial idea for *Imago* grew out of the one-minute piece of music composed by Wishart for Harrison's 50th birthday concert, using sounds found in *…et ainsi de suite…*). Despite drinking glasses being the sound source for both works, the compositional approaches utilised vary in a manner that leads to very different patterns of expectation for the listener. The recognisable sound source heard at the beginning of *…et ainsi de suite…* creates musical tension through punchy gestures punctuated by brief silences and through the implication of aggressive tactility in the manipulation of the sound source. It is a reasonable assumption that listeners will recognise the sound of a glass being tapped and be aware of a wider sense of its physical and sonic properties. They will, for example, be mindful of the fact that glass is fragile and is susceptible to breaking or shattering; leading to an expectation that the impacts to which the glasses are subjected could result in them breaking. Musical tension is built up gradually in the opening minutes of the work as the apparent limit of the glasses' endurance is explored alongside the gradual introduction of other recognisable[23] material such as the percussive character of a manipulated piano sound and the isolation of high frequencies at 00:57. A musical climax is reached at 01:40, with a loud gesture consisting of a single 'clink' of glasses together, followed by a brief silence and finally a heavily transformed attack at 01:46 **[Audio Example 3: 00:57 - 02:00]** which may come as a surprise for the listener as it is clear that the glasses remain intact despite the seemingly physical pressure being placed upon them. The opening section of Wishart's *Imago* takes a very different approach to that observed in *…et ainsi de suite…* A single clink of a drinking glass gradually expands into longer phrases. Within the work, the sound material itself becomes a virtuosic instrument in that the source becomes irrelevant, except for being so inauspicious as to

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[23] In listening to works such as *…et ainsi de suite…*, there is an inherent distinction between sounds that are overtly naturalistic and those that appear to have been manipulated in some way by the composer.

be impressive in terms of the virtuoso treatments applied by the composer[24] **[Audio Example 4: 00:00 - 00:37]**. In Harrison's …*et ainsi de suite…* the glass essentially remains a glass, despite the multiple processes applied to it by the composer. In other words, it is more grounded to its source and the physicality of this. In contrast, Wishart's *Imago* is transformed in such a manner that the glass is abstracted from the source and the physicality is more an imaginary process. This means that the listener is more directed to the aural patterning[25] *per se*, as opposed to the underlying initial sound source or imagery associated with it.

1.9 Enigma

As previously discussed, acousmatic space-form permits the inclusion of 'any' sound. This can lead to the co-existence of sounds that a listener might not otherwise expect to hear in a natural setting. When these sounds cannot be resolved into a coherent setting, the result can be considered 'enigmatic', which John Young describes as a 'unifying, expressive link' (Young, 1989: 372). He goes on to provide the following descriptions of how enigma may be created:

> When a sign sound is juxtaposed or superimposed with other material such as:
>
> (1) sign sounds which are contextually incongruous or together form an ambiguity of context; or
>
> (2) generatively unrelated material (such as "natural" and "electronic");
>
> The combination of materials may be taken as having metaphorical significance. In this way, through enigma, symbolic potential implicit to a sign may be made explicit and a focus on sound for meaning beyond sign reference may be achieved. Successful symbolism will result when a "symbolic" meaning can be perceived as a unifying force, image or idea between different elements (Young, 1989: 372).

Enigma can prove a powerful force for shaping expectation in music. In acousmatic music, the different contexts created by implying the co-existence of what would normally be incompatible objects become inherently enigmatic. The juxtaposition of naturally occurring, recognisable sounds with unrecognisable ones can create a new

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[24] This is an example of a particular kind of schema learnt by me the listener, as a composer.

[25] Within the context of this dissertation, this term refers to patterns of repetition (whether rhythmic or tonal). See Huron (2013: 1-30).

context of unpredictability with the potential for surprise or the thwarting of the listener's expectation.[26]

1.10 Spectromorphology

Smalley's (1986, 1997) descriptive language for electroacoustic music, termed 'spectromorphology', has become the most widely referenced general framework for the classification of sound types and their potential musical functions. At the most basic level, Smalley defines spectromorphology as:

> …An approach to sound materials and musical structures which concentrates on the spectrum of available pitches and their shaping in time (Smalley, 1986: 61).[27]

Smalley replaces the common division of the frequency domain of 'pitch' and 'timbre' commonly associated with Western tonal music practice, with 'spectrum' which 'encompasses the totality of perceptible frequencies' (Smalley, 1986: 65). Smalley also emphasises that this spectral typology is fundamentally connected to a temporal evolution. This is because 'spectra are perceived through time, and time is perceived as spectral motion' (Smalley, 1986: 65). Smalley outlines three spectral types; note, node, and noise which are placed on what he describes as the note to noise continuum. The note proper encompasses elements such as absolute pitch, and intervallic and chordal combinations associated with traditional pitch perception.

Smalley points to instances in which sounds are spectrally coloured in ways that mean we are more concerned as listeners with the fundamental pitch than with the overtones. A *harmonic* spectrum possesses intervallic organisation which is 'based upon the vibrational properties of strings or columns of air' (Smalley, 1997:120). *Inharmonic* spectra are often the result of the technological manipulations of sound but exist naturally in metallic sounds where the spectral components do not conform to the natural harmonic series. *Nodal* spectra are bands or 'knots' of sound which possess

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[26] This is explored in Alistair MacDonald's *Dreel* which presents some different 'scenes' during the work and thwarts expectation for the listener through the means of both real and abstracted sound-worlds. In his programme note, MacDonald writes the following:
> In *Dreel*, I wanted to contrast very different, but recognisable images in sound, without attempting to resolve the images. Juxtaposition and layering, as well as sound processing, are used to create ambiguity and blurring, and the piece leaves questions unanswered (Macdonald, 1996).

[27] While he later revised this idea (Smalley, 1997), I find the first published version (Smalley, 1986) more helpful in this discussion.

enough complexity to prevent the identification of discrete pitches. Examples of this can be observed in percussion instruments such as cymbals which, at a distance, are heard as a rich metallic resonance, as opposed to particular pitches (Smalley, 1986: 67). The noise spectrum's density is formed in such a way that perception of the internal pitch structure is not clear and this is likely to consist of 'granular' or 'particle' motion as opposed to discretely separable pitch components. Smalley also identifies a blurred zone between note and noise as the 'pitch-effluvium continuum' with 'effluvium',[28] referring to the phenomenon where the ear can no longer resolve spectra into component pitches. In acknowledging the presence of the pitch-effluvium continuum, Smalley describes the way in which listeners can change their aural focus as their ears are drawn away from the 'pitch behaviour of internal components' to 'follow the momentum of external shaping' (Smalley, 1986:67).

Because Smalley's notion of spectromorphology takes into account not only the spectral characteristics and qualities of sounds but the morphology of the sounds (that is, the dynamic structure of a sound's evolution over time), we have a way of characterising sonic motion. He also highlights that 'The spectro- cannot exist without the -morphology and vice versa: something has to be shaped, and a shape must have content' (Smalley, 1997: 107). The phenomenon of motion naturally leads to the formation of expectations. In simple terms, the gradual thickening of the spectrum, say from pure pitch, through increasing spectral saturation, inharmonicity, to noise, may at each stage convey the implication of a further stage of the increasing density and create what Smalley terms spectromorphological expectation (Smalley, 1997:112-113).

The listener's comprehension of the broad range of circumstances in which spectral changes occur in both single gestures and longer phrases allows us to develop a wider imagination of spectromorphological change and decode patterns of expectations which might be inferred from a piece of music. Simultaneously, we may reflect on the possibility that some supposed limit of density has been reached, anticipating, for instance, a change of direction, a levelling out, or a regression to an earlier spectral state. In essence, Smalley's approach to spectromorphology gives rise to a framework which provides a greater understanding of structural relationships and behaviours

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[28] It should, however, be noted that Smalley (2010) later makes the following comment about this term: '… I consider the pitch-effluvium continuum to be subsumed in the notion of density: If we combine it with certain types of growth process then effluvium results. Attack-effluvium is still there in 1995 [referring to the 1997 publication] but is absorbed in the texture motion diagram. Maybe this is a case where a separate concept was still thought to be useful. But there is a problem with the word 'effluvium' ...' (Smalley, 2010: 93). He then also acknowledges his inappropriate use of the word 'effluvium' which should have been fluvial or alluvial (Smalley, 2010: 95).

which unfold over time in acousmatic music. Therefore, an underlying assumption of spectromorphology is formed through a knowledge of the physical world because of the schematic understanding of the listener.

1.11 Phrases

A definition of a 'musical phrase' is:

> A short section of a composition into which the music, whether
> vocal or instrumental, seems naturally to fall. (OED, 2017)

The notion of phrasing is important in music because phrases convey natural envelopes of sound that are similar to sentence structure. As with linguistic expression, the evolution of phrasing could be regarded as making the contents of a musical experience digestible and comprehensible. As well as giving shape and articulation to the musical flow, phrasing is important to the sense of motion evoked by a musical experience. A phrase ending can imply directedness toward a new phrase or confirm closure. Kramer (1988: 55) notes that while phrases were a central part of Western music, new music has shown that they are not a necessity. He describes the impact of this as enabling a piece to be:

> …a single present stretched out into an enormous duration, a
> potentially infinite "now" that nonetheless feels like an instant.
> In music without phrases, without temporal articulation, with
> total consistency, whatever structure is in the music exists
> between simultaneous layers of sound, not between successive
> gestures (Kramer, 1988: 55).

In contrast to traditional Western music, extended forms of 'unphrased' music are technically very easy to create in acousmatic music. This is because there is none of the physicality of breathing or bowing demanded in music and no cadential formulae present to imply it. In this sense, Kramer's assertion that the music simply ceases as opposed to 'ending' is crucial as it means that it is a syntax which creates an ending rather than fading out or stopping.

In expectational terms, a lack of phrasing makes anticipating future events more difficult for the listener as there are no distinct builds to climaxes, no tension and release, and the music fails to set up or fulfil any expectations, whether intentional to the composition itself or that have arisen accidentally. This poses a problem in acousmatic music because we will naturally try to impose some sense of continuity onto a work.

A convincing example of phrasing creates an expectation for listeners within acousmatic music is the opening of Francis Dhomont's *Points de fuite (Vanishing Points)* **[Audio Example 5: 00:00 - 01:30].** Over the course of the opening minute of the piece, each phrase grows in length and gradually saturates the frequency space. Dhomont retains some of the frequencies in each phrase which provide a sense of recognition and continuity for the listener. This also creates a metaphor for growth by adding new frequencies which in turn engender a sense of expectation through entirely spectromorphological means. One of the principal ideas of the work is the notion of growth and dissipation of energy. As such, many of the phrases are formed through the fading away of sound. However, the notion of recession into a 'distance' within the work is inherently a spatio-physical and musical property. While at the start of the piece the 'vanishing points' are quite literal, the layering of disparate sound identities through enigmatic means provides a carrier for the expected pattern of emergence, presence and dissipation that is evident throughout the work. Therefore, I suggest that phrasing in acousmatic music can be considered as the natural grouping of events as suggested in the phrases dying out in *Points de fuite*. The notion of the phrase is central to the discussion which follows in **section 1.12.**

1.12 Case study: silence and expectation

The function and meaning of silence in music is a fascinating yet under-explored topic. Its role as a generator of expectation and the implications this has for the acousmatic listener remain neglected. Acousmatic music lacks the physicality of instrumental performers who form an inherent part of traditional music, alongside the associated spectacle of action and non-action. This presents an opportunity to examine the impact silence has within a genre of music whose ontology is non-corporeal. Through consideration of existing literature and the analysis of two acousmatic works, Stollery's *Shortstuff* (1993) and Williams's *Break* (2004), this section will examine the phenomena of silence and gesture within acousmatic music and the ways that the relationship between them impacts on musical expectation.

It can be argued that silence cannot be packed into a simple definition; for example, the *Oxford English Dictionary* defines silence as 'a complete absence of sound'. However, musically speaking, silence can be considered multi-faceted. Silence has a characteristic appearance in both a musical score and a digital audio file, but it also has a punctuating function in musical grammar. The framing provided by moments of silence fulfils an important role in articulating musical structures and phraseology.

Cooper (2011) points to musical functions of silence as being structural or dramatic. Structural silence articulates sections of a work or individual phrases and is commonly observed in music. In contrast, dramatic silence may occur in the middle or at the end of a phrase. Dramatic silence can delay an expected continuation by either extending a structural silence or through the intrusion of silence in the middle of a phrase. This effect is heightened if the interruption[29] occurs where a strong downbeat is expected.

Within the context of a piece of music, a listener will have a culturally received view of what silence can mean, providing him or her with a variety of ways of interpreting it which may differ from those of another listener. Silence is something that is both a musical and 'lived' experience. As such, it can assist in driving and impeding musical momentum. Silences have varying significance depending on the time-scale of a particular piece of music which may either inhibit or encourage the listener's ability to form expectations of future musical events in the work. Furthermore, evoking a representation of silence in music challenges the accepted definition. A total absence of sound is certainly one extreme, but stasis can become a metaphor for silence through the creation of 'stillness' which can imply emergence from or a dissolution into silence. The notion of stillness is a concept that composers have sought to explore, in particular, to express a silent contemplation of a spiritual nature through the efficient deployment of space and silence between musical events.[30]

1.13 Comparative case study: *Shortstuff* and *Break*

Examples from these two works illustrate the significance of silence to the creation of expectation within acousmatic music. The manner in which *Shortstuff* and *Break* behave in terms of spectral space and silence provides us with different views of the ontology of these two pieces as constructs of sound and silence.

The source sound material within *Shortstuff* is created from tiny fragments of sound

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[29] Interruption plays a significant role in my compositional work and is discussed in context of SiO_2 in **section 3.3**.

[30] Messiaen's 'Regard du Silence' (from *Vingt regards sur l'enfant-Jésus*, 1944) provides an example of this stillness in Western tonal music. Within the work, a very sparse texture is created through chord progressions in the upper register of the instrument. These imply silence through the quiet dynamic of the work and the lack of musical events taking place. These are contrasted by a forte dynamic and chords played in the lower register on the piano. This work explores the anomaly of the relationship between sound and silence and accentuates Messiaen's view that the dynamic of pianissimo can act as a fine line between sound and silence (Hill, in Loseff et al, 2007:40).

amassed by the composer—'offcuts' from previous pieces as well as some synthesiser samples. The sound of shattering glass forms the sole sound material in *Break* resulting in the use of similar sound archetypes in both works. However, there is a distinct difference between them in their handling of silence and as such the focus is on the initial section of both works.

In his programme note to *Shortstuff* Stollery states:

> I wanted to make a piece consisting of material which would immediately draw the attention of the listener in to the sound world which I was creating. It is for this reason that the piece is deliberately uncluttered. There is not much counterpoint, or layering of material and the piece is deliberately "up front" with little middle or background, conceived as the development of a single line. Also, throughout the piece, there are sections where gestures are separated by periods of silence or limited sonic activity, which allow the listener to take stock of what has already happened and to anticipate what might be about to happen (Stollery, 1993).[31]

The composer's programme notes highlight two salient features of *Shortstuff*. Firstly, the choice of source material, as suggested by the title and, secondly, the use of silence which permeates much of the work.

Williams places emphasis on the different meanings of the word 'break' and the way in which they influence his work. In particular, he draws attention to the following:

> […] There is a break as in the cutting up and disrupting of material – found here in the fracturing and breaking up of sound material; at its most dynamic with the abrupt cuts between silence and loud, energized sounds […] (Williams, 2004).[32]

While this approach is similar to *Shortstuff*, the 'fracturing' to which Williams refers is of far shorter duration. Although both pieces make use of similar typologies of sound, and extended silences, the overarching nature of spectromorphological contouring of the sounds themselves is distinctly different. In *Shortstuff,* there is a greater degree of nuance and variation in the pitch and dynamic shaping. From a listening perspective, this encourages a more varied range of interactions between each of the gestural forms and the silences around them, leaving more scope for the kinds of musical values that arise from both the structural and dramatic uses of silence such as anticipation, surprise and fulfilment.

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[31] http://www.petestollery.com (accessed 30/5/13)
[32] http://tw-hear.com/wordpress/?page_id=534 (accessed 15/1/16)

1.14 The opening of *Shortstuff*

The entire opening section of *Shortstuff* features short gestural motifs, followed by lengthy silences **(Figure 3)** and a full frequency spectrum and dynamic range **(Figure 4)** which punctuate the temporal canvas. A consequence of the gestural nature of the sonic material used in *Shortstuff* and the silences permeating the musical fabric of the first section in particular, is a tendency for the listener to move through several modes of listening at a brisk pace. Young (2013) points out that:

> Rapidly shifting modes of listening are encouraged by complex registral motion of sounds of very short durations that are considerably varied in spectral fabric, arranged in asymmetrical rhythmic groupings separated by unpredictable variation in the lengths of silences between phrases. We may variously aim to grasp gestural coherence from tight-knit clusters of attacks, to track implied motion through pitch space where there is sufficient density of grains and uniformity of motion within a gesture, as well as locking onto the singular identity of focal pitches and occasional normative intervallic relations, typically at phrases' ends (Young, 2013: 8).

At the start of *Shortstuff,* the transition through listening modes proves problematic because of insufficient information presented in the first gestures of the work. It might, however, be argued that the silences, or periods of *absence* of sound which permeate the first section, allow for expectations to be formed over a longer time scale through association and working memory. The initial gesture heard in *Shortstuff* has a duration of less than a second and is followed immediately by four seconds of silence. The consistency of spectromorphological identity at this point is fragile and results in a shifting sonic landscape—a consequence of which is a difficulty for the listener in knowing what to expect.

While the sound material has been extended and developed spectrally from the initial gesture through the addition of new frequencies (**Figure 5**), the composer maintains the agglomerated nature of sound material and continues to develop a rich sonic canvas through varying bandwidths, grain lengths and spectral densities.
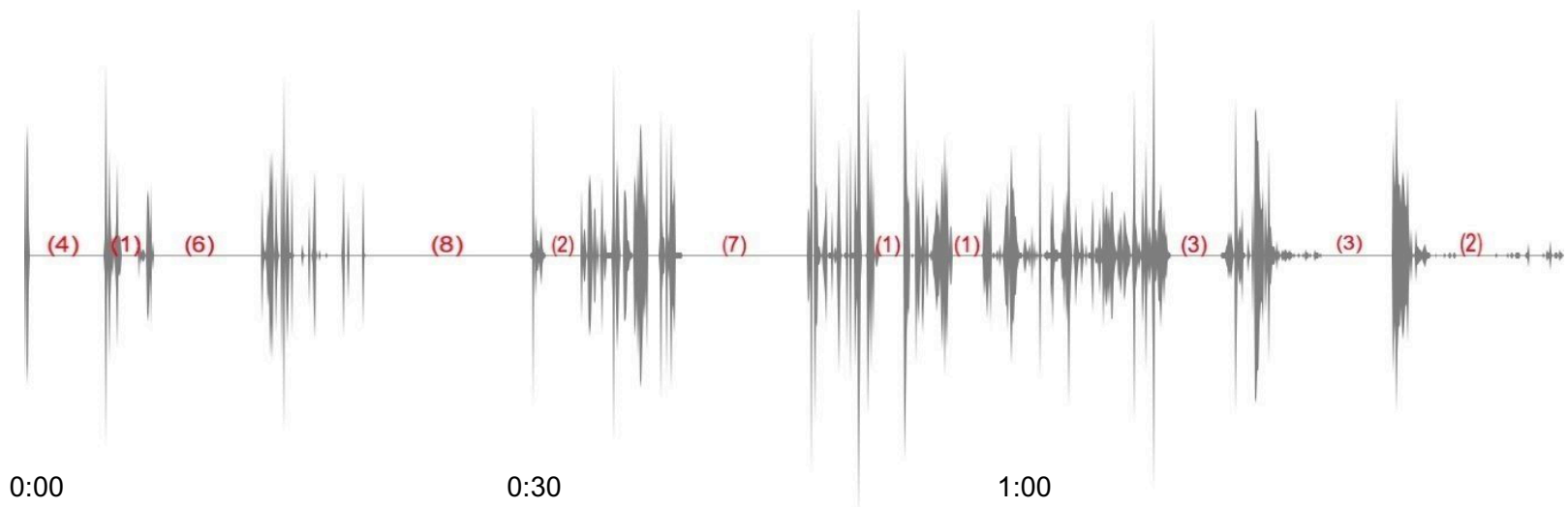
Figure 3: Lengths of silences in *Shortstuff* (seconds).

