RECORDERS AND ELECTRONICS:

An Introduction to the Performance of Electroacoustic Music

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I declare that the research presented here is my own original work and has not been submitted to any other institution for the award of a degree.

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Date: ....5th ....June......., 2014..............

Abstract

The development of the electroacoustic genre has presented modern recorder players with a myriad of new and exciting repertoire, but many acoustic musicians are reluctant to explore these new works due to the barriers of technology. Many different electronic devices are used in composition and performance, and this can be daunting for a performer with no previous experience in the field. This resource is designed to assist the performer in the transition from acoustic to electroacoustic performer, and aims to reach performers and teachers of the recorder to encourage more performances of works in this exciting genre.

This thesis is primarily of interest to recorder players, but is also useful for composers interested in using recorders in an electroacoustic context. It examines aspects of the recorder which make the instrument particularly well suited to the electroacoustic genre, including acoustics and timbre shifting potential of recorders, and provides information about some compositional ideas which are relevant to the performer. An understanding of the importance of audience perception and the expression of gesture and texture in the electroacoustic genre creates a more sensitive performance, where the performer is aware of their role within the context of the music.

A discussion of repertoire is arranged in a progression of least to most complicated electronics; this is to assist the performer in learning to use various electronic devices in performance. All recorders and electronics required for performance of selected works are described in relation to each piece, and performance notes are included as well. This knowledge can be applied to the performance of other electroacoustic works, and it is hoped the thesis will encourage performers and composers to collaborate in the production of new works to contribute to the huge body of electroacoustic repertoire for recorders.

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Contents

Introduction

The rapidly growing electroacoustic genre presents modern musicians with new and exciting options for performance. This new body of repertoire is particularly beneficial to recorder players, who are sometimes categorised as early music specialists despite the large number of works written since the beginning of the twentieth century. Works which use numerous different recorders, works with live electronic effects, with fixed media, and virtuosic recorder parts, make the exploration of this genre very enticing from a performer's perspective.

The transition to electroacoustic performer can be daunting for recorder players who have no prior experience with electronics, especially as equipment requirements usually change with each piece. This thesis looks at different electronic devices and recorders used in current repertoire for recorders and electronics. An exploration of the acoustics of the recorder and of the ability of recorder players to shift the timbre of their instruments shows the versatility of the recorder player; the tendency for recorder players to own many different sizes and models in their instrument collection also increases the scope of potential sounds available when recorders are used with electronics.

Performing with electronic devices involves the consideration of issues which differ from those encountered when performing purely acoustic music. Electroacoustic music is concerned with continuity of sound and with different degrees of gestural and textural settings; emphasis is placed on the expression of gestures and the ability to assimilate with electronic sounds, on tone colour and timbre as compositional tools, and especially on audience perception and the listener's ability to make sense of the material.

An audience's attachment to certain things in a musical piece depends on many elements which are perceived on many levels of recognition; composers of electroacoustic music take this into account when creating works, and so should performers when playing it. These concepts are important for the performer, as they can be taken into consideration to produce a more sensitive and dynamic performance. Some background information and a discussion of these aspects are intended to aid the performer in the interpretation and understanding of their role within the music.

The discussion of repertoire which follows is arranged to aid the performer in the accumulative learning of the use of electronics in modern repertoire; electronic devices initially are simple with only microphone use, and progress to complicated applications of fixed media, live electronic effects, and a multimedia work. Electronic equipment and recorders required for the performance of the repertoire are explained, and performance notes for each piece follow. Examples of techniques, notation, gesture and texture in context, and recorder special effects are included in the performance notes for each piece.

This thesis also aims to provide a useful resource for composers who are interested in writing for recorders in an electroacoustic context. Acoustic information and timbre shifting abilities of recorders, as well as examples of repertoire and advanced uses of recorders in different electronic contexts, provides composers with vital information on modern writing for recorders.

The accessibility of a written resource means this information can reach wider audiences in areas where teachers and players have not encountered this fascinating and rapidly growing body of repertoire. Recorder players can begin to learn about electroacoustic music at a younger age and will be inspired contribute to the genre in new and creative ways, helping recorders further their development in the genre.

Chapter 1: Recorders

Electronic composition involves the creation of artificial timbres through manipulation of the spectrum of sound. This is the name given to complex tones, referring to the specific makeup of overtones (or sine tones) and their relative strengths. In electroacoustic music the spectrum replaces harmony, melody, rhythm, orchestration and form. It is in constant motion and develops through time, and is therefore concerned with continuity instead of discreet values. "The electroacoustic medium makes viable the composition, decomposition, and development of spectral interiors" within a work.[1]

This is done through the manipulation of harmonic spectrae, partials spectrae, transitories, formants, additional sounds, differential sounds, white noise, filterings, and more. As Smalley writes "Spectra are perceived through time and time is perceived as spectral motion."[2] Moskovich says it is the precise control of the amplitude of individual harmonics which lead to the electronic exploration of timbre and states "The use of timbre – instead of tones – is a choice based on technological and cultural parameters."[3]

Recorders have excellent potential for variation in timbre. This is because of the recorder's acoustically pure tone, and the ability to change and distort this pure tone through manipulation of the mouth and vocal tract, varied articulation, singing through the recorder, and other special effects. The ability to swap instruments quickly in performance contributes further to the potential of recorders to alter timbre during a performance. The manipulation of electronically created timbres is often central to electroacoustic composition, and

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[1] Denis Smalley, "Spectro-Morphology and Structuring Processes", *The Language of Electroacoustic Music* (1986), 66.
[2] Smalley, 65.
[3] Moskovich, 21.

electronically created sounds are still present in current repertoire; recorders are therefore excellent live instruments for the electroacoustic context.

Acoustics and Timbre Flexibility

The timbre of a recorder is partly determined by the specific dimensions of the instrument, and this varies between different makes, models and sizes. The player's technique also has a significant effect on timbre. In order to understand the potential of recorder players to alter the timbre of their instruments, and the additional scope for timbral variety due to the ability to swap recorders, we must first examine the basic acoustical properties of recorders.

A musical sound is formed with the aid of two basic components: the **oscillator**, an initial vibration of a string or initiation of an airstream into a windway; and the **resonator**, the body of hollow wood behind stringed instruments, or the body of wind and brass instruments. The oscillator contains a set of harmonic partials, and the resonator has certain natural frequencies with which it vibrates. These natural frequencies of the resonator react with the fundamental frequencies and their overtones, strengthening certain harmonics and weakening others, and therefore determining the quality or timbre of the sound. "Low partials add mellowness to the tone quality; high partials infuse it with brilliance."[4]

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[4] Cornelius L. Reid, *Essays on the Nature of Singing* (Huntsville, Tex: Recital Publications, 1992), 228.
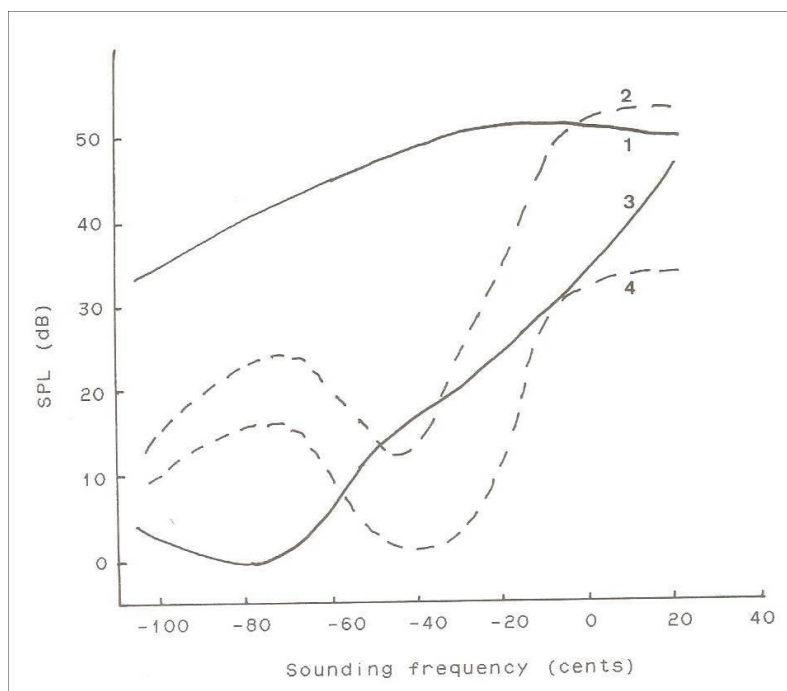
Figure 1 Measured levels of harmonics 1 to 4 versus sounding frequency. Hopf 'Praetorius' alto recorder playing C5.[5]