27
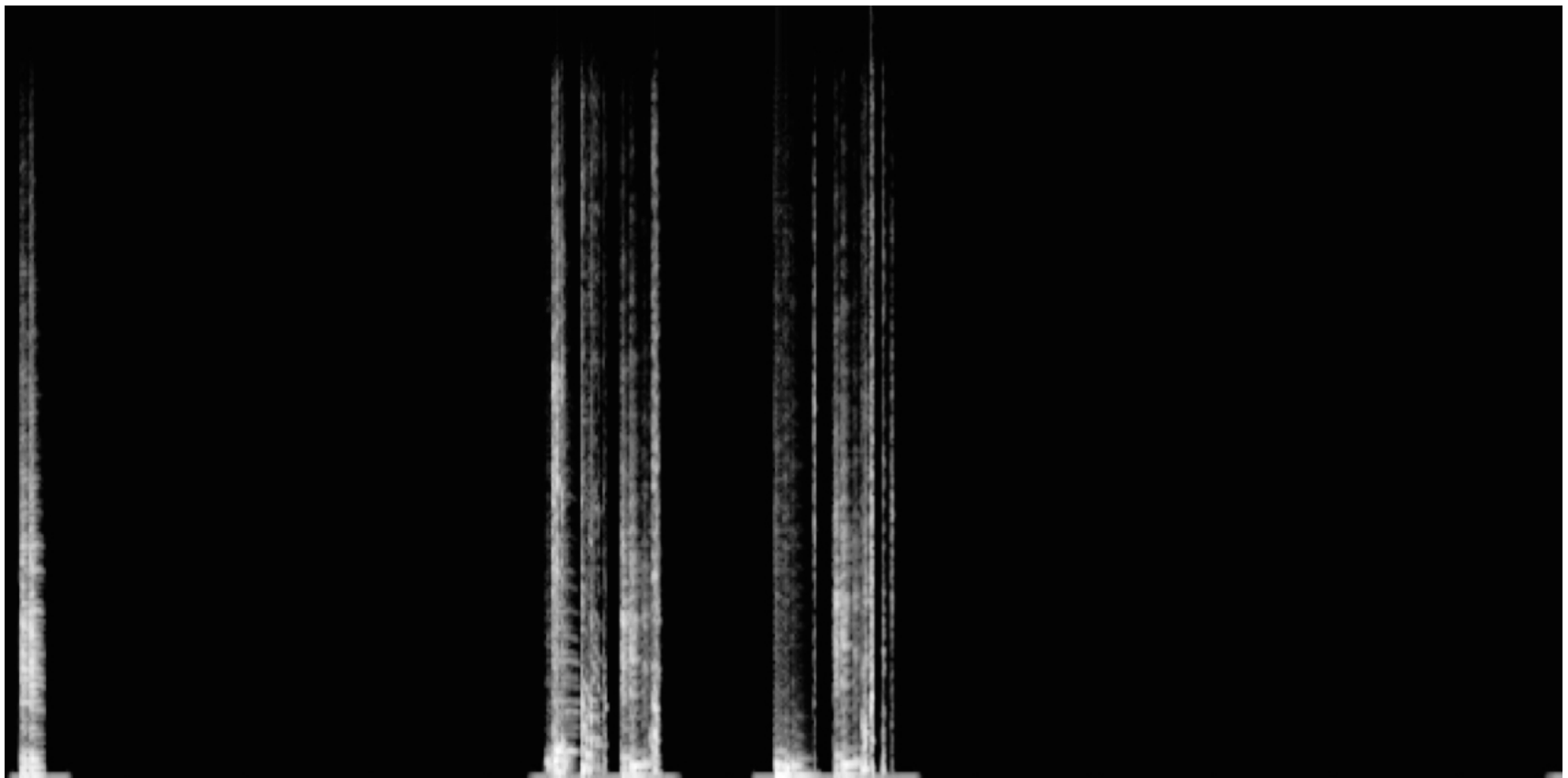
Figure 4: Spectrogram of the opening seconds of *Shortstuff* (00:00 - 00:13).
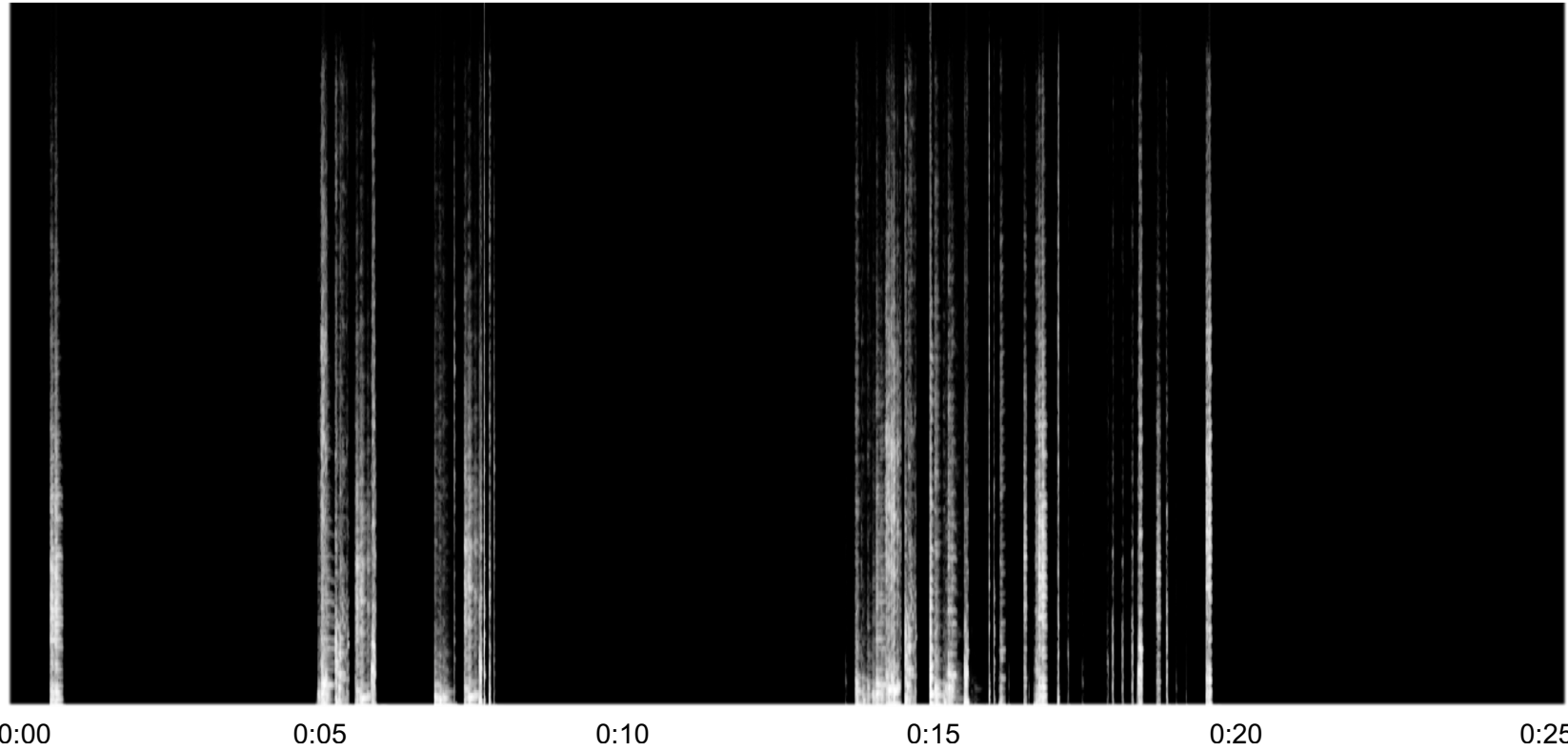
Figure 5: Spectrogram showing addition of new frequencies and gradual increase in intensity over the opening seconds of *Shortstuff*.

However, the growth of gestures in this way is complicated by the silences that continuously interrupt the developmental flow of sounding materials throughout the first section of *Shortstuff.* For the listener, a sense of pattern begins to emerge—in this instance, a very short gesture will be immediately followed by far longer silence. By the end of the first phrase (00:20), enough sonic information has been received by the listener to be able to determine that the characteristic of this work is isolated gestures in a field of silence.

In his programme note, Stollery mentions that periods of silence or limited sonic activity within *Shortstuff* are intended to allow the listener to reflect on previous sonic events and to anticipate what might happen next. In the case of the opening, forming an expectation of future events is nearly impossible as the listener has been presented with little evidence or amalgamation of events. Another similar short gesture occurs at 00:06 and the sonic material presented is again constrained. While it may be considered a continuation of the previous gesture, an abrupt silence lasting six seconds begins at 00:08 and interrupts the listener's anticipation of the development of the sound material. The fourth gesture of the work occurs at 00:11 and could be considered a development of the material previously heard. At this point, there is further development of the spectral content and the granular nature of the sound material, which implies a forward trajectory of development that will be maintained.

However, the phrase is cut short at 00:19 by a silence of eight seconds. **[Audio Example 6: 00:00 - 00:28]**. While the previous silences of four and one seconds respectively had led the listener to anticipate future development of events in the work, six and eight-second silences lie beyond the standard average threshold for short-term memory. With such limited and unrecognisable sound material being presented up to this point in the work, it is unlikely that enough information has been garnered to draw together associations between the sound material heard and the silences that have interrupted its development. A consequence of these silences is an interference with the development of expectation cues that have been formed earlier in the work.

The development in both complexity of sound materials and phrase lengths is echoed by the way periods of silence also increase in duration. Therefore, a listener might expect this pattern to continue. Rather, in contrast to what would perhaps be seen as a predictable evolution of the unfolding musical events, a very short, abrupt gesture punctuates the silence in direct contrast to the silences that have previously interrupted the apparent development of the musical material in the work.

The gesture which occurs at 00:14 is significant as, in addition to signalling a reversal of role between sound and silence within the work, sound now plays the role of the disrupter. It also points towards the conclusion of what might be considered the 'exposition' of this work. This notion of a transition to a period of development does occur as phrases grow in both complexity and duration between 00:43 and 01:09 **[Audio example 7: 00:43 - 01:11**]. Although silences are still present, the length of these is typically one to two seconds, allowing for the assimilation of both sound and silence into the musical discourse as a whole. This blending will also encourage listeners to make associations between these sounds and, therefore, form expectations of future events in the work.

The inherent complexity of sounds in the first section of the work raises the question as to what contributes to a sense of anticipation within *Shortstuff*. What *is* the gesture at the start of the work? Is it a shape or a confluence of spectral material in time? Are the spectra heard in the opening of *Shortstuff* bursts of noise? Or do they possess a sense of pitch, for instance? Is anticipation perhaps created through the periods of 'absence of sound' themselves? If rhetorical questions such as these arise for the listener, they are powerful prompts for an imaginative response.

While at a surface level, *Shortstuff* appears to be preoccupied with gesture and silence, previous analysis by Young (2013) suggests that the listener may try to hold onto gestural coherence and focus on individual pitches, usually at the end of phrases. These may act as psychological reference points for future events in the work. By applying an adaptation of Krumhansl and Shephard's 'probe tone' technique (Krumhansl, 1990), Young draws attention to potential pitch relationships that may be alluded to in the first 37 seconds of *Shortstuff* and the manner in which they contribute to the inherent complexity of the opening sounds in the work **[Audio Example 8: 00:00 -00:43, Young, 2013:1]**. The probe tone analysis draws attention to the moments of focal pitch within the opening of the work and suggests that the silences allow time for the listener to reflect on events, and form expectations of future events. Young suggests that by the end of the introductory section of *Shortstuff,* this use of pitch allows for connections to be made with events already heard previously in the work. He argues that:

> Pitch functions here as a salient phenomenon, a sound type, giving
> whiffs of intervallic structure within the phrases' bristling spectral
> contours that are sufficiently graspable by the ear to invite a forward,
> anticipatory kind of listening that seeks to connect perceptually
> related classes of objects (Young, 2013: 262).

Young suggests that a sense of pitch remains in the listener's mind after each sonic event has concluded in *Shortstuff*. However, Stollery states that his emphasis within *Shortstuff* is on the individual clusters of 'events' (what he terms gestures), their occurrence in time and space and the implication of these for a listener's expectation.[33] For Stollery, pitch, and any consequences it has for expectation within the work is purely a by-product of the material:

> It's not just about the movement of sound in space, but pitch is not really an important part of the piece, it's really just a by-product. For me, it's about gestures occurring in time and space. It's also about anticipation, the decoding of information from sounds that have occurred and to try to anticipate what might be coming next. That's what all the silences are at the start. The piece then goes on to explore gestures within spaces which are more occupied by sonic material. This, in turn, develops into looking at textures within spaces (the ending) (Stollery, 2013).[34]

Pitch within *Shortstuff* is, therefore, important in that it is a salient part of the information in the sounds themselves. This contouring in sound gives *Shortstuff* its richness, and makes expectation easier to form for the listener as opposed to the focus on duration and dynamic range that is present in *Break*.

I suggest that the silences within *Shortstuff* are a source of tension. The initial gesture heard at the beginning of the work is immediately followed by silence—a prominent feature occurring numerous times over the first section of the work. In other words, as the first part of the work unfolds, the silences become more dominant and more of a focus for the listener than the clusters of 'events' themselves. That is to say that the absence of sound becomes more of a tangible feature than the presence of sound.

The lengthy silences within *Shortstuff* provide the listener with an opportunity to reflect on previous events and potential future events within the work.
As the length of the phrases grows there is a shift in focus from forming a generalised impression of the relationship between sound and silence (for example, the way in which sound fragments might accumulate) to more precise attention to the detail heard within the phrases themselves, such as the specific shape of gestures and possible pitch relationships.

A seven second silence occurs further on in the piece at 03:39 and takes on a different function from those prominent at the start of the work by disrupting the musical phrase

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[33]Like Stollery, my listening focus has always been on the individual clusters of 'events' as opposed to the pitches left behind as suggested by Young.
[34] Stollery, P (2013) email to the author, 5 September.

suddenly **[Audio Example 9: 03:30 - 03:48]**. This may be surprising to the listener as, after the initial section of the work, textural material has been more dominant than silence. While the silence might be expected to be relatively short to maintain momentum of the work, its length implies a sudden end to the section. Therefore, the recurrence of the same gesture which preceded the silence comes as a surprise to the listener as it might be expected that repetition of gestural material will occur at this point. Instead, a development of the work begins through a gradual breakdown both of the material itself into a sparser gestural material, and the pronounced slowing down of the pace at which events occur in the work, before coming to a complete halt at 04:30. While the silence at this point is expected, it is shorter than might be anticipated. This is effective as it allows for the momentum of the piece to pick up again and for the sporadic gestural materials to be gradually knitted together until a rupture of material at 06:23 reveals an entirely new sound world of 'short stuff' shrouded in a backdrop of noisy stillness.

1.15 The opening of *Break*

While a similar approach to gesture and silence is present in Williams's *Break*, there is far less exploration of both the frequency and dynamic range than observed in *Shortstuff.* This trend is established within the opening seconds of Break, in which there is little variation in either parameter **(Figure 6)**. This means that the silences utilised by the composer have less effect, leaving little manoeuvrability for the building of tension and release. Prominent features of *Break* are the silences that separate the short, sharp gestures present throughout the piece **(Figure 7)**. In contrast to *Shortstuff,* where short gestures are immediately succeeded by silences beyond the range of short-term memory, *Break* presents silences of between one and three seconds in duration followed by gestures that develop in length. The high dynamic level is maintained throughout the work. The implication of this is that while the formation of associations is easier to facilitate, there is less potential for the creation of surprise for the listener.

I would suggest that expectation is formed over a far shorter timescale in *Break* than in *Shortstuff*. The initial gesture heard in *Break* has, like *Shortstuff*, a duration of less than a second but is followed immediately by a silence of only a second in length. This initial gesture spans the entire frequency spectrum and is of high amplitude.
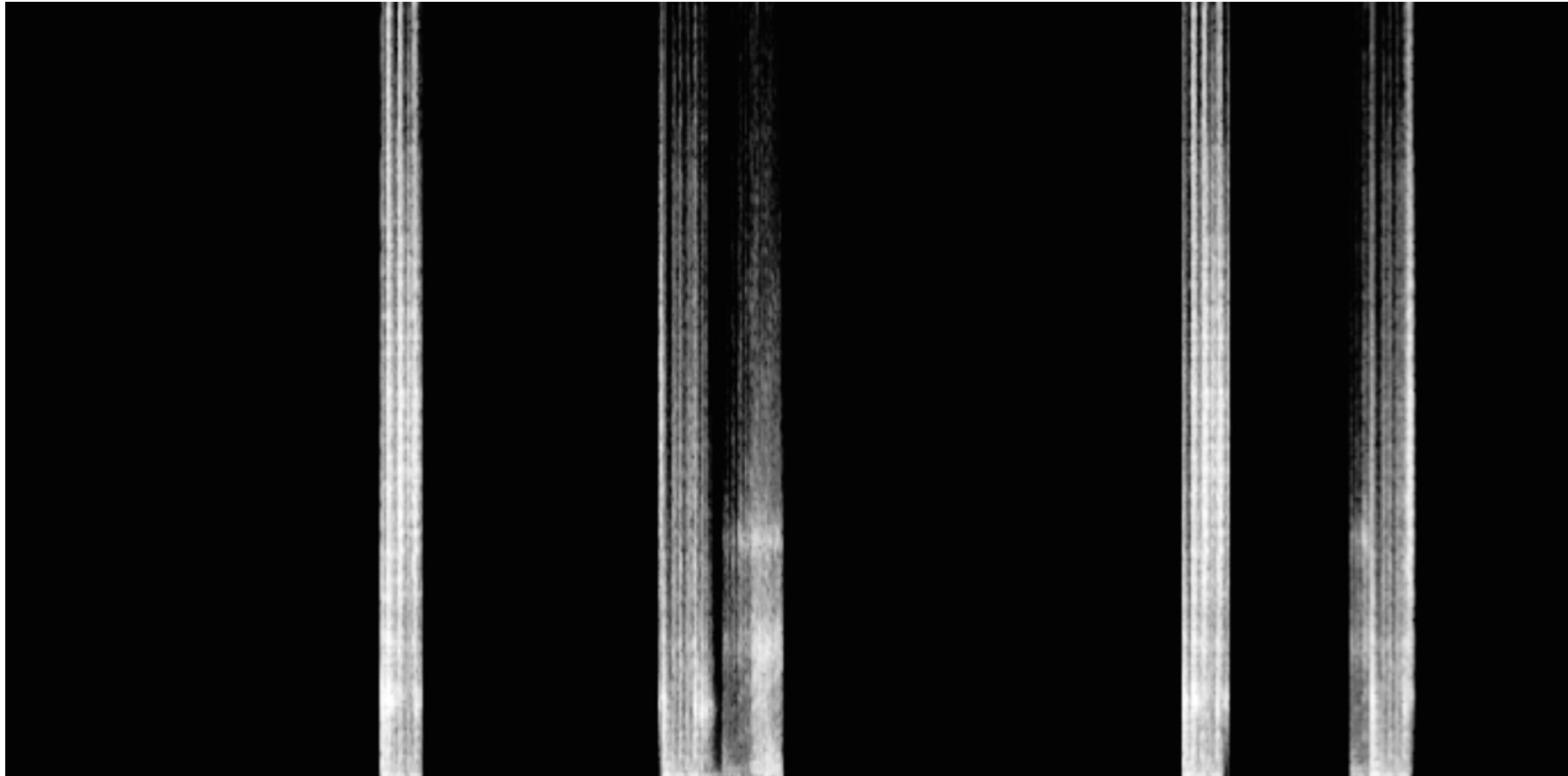
0:00   0:05   0:10

Figure 6: Spectrogram of opening seconds of *Break* (0:00-0:13).
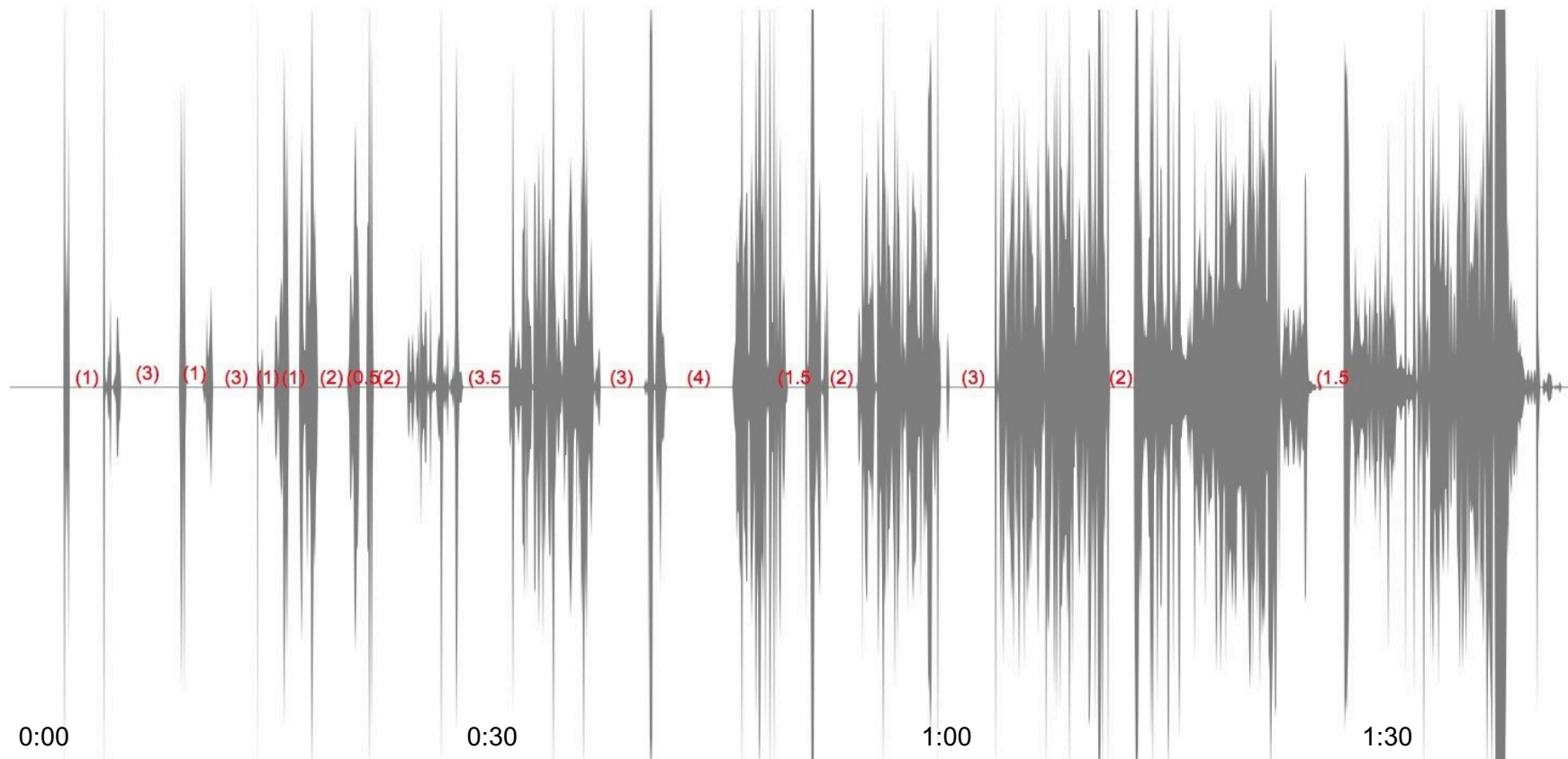
Figure 7: Length of silences (seconds) present in the opening minute of *Break.*

This is effective in immediately drawing the listener into the material of the work. The second gesture of the work occurs at 00:05, and this time lasts for just over a second in length. It also acts as a rhythmic development of the first gesture. The spectral space established in the very first gesture is maintained, while the dynamic level is dropped slightly **[Audio Example 10: 00:00 - 00:08]**.[35] This gesture is followed by a silence of three seconds, then a gesture of less than a second in duration that is almost identical to the first gesture heard in the work.

While this firmly establishes this particular gesture, the musical material is reaffirmed rather than developed at an early point in the work. Throughout the entire first minute of the work, very little is added to the initial gesture heard, making it more predictable due to the repetition and patterning.

In his programme note, Williams describes the relationship between sound and silence in his piece:

> In *Break* the appropriation of silence and quasi-silence—as in
> the use of low tones—is one of the piece's principal motives
> and it is this dynamic contrast of sound and silence, manifest at
> key structural points, which underlies its formal design
> (Williams, 2004).

However, the effectiveness of this in achieving 'charged silence' is questionable because of the lack of time allowed for listeners to reflect on the events leading up to the silence, and the lack of variation regarding spectral space, dynamic range and sound materials used. The employment of abstract and unrecognisable sound material alongside sudden silences could undermine a listener's capacity to draw any association or perceive relationships between the sounds heard and the short silences which follow.

Based on my comparative analysis of the opening moments of *Break* and *Shortstuff*, it would appear that the use of silence within acousmatic music has particular implications for expectation experienced by the listener. In addition to the abstract nature of the sound materials used, ontologically speaking, acousmatic music is also non-corporeal—it lacks the performers so commonly seen in traditional music and the action and non-action associated with them. Although both pieces make use of similar typologies of sound and extended silences, the overarching nature of the spectomorphological contouring of the sounds themselves is distinctly different. In

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[35] Note that the silence at the beginning of this work is intentional.

Shortstuff, there is a greater degree of nuance and variation in the pitch and dynamic shaping. From a listening perspective, this encourages a more varied range of interaction between each of the gestural forms and the silences around them, leaving more scope for the kinds of musical values that arise from both the structural and dramatic uses of silence, such as anticipation, surprise and fulfilment.

1.16 Summary

In the first part of this dissertation, issues pertinent to the creation of expectation within acousmatic music have been explored. Firstly, I concluded that David Huron's ITPRA theory of expectation, though originally intended for Western tonal music, can be applied to acousmatic music despite the problems which exist in the materials being used within the genre. ITPRA's relevance rests on its underlying generalised framework integrating schema-based understanding of cause and effect: that movement and interaction of objects carry implications that may or may not be realised. Furthermore, the emotions that can arise from expectations being realised or thwarted were outlined, alongside the difficulties which are present in a genre of music such as acousmatic, where tonality is side-lined in favour of syntax based on spectromorphological shaping and direct sound images sourced from recorded real-world events.

The role of memory and schemata are critical within this investigation as it is this which permits the listener to retain information about the sounds they hear, to place them within the context of the rest of a piece, and to relate them to their knowledge of the world of sound beyond the piece. The limitations of memory were discussed, emphasising the difficulty in forming expectations in acousmatic music when often many sounds are presented as opposed to the melodies and harmonies more commonly heard in Western tonal music. Because the acousmatic genre as a whole is constituted by a range of sounds much wider than conventional kinds of music based on pitch and quantised durations, the tendency for acousmatic music to draw on more generalised spectromorphological and source-recognition based schemata were discussed. Critical aspects of theory regarding anticipation and surprise were also presented as these are essential products of expectation.

We have a tradition of tonality that is still alive and which already frames what we might expect of music, but also electroacoustic tools which can generate surprising or

shocking results for which we try to find a musical home through the means of composition. The issue within the genre is that the core principles of tonal music are often fractured, disguised or absent. What we do have is an almost unlimited palette of sounds and transitions available, which make expectations harder to form, requiring us to build anticipation of future events around on-the-fly interpretations of sound materials using spectromorphological and source-recognition based criteria—either influenced by the evolving context of one work, or drawn from prior listening experiences.

Part one of the dissertation, therefore, presented the issues surrounding the role of expectation within acousmatic music. Because acousmatic music is facilitated by the mediation of recording it offers a broad range of sound materials which are also often heard in our everyday lives. This issue is summarised in Denis Smalley's examination of *space form*—an aesthetically created 'environment' which may contain connections between sounds of recognisably real-world origin and abstract sound forms. I also proposed that there exists a sonic geography in acousmatic music which we confront during our listening experience, creating a bifurcation of listening between spectromorphological and referential sound, and which draws upon ITPRA through memory and the formation of schemata. Therefore, in acousmatic music, an ITPRA-based approach to sequences of events can be usefully applied both to musical arguments based on spectromorphological manipulation and where source recognition of real-world sounds is central.

Lastly, the final section of the first part of this dissertation explores the phenomenon of silence[36] and its impact on expectation through analysis of the opening minute of Stollery's *Shortstuff* (1993) and Williams's *Break* (2004). Silence became an important aspect of this study overall as it influenced some aspects of the portfolio by forming an aperture through which to examine what implications the *absence* of sound has on the listener's expectations for future events in a piece of music.

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[36] This is also an issue explored in my work *Rift* (2015).

Part 2:

2.0 Introduction

The second part of this dissertation focuses on the ideas arising from the composition of my portfolio and the associated research. While the portfolio was the primary focus, it also provided a testing ground for both compositional and theoretical ideas as they developed over the course of the research project. Two main ideas have been developed during this practice-based research project, and these will both be discussed in this part of the dissertation. The first of these—*acousmatic skip-diving*—examines my workflow of selecting and implementing sound materials. The second – *sonic evidence* – provides the listener – and, to a certain extent, the composer with a way of piecing together sounds to form expectations of future events.

2.1 Acousmatic Skip-diving

Acousmatic skip-diving is my personal interpretation of how Guy Reibel's *séquence-jeu* applies to my practice of working with sound materials. It was inspired partly by the practice of dumpster-diving and the work of the sound artist Neal Spowage[37] who composes with his own instruments built from materials that have been trashed.

Working exclusively with recorded sound and transformations of them inevitably results in the generation of a significant amount of material, all of which needs to be assessed for its suitability. Within the evaluation of materials section of the acousmatic skip-diving diagram **(Figure 8)**, the utility of sound materials and their implications are considered. This calls upon prior experience, imagination and a sense of compositional instinct which in turn includes a consideration of the spectromorphological and referential qualities conveyed by a sound. At any time in the process the evaluation is influenced by my emerging sense of how the piece is developing, what future events are anticipated and how this relates to previously heard events.

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[37] http://www.nealspowage.com (accessed 06/01/16).
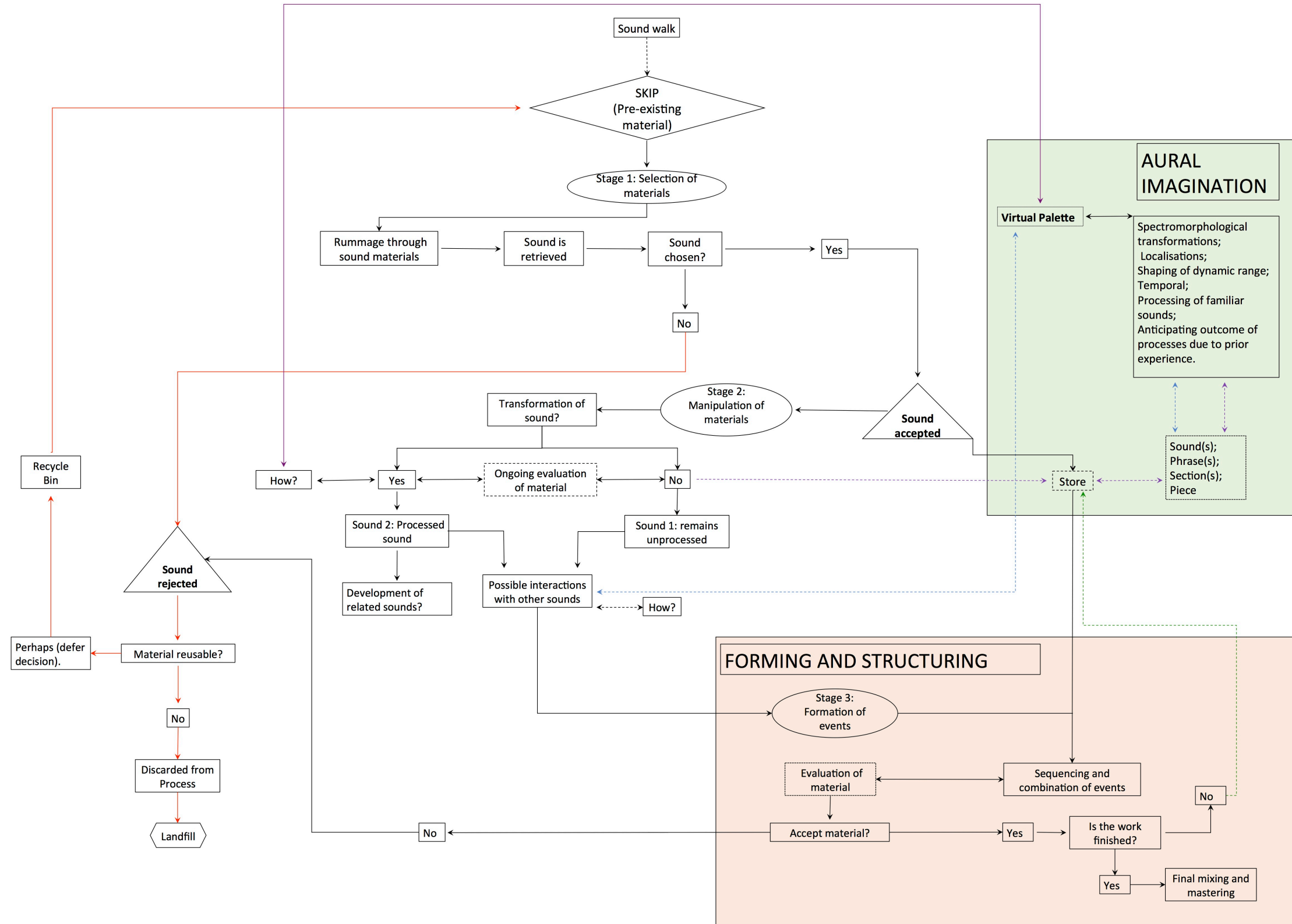
Figure 8: Acousmatic skip-diving

The acousmatic skip-diving approach provides a means of exploring how a composer might evaluate and create expectation within their work – especially when confronted with a large bank of sound files, where intricacies of the materials are swamped by the enormity of the available resources.[38]

The acousmatic skip-diving process is a blend of instinctive evaluation of material with serendipitous combinations of sounds. It begins with the selection of sound material through focused listening or chance encounters which permit a reflection on the emerging criteria of the objects selected for further development. To this end, further material may be added to the skip at any time and equally, one can retrieve material from the skip at any time – for example when the possibilities of the material currently being worked with seem exhausted. Decisions are then made (whether to retain or reject the material and how the material might then be digitally processed). As discussed above, sound materials are judged for their suitability in terms of both spectromorphological and referential qualities. Reduced listening may therefore have a role in the sifting process but will depend on the context in which sound material is being explored, for example when I am more concerned with creating abstract materials or new sounds that are intended to have a functional purpose such as constituent parts of attacks or drones.

The implications presented by a complex sound may be multifarious and become even more so as sound interrelationships form which are continuously re-evaluated as a work develops. With every single sound, there is an implied sense of time scale: motion forward, or an opening out towards stasis or silence. Because there are many ways into the skip-diving process, the musical utility value of a sound can be explored in stimulating ways, which may not necessarily follow any assumed logic. As sounds are drawn from the skip and their implications evaluated, a context may emerge which was unpredictable, or even entirely unexpected, challenging me to forge links between materials or to recognise surprising patterns or connections.

2.1.1 Stage 1: Selection of Materials

The first stage of the acousmatic skip-diving methodology (shown in **Figure 8**) involves the selection of the source materials that will be used in the new

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[38] This is a problem summarised by Pierre Schaeffer through his 'parable of the attic' where he discusses the difficulties in classifying large amounts of materials in a meaningful and manageable way (Schaeffer, 1966: 429-30).

composition. The starting point for this will depend upon the nature of the composition—is the piece intended to be heavily reliant on field recordings? Will studio recordings form the basis of the work? If the work is to be soundscape-based, my initial starting point is likely to be a sound-walk during which field recordings will be made. The sound-walk itself will have been shaped by chance. If I am exploring an unfamiliar city (as was the case when gathering materials for *Mordicum*, *Sacred Voices*, *Our Song (我們的歌)* *and Tout autour de la montagne)* then I will set off with no particular route in mind. Instead, I will allow my ears to guide me towards particularly interesting sounds that I feel may have potential for further exploration in the studio. The nature of the resulting pieces can vary from works that provide a portrait of a particular location (eg. *Tout autour de la montagne)* to those which are more obscure in reference (eg. *Mordicum)*. If the material is to be sourced from studio recordings, then the initial starting point is likely to be a gathering of (sometimes completely random) sound-making objects (marked as 'skip' in **Figure 8**).

As Jonty Harrison notes in his composer recollection included in Moore's *Sonic Art,* 'there is no such thing as a completely unmusical sound…' (Moore, 2016:220). The role that sound might play in a piece of music is dependent on the context in which it is placed and the role of the composer is to establish that context. Harrison notes six stages of listening, which also coincide with my practice:

- Listen *out* … for unique or unusual sound materials, or for more familiar sounds behaving in a way you hadn't noticed before. Hit the 'record' button – they may not happen like that again!
- Listen *in* … by focusing on the individual sound and by trying to get your microphones closer to it than you might be able to get your ears.
- Listen *around* … to the real-world context of the sound – how much is this informing your interest in this sound (and how much or little of it do you want in your recording) and, if you change this context for a different one, how might this affect 'meaning'?
- Listen *within* … the different spaces (open or enclosed, and with unique landscape or architectural features and materials) and places (such as other countries with unfamiliar languages and wildlife) in which you discover your sounds.
- Listen *through* … to anything in the sound's behaviour that strikes you as particularly rich for more 'abstract' musical development (changing spectrum, iteration, pitch content, spatial characteristics).

- Listen *beyond* … to how the sound's energy trajectory might interact with other material to generate musical structure (Harrison in Moore, 2016: 220-221).

Harrison draws attention to the idea of 'listening out'. I find myself following this notion when I am working in both the field and the studio. Often, when working in the field, I am drawn towards sounds that may be considered more unusual or unfamiliar and deliberately shut out common or 'noisy' sounds such as traffic or general crowd noise. The exception to this is if these 'common sounds' have the potential to offer something that will become a unique focal point for the work. In the studio, I am more likely to concentrate on sounds that strike me as interesting from a functional aspect, but which will also be attractive in some way. As my compositional work is centred on expectation, I tend to prioritise more unusual sounds that I can then use to create surprise or manipulate in such a way as to create tension or form an enigmatic sonic landscape. At this stage I am categorising the sounds that I feel will warrant further manipulation throughout the composition process. This takes the form of 'rummaging' through materials by listening, sorting and making notes about their sonic properties.

Harrison's notion of 'listening in' features in my studio recording techniques, where I will experiment with different types and layouts of microphones to gain as many perspectives of the sound as possible. For example, when recording source material for *Rift*, I recorded numerous objects which possessed different sound qualities (the fine, high-pitched sounds of cacti spines being plucked, the low rattling of coins being spun on a wooden desk, the textural crumpling of plastic bags amongst other items). I also experimented with placing marbles on a plate and then moving them between two microphones to create textures of fluctuating pitch and speed shaped by the natural motion of the marbles. Microphones placed close to an object (or the use of contact microphones), provide insight into the structure of a sound that is difficult to obtain from listening directly with the ear alone, while recording from a distance captures ambience and less focused spectromorphological detail of individual events. I used this technique in SiO_2 where I made both close-up and distant recordings of bowed wine glasses. This allowed for the potential of mixing both together at a later stage of the composition process to create a 'hybrid' sound with subtle pitch variations alongside the establishment of

spatial features to be given consideration in the multi-channel deployment of these materials[39].

An initial selection of sounds is retrieved after listening and evaluation. This listening process is analytical, it may involve reduced listening, and it depends upon my prior experience of using similar sounds in previous works, the creative possibilities of the sounds when treated with signal processing routines and an instinctive evaluation of the musical qualities or implications of the sound. For example, lots of peaks and troughs in a file will signify a wide dynamic range, which may resonate with an imagined aesthetic effect, the details of which are not yet known. Similarly, the name I give to the sound file itself (for example giant_panda_call) may also lead to it being selected for the next stage due to it triggering the memory of what that particular file sounds like.

Next, I make a decision as to whether the sound is accepted for immediate use or rejected. If accepted, the sound will be placed in a temporary 'store' until I decide to use it in the session or to process it further. As the work is composed, this 'store' will grow to include phrases and sections of the piece in addition to individual sounds. If the sound is rejected at this stage but has a potential use later on in the composition process, it is placed to one side in a virtual 'recycle bin' which allows it to be placed into the 'skip' further on in the composition process. If the material is disposable (i.e. unintentional pops, clicks, knocks) and will not be used, it is placed in 'landfill' and deleted from the session.

At this point I begin to categorise my sound materials into folders with descriptive titles which will aid their retrieval (for example, traffic sounds, attacks, swooshes, textures). In either case (acceptance or rejection) there is a period of reflection as to the reasons for this decision which could be:

- functional: for example the need to add an attack to an attack-less sound or reverberation to a sound that ends abruptly;

- aesthetic: for example an inherently engaging quality in the sound such as spectral richness, or a the poetic quality by which the spectromorphological or referential distinction stimulates the imagination;

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[39] Space, while not a paramount concern of my research or practice, is nevertheless discussed within the context of my portfolio in more detail in **Section 3.0**.

- transformative potential: prior experience of working with sounds, knowledge of the structure of sounds and how particular sounds may react to specific processes will lead me to make predictions about the potential for chains of related sounds to be created through transformation.

2.1.2 Stage 2: Manipulation of Materials

The next stage of the skip-diving process involves the manipulation of the previously selected materials. After the sound has been chosen, a decision is made as to whether or not the sound is to be transformed. This will depend largely on the sonic properties of the sound being examined as well as those which precede and succeed it. If the decision is made to transform the sound, the next step is to decide what kind of transformations are applied bearing in mind those characteristics of the sound I seek to adapt or manipulate. At this point the sound may be carried to the 'virtual palette' for suitable transformations to be determined.

The 'virtual palette' prompts sounds to be placed aside or processed to test techniques used successfully in older pieces to examine whether they will be effective within the context of the new work. The notion of the virtual palette incorporates prior compositional knowledge and personal aesthetic choices that influence event and phrase construction through an understanding of the sonic fingerprints of particular processing techniques (for instance use of GRM shuffling on a vocal sample).

The result of the decision to transform the sound is 'sound 2'. If the decision is made not to transform the sound it will be transferred to the store until such a time as it is placed into the session. The result of this decision is 'sound 1'.
In both cases, sounds may now be evaluated for possible interactions with other sounds, which may include further processing, or the development of these sound materials into phrases.

2.1.3 Stage 3: Formation of events

The final stage of the skip-diving methodology is the creation of events. The first and second stages can be repeated indefinitely to assemble many new sounds. When composing, I will work with between three and five sounds at a time and craft

these to form events from 'strands' of sonic information. These strands are retrieved from the store and, as the skip-diving process is repeated, can be a mix of previously transformed material, phrases or sections of pieces. These 'strands' of material function as building blocks of individual sounds which will later become 'events' when they are combined or placed with other sounds. After the formation of an 'event' or a 'strand', another change in listening focus will occur. I will now concentrate more on the overall sequence of events in the developing work and the time-scale on which they occur.

This change in listening focus and repeated flow of the process also provides the opportunity to evaluate the sound/the gesture/the phrase. Concerning expectation, it permits examination of whether or not the elements constituting the emerging event function with, say, the kind of forward motion that is intended. It is at this point that a decision is made as to whether the material is kept or temporarily stored. If the piece is not yet complete, the material will be moved to the store. It should be noted that this process is a continuous one. Once this step of the process is reached, I may add new sounds and therefore return to the start of the skip-diving process. Should the piece be complete, the final step is to finalise mixing and mastering in preparation for performance.

In summary, acousmatic skip-diving provides a means of gathering a variety of sound materials together in a creative way, such that the outcomes of a selection process can be surprising and unpredictable, as well as allowing an emergent sense of organisation and coherence .

2.2 Sonic Evidence

As a composer, I think a great deal about cause and effect – in particular, the relationships between materials and the expectations these might engender in the listener. The concepts of sonic evidence and associative evidence are proposed as part of a listening and compositional strategy as a means of unifying elements which contribute to the notion of creating expectation in acousmatic music. By drawing upon existing research both within and outside the acousmatic field, it is possible to piece together the reasons why musical events, or constituent parts such as individual sounds or gestures form expectations for future events within a piece of music. This has been informed by notions drawn from Smalley's spectromorphology (Smalley, 1986, 1997 and 2010) and acousmatic space-form (Smalley, 2007). The idea of

unpicking event sequences and revealing cause and effect relationships within sonic gestures leads to a process of analysis which parallels elements of forensic science and provides an analogy for the way we might form expectations in acousmatic music.

To get closer to objectifying my compositional methods, I have allowed scientific research to filter into my thinking. It is possible to relate different events to anticipate future events within the work, in much the same way as a forensic scientist will gather pieces of evidence to form conclusions as to how and where a particular event occurred and who or what was responsible.

The basic concept underpinning forensics (and my concept of *sonic evidence*) is the *Locard Principle* **(Figure 9)**, which suggests that:

> When one object comes into contact with another, something is exchanged and taken away by both objects (Pepper, 2005: 7).
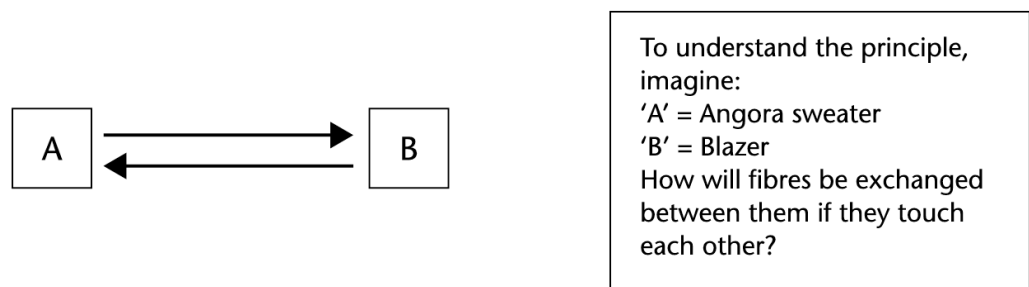
Figure 9: *Locard's Principle* (Pepper, 2005: 7)

This can be employed in a similar manner when considering the broader set of evolving sonic relationships to create expectation within acousmatic music **(Figure 10).**

This interpretation of the *Locard Principle,* allows for several elements of a piece of acousmatic music to be considered as *sonic evidence*. The difference between the traditional idea of 'evidence' within a crime scene and its application in acousmatic music is that the musical work will continue to move forward in time as opposed to forensics where events occurring in the past are examined. Evidence considered in acousmatic music can include our capacity to differentiate between sound materials, gestural motion, underlying causal energy, the surface qualities of textures and the way that these can be bound in time.

Evidence may be defined in the following manner:

> Information, whether in the form of personal testimony, the language of documents, or the production of material objects, that is given in a legal investigation, *to make a fact or proposition more or less likely* (Houck et al, 2006: 52) [My italics].

The definition of evidence is enlightening. Although originally intended for use in crime scene analysis, it also expresses the means by which the composer and the listener will use the sonic information to form expectations and then appraise the event itself.

To understand the principle, imagine:

'A' = sound 'A' (loud resonant attack)

'B'= sound 'B' (pulsing texture with a metallic source)

How is the relationship between sound 'A' and sound 'B' created?
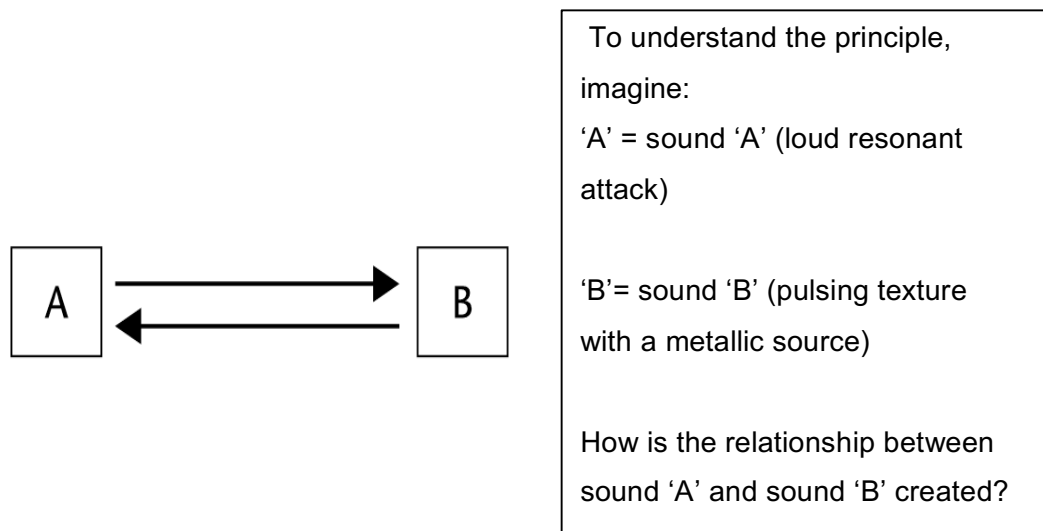
Figure 10: *Locard's Principle* as applied to acousmatic music.