The recorder has a fixed resonator, but the player has ultimate control over jet strength and speed, and Martin has shown that harmonic content can be altered with blowing pressure; he has observed the "nearly independent behaviour of odd and even harmonics, as blowing pressure is varied."[6] In figure 1 "the nearly independent behaviour of the odd and even harmonics is clear."[7]

A commonality in the design of all recorders is the presence of a fixed windway. Unlike the speed and volume of air which are controlled by the player, the shape of the airjet is determined by the shape of the windway. This contrasts to a flute, where the shape of the airjet is determined by the player's mouth shape and angle in relation to the mouthpiece. The recorder airjet travels down the windway and is split by the labium or lip of the recorder to create the oscillation. This oscillation then interacts with the resonator (recorder) to produce pitched sound.

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[5] Reproduced from John Martin, *The Acoustics of the Recorder* (Celle: Moeck, 1994), 68.
[6] Martin, 13.
[7] Martin, 68.

Figure 2 Table of intervallic relationship of harmonics to a fundamental frequency.[8]

COMPONENT	FREQUENCY	RATIO	INTERVAL
Fundamental	f		
		2/1	octave
2nd harmonic	$2f$		
		3/2	perfect fifth
3rd harmonic	$3f$		
		4/3	perfect fourth
4th harmonic	$4f$		
		5/4	major third
5th harmonic	$5f$		
		6/5	minor third
6th harmonic	$6f$		
		7/6	(3– semitones)
7th harmonic	$7f$		
		8/7	(2+ semitones)
8th harmonic	$8f$		
		9/8	major tone
9th harmonic	$9f$		
		10/9	minor tone
10th harmonic	$10f$		etc...

The unique timbre of the recorder is very pure in comparison to other instruments, as it has relatively few upper partials and stronger odd-numbered lower partials. These partials or harmonics occur at an octave, a fifth, and a major third above the fundamental note;[9] all consonant overtones forming a major chord, accounting for the recorder's pure and clean sound. Figure 2 shows the relationship of harmonics to the fundamental note.

Due to the low air pressure required to play the recorder, recorder players enjoy a very loose and relaxed embouchure. This leaves room for a reasonable range of variation in size and shape of the human part of the resonator: the mouth, tongue, palate, and shaping of the vocal tract. Experiments conducted by professional recorder player Dan Laurin take into account the position of the palate of the player when playing different notes across the range. His research shows that levels of odd and even harmonics in the sound can be manipulated by the player with changes in palate position.

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[8] Reproduced from Ian Johnston, *Measured Tones: The Interplay of Physics and Music*, 2nd Edition (Bristol; Philadelphia: Institute of Physics Publishing, 2002), 98.
[9] Martin, 93.

Martin notes "The effect of the shape of the player's mouth on the sound of the recorder is a matter of much disagreement in recorder tutors and elsewhere."[10] Despite physicists' opinions that no noticeable audible change can be heard with these manipulations of the inside of the player's mouth, Laurin's experiments prove there is in fact an audible change in the harmonic makeup of the sound made just by lifting the soft palate inside the mouth. It should be noted that the difference in the strength of various harmonics imposed by the player occurs in the 3-3.5kHz sound range, which is the range in which human hearing is most sensitive.[11]

Important control factors in recorder playing include manipulation of the broadband signal (noise) and changing of harmonic peaks and balance. As well as changes in the player's vocal tract and mouth, conscious control of the pressure and amount of air also has an effect on the strength of different harmonics in the sound. Martin found that "when the mouth cavity volume decreases its resonant frequency increases."[12]

Martin says "there is a possibility that the tone changes are more apparent to the player than to anyone else... [and that] any effects depend on the relationship between the frequencies of the mouth-windway resonance and the played note."[13] Laurin expresses a different opinion, that "a player's deliberate change of palate position is easily recognizable by a listener as a change of sound timbre."[14] Laurin concludes that changes in dynamics can also be achieved through changing vocal tract shape. He states:

> Dynamics… appear to be affected by… changes in the vocal tract. Deliberate control of these changes in order to vary the dynamics would greatly improve the

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[10] Martin, 69.
[11] Irving P. Herman, *Physics of the Human Body* (Berlin; New York: Springer, 2007), 92.
[12] Martin, 69.
[13] Martin, 86.
[14] Dan Laurin, "Shaping the Sound." *American Recorder* 40, no. 4 (1999): 13.

expressiveness of an instrument generally regarded as possessing a somewhat restricted voice.[15]

Two different spectrometers were used in Laurin's experiments, one to display the sound of the instrument and the other to display frequency sound response in the vocal tract while the author was playing. The spectrometers were both hidden from the view of Laurin so that he could not use visual feedback to influence the results. The bottom axis of the graphs in figures 3 and 4 represents the harmonics one to ten and the right hand axis shows their relative frequencies.

The results of the experiments show clear changes in the harmonic makeup of the tone of the recorder with vocal tract adjustments. Figure 3 shows levels of frequency when the player has a relaxed palate. Notice the differences in thickness and density of the general line; this is called the "broadband signal".[16] When the broadband signal of a sound is thicker, the tone sounds "dirtier", more "grainy". Figures 3 and 4 show more "noise" (broad-band signal) is in the sound when Laurin uses a relaxed palate, and there is less noise in the sound produced with a high palate. Also, when adopting a high palate there are more prominent peaks in most harmonics, and an especially significant differences are measured in the 2.5-8kHz range of sound. Included in this range is the human ear's increased response relative to other frequencies, which occurs around the 3.5kHz region.[17] According to Johnston the human ear is most sensitive between around 2.6-4kHz range;[18] changes in the harmonics in the graphs below fall mostly in this range.

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[15] Laurin, 13.
[16] Laurin, 15.
[17] Herman, 92.
[18] Johnston, 233.
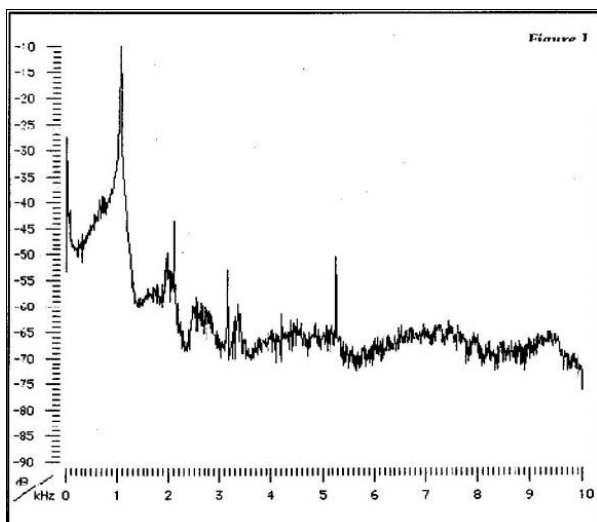
Figure 3[19]: Sound spectrum produced by a standard plastic A=440 Yamaha alto recorder, playing C$_6$, "when the [player] used a relaxed palate with less space in the oral cavity."
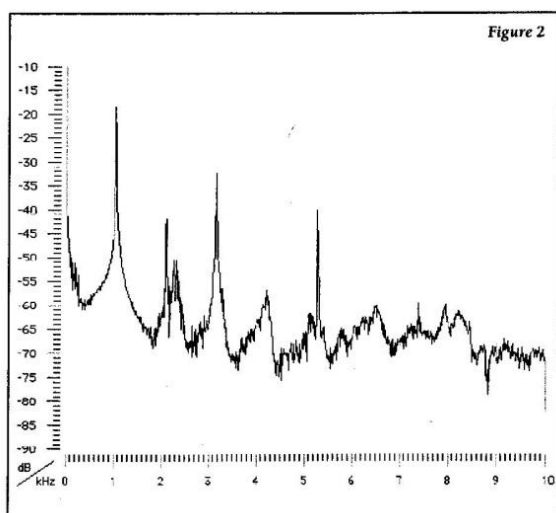
Figure 4[20]: Sound spectrum produced by a standard plastic A=440 Yamaha alto recorder playing C$_6$, this time "using a high palate, as if mimicking a 'giant yawn.'"