The Locard principle can also be considered through the *Physical Evidence Linkage Triangle* (Ogle, 2011: 3), which identifies links between items such as clothing or fingerprints at a crime scene, and between the victim and the suspect. This can be applied to music in that it draws attention to interactions between the listener, the composer and the relationships between elements of a composition. As a composer, I also take on the role of listener. I aim to be the aesthetically detached composer, listening as others listen in an attempt to gain an understanding of the 'logic' of what I hear, but also the poietically informed listener: I listen to my compositions with the ears of a critical listener but make decisions as a composer. Both the aesthetically detached composer and the poetically informed listener seek to interpret different types of 'evidence' to surmise future events in a piece of music. I am also a listener in the normative sense. I listen to the work of other composers and form expectations based on both what I hear and on my prior experience as listener and composer. This

listening process, therefore, impacts upon and becomes an inherent part of the composition process and my musical personality.

2.2.1 Investigation of a Crime Scene

The notion of the crime scene and the manner in which investigation takes place has influenced the development of my concept of sonic evidence. The way the 'scene' is interpreted will be dependent upon the listener's or composer's prior experiences and engagements with acousmatic music. A scene may be interpreted in the following manner: in terms of sonic evidence, the composer is an equivalent of Agatha Christie—the crime writer; that is, they are not limited to witnessing the scene but also have a role in constructing it in that they lay down clues for another listener to decipher. In the case of my portfolio, these clues are often provided in the form of semi-obscured sounds that give a hint of the sound source. The listener is Hercule Poirot—the detective within the narrative—they must be scanning the 'scene' logically in the ways indicated in **Figure 11** (although it is possible that the composer will do the same in order to anticipate how the listener will approach 'the case' and to pre-empt some moments of surprise for the listener).

The listener may perceive a whole piece of music or sections of it as 'scenes'. Effectively, they listen to the work and gather pieces of evidence as they experience different musical events within a work. The listener will draw information from sonic identities of sounds – their behaviours and characteristic patterns – that suggest directions for possible future outcomes in the work. These assumptions are based on previous musical exposure as well as on the natural understanding of the physical world. This is particularly the case in acousmatic music where an appreciation of the spectromorphological 'life' of sound as an interaction between source and cause is paramount. When the listener appraises an event, they will consider it in the context of the timeframe in which it was heard. The composer, however, has examined each object individually to build a scene. This is because they will reflect upon each sound, each phrase, each spatialisation decision and the relationships which exist between these several times to build up a broader picture of what the final piece might sound like.

Best practice in crime scene investigation advocates a methodical approach to the search for evidence that follows an established pattern. Houck et al (2006: 36) present three of the most common search patterns—the spiral, the strip (or lane) and the grid

(see **Figure 11)**. The pattern applied to a particular crime scene will vary according to different factors such as the location, size or type (fire, open ground, confined space, etc.). However, its purpose will remain the same regardless of the pattern implemented—to gather evidence and to take measurements which allow for the precise position of pieces of evidence to be triangulated. While gathering evidence, the crime scene investigator will be making observations regarding the type of evidence: what, when, why and how particular events may have unfolded, and who may have been responsible.

2.2.2 Potential Applications Within Acousmatic Music

Forensic analysis techniques such as the search patterns discussed in the previous section can also be used to understand the ways in which the composer and listener form expectations of future events in acousmatic music. Within the context of a forensic investigation, evidence is gathered to understand the cause of an event that has taken place in the past. In acousmatic music, however, sonic evidence involves the unravelling of time—rolling back the clock to deduce when and how sonic events occurred. For example, revealing an imposed pattern that unlocks a sequence or a set of connections between sounds. However, unlike a forensic investigation where the perpetrators are likely to have made their escape, the musical scene develops continuously as a piece moves forward in time.

Due to the fluid nature of musical experience, there are limits as to how far a two-dimensional description of sonic evidence works in practice—listeners may make other connections and form different implications at variable points in the piece on subsequent listenings—but the style and function of the following forensic pathways remains relevant. While music is heard in terms of its linear evolution, we make sense of musical experience through non-linear connections, associations and assumptions. When we listen to music we are listening to current events which may give significance to past events by enabling us to draw meaning or importance from sounds, and imply development of future directions of the work. Through this investigative listening approach key parallels with crime scene investigation can be found.
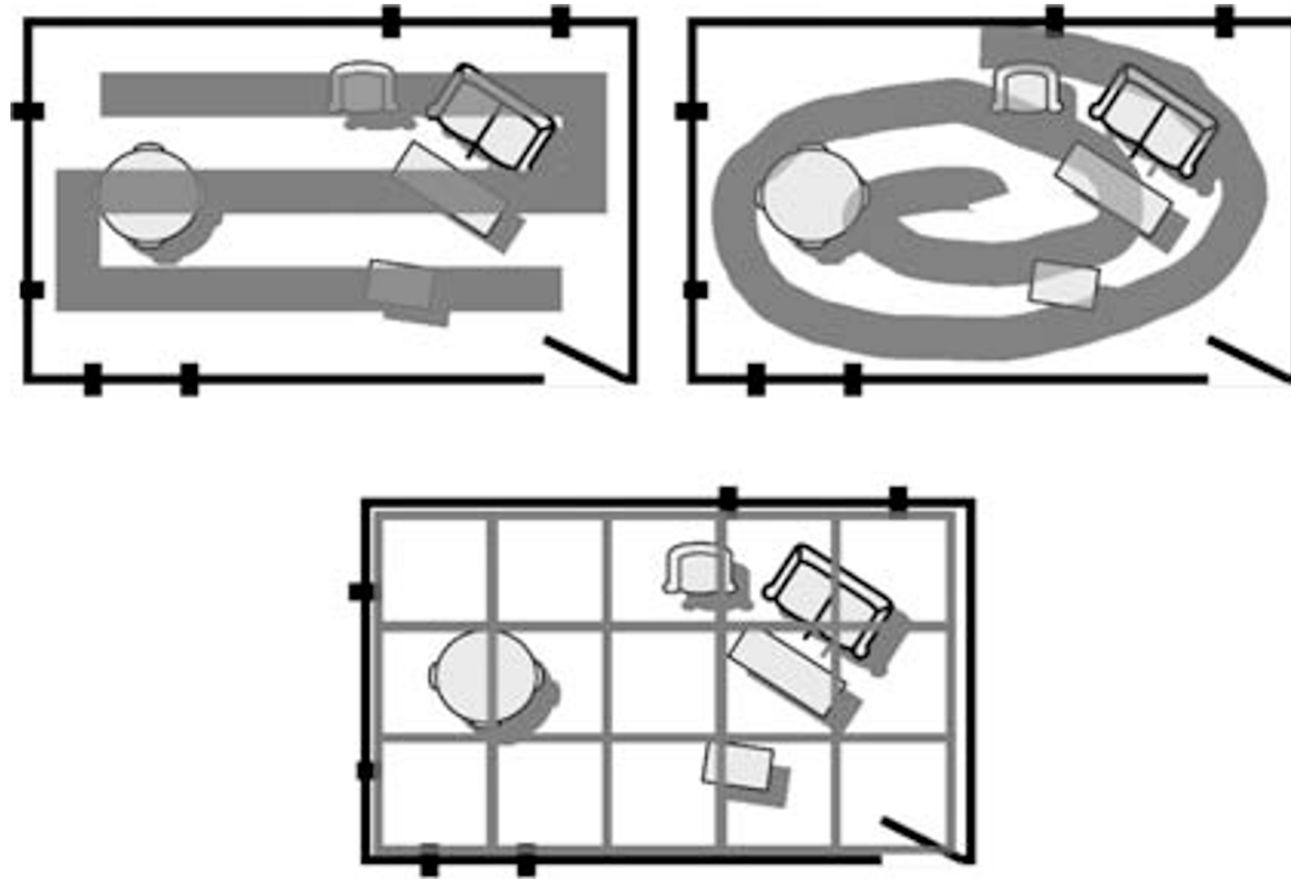
Figure 11: Common systematic approaches to crime scenes. Clockwise: The 'strip' (or lane), the 'spiral' and the 'grid' (Houck et al, 2006: 38)

The Strip/Lane

From a listening perspective, the strip or lane is akin to listening from the beginning to the end of an entire composition (or a smaller component of a composition such as a gesture or a phrase). After listening through the piece to gain an overview of the material (equivalent to observing the entirety of a crime scene), repeated listening takes place and focuses on a different element each time. These may concentrate on returning characteristic timbres, cause and effect, or the morphology of a particular sound which develops to become a gesture as well as responding to connections heard—whether planned or serendipitous.

The composer is essentially assembling material that can be read as evidence of patterns and pathways of musical design to build an expectation of future events into their work. The richness of design that is intrinsic to these materials lends itself to a measure of musical quality. These can be found in situations where a layered argument allows for multiple interpretations. As a result, multiple interpretations are supported through more than one listening.

The opening moments of *Tout autour de la montagne* provide an example of this in my practice. While I will typically compose the opening phrases of work after the key events have been created (as identified in stage 3 of the acousmatic skip diving process), the introduction of this piece was the very first section to be completed. After spending the first week of my residency in Montréal sound walking and gathering material, I decided that the best way to evoke the rich sonic environment of the city would be to include as many of the sounds I had recorded as possible. Gathering together what felt like the most important sounds, I then auditioned them repeatedly, adjusting the amount of time between events and then experimenting with the addition of more sonic events.

After settling on some basic thematic material (which form some of the main musical ideas), I composed the initial gesture of the work—a long swooping bass figure, which rises upwards and comprehensively spans the audible frequency space. This was satisfactory to me as the composer because I felt its distinctive character provided potential for creating tension through the repetition of these gestures at later points in the work.

From a listening perspective, the strip is equivalent to repeated listening of either the entire piece or a section of the piece. As with the composer, the listener's focus may

shift to particular elements of it. For example, the listener may be drawn to the metro door signal on the first listen. However, future listenings may result in the listener being drawn to other elements such as the deep sweeping material which starts at the bottom of the frequency space, and which is contrasted at the same time with a second sweeping gesture which occupies the upper frequencies. The relatedness of the gestures in this series might then imply that sweeping gestures will appear again later on in the work.

The Spiral

The spiral is reminiscent of the part of the compositional process where the composer is listening to sonic events as they occur in time, whilst continuously reflecting on previous, current and future events over both a longer (the entire gesture/phrase/complete work) or shorter (individual attack/short gesture/ phrase) time-scale. When composing, it is likely that the composer will jump forward and backwards in the piece to gain a sense of the relationships forming between particular sounds/gestures/phrases while focusing on a specific event within time and space.

The spiral is, therefore, comparable to Adrian Moore's description of the 'work – reflect process' **(Figure 12)**. Here he describes the practice of generating sound materials through cause and effect, reflecting upon these materials to create new ideas or materials, accumulating similar sounds and then mixing these to form yet further new materials before repeating the process again. This 'work–reflect process' is not dissimilar to the notion of acousmatic skip-diving discussed in **Section 2.1.**
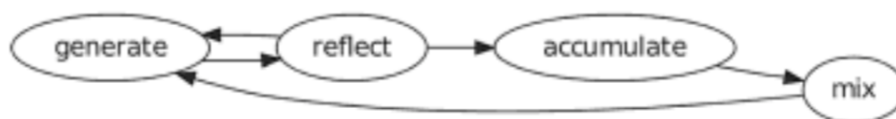
Figure 12: The work – reflect process (Moore, 2016:7).

The fourth movement of *Tout autour de la montagne* entitled *…Ile Notre-Dame…* (04:17-06:23) provides an example of the spiral within my practice as a composer. One of the main challenges of this movement was to create a contrast between the energetic and playful gestures of the previous movement, *…Ligne verte…*, and the slower but much more powerful opening gesture of *…Ile Notre Dame…* which presents

a distant gesture of revving motor vehicles gradually transforming into a surreal soundscape filled with the sounds of cicadas and cars racing around the Montréal Grand Prix track. This moment was created from the first gesture heard in the movement through the implementation of an 'attack decay sustain release envelope' applied to the sound of a car engine. This allowed the opening sound to possess a strong identity that is memorable throughout the movement, as well as being reminiscent of the first gesture heard at the very beginning of the work. It also provided a contrast between the mechanical, industrial quality of the motor vehicle sounds and the undulating trajectories of naturally occurring sounds (cicadas and wide open spaces).

From a listening perspective, then, in the spiral analogy the listener will reflect back on previously heard events in the work and seek relationships between these, current and future events to form an expectation. Recurrence of material may evoke expectation of an ongoing or emerging pattern and may lead a listener to anticipate a recapitulation of material in a work's later stages to provide a sense of conclusion.

The Grid

I propose that the grid is comparable with the initial stages of my compositional process. As with both the strip and the spiral, the original analysis of the 'scene' will provide an overview of the gesture/phrase/entire piece. After gaining a sense of the outline of the work, I focus on one element at a time. This is a non-linear, out of time aspect of the compositional process, less concerned with the linear implications of the strip/lane or spiral approaches. This emphasis is likely to be on spectromorphological elements such as the way the character of a particular gesture is structured by the nature of its spectral shaping.

For the listener, this grid-based approach to the reception of an acousmatic form is akin to the notion of the moment form.[40] 'Moments' on the grid are not devoid of context: they exist as defined units within the patchwork of materials around them and can carry reference to real objects and places. By definition, 'moments' are differentiated from the materials around them, but the listener may infer connections from across sections of the grid where patterns of related sonic character, behaviour or source are sensed.

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[40] See Kramer (1988: 201) for a full discussion. The image of the grid has a clear parallel in Kramer's use of the term 'mosaic' in relation to moment form.

It is in the nature of a grid-based architecture that expectations are potentially encouraged by very distinct sonic qualities of a 'moment' but also potentially negated where a sequence of shuffled events is offered. This is present in material heard in the drone section of *…Sur le troittor…* **[Audio Example 11: 06:10 - 06:25**] where, in a structure characterised by juxtaposition of material, repetition allows the listener to reflect back on previous parts of the work and in particular the *… ligne verte…* movement, in which these sounds originate. The fact that these self-references recur in ways that are neither cyclic nor predictable make the grid, rather than the spiral model the most appropriate in this instance.

2.3 Sonic Evidence Categories

Crime scene analysis also employs a series of six questions, the 'Six W's' to interrogate a scene, namely: Who? What? When? Where? Why? How? Each of these basic questions allows a particular piece of evidence to be attached to an agency, a location or a motivation. Some of these terms are also used by Huron (2006: 357) when he mentions anticipation of the 'what, when and where of likely stimuli.' My view of sonic evidence offers expansion of these ideas.

The notion of sonic evidence proposed in this chapter draws parallels between those commonly witnessed within crime scene investigation and acousmatic music. They are formed from a number of generic descriptors that are grouped into spatial, gestural, analytical, discursive and stylistic characteristics. As with evidence retrieved from a crime scene, it is permissible for evidence to be grouped under more than one descriptor. As with the overlying principles of sonic evidence, this did not directly influence the creation of the folio element of this practice based project – rather it came about as a rationalisation after the practical work had been completed.   Inspired by crime scene analysis, I propose two broad categories of sonic evidence relevant to acousmatic music: primary and secondary evidence. Within those, distinct genres of evidence are proposed which reflect the possible listening contexts, states and biases of the auditor.

Primary evidence is the actual sounding material found in the work. Expectations forming in the mind of the listener are derived from the concrete experience of listening. Primary evidence might be affected by any previous listening experience of

the work – and the change in listening environments. Despite the 'fixed' nature of most acousmatic music, performance practices such as diffusion inevitably do bring different inflections and emphases to how acousmatic pieces are heard in concert situations.

Secondary evidence: is information processed with influence from another source, which can be either musical or non-musical. These include cultural influences and prior real-life aural experiences. Secondary evidence calls on schema-based understanding and can influence expectation in that it draws on preconceptions formed before the listening process has even commenced[41].

2.3.1 Sub-categories of sonic evidence

Anecdotal evidence is a special case of secondary evidence where sounds heard within a work are recognisable to the listener as being a particular place or object. As with primary and secondary evidence, prior experience and familiarity will determine how one might decode sound—an idea closely related to the idea of the aural landscape (Wishart 1986: 1996). This type of evidence can be heard in many pieces of acousmatic music. Within my folio, an example of anecdotal evidence might be the sound of the STM metro doors opening and closing (c.00:38-00:40) in *Tout autour de la montagne.*

Impression evidence is intertwined with spectromorphology, and in particular, spatiomorphology (Smalley 1986, 1997), impression evidence is formed from the analysis of the strength of gestural and textural implications. In an acousmatic work, the morphology of the attack can be particularly important in providing clues to future events. For instance, a gesture with a sharp attack and full dynamic and frequency range can suggest the recurrence of further sudden releases of sound energy which, in formal terms, might imply an impending climactic point. The quality and degree of sharpness of attacks allow for a shaping of perception and expectation within the 'scene'. Again, this may be found in many pieces of acousmatic music. An example within my own portfolio could be the series of attacks at the conclusion of *Cyclic Motion* (c. 06:30-07:44).

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[41] These ideas are discussed at some length in *The Listening Imagination: Listening in the Electroacoustic Era* (Smalley, 1996).

Analogical evidence is formed on the basis of prior experiences in listening, composition and performance situations. This type of evidence can be gathered from a listener's prior knowledge of musical and composerly style. Where present, analogical evidence may suggest particular kinds of sonic development or treatment of materials – for example, the presence of a tonal progression within a work, particularly an idiosyncratic one, or one associated with a particular period or style. Analogical evidence is similar to Mathew Adkins' notion of acoustic chains (1999), which provide links to different works through the use of the indicative listening mode (Smalley, 1992). This also raises the possibility of sounds and events heard in one work, influencing the listener in another work should a similar sound or event appear. An example of this within my portfolio might be the clicking textures heard in *Cyclic Motions* from 01:00, which begin to develop into drones as the piece progresses. I consider this analogical evidence because it sounds similar to my earlier works such as *Black Velvet* (2010).

Obstruction of evidence/incomplete evidence occurs when a sequence of events, gestures or phrases appear to remain incomplete or have not drawn to a satisfactory point of closure. The sonic material provided does not present a full picture of future events and may be used by the composer to build anticipation, ambiguity and surprise. A typical example is the truncation of the expected evolution of a sound of known origin. This is particularly acute in electronically mediated sound where unnatural interventions in sound are possible – for example, a sudden reduction in gain before the expected decay of a piano note. This may be heard within my own portfolio at the conclusion of *Cyclic Motions* where the sudden silences are abrupt and do not develop into any new material (c. 06:30-07:44).

Circumstantial evidence is presumptive and thus requires another piece of evidence to deem it conclusive.[42] Within sonic evidence, circumstantial evidence can include the co-existence or co-action of companion sounds which can link individual sonic events within extended and long-term evolutions in order to build up expectation for future events in sequences. Circumstantial evidence can be drawn on in listening to make assumptions about relatedness of sound types or events. For example in my *Tout autour de la montagne* it may be assumed that drone sounds appearing throughout are related because of their morphological similarity.

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[42] For example, a fingerprint is convincing evidence of a perpetrator being at the crime scene but his car being parked outside when the altercation is thought to have taken place is an example of circumstantial evidence.

Trace evidence points to minuscule fragments or generalised characteristics of sonic information that may allow links between materials to be inferred—for example, a portion of a phrase heard previously. Trace evidence may be conveyed in the spectro- or spatio- morphological domains – for instance through the recall of a particular timbral colour, an intervallic pattern, or a specific pattern/trajectory of spatial motion. An example of trace evidence within my portfolio is the sonic material heard in *Tout autour de la montagne* between 06:57 and 07:15 which is similar to that heard in the introductory portion of the piece **[Audio Example 12: 06:56 - 07:18]**.

Associative evidence is defined as:

> [e]vidence that can link people with people, people with objects, or people with places (FutureLearn, 2013).

Within the context of acousmatic music, associative evidence can be defined as evidence that can link sounds to sounds, or sounds to 'things' and places in order to provide a frame for a listener's formation of expectations. It is intended as an umbrella term that can incorporate schematic references from outside the work (a sound that is 'watery' in nature) or intrinsic connections (that sound is similar to one heard earlier, but now it is harsher). These instances of associative evidence may cause surprise upon first hearing/experience. Associative evidence can be considered in three streams—those of style/composer, object, and place.

The most obvious example of style/composer associative evidence is the inclusion of sound material similar to that heard in another composer's work, or self-quotation through the recycling of material used in a previous work. One example from the electroacoustic repertoire is a phrase sung by a female voice in *La Disparition*, (Calon, 1988). This phrase is heard at 07:54 and the voice is nested within a soundscape evoking a jungle. Shortly after the phrase is completed an aircraft is heard passing overhead. A very similar sample of the female voice is heard in *Rumeurs (Place de Ransbeck)* (Normandeau, 1987). A fragment of the sung phrase is heard in the opening seconds of the work (an example of *trace evidence)*. At around 07:28, a very similar scene to that witnessed in Calon's *La Disparition* is heard **[Audio Example 13: 07:28 - 07:44].** The timbre and vocal quality of the sung voice is much the same, as is the melody, which is transposed downwards to a lower frequency in the latter half of the phrase. The sonic landscape at this point is almost overwhelmed by a drone and by high frequencies that give an effect of shimmering, or are perhaps reminiscent of a

rainforest. At the conclusion of the phrase, the high frequencies are merged into the sound of rain, and the sound of a door closing is heard, marking the end of a section.

Familiarity with a particularly memorable phrase means that it is more likely to stand out should it be heard in a different musical context. This is an idea that influenced my own work, *Our Song* due to hearing *Auld Lang Syne* being played in China. Similar associations can also be made where a composer clearly and evidently reuses materials across two or more works, which can contribute to the development of a recognisable style and ultimately to mannerism.[43] In terms of associative evidence, the notion of the object can be considered from the perspective of the sound object and source-bonded object defined previously, alongside my concept of the referred object:

> …a sound directly relatable to a scenario, composer or musical
> style. It will be familiar in some way to the listener (Rossiter,
> 2014).

Robert Normandeau's *Jeu* (1989) presents several examples of the referred object as the aim of the piece reflects the manner of the sound materials used within the work – in this case, the notion of 'game' or 'play'. For example, between 12:11 and 13:49 **[Audio Example 14: 12:11 -13:49]** the sound of an organ places us in the familiar scenario of a concert. As we listen, we follow the logical musical progressions until spiky interruptions occur at 12:30. Although timbrally connected to the organ, the interruption created diverts attention from the initial 'concert' scene. Once that rupture has occurred, imaginative predictions are evoked about the nature of future events as they begin to unfold.

At approximately 08:10 there is a particularly interesting example of association and the referred object—a quote from Stockhausen's *Hymnen*. In this particular instance, spoken phrases used by casino croupiers (*rien ne va plus* and *faites vos jeux*) are heard, spoken by Stockhausen himself. Therefore, by including this particular sound sample, Normandeau is referring not only to *Hymnen* but also drawing in Stockhausen's self-reference and that of the casino croupier character.