After conducting these experiments, Laurin concludes that it is evident that "different [vocal] tract configurations associated with different vowel sounds entail different responses in the high frequency regime and thus produce the different effects on recorder sound."[21]

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[19] Reproduced from Laurin, 15.
[20] Reproduced from Laurin, 15.
[21] Laurin, 17.

The frequencies from the resonance of the instrument itself combine with frequencies from the pitched note and also with the resonant frequencies inside the player's mouth and vocal tract to form the timbre at any given point in time. The shape of the inside of the player's mouth therefore has less effect when playing smaller recorders (Sopranino/Descant) because mouth resonances are generally below that of the recorder and therefore do not contribute as much to the resulting sound.

This applies to large sizes as well (Basset/Great Bass), where mouth resonances probably lie above or at the top of the range of the instrument and therefore may affect the harmonic structure of most notes. As Martin remarks "For trebles and tenors the resonances may fall in the same range as the instrument, and may affect articulation, overblowing, and tone."[22] Auvre, Fabre and Lagrée's article *Regime change and oscillation thresholds in recorder-like instruments*, written 2012, also discusses the acoustic behaviours of recorders and includes equations and more experiments (confirming similar results).[23]

Also affecting the characteristics of a sound for the listener is the initiation and conclusion of the sound.[24] More information, such as the attack and decay states of a sound, can be taken into account and used to identify the timbre of an instrument.[25] Johnston says "the human ear does not recognise the sound of different musical instruments simply by listening to harmonic structure;"[26] he includes graphs of attack-steady state-decay for violin, organ, and piano.[27] Experiments on attack and decay states of the recorder sound appear not to have been conducted except when an artificial blowing device is used to produce the

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[22] Martin, 86.

[23] Roman Auvray, Benoît Fabre, and Pierre-Yves Lagrée, "Regime Change and Oscillation Thresholds in Recorder-Like Instruments", *The Journal of the Acoustical Society of America,* 131 (2012): 1574-85.

[24] Cornelis Johannes Nederveen, *Acoustical Aspects of Woodwind Instruments* (Amsterdam: Frits Knuf, 1969), 94.

[25] James A. Moorer, "Signal Processing Aspects of Computer Music: A Survey", *Computer Music Journal,* 1 (1977): 7.

[26] Johnston, 295.

[27] Johnston, 296.

airstream. Future experiments on the acoustic of different recorder sizes and models and their transient states would be interesting, and no doubt useful for recorder players and electronic composers.

David Lasocki talks of Cardan's treatise written in 1546, which discusses tongue shape as well as syllables to improve, vary and colour notes.[28] These skills apply when deciphering a score, and also in the musical interpretation of the overall piece. A common part of Baroque performance practice – the recognition and fluent interpretation of gestures, patterns, and passages with rhythmic freedom – is also an important part of modern music with electronics. Recorder players, with their background in Baroque music's rhetoric and florid ornamentation, improvisation, diminutions, and the idea of a moment or particular sentiment stretched out in time, are good partners for electroacoustic musicians; these skills of interpretation and gestural expression are very useful when deciphering a modern electroacoustic score.

Professional recorder player Walter van Hauwe said "the recorder, with its poor dynamic potential, really needs its articulation, which is possibly the only thing it can do better than any other woodwind instrument."[29] The claim that recorder articulates better than other winds possibly comes from the lack of resistance to the air and predetermined windway, two things which give the player freedom of a relaxed mouth which sits in a relatively natural position due to the lack of a fixed embouchure.

Not only the attack of the note is important, but the ending of a note is something a recorder player pays close attention to. The recorder's sound naturally decays at the end due to the lack of pressure required to blow. In Baroque music this has posed a challenge, and

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[28] John M. Thompson and Anthony Rowland-Jones, *The Cambridge Companion to the Recorder* (Cambridge; New York, USA: Cambridge University Press, 1995), 122.
[29] Walter van Hauwe, *The Modern Recorder Player Vol. II.* (London; Mainz: Schott, 1987), 78.

recorder players have learned to taper off notes appropriately so as not to allow the pitch to drop. This subtle nuance of the ending of notes on recorders can be pronounced in a number of ways. The note can be ended abruptly, or with a very hard articulation thus creating an accent on the end of the note. Alternatively the note can be tapered off gently without allowing pitch to drop, or as in some modern compositions, the note can be deliberately tapered off, even adding the effect of glissandi downwards to accentuate the effect.

Van Hauwe advises that there are no significant differences in articulation techniques between the different sizes of recorders. The only comment he makes refers to the close relationship between articulation and air pressure. The larger recorders of the Baroque kind, which he calls "slow" recorders (tenors, bassets, great basses) require a larger quantity of air due to their larger size, and so the movement of the tip of the tongue is slightly restricted and articulation is less subtle. The "fast" recorders of the Baroque kind (sopranino, soprano, alto) require relatively mild articulation. This is due to the smaller windway and bore which has the effect of decreasing the quantity of air required for playing. Smaller Renaissance type recorders are considered "fast" by Van Hauwe's categorisation, but need a lot of air due to their wide bore and require the less subtle articulation applied to tenors and bassets of the Baroque kind (also due to their wider bore and windway).[30]

There is a huge scope for variation in the recorder's sound. This is because the acoustically pure tone of the recorder can be heard if desired, or it can be manipulated in a number of ways with articulation, changes in vocal tract shape, and other special effects.[31] The additional ability of recorder players to swap instruments quickly while playing provides further potential for timbre variation. This is useful in a genre where the exploration of timbre has been important to its development and continuing aesthetics.

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[30] Van Hauwe, *Modern Recorder Player Vol. II*, 100.
[31] Special effects will be discussed in relation to each work in the repertoire progression (from page 26).

Chapter 2: Aspects of Electroacoustic Music for Performers' Consideration

Since the beginning of the 20th century two correlated factors have influenced the aesthetics of the musical world: the emergence of timbre as a fundamental factor in composition, and the development of new materials such as electronics, transmission, recording, computers and data processing. The use of timbre – instead of tones – is a choice based on technological and cultural parameters.[32]

Early in the twentieth century the first electronic instruments including the electronic harmonium and the theremin were invented, and by the 1950s electroacoustic music had developed two separate aesthetics – *Musique concrète* and *elektronische Musik*. *Musique concrète* deals with the creation of music using pre-recorded sounds, and *elektronische Musik* is concerned with the construction of sounds using electronic devices. The two aesthetics differ mainly due to the type of electronic equipment used; tape recorders for *Musique concrète* and spectral analysers and signal generators for *elektronische Musik*.[33] The fusion of *Musique concrète* and *elektronische Musik* was an important step in the evolution of electroacoustic music.

a part of the history of electroacoustic music can be seen as a quest to mix the two points of view: the precise numeric control of *elektronische Musik* and the diversity of timbre, the richness of sound from acoustic recordings used in *Musique concrète*.[34]

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[32] Viviana Moscovich, "French Spectral Music: An Introduction", *Tempo,* 200 (1997): 21.
[33] Gaël Tissot, "The First Electroacoustic Pieces by Karlheinz Stockhausen: Technologies and Aesthetics", *Organised Sound,* 13 (2008): 167.
[34] Tissot, 168.

This quest to mix the two points of view is further complicated with the addition of live instruments. The scope for sound creation and distortion is huge for composers, and performers are presented with lots of exciting new repertoire.

> I always say with the electronics and especially in combination with live instruments you can use the best of both worlds... we need a live element in electronic music.[35]

Composer Roderik De Man suggests that the need for a live element in electroacoustic music is due to boredom on the part of the audience.[36] During concerts where there is no visible live performer, but instead some sort of stage setup – he gives the example of a pot of flowers in the middle of the stage – the audience doesn't know where to look and what to focus on. The resulting audience reactions to the music are often somewhat mediocre. When instruments are added to the electroacoustic setting, however, new sonorities become possible and the scope of material with which to grasp the listener's attention is greatly increased.

When combining electronic devices with acoustic instruments the electronic component can potentially function in two ways at any given time: to extend the live instrument, and/or as an instrument in its own right. Of course the ability of electronic devices to pre-record material means that both functions can be operative simultaneously.

Current employment of live instruments swaps between the influences of the instrumental domain and the electronic domain. The musical content is sometimes melodic in nature with finite pitches and duration, and at other times material is more influenced by an electroacoustic aesthetic featuring indeterminate pitch, durations modified with the aid of

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[35] Francesca Clements, "Interview with Roderik De Man" (2013). http://www.visisonor.org/VisisonorORG/Articles_RoderikdeMan2013_FClements.htm. Accessed 28/05/2013.
[36] Clements (2013).

microphones and reverberation, the looping of sounds, multiphonics, and other special techniques.

Electroacoustic music has more recently been described as a "problem genre" for various reasons, most of them involving difficulties in achieving an effective combination of acoustic and electronic components.[37] Live and electronic elements should complement each other in the same way as members of a chamber ensemble. If they sound as if they do not belong together, if they are too different in timbre, rhythm or energy then integration has not been successful.

Various techniques are discussed by different composers and authors for the integration of the seemingly obscure relationship between electronic and acoustic sounds, in relation to the compositional process. Pennycook talks about performance issues in software-based real-time music, fixed media, fixed media fragments, and using fragments of pre-recorded material with a MIDI-LIVE system. The relationship between technology and instrumentalist is discussed, as well as relationships between technology and style or form of the music.

Examples are given from a harpsichord piece with MIDI-LIVE system to illustrate Pennycook's methods of integration of instrumentalist and MIDI system,

> Such as unison and parallel 'colorising' [sic] of the harpsichord notes with MIDI-generated sounds, performer-initiated file playback, MIDI data recording, and playback with a variety of modifications such as harmonisation, transposition and time delay. It also supported sustain and volume pedals, which provided the performer with a new dimension for her instrument.[38]

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[37] Simon Emmerson:"The Electroacoustic Harpsichord", *Contemporary Music Review,* 20 (2001): 36.
[38] Bruce Pennycook, "Who Will Turn the Knobs When I Die?" *Organised Sound,* 13 (2008): 201.

Pennycook also talks about a piece written for clarinet in which there are electronic devices attached to the instrument, and comments that it is useful for the performer if unfamiliar actions are minimised.[39]

Emmerson discusses four methods for the live electronic process of progressive removal of recognisable instrumental sounds, which he says can act to bond textures and create "subtly distorted perspectives".[40] They are 1) Foregrounding; 2) Rebalancing; 3) Estrangement; and 4) Homogenisation. Emmerson feels that "it is through close composer/performer working relations that... superficial approaches may be avoided."[41] He is referring here to something he calls "historical tourism" – when a composer uses historical instruments but does not connect with a performer in the process of composition.

Kimura discusses interactive systems which respond to the performer and adjust accordingly[42], and MAX/MSP patches with conditional specifications such as this one: "trigger the electronic part when the violin plays A, but only after it plays C."[43] Kimura discusses problems with performing with interactive systems in her article.[44]

Without the use of interactive systems in which the electronics respond to the performer, the performer is the only component which can adjust and interpret the music live. This means the execution of the performance is very important to effectively combine live and electronic elements.

One consideration unique to electroacoustic music is the projection of musical materials, both pre-recorded and live sounds, into a space. This aspect could "make or break a musical structure... It is a question of adapting gesture and texture so that multi-level focus is

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[39] Pennycook, 201.
[40] Emmerson, 43.
[41] Emmerson, 56.
[42] Mari Kimura, "Performance Practice in Computer Music", *Computer Music Journal,* 19 (1995): 72.
[43] Kimura, *Performance Practice in Computer Music*, 74.
[44] Kimura, *Performance Practice in Computer Music*, 74.

possible for as many listeners as possible."[45] This is the art of sound diffusion, and is considered from a compositional perspective when works are to be performed live in a venue. Roderik De Man discusses spatial awareness and moving sounds from one place to another with the use of carefully placed speaker systems; he compares this task to projecting light.[46]

> Music is transferred via loudspeakers into a new acoustic space – the listening environment. Neither the electroacoustic means of transferral nor the final space is neutral: both affect musical substance and structure.[47]

Due to the lack of variety of performance spaces used in performances for this research, the art of sound diffusion is somewhat neglected in discussions in this resource. More about spatial trajectory and sound diffusion in indoor and outdoor spaces can be found in the books and articles of Australian composer/recorder player Dr. Ros Bandt.[48]

The following sections (audience perception, gesture and texture) are intended to give the reader an understanding of some things which composers of electroacoustic music consider when constructing pieces; these sections will also offer useful knowledge for performers.

Audience Perception

Audience perception and appreciation of music is an important consideration for performers. Much of the preparation and interpretation of works focuses on the performer's clear expression of ideas to aid the listener's comprehension of the music. This is especially

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[45] Smalley, 92.
[46] Clements, *Interview with Roderik de Man* (2013).
[47] Smalley, 92.
[48] Bandt has written many articles, books, and sections in books. One such example which discusses spatial trajectory and sound diffusion is found in the following book chapter: Bandt, Ros, "Spatial Counterpoint", in Nadine Thierault-Copeland (ed.), *New Adventures in Sound Art*, Canada, 2003, pp. 2-15.

important in electroacoustic music due to the apparent estrangement between electronic and acoustic sources of sound. The range of sound sources available to the electroacoustic composer, and the scope of spectro-morphological influence "demonstrate an unprecedented broadening of our conception of the nature of music, demanding of the composer a much deeper and broader understanding of the role of sound in human life."[49]

Perception is active at many levels of awareness for the listener. All sounds possess abstract and concrete aspects when it comes to perception.[50] When interpreting music the listener will make connections with large and small scale structures, with any tonal references they may hear, and tonal relationships are even recognised subconsciously. The human ear will also connect with the music through associations made based on life experiences and knowledge of different human activities including the playing of musical instruments.

A perceived connection with human activity can be at the centre of perception for the listener, and can therefore be a very useful tool to ensure comprehension and enjoyment of the music. Smalley says that in order to please listeners and be accepted and recognised by audiences, computer music mimics the imperfection of human existence.[51]

There is a connection to the instrumental world, and therefore the human world, through gesture.[52] Smalley talks about the "Idea of gesture as an almost tangible link with human activity."[53] So it follows that the expression of gestural figures and their relationships to one another can be the key to creating and performing a work which will be understood and appreciated.

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[49] Smalley, 80.
[50] Smalley, 64.
[51] Smalley, 70.
[52] Smalley, 62.
[53] Smalley, 82.