The idea of an object may also be affected by the listening modes proposed by Michel Chion, which drive our listening experience and composer experience:

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[43] An example of this is heard in my work *Sacred Voices* discussed in **section 3.2**.

> Causal listening … listening to a sound in order to gather
> information about its cause (or source).
> Semantic listening … listening […] which refers to a code or a
> language to interpret a message …
> Reduced listening … listening […] that focuses on the traits of
> the sound itself, independent of its cause and of its meaning
> (Chion 1994: 22 – 33).

Within an associative evidence framework, these notions of the object enable us to see distinct layers of reference within acousmatic music: the self-contained, 'abstract' musical argument; the use of sounds that naturally refer to the sources and causes from which they spring; and reference to objects that already have an existing musical context.

Associative Evidence and Place

There are numerous instances of the use of place and associative evidence within acousmatic music, which in turn can help listeners form expectations through familiarity with sounds. Over the years, there have been several projects utilising mapping technology, which allow the connection of sounds to a map. For example, the Aberdeen Sound Sites project[44], encourages users to record sounds from around Aberdeen and the North East of Scotland and upload them onto a map along with a written or visual description of what they heard.[45]

My own work *Our Song (我們的歌)* utilises a sound recording of the daily flag-raising ceremony in Tiananmen Square, Beijing—when the national anthem is played— alongside sounds of bicycles moving at great speed up and down hutongs, and the sound of Chinese temple chant. The inclusion of these sounds is intended to act as an association or as a trigger for associations with sounds. Some of these sounds, such as the anthem, might be considered as 'keynote sounds'—described as those sounds '… which are heard by a particular society continuously or frequently enough to form a background against which other sounds are perceived' (Truax, 1999).

Stollery (2013) proposes that 'multiple levels of association' can be present within a piece of acousmatic music and that listeners may access different associations with sound depending on prior experience. Stollery uses an example from his work *ABZ/A* (1998) which features sounds drawn from around the city of Aberdeen and offers different levels of association depending upon the extent of a listener's familiarity with

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[44] http://www.aberdeensoundsites.net (Accessed 21/12/15)
[45] Another example of a similar project from the North East of Scotland is the Gordon Soundscape Project: http://www.gordonsoundscape.net (Accessed 21/12/15)

that place. For example, in *ABZ/A,* the beeping heard at 01:11 is likely to prompt listeners to seek meanings based on previous experience. Is it a pedestrian crossing? Is it an alarm warning about something? Where are the recordings from? It might be possible that the listener is able to recognise the sound of a city without knowing that the sounds are drawn from a particular city, in this case, Aberdeen.

The gathering of associative evidence can be regarded as a process of establishing an acousmatic scene. In the terms offered by Emmerson's language grid (see above) this may be weighted toward mimetic or aural discourse and abstract or abstracted syntax, or some hybrid state (bearing in mind that a work may move between different sections of the language grid as it evolves). The nature of that scene will tend to allow expectations to form in the mind of the listener. For instance, if a listener assumes they are hearing a warning alarm at 01:11 in *ABZ/A,* their expectations about subsequent events in the work may vary considerably from those of a listener who interprets it as a pedestrian crossing. Such expectations may therefore be derived from the apparently realistic physical nature of the scene whether known or imagined, experienced in reality, or from the play of cause and effect as an abstract virtual scene (as already discussed in relation to Adrian Moore's *Power Tools*). Whichever domains of the language grid are evoked, and as Smalley's outline of acousmatic space-form suggests, expectations derived from associative evidence may be drawn from many different directions: from the culturally understood grammars of traditional instrumental music, through the build-up and dissipation of energy in more abstract sound events to vicariously understood real-world sounds.

Spatial Evidence: Motion and Trajectory

In crime scene analysis, the examination of blood patterns can assist investigators in determining what may have caused any blood stains found at the location at the location of a violent crime—this is known as spatter evidence. For example, a circular stain will indicate drops of blood falling vertically onto the surface. A blood stain that is circular with a tail will indicate the striking of the surface onto which it has fallen at an angle. The tail will also reveal the direction of travel of the blood. Forceful impacts that result from being hit by a baseball bat or being shot by a gun produce blood spatters that are smaller than freely dropping blood. As a general rule, the more force inflicted by a weapon, the smaller the individual drops of blood spatter will be. The same principle can be applied in consideration of space[46] and expectation within acousmatic

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[46] A full investigation of space and expectation lies beyond the scope of this research project due to the complexities involved (see **Section 3.1** which discusses the role of spatialisation and diffusion within my compositional work). However, its role within

works. In acousmatic music, spatio-morphology and space memory are implemented to define limits and to establish patterning, timing, pace and direction of gestures which may be present within the work. In multi-channel contexts in particular, the placing of sounds in specific locations may lead the listener to anticipate sounds appearing in certain places within the sonic space in the future.

Spatter evidence connects elements of an event that are distributed over time – for instance, an event heard in a piece of acousmatic music that breaks off into smaller pieces of sonic materials separated in spatial and temporal terms as they travel away from the initiating event. However, these sounds are still components of the original event because the listener will infer a trajectory from it. A spectromorphological entity projecting a profile of continuous energy or tightly packed iterations can create the impression of being unified by an underlying cause. In the case of spatter evidence, smaller pieces of sonic materials can be thought of as 'debris' because they appear as remnants of larger moments of energy release. The application of the term 'debris' to sonic materials is not necessarily to suggest a lesser value of those materials; it merely infers an impact-consequence relationship and its spatial legacy'. For example, a sound suggestive of physical impact with a reverberant tail may suggest to the listener that a new, reverberant space will be explored because a very extended reverberation or resonance will tend to lose any apparent connection to an initiating attack. Alternatively, that 'impact' may appear to give off further micro-sonic events which disperse in space and time, and while initially perceived as related to the original event as a consequence of the apparent causal energy, develop independent spectromorphological lives.

Cyclic Motions (2014) features many impacts within the space occupied by work that are intended to surprise the listener through climactic points that are surprising and unexpected. The introduction to the work fills up the lower and middle parts of the spectral range with resonant gestures that engulf the listener through spatialisation of the material from the main loudspeakers to the eight loudspeakers immediately surrounding the listener. The spectromorphological and spatial energy profiles of the gestures introduced at 00:11 work in tandem to produce a continuous morphology in the form of pulsing, mechanical sounds that develop into a central feature of the work and give the piece its forward impetus.[47]

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sonic evidence is examined here in the context of its application to the portfolio of works.

[47] *Cyclic Motions* is discussed in more detail in **section 3.8**.

2.4 Conclusions

The notion of sonic evidence provides a channel for the interrogation of both the listener's and composer's expectation. Where crime scene analysis and forensic science raise questions as to how and why a crime occurred (the six 'W's'), a sonic evidence perspective allows the formation of questions by both listener and composer. What in the material (as evidence) implies or suggests how a phrase will end? What material should be used? What will happen to this sound spectromorphologicially?

Forensic science allows investigators to observe a scene, develop a hypothesis and apply reasoning and prior experience to test that hypothesis. Its foundations an analogous basis for the identification of sonic evidence by the listener and composer, interpreting and analysing sonic events on the fly – anticipating future events by forming hypotheses – and then appraising the outcome of the event (as in Huron's ITPRA theory discussed in **Section 1.1)**. Some collections of evidence may be resolved in a way that corresponds with what we anticipate; others may remain unresolved in the listener's mind, or they may conclude in an unanticipated way. Where a collection of evidence contains many conflicting clues or associations, a clear sense of expectation may have to be side-lined. If our prediction proves to be correct, then we will likely apply this (or a variation of this) to future listening where sonic events share a similarity. If we are proved wrong, we will revise our prediction in order that our expectation is more accurate on the next occasion.

Part 3:

3.0 Introduction

The final part of this dissertation focuses on a piece by piece discussion of the portfolio of acousmatic works which form the most significant part of this research project. The compositions have not only provided a testing ground for compositional ideas but also the concepts of *acousmatic skip-diving* and *sonic evidence* proposed in **Part Two**. This practice-based methodology has therefore opened up many unanticipated situations and on numerous occasions led to new ideas being formed which influenced the research.

Two main themes run throughout the portfolio. The first is the notion of arrivals and departures: transitions between complex, abstract and unrecognisable sound-world and field recordings and composed soundscapes. Such arrivals and departures can be heard in *Mordicum, Our Song, Tout autour de la montagne and Sacred Voices.* The second theme that is threaded throughout is a gradual progression in the manipulation of silence throughout the portfolio. This began with SiO_2, in which I tried to explore the extremes of sonic possibilities within an acousmatic composition. For example, I included sounds that were at the very top and bottom of the audible frequency ranges, and began to experiment with the creation of very sparse sonic landscapes and silences between phrases. In *Cyclic Motions,* I attempted to manipulate the listener's expectation to create surprise by including a sudden silence towards the end of the piece. Finally, *Rift* engaged in a more focused way with the notion of sound and silence, and like Stollery's work *Shortstuff,* which greatly influenced it, used silences of varying lengths from the very outset of the work to manipulate the listener's expectations at key moments.

3.1 Use of space and multi-channel formats

Spatial design and the localisation of sound is an important feature of my compositional practice and acousmatic music in general. This is because, when viewed holistically, any sound-object can be regarded as having spatial identity from more than one perspective. For example, the contour of a spectrum can be thought of as a space while space may also take the form of a setting by situating frame of

listening in a particular place (a sound image of St Pancras station for example). A holistic view of space links not only interaction between sounds and the characteristics of a reverberant field but also the relative localisation of objects within it—perceived proximity of sound sources and their apparent motion within a spatial frame. Thus space is inherent to perceptions of time, imagery and sonic envelopment in acousmatic music because of the means by which sound objects interact. All of these spatial properties are intrinsic to the notions of sonic evidence and acousmatic skip-diving proposed in **Part 2.** For example, a sound that appears to burst suddenly from the centre of stereo space and scatters 'debris' is a spatial event and an example of *spatter evidence* **(see Section 2.3)**. The composer can then manipulate this gesture by adding three-dimensional spatial motion or by playing with perceptions of place, or underlining contrast between distant and close-up sound objects. Three-dimensional motion of sound in space evokes expectations: where the implication of a trajectory is created, divergence from an assumed path can arouse surprise. Similarly, tensions can arise from events defined by a perception of threat if a sound appears to approach a listener, or if assumed lines of sound motion are erratic or constantly interrupted.

Several spatial formats have been employed throughout the portfolio, each determined by the nature of the materials used within each work. However, three-dimensional spatial design was not a part of the research into expectation *per se*. While an examination of space might provide new insights into creation and negation of expectation in acousmatic music, its layered complexities mean that a comprehensive evaluation of spatially aroused expectation lies beyond the scope of the present research project.

3.2 *Sacred Voices* (2014)

The title *Sacred Voices* was suggested by my use of sounds recorded in China. I selected material indicative of religion, culture or species. The main sound sources for the piece are recordings made at Dujangyan Panda Reintroduction Centre and that of monks singing in a Buddhist temple in Xi'an. I felt that these recordings were appropriate to use in a study of expectation, finding them intrinsically enigmatic, because neither the sound of pandas calling nor the recording I made of the monks singing are inherently recognisable.

My focus on surrealism and enigmatic sounds created throughout the work might be called 'unrecognisably recognisable' sounds (Rossiter, 2016). These require the

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listener to use their imagination to form a plausible virtual 'scene' which might then determine the way expectations of future events develop which is perhaps akin to a surrealist aesthetic. The nature of this approach means that it is harder to predict a listener's expectations since, unlike *Our Song,* which also draws on field recordings made in China, there are no points of arrival in what might be recognisable sound-worlds through a process of dynamic predictability (Huron, 2006:240). This will be dependent upon the listener's prior experiences of pieces which use abstract sounds, and will require them to draw on elements in the rhythmic or frequency domains. The piece falls into four sections.

Section 1: Introduction (00:00-00:50)

 As with much of my work, the intention in *Sacred Voices* was to create an imaginary place which features real and abstract sounds interacting in such a manner that an enigmatic environment is produced. The piece opens with a reverberant attack suggesting envelopment within a large space and this initiates interplay between noisy and pitched sonorities. A rising quasi-vocal sound appears as a response to the attack and blends into a stable flute-like tone (recordings of xūn and panda call are mixed and time stretched). The strands of focal pitch in this introductory section aim to draw the listener's close attention, but they also form a stark contrast to the noise gestures emerging at 00:03 which could, as *trace evidence,* be heard as some form of sonic debris—a wash of noisy sound energy initiated as a consequence of the impetus of the opening gesture. From this a pattern of interruption/contrast is subsequently established as a way to trigger new gestures in the work or to act as a 'glue' linking otherwise contrasting sonic material.

Section 2: (00:51-03:49)

This section of the work contrasts the introduction through the interaction of abstract gestural sound materials suggesting that cause and effect will be an important device. Expectation is thwarted throughout this section by periods of interruption and stasis. These interruptions focus on a rapidly panned 'whip-like' gesture first introduced at 00:51, rupturing the four-second silence which precedes it. This sound is also an example of *circumstantial evidence* as it relates to the sound that launches the work. Appearances of the gesture tend to herald change and as such this association encourages an expectation of shifts in texture and momentum in the piece. These 'whip-like' gestures recur as variations with a mostly interruptive function at 01:00, 01:34, 02:01, 02:31 and 02:44. These have recognisably familial relationship and each occurrence, whilst not predictable, helps to establish a sense of continuity through this section, reinforcing their memorability. As well as functioning as interruptions, these

gestures also 'herald' change. For example, the gesture at 02:31 announces the transition from a quasi-vocal timbre to a steadier drone state.

From 01:30 to 01:42, a phrase created from a marriage of the abstract, spatialised attacks and a recently introduced clattering sound is heard. However, this development within the work seems incomplete. It is interrupted sooner than might be expected at 01:42 by a 'smeared' variant of the 'whip-like' gesture heard at the start of the section. After 01:44, streams of clicky impulses fade out through a drone rooted on 45Hz. The patterning of these clicking sounds provides a sense of cohesiveness and forward impetus. Whilst this drone is quite static in terms of spectromorphological quality, the growth in energy leads the ear to the recurrence of the 'whip-like' gesture at 02:01.

At 2:05, the stasis of an isolated 1kHz sine tone focuses attention on a single sonic point prior to the emergence of another static but undulating vocal sound at 02:13. The sine tone is an important device because, as it has only a fundamental frequency and lacks any other spectral content, it can imply both departure and arrival: a resonant trailing off or a thread of sound that will be elaborated (a pattern already established in the first 45 seconds of the work). From 02:35, spectral instability is created through fluctuations of frequency in the pitched drone. This arouses uncertainty as to the direction in which the material is likely to develop. As the trajectory of the material is forced downward at 02:50, the pitched drone material is allowed to blend with a new emergent drone at 03:05—the most immersive so far—with the now expected disturbing/unsettling function of the whip-like noise gestures suggesting imminent dissolution of that texture. Whilst one interpretation of this 'interrupting' material is that it is a form of debris arising from the work's initial sonic impact, the collapse of the texture at 03:40 can be taken as confirmation of its functional role.

Section 3: (03:50-05:24)

This section again focuses on the interruption of expected developments of sonic materials, with a greater emphasis on drawing together abstract and realistic sounds and the ambiguity between them. As in the previous sections, the drone is an agent of textural growth. At 04:27 a rich drone on a B fundamental emerges, but on this occasion the drone carries with it a subtle texture of pulses (derived from drum and chant in the Xi'an temple), metallic resonances and voices, all of which might collectively suggest covert human presence and ritual. As the drone now implies referential meaning, expectation of ongoing progression toward more realistic states could be warranted.

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Section 4: (05:25-09:13)

The final section of *Sacred Voices* is also the longest and represents a formal recapitulation of the materials heard earlier in the work. Therefore, the underlying aim of this section is to drive the piece towards a satisfying resolution by the repetition and development of previous ideas already heard. The section begins with the 'whip-like' panned noise gesture again appearing to function as a catalyst for interruption and textural change. This sense of a return to earlier material could be interpreted as an indication that the work is moving toward closure. A behavioural pattern from the beginning of the work sets this off: namely a sudden spectrally-rich gesture triggers pitched resonance. This flute-like sound that descends from 05:38 before being accompanied by the isolated 1kHz sine tone first heard in section 2 is increasingly overlaid with agitated whip-like noise bands. An inherent tension is created as textural density increases and short drifting vowel-like sonorities (from 06:01) periodically project into the sonic space. If the apparent vocal quality of that sound leads to an anticipation that human or animal presence will be fully revealed, that expectation is only partially fulfilled after 06:40 with the faint presence of chanting and percussion.

The remainder of this section presents a kind of shuffled texture of many previously heard materials now joined by short metallic resonances. This creates a generalised sense of stasis and is intended to signal the likely closure of the work. In these final two minutes, it is really only the presence of gentle downward glissandi, mostly of resonated noisebands, that carry expectation though clear but short-lived directional implications.

Summary

Sacred Voices aims to present the listener with a compellingly enigmatic sound world. Abstract sound forms, such as pure tones and twisted, complex noisebands interact in generating textural and gestural energies that convey states of stasis, motion and moments of interruption. Woven within this are suggestions of real-world ritual and animate presence. A listener's natural tendency to seek recognition of sources is relied on to generate expectation that some kind of opening out onto definitively recognisably human action or living presence will occur.

3.3 *SiO$_2$* (2013)

Glass, in many forms, is the sole sound source of *SiO$_2$*. Compositionally this work focuses on the blurred boundary between pitch and noise which is often exploited in

acousmatic music. As such, it aimed to carry the listener through different sound-worlds and sonic landscapes—from noisy and frightening to light and chorale-like. However, for the purpose of this commentary, the focus will be on the interruptions that disrupt the flow of the work and the effect these may have on listeners' expectations. These interruptions take the form of sudden silences, material disrupted before it has run its expected duration, material which fails to develop fully due to the intervention of another sound, or unexpected shifts to or from different types of materials.

Like *Rift, Si0$_2$* was influenced by listening to, performing and analysing Pete Stollery's *Shortstuff,* which uses silence as a means of manipulating expectation (see **Section 1.14**). It falls into four main sections.

Section 1: (00:00-01:48)

One of the most prominent sounds in the piece is that of wine glasses filled with different volumes of water and then bowed with a viola bow to produce distinct pitches. Tension is inherent in the opening of the work through dissonance, which gradually emerges through the layering of two sustained frequencies (00:00-00:35). An imagination response (viz. ITPRA) derived from knowledge of Western tonal music, might lead to expectation that the sustained frequencies will resolve into unison or open out into a defined chordal construct. Instead, the dissonance is swept aside by a wash of turbulent noise at 00:35 which is effective in thwarting expectation by disrupting any suggestion that the continuous pitched sonority would develop as a stable identity over the course of the piece. Instead, an alternative pattern of structural development is implied: that dissonance and tension will be fundamental in creating or subverting expectation throughout the work. The disruption at 00:35 yields to a new complex sonority blending pitch and fricative noise with a markedly turbulent texture.

In *sonic evidence* terms, the evolution of the work to this point conveys both *circumstantial* and *trace evidence*. The inner turbulence of the texture from 00:40 implies a (circumstantial) connection with the noisy interruption, whilst simultaneously suggesting that a trace of its energy contour has influenced the nature of the sound. Energy surges give rise to tension and a sense of precariousness through an enrichment of spectra beyond the relative purity of pitch at the opening of the work, alluding to a potential for growth, interruption or a change in the direction of travel of the sustained sounds, and the listener may anticipate that the bowed glass-like sound will provide a sense of stability throughout the work.

The remainder of the opening section of SiO_2 reinforces the pattern of interruption before an increasing dynamic level leads the pieces to reach a moment of relative spectral saturation at 01:30. Spectromorphological intensification of this kind can induce a range of possible outcomes that might be expected from this intensification of sound energy. These might include the production of 'debris' or a period of sustained noise. In this case, it heralds a reappearance of the bowed glass pitch from the opening whose fade-out implies a cadential function. The segue into 'bouncy' attacks, suggestive of tactile interaction with glass, forms a structural point that is both recapitulatory and forward moving. In ITPRA terms, this shift in material evokes an imagination response as investigation of a new class of sound material is implied.

Section 2: (01:49-04:59)

In contrast to the opening part of the work which introduced the theme of disruption, the second section focuses on interruption of phrases through short periods of silence. With the core compositional intent of the work being the blurring of the boundary between noise and pitch, this section focuses on manipulating extremes of the frequency range. Playful gestures created from clinking together glasses are interwoven with silence and the bowed glass material introduced in the first section.

This section emphasises the phenomenon of the attack. Individual and clustered impacts of glass objects and 'shards' of fractured attacks are formed into phrases which are articulated by extended silences. These also act as gestures with apparent causal functions, which initiate more continuous sound objects. This is first signalled at 01:59 where a deep attack produces a strong reverberation. The capacity for this to evoke surprise (since the implication is that an enclosed space has spontaneously formed around the source of the sound) is lent added tension through an extended silence. This 'waiting' time allows prediction and reaction responses to gel—will the evidence of apparent physical enclosure of the sound be confirmed? Further causal interactions then follow. The very deep tone initiated at 02:19 is subsequently truncated by an attack at 02:31, which makes assumed source-cause relations more complex as does the emergence of a low drone at 02:53, which does not have a direct causal connection with the clusters of attacks above it. The decline in momentum to 03:17 is anticlimactic, but again leaves room for renewed growth in sonic energy from 03:23. A clear distinction is maintained between attacks of indeterminate source (short glitches) and those more overtly suggestive of manual clinking of glass objects, the latter forming a recurrent gesture that might be heard as 'calling' for new materials to form around them. Rolling gestures (from 03:26) become increasingly important to an implied tendency toward a gathering of energy, but with tension exaggerated through

extended silences. Unpredictable attacks and short silences (marked by arrows in **Figure 13**) allow time to anticipate how these may develop, until at 04:16 the rolling gesture, iterated attacks and the deep drone coalesce into a cohesive texture, bringing this section to a close.

Within this section of the work, there is a sense of movement towards an assembling of sound that may suggest development to a coherent pulse or to sound objects possessing a rhythmic quality. At this point, the sounds become not only spectromorphological objects but also possess a 'thingness' about them which, as glass 'things' subject to physical stress, may break.

Section 3: (05:00-07:08)

This section acts as a development of the first, continuing the pattern of interaction between gesture and resonance. An unexpected twist in events occurs at 05:29, where the resonant figure is interrupted very suddenly by a sharp attack leading to the deployment of a disconcerting high-frequency tone (17kHz). The tension inherent in this uncomfortably high frequency tone is alleviated by a fragmented glass-like gesture at 05:32, re-orienting attention to the middle of the frequency range. At 05:52 and 06:00 short attacks launch sustained pedal tones suggestive of the bowed-glass gestures heard at the start of the work. These extreme high and low extensions of pitch describe a frequency space that has a minimal sparseness that is inherently tense: virtually any direction in the movement of frequency space could follow, making it difficult to anticipate further development of sonic materials. Furthermore, the gestural material deliberately 'wanders' at this point, giving the impression that the interplay of cause and effect is temporarily suspended and produces the impression of sounds being allowed to flow freely without being clearly forced in any particular direction.