Smalley also states that "listeners and structures thrive on ambiguity."[54] The live instrumentalist should be aware that this genre requires a huge amount of variety in expression of musical ideas, which are less random than they may initially appear. Smalley refers to context as a framework for perception; "Context changes the level at which the ear can respond to the musical structure."[55] The perception of context, like structure, applies at many levels.

Even "pitch is a perceived property;"[56] the pitch of a sine tone is determined by its frequency and intensity,[57] so if very high pitches are used the ear will hear these sounds as being louder than lower pitches. The smallest audibly discernible change in pitch perceptible by the human ear is less for higher pitches and/or intensities, and is lower for lower frequencies and softer sounds.[58]

Gesture & Texture

When performing electroacoustic music it is important for performers to consider what they are playing in relation to the role of gesture and texture in the music. Within electroacoustic music, structures are referred to as being either gesture-carried or texture-carried "depending on which is the more dominant partner."[59] This is an assessment based on the relative speed of, or level of movement within a given sound over time. According to Smalley's scheme a gesture is anything involving relative movement or action, and texture is anything which continues behaving, or anything which is accelerated sufficiently to create an inward focus for the ear. All things are considered in relation to what surrounds them, as the concepts of gesture and texture are merely different degrees of the same thing. The key factor

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[54] Smalley, 86.
[55] Smalley, 67.
[56] Johan Sundberg, *The Science of Musical Sounds* (San Diego: Academic Press, 1991), 44.
[57] Sundberg, 45.
[58] For more information on the perception of pitch see Sundberg's *The Science of Musical Sounds*.
[59] Smalley, 83.

which creates the illusion of separation between gesture and texture is the focus of the listener, which again is also determined through context.

Gesture and texture are inherently related; gesture stretched in time becomes texture and texture when accelerated becomes gesture. The inclination of the focus to shift becomes the defining point for attention; textural variations are controlled through intricate manipulation of internal structures, while gestural interpretation arises when the ear zooms out its focus, putting the contours of gestures in the foreground of hearing.

Gesture is associated with action away from or towards something. It is connected with growth and progress, the "application of energy and its consequences."[60] Smalley's description of gesture here includes many different states at which a sound can be initiated, directed, and withdrawn or decayed. This means that almost any decisive movement with even a slight suggestion of action or the aftermath of an action, is considered to be some form of gesture. The broad application of the term is useful because Smalley has described not how the gesture will look or what it will do, but what it represents.

Texture on the other hand is concerned with internal patterning behaviour and is associated with contemplation.[61] In a textural setting "energy [is] directed inwards or reinjected, self propagating... instead of being provoked to act [the texture] merely continues behaving."[62] Under Smalley's definitions of gesture and texture, almost any work in the electroacoustic genre can be thought of as having gestural and textural aspects.

Often music which includes live instruments features a combination of the two settings, often functioning simultaneously. This is partly due to the breath, tongue and finger movement limitations of the live performer; physical restriction means that most instrumental

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[60] Smalley, 82.
[61] Smalley, 82.
[62] Smalley, 82.

sounds are essentially gestural in nature. This can be thought of as a positive aspect due to the tangible link with human activity present with gesture, and also with the presence of a live performer. At times the recorder blends with electronically created textures, but this usually requires the addition of live electronic effects on the recorder's sound.

When the performer is aware of their role within the texture, or their function in the expression of gesture, this knowledge can be used to guide the performer to effectively convey this meaning to the audience. A closer study of some repertoire provides examples of above mentioned techniques and concepts in context.

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The electroacoustic genre is one of endless possibilities for an instrumental performer. This is both exciting and daunting, as the music with live electronic effects is unapproachable without technological experience. The performance goal for this research was to explore different settings of electroacoustic music with recorders, and to reach the level of understanding and performance practice required to play works with live electronic effects.

From a technical perspective, the employment of electronics had to begin simple and increase in complication throughout the project. As this is a useful format for the performer, the following discussion is presented as a progression of repertoire ordered from least to most complicated use of electronics. Many works were considered; the following were selected because of their interesting and varied treatment of recorders, the instrumentalist-electronic relationship, and their different electronic requirements. Performance notes, explanations of electronic equipment, and some problems encountered are referred to in relation to each work.

Chapter 3: Amplification

Seascape ~ Fausto Romitelli

Amplified Contrabass Paetzold[63]
(1994)

Electronics

Amplification seems like such a simple addition to an acoustic instrument but it brings with it the potential for subtle nuances and intimate sounds which usually wouldn't reach audiences. These effects include pitched finger tapping, breathy tones, variations of white noise and whistles, and vocal sounds. Paetzold recorders open up a particularly large range of possibilities with their breathy tones, different kinds of white noise, and clicking and tapping sounds made by the keys. These uniquely designed recorders also have many more upper harmonics than their baroque equivalents.

For the purposes of this research Shure SM57 microphones have been used; they have a very clean sound and are designed for instruments so have a high tolerance for loud noises, distortion, and all sorts of effects, as well as high sensitivity to soft sounds. They are also affordable, making them an ideal investment for use in performance and practice. Any other directional microphone can be used, as long as it is intended for instruments.

For practice purposes it is useful to buy a small amplifier, as this permits practice with live electronics away from the venue. When using microphones in the performance of *Seascape* it is suggested that the performer use two: one positioned at the fipple opening of the Paetzold and one lower down to pick up the sound of keys clacking when required for effect. It is best to point the second microphone in the middle of the left and right hand positions so the keys are more or less amplified equally.

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[63] A recorder designed by Herbert Paetzold in the twentieth century. This instrument will be explained further below.

John Martin found that "the sound pressure levels for the fundamental and harmonics depend strongly on microphone position."[64] For this reason it is important to position the fipple microphone above the hole and point it downwards towards the hole, not on a right angle towards the hole. This is because of the angle of the airstream in relation to the most sensitive range of the microphone. Due to the large range of harmonics and breathy sounds present in this work, and whenever amplifying a Paetzold recorder, microphone positioning is especially important. It is also important to consider performer visibility from the perspective of the audience, keeping in mind the large head joint of the Paetzold and microphone set up.

Recorders

Herbert Paetzold was inspired by the design of square organ pipes earlier in the 20th century and began to make recorders in this style.[65] Part of the motivation for the design was to create larger sizes such as great basses, contra basses and sub-contra basses which were more affordable for purchase by a wider audience. Because of the square design Paetzold was able to use plywood to build the recorders, and this made them very affordable compared to their Baroque alternatives.

An unexpected by-product of this unusual construction was a rich palate of breathy tones, percussive sounds, white noises, and a huge range of multiphonics which are far easier to play with lower breath pressures than on Baroque recorders. Considering the potential of Paetzold recorders to create a wide range of subtle nuances it is not surprising these instruments have become a popular addition to the electroacoustic genre.

A general rule which applies to all types of recorders is that the palate of available multiphonics grows richer along with the increasing size of the recorder. If a composer

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[64] Martin, 16.
[65] http://www.blockfloetenbau-paetzold.de

wishes to exploit a large range of multiphonics they are advised to write for recorders of the tenor, basset and/or larger sizes; when an especially expressive range of multiphonics and overtones is desired, Paetzold recorders are ideal. This is because multiphonics can be played at very low breath pressures, and a wider range of harmonics is available due to differences is design and the fact that they are made in larger sizes (the smallest commonly owned Paetzold is basset size).

The ability to play at lower breath pressures means that softer sections of music can be written to create some very different effects than when multiphonics are employed on smaller Baroque recorders. The sound on these bigger Paetzold recorders is very mellow and, not surprisingly when considering the inspiration for their design, more like an organ. Multiphonics on smaller recorders are often harsh sounding and dissonant, whereas on lower recorders (especially Paetzolds), multiphonics can create more gentle and expressive tones despite their inherent dissonance.

Another technique used in the past 30-40 years in contemporary compositions and utilised in *Seascape* is singing through the recorder. This is used to change the timbre of a note, or to create counterpoint or harmony between recorder and voice part. Singing changes the harmonic makeup of the sound by adding an extra set of overtones to the sound, specific to the vowel shape and pitch sung. This means the recorder player can control the timbre of the note produced by singing and playing with the shape of their vocal tract, mouth and tongue.

Figure 5 shows the strength of first and second formant frequencies for different vowel shapes in the vocal tract; each of these different vowel sounds brings with it a complete set of overtones when sung. There is an obvious extension of harmonic complexity gained by adding a voice to the recorder sound, and with the aid of vocal tract shaping the

performer can manipulate both the tone of their recorder and the tone of their sung voice. An "ee" (HEED below) sound will produce a sweeter, softer tone than a syllable with a heavier effect on the sound such as "o" (HOD).
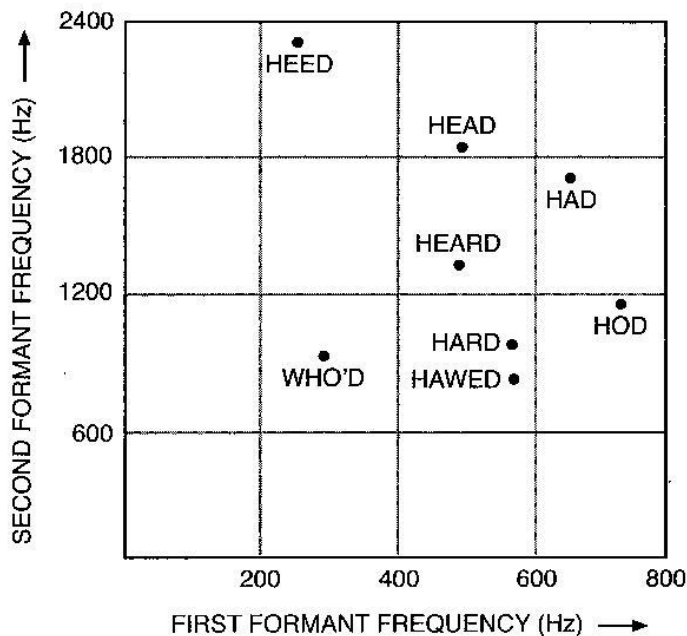
Figure 5 Strength of 1st and 2nd formant frequencies for different vowel shapes in the vocal tract.[66]

Formant frequencies in a sung tone are the overtone frequencies at which there is a peak in strength and therefore volume. Changes in these formant frequencies produce a noticeable change in the timbre of the voice. The extra overtones present when singing through the instrument add extreme complexity to the recorder sound compared with the potential purity of tone achievable on a recorder when played without special effects.

During the second international blockflute and electronics festival, held in 1999, Walter van Hauwe agreed with Donald Bousted that "the treatment of... recorder sounds has been unadventurous"[67] in electroacoustic compositions with recorders. *Seascape* is a piece which was perhaps not considered in this equation due to the limitations of the 'electronics' (only amplification is required). The treatment of the Paetzold in this composition is very

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[66] Reproduced from Barry Parker, *Good Vibrations: The Physics of Music* (Johns Hopkins University Press, 2010), 201.

[67] Donald Bousted, "Walter Van Hauwe [Interview]", *The Recorder Magazine,* 19 (1999): 16.

creative, and it is possible van Hauwe was talking more specifically of recorder types other than the Paetzold, as he later comments that on a Paetzold "melody is very hard to play... I almost see it as a percussion instrument."[68]

The Paetzold has been separated by some authors from the characteristic sound of recorders; Pete Rose comments in relation to Brazilian recorder player Cesar Villavicencio's CD exploration of the electronic Paetzold that he does not "believe that any musician [he] knows would be able to listen to this CD without any prior explanation and deduce that this is some kind of recorder music."[69]

The Prime ensemble is an international group of recorder players particularly interested in exploring the many sounds of Paetzold recorders in the electroacoustic genre both in ensemble and solo situations. "Virtual, artificial, and imagined resonant spaces are applied electronically as an extension of the instruments' bodies"[70] in *Just Like Starting Over* by Aaron Einbond. Works are created based on conceptual structure, and both recorders and electronics follow the image from the composer's mind. Spatial displacement of instruments is employed in such a way as to create echoes, movements, and reflections of sound. Composers also explore concepts of distance and imagined space with the use of a white noise "curtain" which can be altered according to desired effect.[71] The Prime ensemble recently released a recording of works for large recorder ensemble which features many electroacoustic works: *Spray*.[72]

Performance notes

Listener perception is all about the listener's identification of material and the organisation of that material into something comprehendible. "Listeners can only apprehend

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[68] Bousted, 17.
[69] Pete Rose, "On the Cutting Edge: Altered Sounds and Midified Music", *American Recorder,* 43 (2002): 32.
[70] http://www.primerecorderensemble.com/Composers.html. Accessed 1/4/2014.
[71] http://www.primerecorderensemble.com/Composers.html. Accessed 16/4/2013.
[72] http://www.primerecorderensemble.com/Media.html. Accessed 18/6/2013.

music if they discover a perceptual affinity with its materials and structure."[73] Awareness of this can help to create a theatrical and engaging performance, which can be especially difficult when it is just the performer and microphones to amplify every sound made on stage.

The title *Seascape* implies the programmatic nature of the piece, and the clever writing of breathing into the work aids the creation of an imaginary seascape, as it mimics the sound of waves and water whooshing around. The excerpt below shows the "INspirare" (inhalation) and "ESpirare" (exhalation) of the performer, as a notated effect in the work. This aspect of *Seascape* is challenging, as the performer must work their breathing into the piece in a more obvious and audible way than usual (the inhalations are drawn through the instrument, not separate from it). The result is a naturally rhythmic and meditative work, for both performer and listener.

Example 3.1: *Seascape* by Romitelli; page 1, systems 1-3[74]

An intimate connection exists between performer and instrument throughout the work, and a very human connection to the music is present for the audience. This aspect of breathing is reflective of the motion of waves and living things, and its importance in the

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[73] Smalley, 62.
[74] Fausto Romitelli, *Seascape* (Ricordi Milano: Italy, 1994).

execution of the work should not be underestimated. Note that a bass clef is not present throughout the score, only the clef in brackets in example 3.1 is notated in the score. It is assumed that the bass clef is in use for the entire work.

Sounds which imitate boats are created with special effects of singing through the large recorder while playing sustained low tones (like a foghorn). The performer's awareness of the ability of these effects to create a link between the music and the audience's own human experience can guide preparation of a work; emphasis on certain sounds and on the continuity between gestures in performance is paramount.

Example 3.2: *Seascape* by Romitelli; page 2, system 6

Seascape is an excellent piece to study if the performer has not had much experience with the contrabass Paetzold. It has very creative special effects including singing through the recorder, multiphonics, a variety of breathy tones and different articulations, and percussive effects. In the excerpt below, the inhalation is articulated as a series of trills which results in a rising pitch change during the breath, increasing tension.

Example 3.3: *Seascape* **by Romitelli; page 2, system 9**

The simplicity of the electronics in *Seascape* makes it the easiest work to prepare in this respect. From a performance perspective the work is suitably challenging, and can be a very effective and engaging piece to witness. There is a strong theatrical element to this work as the performer is totally exposed in a solo setting while amplified. The magnification of every utterance of sound including the performer's breathing brings a very personal element to the performance.

Chapter 4: Fixed Media

Click & Pitch ~ **Toek Numan**
Amplified Baroque Alto and Fixed Media
(2001)

Fixed Media

Author Bruce Pennycook consistently returns to fixed media as the most performable electroacoustic music.[75] Combining fixed media with a live acoustic performer provides the simplest electronic set-up after amplification, and a context in which the most reliable reproduction of the work can be achieved without the assistance of the composer. Works with fixed media accompaniment to the live performer are also convenient to prepare, as no other people are needed for rehearsal and the performer needs minimal knowledge of electronic devices to give a good performance.