Section 4: (07:09-09:38)

This section functions as a recapitulation of the materials heard in Section 1 and begins with bowed glass sounds which share the same frequency as those which opened the work. However, more partials are added in order to add a sense of depth, provide a sense of development and to enrich the spectrum further. The section contains several moments of acute anticipation as a result of a build-up of layers of pitch in the bowed material. This is elaborated by glitch gestures which function as appoggiaturas (07:22) and counterpoints of additional pitches created through bowed glass sounds (07:08-07:18).
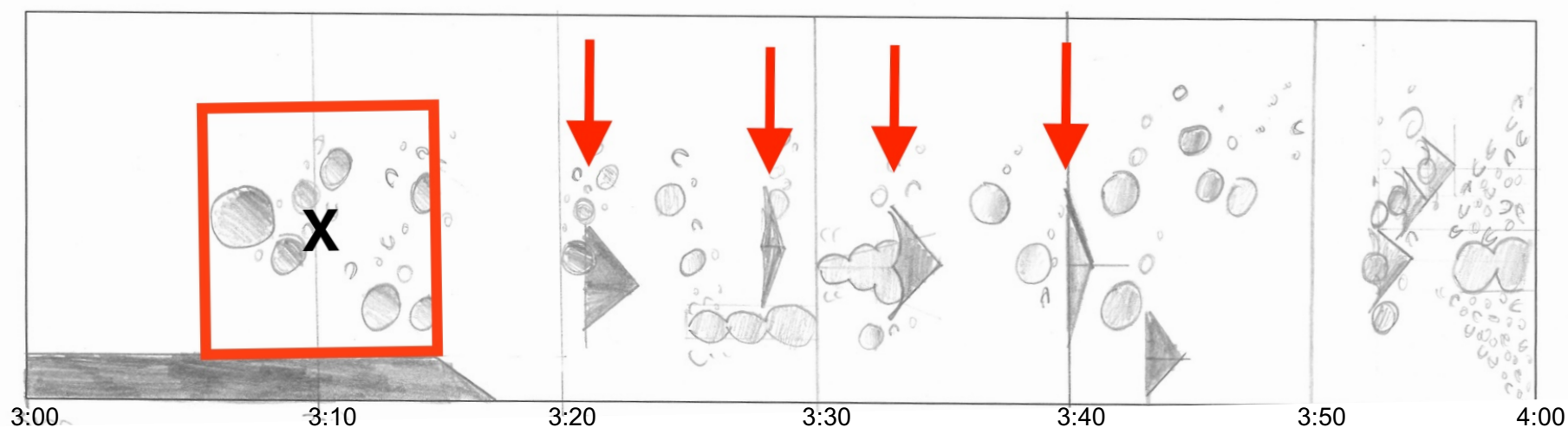
Figure 13: Annotated score with 'X' marking 'glitch' sounds and arrows showing moments of interruption in SiO_2 (03:00-04:00)

The tension created in this section is only resolved in the closing seconds through means of a 'spectral fade' between 09:19 and 09:30. Whilst the gradual decrescendo of the single tone (1312Hz) anticipates dissolution into silence, the richer bowed glass tone is reminiscent of the opening of the work. This acts as a kind of 'sonic shadow', which suggests that the resolution may not be complete.

Summary

The juxtaposition of continuity and wholeness with fragmentation make it very difficult to form a coherent pathway for the resolution of the many kinds of expectation arising from SiO_2. The result is anticipation that some new synthesis will emerge out of this disparity. SiO_2 works at the level of sound objects and the use of evocation of material with known properties of fragility. Throughout the work, the listener will sense that the sonic materials possess a capacity for breakage/rupture, and this is an expectation that is realised as we hear fractured sounds throughout the work. Therefore, if read from both *sonic evidence* and ITPRA perspectives, expectation is induced by the implication of quite fundamental attack-resonance sound models. However, this is also negated through events not being permitted consistently to take the course implied by an instinctive knowledge of normal patterns of sound morphology.

3.4 *Rift* (2015)

Rift deals with processes of gestural interaction and the formation of cohesive textural constructs as an apparent result of these interactions. As suggested by the title of the piece—which can mean crack, split, or a break in something—the framing of gestural forms is present in two main ways: sound punctuating silence or silence punctuating sound. The function of silence in this manner fulfils an important role in the work by articulating musical structures and providing listeners with an enjoyable musical journey. The silences in the work serve a structural and dramatic purpose (see **Section 1.12**) and also have a bearing on the spatial and structural trajectories of the work.

Silence can be considered a potent property within the composition itself and in its performance over a diffusion system. Within a performance, the role of silence extends to being a functional one, which allows the performer to spatialise the work in a way that further enhances expectation. This can be achieved by deploying sound in surprising ways. For example, in *Rift*, the sound could be deployed through the main and wide frontal loudspeakers for the opening gesture, and the seven-second silence

used to prepare the diffusion board for the following gesture to be projected through loudspeakers placed in the ceiling. The lengthy silence heard at the conclusion of the work is intentional and aims to contribute to the unexpected ending.

Various sound materials were used in the composition of *Rift* including water, glass and objects that were hard, soft, elastic or resonant. These objects permitted a very free form of exploration in the studio, revealing a wealth of sonic properties for use in the composition. A careful examination and sifting of the recordings identified those, which, in my view, could work well in partnership with structural silences, while also possessing clearly differentiated spectro- and spatiomorphological properties. The work comprises three sections.

Section 1: 00:00-02:00

Many of the sounds in the opening section of *Rift* are abstract in nature. This compositional decision was intended to draw the listeners' attention away from the sources of the sound material used and closer to a fundamental distinction between sound and silence.

The abstract nature of the sounds in this section relies on a listener's ability to recognise spectro- and spatiomorphological features of sounds in order to differentiate elements of the work, and find links between similar sound types and behaviours— drawing meaning from and building anticipation of future events from these sounds **(see Sections 1.1–1.6)**. For example, the 'swooshing' sound first heard at 00:35 is manipulated through the application of a panning effect. The distinctiveness of this material's morphology is memorable through both fluctuation in frequency and spatial movement. These characteristics function as thematic material that can be recognised as a developing sonic theme at later stages in the piece.

As well as having a functional role, the silences in the opening section of the work are intended to create tension, surprise and the encouragement of the anticipation of events, permitting resolution of this tension over time. Expectation is negated at 00:30 as a silence of four seconds disrupts the momentum of growth in the gestural material which forms a fourteen second phrase up to this point. This interruption results in a disintegration of the patterning which had emerged between lengths of phrases and silences over the course of the opening thirty seconds of the work. This is answered between 00:45 and 01:09 by a slight build in momentum and phrase growth due to silences which are shorter in duration. In terms of ITPRA, imagination and tension

responses are thus activated in order to build the expectation that the growth in phrase lengths over the opening section will develop toward textural coalescence.

This section is characterised by explosive gestures formed into phrases of varying lengths determined by the apparent strength of underlying causal energy, and articulated by silences of varying length. A variety of sound forms emerge as apparent consequences of gestural action. These range from forms of *trace evidence* as 'debris' following the release of a gesture (e.g. the rattle at 00:10 'liquid' material at 00:24) to the apparent generation and co-presence of new sounds (e.g. the swooshing noise bands from 00:33, or the granular resonance from 01:15). In the latter cases, these act to extend phrase lengths with the intention of drawing listeners into an expectation of the agglomeration of sound energy into a more continuous textural state. Playful unpredictability in the way this section evolves, especially in the variability of silence lengths, makes any such expectation quite tenuous until 01:32 when a deep drone underpins the texture and appears to draw to it a stream of iterative glass clinks.

A bouncing gesture formed from a marble bouncing on a hard surface (01:58) is the clearest unprocessed sound heard up until this point. The referential clarity at this point acts as *anecdotal evidence,* drawing listening toward more 'real-world' schematic listening and, in relation to the abstract nature of the preceding music, the sounds are likely to be considered enigmatic. While the section up to this point has strong cause and effect logic (gestures appear to generate traces of sound energy or generate new sounds), this bouncing gesture is the first recognisable sonority that can be plausibly related to something known from lived experience. It therefore raises the question of where the music might go next.

Section 2: 02:00-03:43

In this section the work was intended to function as a development of the materials heard in the opening section. While silence had a structural function of interrupting phrase growth and continuity in the first section of the work, this role is reversed in Section 2, with sound punctuating the sonic canvas that is now far more textural and granulated in nature. At 03:11, materials that remain relatively unprocessed and which are recognisable as pitch-shifted marbles dropping into a glass jar, are heard and are a restatement of material first heard at 01:58. This marks what may be a significant moment within *Rift* in terms of the anticipation of future events for the listener. The high frequencies and gestural energy which constitute this sound are repeated a number of times in order to etch them into the memory of the listener. The range of pitches heard within the clusters of gestures at this point invites speculation that fluidity

and layering of pitch levels will be an ongoing feature. At 03:40, continuity is interrupted by an amalgam of gestural material followed by six seconds of silence. This is a key moment of dramatisation in the work as the interruption results in a naturally rounded phrase ending: a panning noise gesture (reminiscent of that heard earlier at 00:35) dissipates with a similar ritardando to the marble bouncing gestures heard in parallel with it. As such, the worlds of the abstract and the recognisable source appear to be acting together.

Section 3: 03:43-07:25

The third section of the work functions as a platform for the development of pitch, gestures and texture. It also provides a means for a concentration and eventual resolution of tension to draw the piece to a satisfying (if not surprising) conclusion. The section opens with a high-pitched beep, quickly interrupted by an attack at 03:47 and followed by the sound of a marble rolling. This sound is repeated and quickly takes on a textural quality that supports the gestures continuously punctuating the sonic canvas throughout this section. This may suggest that more unprocessed material will be heard and that this will be interrupted, as opposed to being permitted to expand. It may also indicate that silence, while still occasionally present, is employed as an interrupter of the development of materials. From 03:52 to 04:04 interactions take place between processed rolling marbles and more complex attack and glissando gestures. While carefully considered during the compositional process, the placement of these gestures might appear random to the listener, as there is no substantial growth in phrase length or change in frequency. This may raise tension as it is difficult to predict what direction any development will take, or how and when it will occur.

At 04:04 there is a very short silence. This may be surprising, as based on prior events in the work, we may have expected this to be of a longer duration. Additionally, between 04:05 and 04:09 there are gestures reminiscent of the opening section of the work, backgrounded with shimmering textural material. This may lead to an expectation that there will be a recapitulation of this material with the regular punctuations of silence. Instead of repeating the material heard at the outset of the work in its entirety, however, the abstract gestures trigger a drone at 04:18 that varies in terms of pitch and tonality. While this drone is in the background of the sonic canvas at first, it gathers momentum through a raising of the overall dynamic level, increasing speed of tremolo textural material and discordant pitches (04:18 - 05:05). The drone itself also gradually descends in pitch and speed. My intention at this point was to saturate the textural material to coax the listener into anticipating that the sound must come to a halt in the near future. This is supported at 05:45 where a reprise of the

textural drone material heard between 04:18 and 05:05 reinforces the suggestion that the immersive nature of this texture is heading towards a conclusion.

At 05:55, the bouncing glass-like gestures return and function as a resolution to the tension built throughout this section, as the dissonances of the drone material finally resolve into a single sine tone at 06:16. While it may be expected that the piece ends upon reaching a resolution, the sine tone is interrupted by gestural material heard earlier in the work. This injects tension as the listener may recall the manner in which sound punctuated silence (and vice-versa) earlier on in the work and might cast doubt on the imagined ending of the work. Drama is present throughout this section via the tension built as a result of an apparent game of domination between the continuous drone textures and the attack gestures which function as interrupting agents. The final gesture at 07:15 is surprising as, while more development might be expected, the piece instead ends suddenly with the evaporation of 'debris' (see definition in **Section 2.3**), followed by a period of silence.

Summary

In *Rift*, sounds function as agents of energy, growth, momentum, transition, interruption and transformation. The silences, on the other hand, are vehicles for interruption, tension and dramatisation. In both cases (sound and silence), periods of interruption, suddenness or gradual change work together in an attempt to create drama, excitement and engagement.

3.5 *Our Song (我們的歌)* (2013)

Our Song (我們的歌) was written as part of the SCEN Music Project[48] which took place during 2013 and involved a period of field work in China. The project (and this piece in particular) was inspired by a trip to Shanghai in 2011, during which I experienced an aural and visual culture shock. This resulted in a number of expectations as to what I would encounter both aurally and visually on my second trip to China. However, rather than the reinforcement of the culture shock experienced in Shanghai, my second visit

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[48]The SCEN music project was the result of commissions from the University of Aberdeen Confucius Institute, De Montfort University Confucius Institute, and the Scottish China Education Network to explore China through sound and image. The result of the project was an audio-visual installation (in collaboration with Andrew Connor, University of Edinburgh) and two acousmatic works included in the portfolio *Our Song (我們的歌)*, and *Sacred Voices*. Further information on the project can be found at www.scenmusic.info (Accessed 13 October 2015).

to China negated my expectations as I experienced excitement at the huge variety of colour, music and lifestyle, along with some striking similarities to Scottish musical traditions.

While field recordings are often used in acousmatic music, it is not always a given that listeners must recognise a sound as being of a particular place. Rather, they will be more likely to match them to a place or situation from their own experience. Within *Our Song*, a basic but important distinction exists between 'real-world' sound and abstractions. As such, the notion of arrivals and departures become an integral part of the piece where 'real-world' sounds tend to function as points of arrival out of the more 'imaginary' states of abstract textures. The transitions between real and abstract soundworlds in *Our* Song are inherently comprehensible for the listener through cultural knowledge—for example through the presence of vicariously recognisable sound sources and knowledge of electronically mediated sounds and music (for example, in film, on radio dramas and in electroacoustic music).
Our Song consists of four main sections.

Section 1: Beijing (00:00-03:34)

The first section of *Our Song* represents Beijing. The field recordings made here portray a diverse range of activities: the subway system, flag-raising in Tiananmen Square and musicians improvising in the Temple of Heaven Park. However, alongside sounds that may be heard in any city in the world, there were some very surprising sounds to be experienced as an 'ear witness'[49] such as the sound of bicycles in the quiet hutongs (tiny side-streets) which provided a stark contrast to the hustle and bustle of the main thoroughfares.

The opening of the work comprises a sudden attack, a call to attention made by combining pitch-shifted gestures extracted from recordings of machinery. The resulting 'debris' which immediately follows quickly spreads into a causally enigmatic space consisting of a steady textural pulse which dominates the middle of the frequency spectrum and which appears to smother the presence of a motorised vehicle heard at 00:20. This implies the possibility of an emergence of realism from the abstract sound-world present at this point.

The first main 'scene' occurs at 00:27 and presents the Chinese national anthem. Whilst the anthem is given a 'distanced' sound quality through the application of GRM Tools Band Pass, it has the ambience of an outdoor performance. This point of the

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[49] In this sense, I mean the sonic equivalent of an eyewitness.

work is critical for the creation of expectation. If we are familiar with the anthem being heard, we will deduce that the piece is about China and begin to link what is heard with our pre-conceptions of that country. If we do not know what the anthem is, continuous appraisal of the sounds will occur in order to form a clearer picture as to the place being depicted. It does not matter if the anthem is not recognised as that of China, rather its purpose is to provide a sense of place—music in an open environment—and therefore to encourage the listener to form an expectation that this place (whether real or unreal) will be developed.

The end of the national anthem occurs at 01:08, where the final chord is synchronised with a bell sound prompting a sudden cut into a street scene characterised by passing bicycles. The clicking of the bike wheels takes on a 'life' of its own at 01:46 and forms an abstract texture placed in the upper range of the frequency spectrum which exists in parallel with the city sounds that surround it. The accelerando and ritenuto gesture at 02:15 creates the expectation of another transition, which is then confirmed through the emergence of a pitched drone. Tension is raised and released through the accelerando and rituento gesture at 02:15 as it gives a sense of an object approaching and then receding from the listener. This could be considered *analogical evidence* as at 02:56 what appears to be a heavy vehicle appears to approach and then depart into the distance and provide a sense of the arrivals and departures that lie at the heart of this work.

Section 2: Xi'an (03:34-08:33)

Xi'an possessed a completely different character from Beijing and provided a contrast between the city walls of the ancient province's capital and the new skyscrapers beginning to dominate the surrounding landscape. In Xi'an, I was able to make field recordings that could be considered sonic landmarks of the city itself and icons of Chinese history—for example, the sound of chanting, cymbals and drums of the monks' temple prayers that are characteristic of East Asia and China.

The transition to section two occurs at 03:34 and comprises a resonant drone created from recordings of street musicians and temple chant and prayer. These were slowed down using time stretching in Sound Hack and a drone created by using GRM Tools Freeze and GRM Tools Reson. The slowing down and added resonance of the sonic material at this point in the work create a surreal and unearthly effect, which becomes a backdrop for the musical field recordings heard later on in the section and reinforces the emergent pattern of arrivals and departures that permeated the first section.

At 05:04, sonorous, resonant materials with enigmatic vocal qualities (created by time stretching and the application of GRM Tools Reson) suggest human presence in a veiled form, which may evoke the imaginative anticipation of an arrival, or the revelation of a definitive source. The sound of a bell striking at 06:15 again demands attention as it signals human agency. The vocal chanting heard clearly at 06:43 confirms a human presence, giving a sense of realism to an otherwise abstract scene and drawing the listener's imagination in different directions. This creates a contrast between the real and unreal sound worlds and may negate expectation through the enigmatic nature of the sounds at this point in the work. This section draws to a close from 08:14 through a gradual drop in pitch and a slowing down of the pulsing material that has been a constant feature. This affords an expectant 'air', but with little material from which to anticipate how the next section of the work is likely to unfold.

Section 3: Chengdu (08:34 – 10:35)

The final city visited during the fieldwork trip was Chengdu (Sichuan province), which provided further aural and visual contrast to both Beijing and Xi'an. The vast majority of the sound material in this section is created from recordings made in the Dujangyan Panda Reintroduction Centre and the immediate surrounding area.[50]

This third section contrasts the previous two sections and will come as a surprise, as much of the material is created from recordings of animals (bull-frogs, birds and giant pandas) as opposed to the sounds derived from human agency which dominated the first two sections. These recordings are heavily processed by delay and reverberation effects, and, consequently, there is a reliance upon the listener piecing together schemata and gathering *sonic evidence* to form the bigger picture of what events the final section in the work will hold. At 08:56 the bicycle clicks which have been so prominent throughout the work return with an agitated character that harks back to the previous abstract scenes of the work. By this point there have been enough instances of transition in and out of realistic and abstract states that a parallel existence of these sound worlds and the transitions between them could be considered a 'natural' state.

Section 4: Coda (10:36-11:36)

One of the major objectives of the commission from SCEN was to explore sonic links between China and Scotland. While travelling between Beijing and Xi'an by sleeper train, music was played through the cabin loudspeaker system before departure from major stations. In keeping with much of the piped music heard throughout China, most

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[50] The sounds from this section also formed much of the source material for *Sacred Voices*, discussed in **Section 3.2**.

of the pieces heard were popular songs common in Europe. However, what was completely unexpected was hearing the traditional Scottish piece, *Auld Lang Syne,* played on saxophone and guitar. Perhaps even more surprising, however, was hearing the same piece played on the xūn[51] in Xi'an's ancient bell tower. Upon discussing the relevance of *Auld Lang Syne* to Chinese culture with various people, I discovered that it is well known as a piece entitled *You Yi Di Jiu Tian Chang* or *Friendship Forever and Ever.*[52] It therefore seemed appropriate to tie the two cultures together by concluding the work with recordings of the xūn and Highland bagpipes in renditions of the song and, by doing so, encapsulating the ambiguities concerning place and cultural identity within the work.

Summary

Key moments in the work are those heard early on in each section (Beijing, Xi'an or Chengdu). These may lead the listener to imagine a possible source or particular place (an example of *associative evidence)*. This, along with sequences of transformed materials which undergo various types of spectro- and spatiomorphological development, are intended to encourage the listener to expect progression to new sonic states and the revelation of recognisable sounds and places. Through the fusion of the two versions of *Auld Lang Syne/You Yi Di Jiu Tian Chang* in the final section, *Our Song* also enshrines what were, in real life, completely unexpected moments of cultural overlap.

3.6 *Mordicum* (2013)

Mordicum is Latin for a fragment, and many of the sound sources derive from recordings made in Brussels in October 2012 while I was there for the *L'Espace du son Spatialisation Contest*. The piece aims to explore expectation through sounds that are ambiguous or enigmatic in nature because of their ability to prompt the listener to anticipate the emergence of more recognisable sonic characteristics. This is an idea supported by the way in which only fragments of real sound are heard as the listener is carried through various sound worlds. The resolution at the conclusion of the work is effected by the materialisation of unprocessed field recordings out of an otherwise

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[51] An xūn is an ancient instrument often made from clay or stone. http://www.chinaculture.org/gb/en_madeinchina/2005-12/05/content_76659.htm (Accessed 5 June 2016).
[52] It is believed that the work first became popular when the film *Waterloo Bridge* gained popularity in China at the conclusion of World War Two. http://www.bbc.co.uk/news/blogs-china-blog-25556778 (accessed 9/11/15).

ambiguous sonic environment. This sense of emergence converges on the boundaries of spectromorphological and source recognition-based presentation. Because these transitions are symptomatic of progressive changes in sound states, the work attempts to encourage expectant, forward listening. *Mordicum* is in four main sections.

Section 1: introduction (00:00 – 01:35)

Mordicum commences with a long, low bass figure which varies in frequency. Tension is inherent in the way in which this is sustained—it lingers to the extent that it assumes a stability that emphasises textural presence rather than gestural motion. A schema-based interpretation of a sustained low-frequency state such as this tends to carry the implication that higher frequency zones will open up. In other words, this absence of the higher end of the frequency spectrum may, through prior listening experience, lead the listener to anticipate ongoing expansion of the spectral space. The lack of a defining attack also means there is an enigmatic air about the presence and provenance of this material. At 00:30 a stream of higher frequency content is introduced which hints at the expected upward opening of the spectral space. At 01:01 any further anticipated raising of pitch is confirmed in a surprising way with a pulsating noise gesture that significantly opens the spectrum which was limited to ca. 400Hz until that point.

Diverging streams of pitch derived from the pulsing noise lead to significant new sound events at 01:35—reverberant attacks suggestive of impact, with a somewhat metallic quality. The progressive rise in pitch in this opening section is an example of *impression evidence* because each stage can be interpreted as the emergence of new energy, prompting questions about its possible causes. This introductory section (00:00-01:35) is important for the development of the listener's expectation because the material sketches a trajectory for the extension of spectral space that sets the tone of the work, reinforced by increasing emphasis on attack-resonance spectromorphological models. For example, the unstable gestures at 01:50 could, by virtue of the slightly sharper attacks than at 01:35, be taken as further progression toward a more real-world presence—as though the listening environment is being shaped not solely by a gradual rise in frequency content, but also moving toward a more recognisably realistic world of attack, resonance and cause and effect.