Although fixed media accompaniment is one of the least complicated electronic set-ups, there are some restrictions from the performer's perspective. The fixed media, usually in the form of a pre-recorded tape or CD, acts as an accompaniment or duo partner to the live performance; a huge part of the challenge for the instrumental performer is to create the illusion of interaction despite the passive nature of the pre-recorded material.

The performer in this context has less flexibility to adjust the music to accommodate personal interpretation, as the part performed live must remain in sync with the fixed electronic component. The live performer must therefore not only prepare the music in the usual way during practice, but must spend a large portion of time playing with the tape accompaniment to stay with the recording in order to create an illusion for the audience of two parts interacting with each other.

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[75] Pennycook, 203.

Many composers exploring the world of electroacoustic music have repeatedly returned to the fixed media genre because of its reliable reproduction in performance, and its independence from the original source or performer for whom it was written. The convenience of having a CD accompaniment means any performer who has access to the recording and score can produce their own version without aid. This factor makes it the most convenient and therefore most widely performed electroacoustic media with live instrumentalist.

Electronics

Two microphones are needed for *Click & Pitch*, one for the fipple and one to be placed between left and right hands on the recorder (preferably). If this is not practical due to movement, a microphone can be placed lower down which the performer will have to lean into for the pitched finger tapping (shown in example 4.1). Regardless of positioning keep in mind the blocking of the bottom hole, and how you will move in front of the microphone for the knee note pitched tapping. If the performer has access to a clip-on microphone this is ideal, as it can be attached to the mouthpiece and will allow for movement on stage.

Example 4.1: *Click & Pitch* by Numan; page 2[76]

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[76] Toek Numan, *Click & Pitch* (Unpublished, 2001).

Projection of the audio file into a space is also a concern in performance. A pre-installed speaker system may be available for use in the venue, in which case microphones must be positioned to avoid feedback. Because microphones are placed behind the speakers in the room, the volume from the performer's perspective and from the audience's perspective are going to be quite different; the audio track cannot be too loud for the audience, but must be audible enough for the performer to hear.

If available, a portable speaker system can be placed behind the performer on stage. This is a dynamic option as the electronic accompaniment sound is in close proximity to the live instrumental sound, furthering the illusion of interaction. Another advantage could be the louder volume of the audio track for the performer, although this could be seen as a disadvantage if the accompanying track is too loud and the performer needs to wear earplugs; also if the accompaniment sounding from the speaker is too loud the microphone will once again cause feedback.

For practice purposes a small amplifier can be used to project the sound of the live instrument and a normal stereo can play the audio track, but this option is not ideal for live performances as the sound quality will be inferior.

Recorders

Baroque recorders have minor differences between model types and makers, but their overall dimensions are similar enough for the purposes of this discussion. Baroque-type recorders have a tapering conical bore, as opposed to early models such as recorders modelled after Haka[77] and Ganassi[78] which have an outward flaring bore. The difference in

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[77] http://www.flute-a-bec.com/prebargb.html
[78] http://www.monikamusch.de/ganassi.htm (this site is in German, so will need to be translated. There is an excellent section with information on early recorders including those modelled after Ganassi).

bore shaping creates more consistent tuning over the range of the instrument while also refining the tone, making lighter and more varied articulations possible.

A general rule of recorder design is that an expansion at the end sharpens the notes on an instrument, while a contraction at an end flattens all notes.[79] From this we can gather that the effect of the tapering bore on the Baroque-type recorders is the flattening of the lower modes.[80] Changes to the recorder late in the 17th century also include the narrowing of the windway; the smaller space for the airstream provides more resistance to the air.[81] This allows for a lower airflow rate and therefore longer phrases.[82]

Performance notes

Certain performance practices are new to recorder players when performing in this genre, as they are only possible with the added benefits of amplification. Toek Numan provides a good example of this in his piece *Click & Pitch*[83]; it cannot be performed without the aid of at least one microphone, preferably two, as clicking and pitched tapping on the holes would not be heard without them. Another technique magnified to audible recognition by microphones is the use of breathy tonguings, which appear in *Click & Pitch* also. Example 4.2 shows a breathy sounding articulation (tktktkt) for notes at the bottom of the alto recorder range, which produces a subtle airy tone.

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[79] Martin, 50-51.
[80] Martin, 49.
[81] Eve O'Kelly, *The Recorder Today* (Cambridge: Cambridge University Press, 1990), 30.
[82] Martin, 22.
[83] Susanna Borsch, "Off Limits" (Karnatic Lab Record Label, 2006), Track 3.

Example 4.2: *Click & Pitch* **by Numan; page 5**

"Transposing studio techniques to the orchestra corresponds to a synthesis."[84] This means that at any given moment a composer can integrate recorder and electronic parts simply by treating them in the same way compositionally. During *Click & Pitch* the connection between recorder and electronic sounds is in the generally busy nature of sounds, as well as the similarity in timbre between pitched finger tapping and clicking sounds which appear in the electronic accompaniment.

Example 4.3: *Click & Pitch* **by Numan; page 1**

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[84] Moskovich, 23.

During this opening section (example 4.3) the recorder part features gestural figures which are often combined with physical gestures required to achieve the fingerings.

Despite the similarity in tone of the pitched clicking in both instrumental and electronic parts, the very gestural nature of the instrumental part is somewhat different to the electronic part, as the consistent popping noises in the accompaniment act more like a texture. Popping sounds increase in frequency and gradually the texture becomes denser; pitched clicking and beeping is gradually introduced into the fixed media, and the recorder soon follows with gradually increasing pitched tones (example 4.4). Again the accompaniment is more like a texture and the live recorder part is highly gestural with an increasing intensity in the figures.

gradually start adding pitch

Example 4.4: *Click & Pitch* by Numan; page 3

Click & Pitch features sections of music which can be arranged as the performer wishes in a sort of improvisation using specific elements (example 4.5). This gives the performer more expressive control over the piece and leaves space for personal interpretation.

Example 4.5: *Click & Pitch* **by Numan; page 2 - improvisation box**

Approximate times are given for the beginning of each new improvisation box, and for other sections afterwards, so the performer knows when to begin a new section of the piece. These check points are very useful for the preparation of the work, and some may choose to use a visual timer for performances as well. With sufficient practice the use of a timer on stage can be avoided; this can strengthen the illusionary relationship with the fixed media, but this is a personal choice unique to each performer.

Page four contains the instruction "Very playful, like a mouse (?)".[85] This rapid and extremely gestural section has many tonal references despite its apparently random nature. The opening gives an impression of A minor. This begins to fade as more accidentals are added, but other tonal relationships remain; the use of semitones creates direction and movement while giving the listener an interval which implies direction and which they are familiar with.

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[85] Toek Numan, *Click & Pitch* (2001). For more details see http://www.blokfluit.org/no_cache/modern/search-by-name/simple-search/detail/title/3747/full/

Example 4.6: *Click & Pitch* **by Numan; page 4, systems 1-3**

Numan's work seems to be unified with the use of certain pitches, which are treated in different ways rhythmically and melodically throughout the piece. These pitches are heard in full, loudly and clearly in the fifth system of page 4:

Example 4.7: *Click & Pitch* **by Numan; page 4, system 5**

By the middle of the piece the listener will have already begun to identify these as recurring pitches. They are then repeated in different orders and ways, rearranged rhythmically and melodically, and eventually stated loudly once more. Tones from the stated melody are present, sometimes in enharmonic form (D# instead of Eb, G# instead of Ab, etc.).
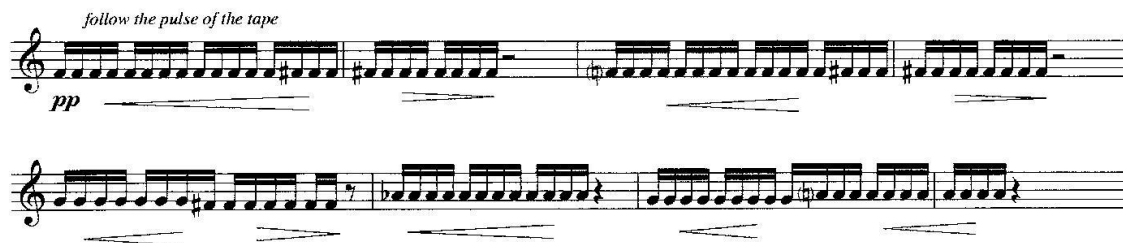
Example 4.8a: *Click & Pitch* **by Numan; page 4, systems 7-8**