Section 2: (01:36 – 04:16)

This first major section allows for the development of the materials heard in the introduction through new strands of pulsing material which create a distinctly stratified texture. As in the introduction, this is designed to evoke tension but through a different

musical process: the component streams congeal and the texture becomes increasingly saturated from 03:15, suggesting resolution to a drone around G but not resolving definitively to a decisively pitched sonority, and fragmenting toward granular noise from 03:30. Through this passage, there are also hints of extraneous sound—a squeak at 03:10 (heralded at 02:53 and at 03:04) is the first truly prominent fragment of recognisably real-world sound and is heard with the passing of a vehicle, followed by the squeaking of a tram on its rails. This marks a point of arrival within the work and a point of contextualization. Because the car sound is muffled through low-pass filtering, it appears as possibly source-related to the throbbing gestures heard in the introductory section of the work, but the disguised nature of its presentation is intended to offer a hint rather than definitive recognition at this stage in the work. From 03:19, there is a a substantial build-up and development of material heard earlier in the work. The high frequency pitch textures first heard at the start of the work now become more granulated, and momentum is built through texture, dynamic and the overall level of tension. The section finally reaches its climactic point at 04:16 when the high-pitched tone rises to the very top of the frequency range. The clunky machine-like sounds splinter to reveal a new sound-world which is far more static and minimalistic in nature, and which extends the pattern of emergence through the building of sonic layers upwards through the frequency space. However, it deliberately does not definitively resolve expectations – which may arise from hints of real-world sound – namely that we will witness the emergence of clear statements of place or environmental settings.

Section 3: (04:17 – 05:28)

This section is intended to be a complete contrast to the material heard before, presenting a surreal and abstract sound world in which it is very difficult to form expectations of any future events. This is because, in contrast to the second section where there was a sense of motion and forward impetus present through the spatio- and spectromorphological development of material, this section functions as a period of stasis, a zone of reflection for the listener who may at this point be left with the impression that an experience of real-world sound is still lying dormant within, or underneath, the sonic substance in which they have been immersed. In this section there is a development of materials toward more resonant states, and the deep bass gestures heard at the outset of the work now return. The clicking textures heard in the introduction of the work are transformed to become increasingly water-like while resonant tones take on a more melodic role.

Section 4: (05:29 – 06:55)

Here the sound of 'what could be machinery' is recapitulated—albeit in the background of the sonic image. The clicking textures heard in the previous section act as a prelude to sounds of real-world traffic, so heavily muffled that it is difficult to definitively discern the source. As an example of *obstruction/incomplete evidence,* this greatly limits the extent to which a listener might assess their distance from an assumed or emergent realism in the sound world: expectation is held back. Gradually this unreal, slightly subdued and enigmatic sound-world begins to metamorphose into something resembling an image of reality, as the listener now draws upon sounds such as the tram wheels or rhythmic material heard earlier in the work to build up a more detailed scene from the sonic canvas.

Tension begins to mount at 06:03, when a sound suggestive of a tram or train returns and the dynamic level of the piece as a whole increases. The noisy, turbulent material heard in the first climax of the piece (01:35) returns at 06:12. This time, the dense noise partially masks the sound-image of a city square in Brussels, characterised by voices and the pealing of bells, which brings the piece to an abrupt close.

While the dynamic level does add to the sense of 'ending', the new material is neither developed nor reaches a clear climactic point.

Summary

Key moments in the work are those that might, early on, be suggestive of distant machinery or industrial sounds, leading the listener to imagine a possible underlying source. This, along with sequences of textural expansion and development is intended to encourage the listener to expect progression to new sonic states, and the revelation of recognisable sounds. Processing, including low-pass filtering, allows just enough of a sound through to retain some suggestion of recognisability, and as such produces *incomplete evidence.* In seeking to connect these sounds, a listener may resort to connecting traces of *sonic evidence,* drawing together links between the spectromorphological qualities of the sound heard throughout the piece. In making these connections the listener will draw on schematic knowledge of sound sources such as heavy machinery, the rumble of traffic and the effect of naturally occurring filtering (for instance the experience of listening through barriers).

This kind of schematic listening (assuming an underlying source on the basis of *incomplete evidence*) is a means of prompting pre- and post-outcome responses as proposed by Huron: listening can stretch forward in the anticipation of more definitive

real-world revelations and 'glance' backward as new stages of recognisability are implied or reached.

3.7 *Tout autour de la montagne* (2014, Revised 2015)

Tout autour de la montagne aims to explore expectation through the presentation of ambiguous and enigmatic sound using both real-world sounds and more abstract sound worlds.[53] The work consists of a cycle of short acousmatic spaces created using field recordings made during autumn 2014 in Montréal. The title, which translates to *All Around the Mountain*, is a reference to the mountain that gives Montréal its name—Mont-Royal. Material for the work is derived from recordings made on sound walks around Montréal, on which I identified a group of defined sonic spaces, each possessing unique sounds with great potential for studio manipulation. One of the 'signature' sounds of Montréal is that heard on its metro system, the STM. The door closing warning tone heard on the subway was modelled on the sound that the trains make when preparing to leave each station. Coincidently, it also conveys the same three note motif heard in Aaron Copland's *Fanfare for the Common Man* (1942).[54] The returning STM theme and other sounds immediately relatable to Montréal, such as the voice of a female station announcer, act as important structural and referential markers throughout the work, allowing for the development of drama and moments of tension and release to be created.

Tout autour de la montagne consists of five short movements, or 'acousmatic spaces'[55], each of which explores a particular sonic landscape heard during sound-walks undertaken during the first week of the residency.

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[53] The work was originally composed for loudspeaker dome, and that version is far more immersive than the final stereo version, which is more suited to multi-channel sound diffusion. On my return to the UK, I revised the work into a stereo version intended for diffusion in response to feedback from audience members and supervisors. For example, the original version featured the recording of a funk band performing in a shopping centre in the city. This was replaced by more abstract sound materials, which better suited the tone of the work. The stereo reduction required several adjustments in panning and phrase.

[54] Copland's *Fanfare for the Common Man* was also one of the main musical themes for the Expo '67, which took place in Montréal a year after the metro opened. See https://kaleidophonic.wordpress.com/2012/06/19/fanfare-fore-the-common-man-montreals-melodious-metro/ (accessed 13/01/2016).

[55] Derived from John Young's use of the term in the programme note to his work *Five Versions of Reality* (2013).

1: *…Prologue…* (00:00-00:56)

The prologue presents a deliberately unstable mix of abstract sonorities and real-world imagery: thunder-like, stable pitched resonances and twisting, turbulent noise-bands blend with sounds of rain (00:17), the Montréal metro (00:38), musical instrument gestures (a jazz band warming up (00:49)), and an elongated trumpet-like resonance (00:25). Rather than offering solely a 'cut and paste' mix of sonorities, causal connections are implied through the dynamic and spectral shaping of sounds. Two examples are the sequence from 00:23, in which a surge in sound energy appears to initiate the trumpet tone, clearing a space for the emergence of a deep, reiterated machine-like pulse, and from 00:50 where the coordinated downward trajectory of jazz band and a glissando of noise arrive at a common pitch of F-sharp. The fast pace of this section requires the listener to draw rapidly on schemata to arrive at a coherent or plausible explanation for the co-existence of the material. A likely response is the perception of a multiplicity of co-existent sound worlds and a sequence of surprises rather than any clear expectation as to the flow of events. One of the main themes of the work, the STM signal, is heard in isolation at 00:38, which suggests that it might have an important role to play as the work progresses, since it has a more focal presence than other sound material at that point.

2: *…Parc…* (00:57-02:52)

This section is a space for play on pulse and rhythm. In contrast to the flurried gestures that concluded the first section of the work, the opening to this movement is relatively still and is much more focused on the lower end of the frequency range. The sonic background is initially a granular shimmer providing an unobtrusive 'pulse' affording the effect of stasis. The self-contained movement of this texture lends itself as a platform for smaller, higher frequency materials to consistently take a central role in the movement. The 'squeak' sounds first heard at 01:04 are created from recordings of escalators at Peel station. In this context, machine-like imagery might be inferred, particularly through the co-presence of low rumbles and the emergence of a deep reiterative pulse. Together these could be taken as *circumstantial evidence* of a machine image. Certainly the compositional intention at this point was to create an impression of the mechanical and, to an extent, automated sound world located beneath the surface of Montréal. Pulsing, tapping and squeaking figures with interjections of surges of noisy energy (such as that of a skateboarder recorded in Montréal's Parc district (from 01:49) are designed to elicit expectation of overwhelming envelopment and a sense of looming tension, which is not fully realised as the texture dissipates abruptly into a static resonance.

3: …*Ligne verte…* (02:53-04:16)

This movement focuses on the sounds heard in the Montréal metro system, and in particular those sounds recorded during a ride on the 'green line' which crosses from the West to the East of the city. This short section rests on the interleaving of several distinctly differentiated sound types derived from the sound of turnstiles, the beeping of metro card readers, the squeaky escalators at Peel station and the voice of a metro announcer. These are heavily processed and integrated with the recognisable sound of the STM theme heard at the start of the work. Attention is drawn back to the start of the previous movement with squeaky sounds and from 03:08 there is a general accumulation of pitched resonance with a blurred outline of the F-sharp—B—F-sharp figure of the STM signal answered at 03:15 by a definitive statement of the signal. Expectation is likely to be suspended from here as the texture remains relatively static and noise-dominated, with recurring pitched resonances (articulating the interval of a fifth derived from the STM signal) leading to a final statement of the signal itself at 03:35). The heavy resonance at 03:52 (actually a metro train departing the station, though possibly unrecognisable as such) provides a natural wave of receding energy to conclude the movement, but also drags the focus of pitch to extreme low frequency regions, which also leads into the next movement.

4: … *Ile Notre-dame…* (04:17-06:24)

This movement was created using recordings made at the Grand Prix racetrack on Thanksgiving Day 2014. While the original intention of my trip to Ile Notre-dame was to capture some more rural sounds away from the hustle and bustle of the city centre, the focus of the recording session shifted to four high-performance vehicles that were racing on the track. These sounds were then contrasted with sounds of cicadas recorded in Toronto in summer 2011. This movement provides the listener a moment of surprise as its sonorities are quite distinct from those found in the previous movements, offering a timely contrast within the sequential flow of the 'spaces' created within the work.

The movement begins with a long, low creaking gesture, which leads into a sweep of sound and a drone at 04:24 followed by debris reminiscent of raindrops. The opening gesture is repeated at 04:33, and evaporates once more into a drone emphasising the importance of cause and effect in the movement and suggesting that it will have a key role as the movement progresses. Although lacking a specific context, a creaking sound of this kind naturally implies the presence of an object under imposed pressure[56] and functions to evoke anticipation of change in the sound world. At 04:47, this role is

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[56] See also Wishart's notion of *natural sound morphology* (1996:182).

confirmed when it initiates a powerful surging drone which greatly shifts the momentum of the section through a rapid onset of increased dynamic level and frequency range (shown in **Figure 14**). A naturalistic soundscape of the race track is opened up (processed using bandpass effects) and from here on the structure is shaped by gestures of the rapid approach and passing of cars at high speed against an emergent naturalistic backdrop of cicada and bird sounds. Between 05:56 and the end of the movement at 06:24, the soundscape becomes more prominent, and the car gestures simply punctuate the sonic canvas on occasion in order to provide a forward impetus in what would otherwise be a static section of the work. Throughout this time there is a full use of the frequency space alongside the drone which is ever-present and unchanging. This builds tension between states, implied by the sounds of cicadas, background traffic and drone material. These tensions derive from the enigmatic nature of the combinations of sounds in the movement.

The structure of this section is shaped by the emergence of the car imagery and the associated sensation of motion and speed. As *anecdotal evidence* this imagery can naturally lead to expectations around the degree of proximity we are likely to experience with each approach of a vehicle. This can be characterised effectively with ITPRA: as the car approaches in the distance the *imagination* response is triggered in anticipation of its arrival; *tension* is raised in reaction to the possible dangers represented by high speed, as the uncertainty as to the speed and trajectory of the object imagined to be producing the sound. *Prediction* can result from the apparent speed of approach. The *reaction* response is activated as the vehicle actually appears to move in front of us, and finally an *appraisal* of the event occurs as we are bypassed by the vehicle and the nature of the whole trajectory is assessed.

5: *…Sur le trottoir…* (06:24-09:24)

This final movement marks a reprise of the highly contrasted mix of sound materials that characterised the first movement. The idea at this point was to create a pixelated sonic image or sonic 'soup' out of which clearer fragments of sounds are pulled, in the same manner as in the introduction to the work. The varied nature of the recognisably real-world sound sources – walking through leaves, thunder, rain, instrumental sounds, aircraft overhead, the STM signal, voices from the street, bells (from the Basilique Notre-Dame de Montréal), footsteps on the pavement – and quasi-mechanical sounds is fused through spectromorphological reshaping, careful matching of pitch and the layering of sound shapes derived from heavy processing. The multiplicity of *anecdotal evidence* is a deliberate scuppering of the forming of clear expectations, forming a kind of acousmatic *stretto*.
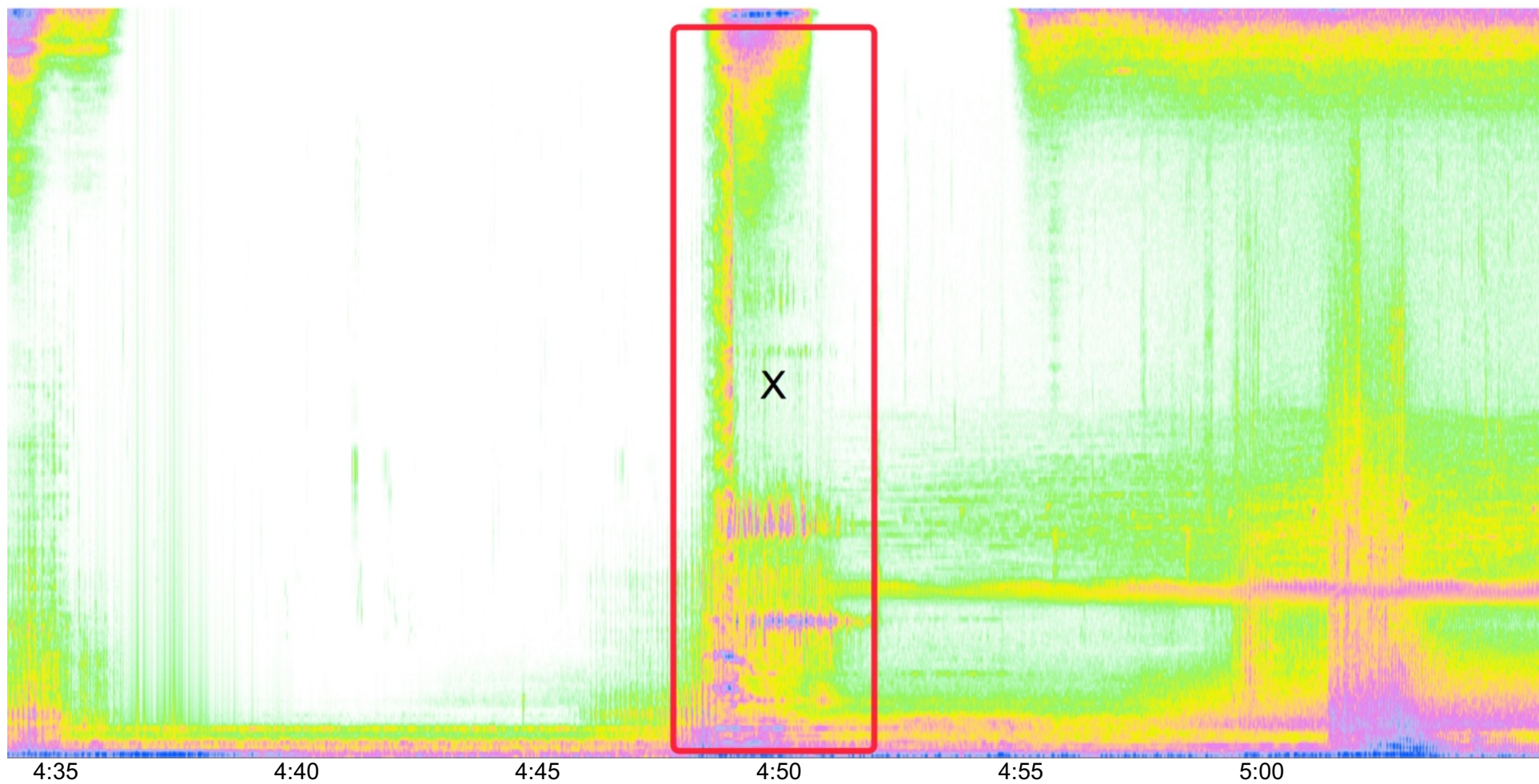
Figure 14: Sonogram annotated with sudden increase in frequency range (marked **X**) in *Tout autour de la montagne*.

The movement acts as a recapitulation of material heard throughout the work and, in particular, develops sounds from the opening section such as the simulated trumpet sound. There is an emphasis on musical quotation by drawing upon recordings made of the numerous bands and buskers heard on a daily basis when walking the streets in Montréal.

Care was taken to structure the duration and context of each recognisable sound. The orchestral tuning at 08:21, for instance, can be taken as a resolution of the emphasis on pitch starting at 07:55 and is extended to imply (falsely) a possible 'arrival' at a point of resolution. From 08:21 the concentration of sounds with recognisable sources increases, starting with the orchestral tuning 'A' which connects to the A major key of the band (from 08:54), the relaxed, informal quality of which implies a sense of finality. At this point the focus on layers of realistic sonic imagery acts as if to imply closure: we have arrived at a state of consistency, albeit with what surreal juxtapositions remain..

Summary

I intended the vignette form deployed within *Tout autour de la montagne* to allow for the creation of surprise. Each movement contains twists and turns which never permits the material to develop fully before the next section begins. It may depend greatly on a listener's capacity to draw on familiar sounds or to form imagery from vicariously understood sounds.

3.8 *Cyclic Motions* (2014)

Cyclic Motions is a 16-channel work in three sections that seeks to explore expectation through the repetition of thematic material throughout the work. The sound materials used in the piece are limited to those previously unused or discarded during the composition of older pieces or projects.

The piece explores expectation through musical devices recognisable from modal music: melody, harmony, repetition and interruption. As such, many of the sounds contain a sense of intrinsically implied growth, forward motion or movement into silence or stasis. The piece marked a significant milestone in my research by directly influencing the notion of *acousmatic skip-diving* (discussed in **section 2.1)**, which

provided a means of articulating the evaluative process of composition through a step-by-step approach.

Throughout the composition of *Cyclic Motions,* I was acutely aware that, integral to their inherent spectromorphological qualities, every sound projects an inherent sense of time-scale which may be heard as a forward impetus, or a trajectory towards stasis or silence. My intention at each point of the composition process was to attempt to create phrases and larger patterns around the type of continuation that might be implied by particular sound materials.

One of the sounds chosen for inclusion in *Cyclic Motions* was a recording made of the University of Aberdeen Balinese Gamelan Ensemble in 2008. While I previously rejected the recording because of the highly resonant and melodic properties, I felt that these could be used to create or negate expectation through surprise, tension or repetition. For example, pitches, resonances and attacks inherent to these sounds provide a wealth of potential material that can be manipulated to build tension or create surprise for the listener. In other words, this highly melodic material provided an opportunity to investigate how these types of sounds function outwith the context in which they were intended (i.e. shadow puppet plays in Balinese communities).[57]

At each point of the composition process, my intention was to attempt to create a sense of continuous growth and repetition despite continuously changing the sonic material used. This was achieved through the means of local repetition and patterning. *Cyclic Motions* consists of 3 sections.

Section 1: 00:00 – 02:00

This first section deals largely with variations in the pace of sonic events. The introduction to the work consists of waves of sound that envelop the listener with noisy resonance in the low- and mid-range frequency spaces. The velocity of the spatialisation and gestural evolution in the opening seconds suggests that material will develop rapidly and that the piece will have a strong sense of momentum. Therefore, it might be expected that this material will evolve through an increase in speed or through expansion of the frequency range. The spectromorphological energy carried by these initial sounds reaches a climax at 00:11. This is achieved through the

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[57] Having clearly recognisable Balinese gamelan sounds is also an example of *associative evidence* proposed as part of the *sonic evidence* framework in **Part 2** of the dissertation.

introduction of entirely new machine-like gestural material cutting across the initial material and introducing a new morphology in the form of pulsing mechanical sounds. The sudden change in momentum could be taken as a signal that interruptions will be a constant feature of the work. This also creates a degree of uncertainty—firstly because the piece is unstable and no sound has been allowed to linger for sufficient time to be established through a process of dynamic predictability (Huron, 2006: 240).

After this initial interruption, play with the pace of cyclic repetition of materials is a focal point, with short phrases formed through patterns of repetition and looping. The patterns of *ritardando/accelerando* between 00:15 and 00:47 impart an impression of uncertainty, evoking tension, especially with the counterpoint of more dispersed 'industrial' sounds cycling at different rates. The resonant, metallic attack at 00:47, implies a further change in sonic emphasis, and the expectation that the momentary novelty of this new timbre might herald new materials is fulfilled as it triggers material which is markedly rhythmic and melodic in nature (a sample of Balinese Gamelan heavily processed with GRM Doppler). This is quickly followed by an unprocessed fragment of a short gamelan phrase and represents a point of emergence as there has been a continuous development from the noisy, abstract material to a development of texture and pulse through mechanical sounds at 00:11, then to processed gamelan sounds, and finally, to the raw, unprocessed gamelan sounds themselves. To balance the comparative instability of this progression, the pattern of resonant attack-loop-gamelan phrase is reiterated from 01:00. From 01:23 a slow, oscillating chord progression underpins the cyclic patterns that continue through the remainder of this section. This confirms the essence of the work to this point to be one dealing with cycles, or loops, and event structures implying continuity and the breaking of expectations with interrupting gestures.

Section 2: 02:01 – 04:45

This begins at 02:01 with an attack created from 'orchestra hit' and gamelan samples. The pitch and timbre of these are recognisable from the first section (01:32) but on this occasion as they initiate a deep organ-like drone. Tension is created for the listener at this point through the layering of crunchy, noisy materials, selected through the *acousmatic skip-diving* process for their enigmatic quality and ambiguity of source. The inclusion of these sounds permits juxtaposition between the well-established tonal material and gestural material, which has no apparent source or cause and is abstract and noisy in nature. An increase in the phrase lengths of the gestural material implies a sense of growth. A climax is achieved through a sudden build in dynamic range and

a rupture at 02:28, leading to a scattering of 'debris' around the listener, followed by a moment of pause that interrupts the flow of the work.

Momentum is rebuilt through figures looping and pulsing at different rates (such as the resonance from 02:54), and from the more synthetic drone which is unwavering and has the effect of pushing the music forward. Pulsing machine-like material at 03:05 is reminiscent of a texture heard at 00:11 and may trigger the imagination of a range of possibilities, including a return of material heard in the first section and a transition from noisy material to sounds that are far more tonal in nature. The compositional intent at this point in the work was to challenge the listener to recall material heard. The memory recall required for this might happen at two levels: recognition of timbral relatedness (for example, the noisy sounds which formed the opening) or patterns of rhythmic behaviour (such as the machinery that provided pulsing, textural material.

Section 3: 04:46 – 07:43

Interplay between looped sonorities and more gestural interruptions again characterises this section. The recurrence of the opening gesture of the work at 05:47 may trigger expectation of some kind of recapitulation. However, in keeping with the idea of interruption, 'dead' silences at 06:35, 06:41 and 06:45 are used as a more alarming form of interjection in this final section and are intended to surprise and raise tension.

Summary

A key feature of *Cyclic Motions* is the exploration of expectation through the suggestion of emergent looping rhythmic patterns interrupted by strong gestural statements, and in the final section by what are likely to be unanticipated silences. Contrast between source-recognisable instrumental gestures of gamelan and digitally processed abstract sound are linked by the cyclic patterns which, overall, never cohere as a rhythmically coordinated texture. Rhythmic patterning in cycles evokes anticipation of that possibility as 'future oriented' imagination responses in Huron's (2006) terms, but these are continually undermined by changes in pace and montages of gestural interruption. In *sonic evidence* terms this reading is indicative of *circumstantial evidence* as emergent patterns are sensed and predictions made about their evolution, and *obstruction of evidence* through interruption and looped events jostling for the listener's attention.

Conclusions

The aim of this practice-based research project was to identify ways in which expectation might be created and manipulated in acousmatic music. It is not the intention of this dissertation to present a complete theory of expectation *per se*; rather, its aim is to identify some of the processes through which we form and experience expectation in the genre. As the central part of the research project, the portfolio of compositions led to the development of the ideas of *acousmatic skip-diving* and *sonic evidence* applicable to a critical approach to the decisions made in my creative practice. The notion of *acousmatic skip-diving* provides a window on my studio workflow and a means of evaluating the implications of sound materials when faced with a huge number of sound sources in the composition process. Because *acousmatic skip-diving* articulates what is a serendipitous process it also permits examination of the implications of compositional decisions on a listener's expectation. Whilst this framework has been built around the intricacies of my own compositional practice, it may provide avenues for further exploration of the effect on the listener of decisions made in the studio.

My concept of *sonic evidence* was inspired and influenced by forensic science and crime scene investigation and provides a way of examining the relationships between sounds in a work in order to anticipate future events and analyse previous events on the fly, using listening strategies such as 'the strip', 'the spiral' or 'the grid'. Within this concept sound is treated as evidence of both spectromorphological activity and states of recognisable realism. A spectromorphological view gravitates to qualities of energy profile, trajectories and differentiation of pitch and noise, while source recognition evokes place, substances, objects and causal processes. By linking these two broad ways of deriving meaning from sound as sonic evidence the often hazy and difficult to articulate boundary between them is linked into one cause and effect concept. Thus it becomes an integral part of acousmatic thinking to expect, say, a surge in noisy sound energy to propel the listening experience toward a real-world sound image. A sense of coherence in the range of sound materials participating in a work is also a factor in the consideration of expectation. It is possible that a forward impetus can be created within a work through sound materials that are tangibly in processes of continuous transformation. On the other hand, a sense of the underlying coherence of sound materials, even if lacking in a variety of evidential fragments, may lead to too much

predictability or what one might regard as an excess of expectation, leading to little or no surprise within a work and boredom or a loss of interest for the listener.

A feature of all the works in the portfolio is the amalgamation of heavily processed digital audio files with source-recognisable sounds recorded in the field or the studio. Movement through and across these domains of 'abstraction' and 'realism' is the most fundamental way of reading these works. Processes by which audio files are granulated, resonated, pitch shifted, time stretched or 'frozen' and micro-edited into tiny fragments are all techniques used in the portfolio that allow for the reassembly of sound into new spectromorphological constructs and progressive transformation toward new states. By providing evidence of natural objects at key points in the works, the analyses point to ways in which listeners might be encouraged, through imaginative responses, to anticipate the emergence of sound events recognisable form real-world experience.

Expectations are not solely created around gradual emergence of source-recognisable material. Surprise, as a way of undermining expectation, is also a core device used in the works—through the sudden appearance of unanticipated types of material, to evoke interruption and/or revelation of new sonorities or through the bold use of silence. The function of silence, which has been related to the problematic ontology of acousmatic music, has been of particular interest in this study. There is no visual element during a performance as is the case in instrumental music, and the sense of physical engagement that commonly supports musical performance takes on a virtual role. Because the preparation and release involved in producing sound in the real world are not relayed, or perhaps most significantly, anticipated visually in acousmatic music, there exists a sensory deprivation which requires a musical 'picture' to be formed from prior knowledge and on a moment-to-moment basis. Silences in the acousmatic domain can therefore mean that expectations of continuity in the apparent sound source or the ongoing spectromorphological characteristics of sonic material are apt to be unpredictable; thus transitions between realism and extreme forms of sonic abstraction can be made potent structural moments through the ontological blankness of acousmatic silence, and a powerful device by which the composer can lead and subvert listeners' expectations.

The nature of acousmatic music is an electronically mediated and virtual experience. Within the genre any sound is permitted for use and its materials possess the capability

to function as objects: Schaefferian sound objects, source-bonded or referred objects. Because composer and listener rely upon an instinctive knowledge of music and the natural sounding world, it is evident that there is no simple answer to how expectation is experienced in acousmatic music.

On one level, we draw upon schemata shaped by musical and cultural experiences and, on another level, by our direct experiences of the surrounding environment. Both of these dimensions participate in the way we interpret and evaluate the unfamiliar sounds that are inevitably created through the signal processing that is common to the acousmatic genre. In this project I have proposed that a number of factors influence the creation or negation of expectation, but that all are dependent on the listener's and composer's prior experience. The implications carried by acousmatic sounds are the product of the listener's imagination but are also shaped by the context created by the composer.

In Western musical traditions, classical and popular, tonal functions are especially pertinent to expectation, for example in the way a listener can anticipate the sounding of the tonic harmony prior to actually hearing it. There is possibly no directly equivalent experience to this within acousmatic music, although focus on pitch may evoke expectations that draw on inherent knowledge of tonal systems in music, such as tension derived from dissonance or resolution to singular pitch or harmonicity. Similarly, devices like *crescendo/diminuendo*, extremes of register, or the filling/thinning of spectral density to shape and articulate phraseology are generic musical processes for manipulating tension, arousing and deflecting expectations.

However, one of the features of my portfolio is the way products of sound transformation can be constructed to imply movement toward real-world imagery. In many cases anticipation of emergent real-world sounds may enable the listener to conjure points of arrival prior to hearing, or even in the absence of source recognisable material. My portfolio demonstrates in original ways that, in composed structures, source recognition can function as both goal state and point of departure in acousmatic music forms and that this has consequences for dynamically evolving expectations.

The question of expectation in acousmatic music is a topic possessing much potential for future research and development. Acousmatic music is a child of technology that draws upon the imagination in many new ways. It is one thing to be technically able to

record and intertwine a wide range of sounds, but it is another thing for the human mind to be able to accept these constructs as being meaningful. Overall, there is a very bright future for the acousmatic medium as a creative playground for surprise and invention.

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Appendix A: Programme Notes

Mordicum **(2013)**

Mordicum is Latin for fragment. This piece aims to explore expectation for a listener through ambiguity. Throughout the piece, it is intended that only mere hints of a real world are given as the listener journeys through various sound worlds both expected and unexpected.

Most of the sound sources in this piece derive from recordings made during a recent trip to Brussels in October 2012 for the *l'Espace du son* contest.

There are two versions of the work—the 8-channel and the stereo versions. It was realised in the studios of the Music Technology and Innovation Research Centre at De Montfort University between November 2012 and January 2013.

Our Song **(我們的歌) (2013)**

Our Song (我們的歌) was written upon return from my second trip to China in May 2013. On this occasion, I visited Beijing (Peking province), Xi'an (Shaanxi province) and Chengdu (Sichuan province). During my previous trip to Shanghai in 2011, I suffered from an aural and visual culture shock. The sheer size of Shanghai and the way of life there stunned me. As a result of this, I had many preconceptions as to what I would hear and see this time around.

However, I was pleasantly surprised when I found that I was able to embrace Chinese life fully. What I discovered was a massive variety of culture, colour, music and lifestyle, along with some surprising similarities to Scottish tradition. This work follows on from my previous work *Culture Shock* (2011), and explores expectation of place – how one can have preconceptions of a particular place through sound.

The sound of bikes zooming down tiny hutongs (small streets of traditional housing) may for some, remind them of a particular place or a memory of a place. An individual experience may also be associated with particular aural memories or sounds, and this is what I aim to explore in this piece. *Our Song (我們的歌)* was commissioned by Scotland China Education Network and the University of Aberdeen Confucius Institute.

It was composed in the studios of Music, Technology and Innovation Research Centre, De Montfort University between June and July 2013.

$Si0_2$ (2013)

Silicone is the main constituent component of glass. Dependent on the type of glass and its function, the amount of silicone applied during the manufacturing process will vary. Glass in its many different forms, is the sole sound source of $Si0_2$. The piece aims to carry the listener through many different soundworlds and sonic landscapes-from frightening to light and chorale like.

$Si0_2$ is an 8-channel acousmatic work and explores a number of different issues concerning the movement of sound in space and time, and how this contributes to expectation within acousmatic music.

$Si0_2$ was composed between April and September 2013 in the studios of the Music, Technology and Innovation Research Centre, De Montfort University, Leicester.

Sacred Voices (2014)

The title *Sacred Voices* was suggested by the use of and manipulation of sound materials which are considered to symbolise religion, culture or species. The piece was composed mainly of material that had been recorded during a research trip to China in May 2013. Much of the material was derived from a rare opportunity to record giant pandas in their enclosures at the Dujangyan Panda Reintroduction Centre, alongside a recording made in Xi'an of monks singing in a Buddhist Temple and carts being driven up hutongs in Beijing. These sounds (voices) are explored in a manner straddling the very edge of real and unreal sound worlds and act as expressions or traces of place or moments in time.

Sacred Voices attempts to convey the idea of a series of momentary structures and forms experienced in space and time. Throughout the work, sounds are presented as 'moments' in time and space. These moments are then expanded and explored throughout the piece—with each idea being mined for potential developments. The idea for this derived from my fascination with the manipulation of field recordings, but

also with sound design and spatialisation, both within the concert hall and in a piece itself.

Sacred Voices was composed from December 2013 to January 2014 in the studios of De Montfort University (Leicester, England, UK). The work was commissioned by Reinhard Fuchs and Forum Liverpool with support from Scotland China Education Network, University of Aberdeen Confucius Institute and De Montfort University Confucius Institute. Special thanks to John Young.

Cyclic Motions (2014)

Cyclic (def): -

1.   Revolving or recurring in cycles, characterised by recurrence in cycles;

2.   of, pertaining to, or constituting a cycle or cycles.

Motion (def): -

1.   the action or process of moving or being moved.

Cyclic Motions is a 16-channel acousmatic work which seeks to explore expectation through the recycling of thematic material throughout. The sound materials used in the work are limited to those previously unused or redundant from previous works – all of which had at some point been destined for the (Mac) Trash. One of the first sounds that I was attracted to when listening to this previously redundant sound material was a recording I made of the University of Aberdeen Gamelan ensemble several years ago.

Through exploration of this material in the 16-channel studio, I decided that spectrally, this particular recording would be significant to the work. Other material used was derived from material I worked with (but ultimately did not use) in previous works, and recordings of some orchestral rehearsals made over the years.

The work is also a venture into composing 16-channel music. I wanted to explore this format, and investigate its effectiveness regarding the magnitudes of spatial resolution, depth and polyphony which can be achieved, as opposed to other formats such as stereo, 8-channels or 5.1.

Cyclic Motions was composed between April and September 2014 in the studios of the Music, Technology and Innovation Research Centre of De Montfort University.

Tout autour de la montagne (2014, revised 2015)

To John Young

(…Prologue): 0:00: dur. 00:56
(…Parc): 00:57: dur. 01:55
(…Ligne Verte): 02:53: dur. 01:24
(… Ile Notre-Dame): 04:17: dur. 02:07
(…Sur le Trottoir…): 06:24: dur. 03:00

What is a city? Places within a 'place'. Spaces within a 'space. All is not as it seems… Spaces speak with sounds, melodies… noise… What does it conceal? Peeling back the layers of sound, what will it reveal?

Tout autour de la montagne (All Around the Mountain) is a cycle of short acousmatic spaces, created with field recordings made during fall 2014 in Montréal. The title is derived from the mountain which the island of Montreal is named after (lit. Mount-Royal) and which everything in the city is based around. Concealed within the island, are numerous spaces hidden and just waiting to be explored. Within the work, each 'space' has a similar formal approach to manipulating the sounds to reveal different and ultimately surprising, unexpected sonic spaces.

Tout autour de la montagne was realised in the studios of the Université de Montréal during the fall of 2014. I wish to express my gratitude towards the funding bodies who supported my residency in Montréal: De Montfort University (The Arts and Humanities Research Council Support Grant), The Scottish International Educational Trust who awarded me a fellowship to support my work in Canada, to De Montfort University's Music, Technology and Innovation Research Centre, and the Faculté de Musique de Université de Montréal for their overwhelming support of the project. *Tout autour de la montagne* was awarded a mention in the 2015 Destellos Composition Competition.

Special thanks to Robert Normandeau.

Rift (2015)

noun

A crack, split, or break in something.

Synonyms: crack, fault, flaw, split, break, breach, fissure, fracture, space, aperture…

There are a number of different meanings of 'rift' permeating this work. The deliberate destruction of source materials allows for the creation of gestures that permit the fracturing and breaking of the sonic space. One of the piece's principles functions is an exploration of relationships between sound and silence. The silences that punctuate the sonic canvas throughout *Rift* are intended to allow the listener to reflect on events in the work and anticipate what might follow.

Rift was realised during summer 2015 in the studios of the Music, Technology and Innovation Research Centre, Leicester, UK.

Appendix B: List of Performances

Mordicum

Premiere: Birmingham Electroacoustic Sound Theatre, May 2013

Sound, Sight, Space, Play Conference, Leicester, June 2013

Ionian University, Corfu, (performed by Professor Simon Emmerson), June 2013

Franz Liszt Academy of Music, Weimar, Germany, 12-16 July 2013

INTIME Conference, Coventry, 19 October 2013

Liverpool Forum, Liverpool, 20 October 2013

Sweet Thunder Music Festival, Fort Mason Center, San Francisco, April 2014

Our Song (我們的歌)

Premiere: MiniBEAST, Birmingham, November 2013 (performed by Norah Lorway).

Commissioned by University of Aberdeen Confucius Institute as part of the SCEN
Music Project.

Presented at MiniBEAST, Birmingham, November 2013.

Extracts presented at the opening of the University of Aberdeen Confucius Insitute
(September 2013), Scotland China Education Network Conference (November, 2013)
and De Montfort University Confucius Institute (February 2014).

Broadcast: CKCUfm 93.1fm Ottawa September 2014

Si0$_2$

Premiere: De Montfort University, Leicester, October 2013

NYCEMF, New York, June 2014

Sacred Voices

Commissioned by Reinhard Fuchs, Liverpool Forum

Award: Finalist in the Destellos 2014 International Composition Competition

Premiere: Cultural Exchanges Festival, De Montfort University, February 2014

Sound Junction, Sheffield, April 2014

Liverpool Forum, Holy Trinity church hall, Liverpool, 9 June 2014

Sound, Sight, Space, Play Conference, Leicester, 18-20 June 2014

Broadcast on CKCUFM 93.1, Ottawa Canada- April 2014

Cyclic Motions

Premiere: De Montfort University, Leicester, 12 November 2014

Bologna Conservatory of Music, March 2014 (8-channel reduction)

Bangor University, Wales, 27 November 2015

Tout autour de la montagne

Award: Mention in the Destellos International Composition Competition

Premiere: Cultural Exchanges Festival, De Montfort University, February 2015

Listening Beyond, City University, London, 10 March 2015

Acousmatic Transcendence, University of Kent, May 2015

Electroacoustic Music Studies Conference, Sheffield, June 2015

Sonic Voyages: Mass and Motion, Bristol University, 16 October 2015

Broadcasts: Acoustic Frontiers, CKCUFM 93.1, Ottawa Canada, March 2, 2015;

Acoustic Frontiers, CKCUFM 93.1, Ottawa Canada, September 28, 2015

Rift

Premiere: De Montfort University, Leicester, 14 October, 2015

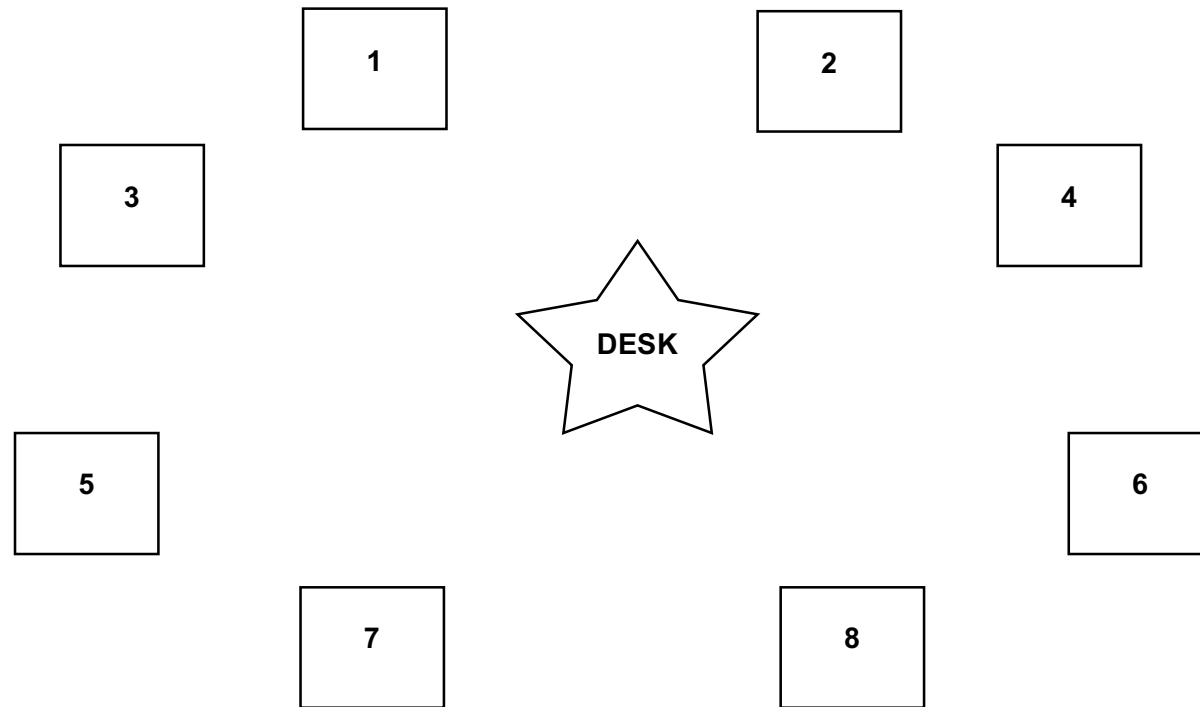Award: Finalist in the Destellos 2016 International Composition Competition

L'Espace du Son, Brussels, October 25, 2015

NYCEMF, New York, June 2016. (Performed by John Young).
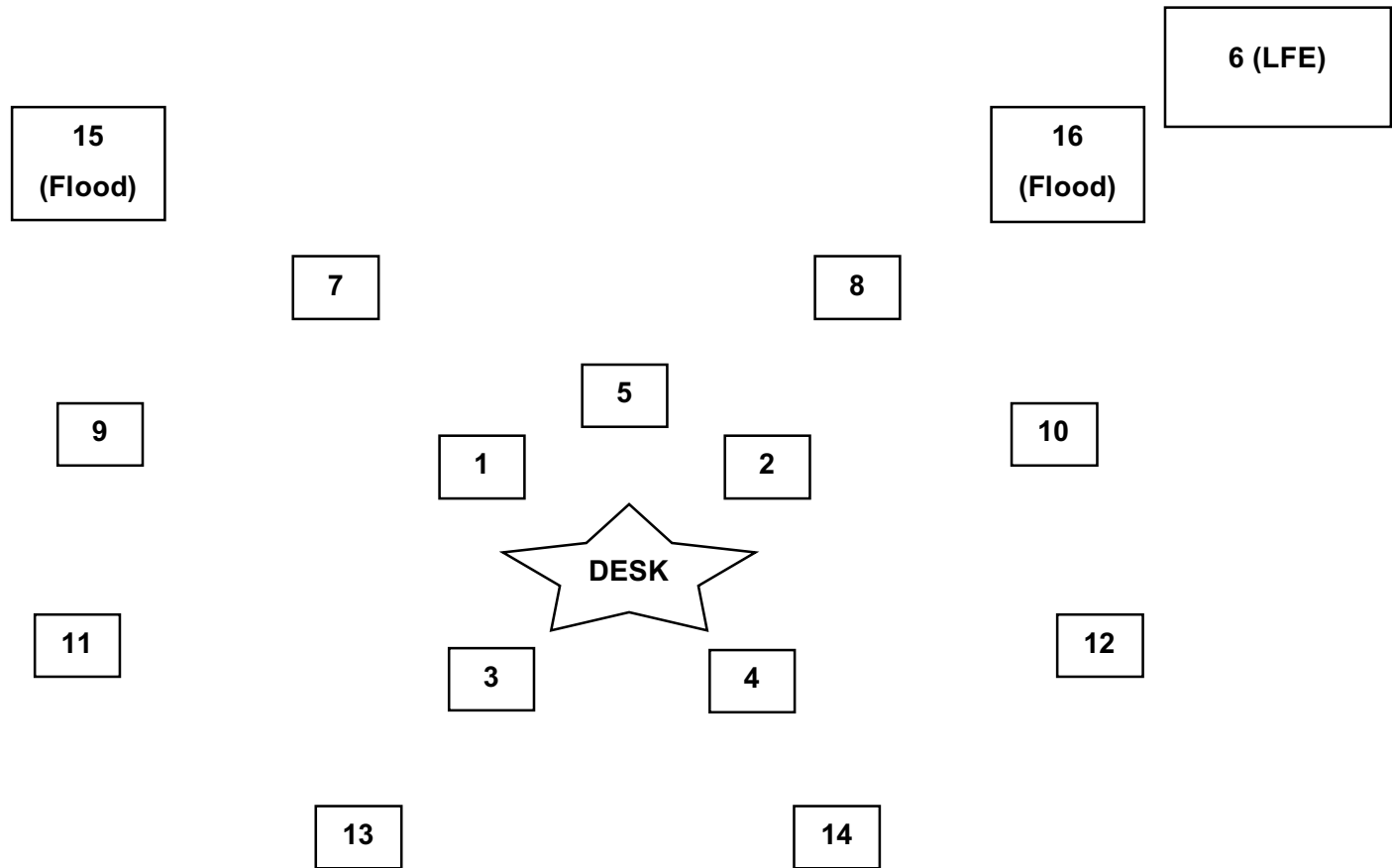
Appendix C: Loudspeaker Configurations

8-channel Loudspeaker Configuration

(*Mordicum, Si0$_2$*)

16-channel Loudspeaker Configuration

(*Cyclic Motions*)

Appendix D: Zirkonium setup for *Tout autour de la montagne* (2014 version)

Tout autour de la montagne was originally composed for loudspeaker dome. Whilst the version composed during residency in Montréal was revised into a definitive stereo version upon return to the UK, the piece that was composed for loudspeaker dome, has been included in the appendix of this dissertation for posterity. The necessary software, files and instructions, can be found on the accompanying USB drive in the folder marked '9. Tout autour de la montagne (DOME)'.