Example 4.8b: *Click & Pitch* **by Numan; page 5, systems 4-5**

Example 4.8c: *Click & Pitch* **by Numan; page 6, systems 1-2**

There is a binding of acoustic and electronic parts on a level of general tension created through the treatment of sound materials of each part. This commonality in the treatment of melodic material can be used to connect electronic elements to live recorder

parts. From what we know about the human ear's perception of sound we can assert that changes in lower frequencies or intensities are less discernible to the ear.[86] This means that when recorder parts move quickly and electronic parts move quickly, and they are both placed at similarly low pitches, the sounds are more easily assimilated. Example 4.9 shows a context in which the recorder player must assimilate with the pulse of the fixed media accompaniment, and since the pitch is similar in both parts, integration is more easily achievable.

Example 4.9: *Click & Pitch* **by Numan; page 3**

Gestural figures occur throughout the recorder part of *Click & Pitch*, and the texture is generally quite transparent. The work features a very simple fixed media part with no recorder sounds other than the tapping sounds at the beginning, which are sounds made by another alto recorder.

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[86] Moskovich, 49-50.

At other times, pitched electronic sounds meander in a rhythmic pulse below the gestures in the recorder part. The recorder alternates between playing lower pitches which are in time with the pulse of the electronic sound, and playing explosive expressions of gestures and gestural melodies (example 4.10).

Example 4.10: *Click & Pitch* **by Numan; page 5, systems 2-3**

Brat ~ **Donnacha Dennehy (1970 -)**
Amplified Baroque Alto and Fixed Media
(2000/2005)

Electronics

Only one microphone is required for amplification of the alto recorder used in *Brat*. It should be placed in the middle of the any music stands used, or an attachable microphone can be used.

Some performers use click tracks (a metronome-like beat which runs in perfect sync with the fixed media heard only by the performer through headphones) or visual counters to stay in time with the CD during performance. These options can be a distraction though, so the adequate preparation of the work will ideally include the learning of cues aurally as a good alternative to the use of click tracks in live performance. This is a personal decision to be made at the performer's discretion, but using a visual timer or click track for the rehearsal process can be very useful, keeping in mind that timer cues in the score may not always match the audio file you have (as is the case with the recording of *Brat* obtained for this research).

Luckily this particular work has a fully scored electronic part which includes rhythmically notated cues for electronic sounds (example 4.11) and fully scored parts when pre-recorded material includes recorders (example 4.12); this aids performer preparation greatly.

Example 4.11: *Brat* by Dennehey; bar 5[87]

Example 4.12: *Brat* by Dennehey; bars 58-60

A particularly good way of combining electronic and acoustic elements, creating textures not normally possible with only two parts, is the use of like instrumental sounds in the fixed media accompaniment. The advantage in this circumstance of having pre-recorded material is that layers of sound can create a huge scope of textural variety from one solo player to what sounds like an entire ensemble. This flexibility can be very appealing to a solo performer who wishes to create variety and interest in their program but does not necessarily wish to commit to the use of live electronic effects on their sound, which would require learning to use looping and other pedals during performance.

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[87] Donnacha Dennehy, *Brat* (Contemporary music Centre: Ireland, 2005).

Recorders

One model which has gained some popularity is the modern "Ehlert" recorder designed by Ralf Ehlert. Considered to be the true modern recorder by its maker, the Ehlert boasts features such as a wider bore, wider finger holes and a broader windway. This gives the Ehlert a very loud and open tone compared with its Baroque counterpart. The most exciting feature of this recorder for professional players is the addition of two keys in place of the bottom two holes; although these keys limit the ability to do glissandi on those notes, they give the player a bigger and more accessible range in the highest register. Due to the rapid speed of passages in the highest register of the recorder's range, the Ehlert is an excellent choice for instrument in a work where the only specification of recorder is "alto".

To sound notes in this high register recorder players are usually required to play knee-notes; the bottom hole of the instrument must be blocked to play certain notes, which can impose limits to the degree of technical difficulty in which high passages are written due to physical constraints. Ehlert recorders have minimised this difficulty with their unique design and are proving very useful in the context of modern music.

Performance notes

Born in Dublin, Dennehy is a well-noted composer and has received commissions from the BBC, WNYC (public radio NY), RTE, Amsterdam Funds Voor der Kunst, Arts Councils of both England and Ireland, and from numerous individual ensembles.[88] *Brat* is a cheeky and challenging work originally known as *Fat* and written in 2000 for flute and fixed media, but never performed.[89] This is an arrangement made in 2005 for recorder and fixed media.

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[88] Orozco, Keyla. *Mani Electrico*. (Keyla Orozco, 2003).
[89] Borsch, *Off Limits* (2006).

Combining fixed media with a live acoustic performer provides the simplest electronic set up, and a context in which the most reliable reproduction of the work can be achieved without the assistance of the composer. Works with a fixed electronic accompaniment are the most approachable for performers who are newcomers to electroacoustic works and are the most easily prepared in a physical sense, as no other people are needed for rehearsal. Most importantly, the performer needs minimal knowledge of electronics for performance.

Playing with a pre-recorded accompaniment has its disadvantages too, the most obvious of which is the inflexibility of the accompaniment and its lack of responsiveness to the live performer. This is especially restricting in *Brat*, where the performer is required to move their fingers and tongue faster than what would seem humanly possible in order to be part of the ensemble. The opening passage (example 4.13) is to be played at crotchet equals 120, and speed is consistently increased throughout the piece.
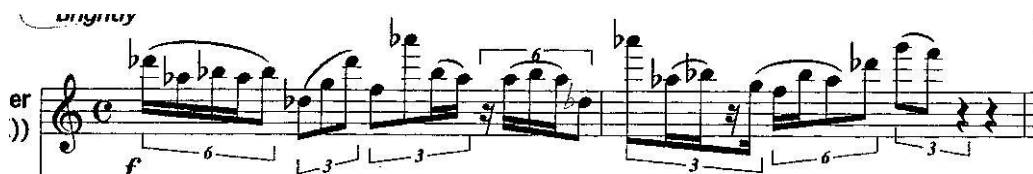
Example 4.13: *Brat* by Dennehey; bars 1-2

Many authors discuss the problem of integration of electronic and acoustic parts from a compositional perspective within this genre. This is a task not just for the composer, but for the performer too. When the performer is aware of their role within a gesture or texture carried section of a work, they can perform to maximise the effect desired. For example, in *Brat*, when the recorder player has melodic material over the top of a sustained morphing

spectrum of sound, this can be expressed more freely than when there are other recorders accompanying in a weaving texture which the performer must match in tone, articulation, and style in order to properly create the illusion of interaction and really integrate with the fixed media.

Example 4.14a: *Brat* by Dennehey; bars 18-20. Free melody over morphing timbre (gesture carried)

Example 4.14b: *Brat* by Dennehey; bars 130-132. Weaving textures with similar instruments (texture carried)

A challenge for the instrumental performer when playing with a fixed media accompaniment is to create the illusion of interaction despite the passive nature of the pre-recorded material. This can be considered from a number of angles. The performer can use techniques to assimilate with the accompanying electronic sounds, for example, in example 4.15 the recorder player must use relatively harsh articulations to mimic the edgy tone of the retro-tape sounds[90] in the accompaniment.

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[90] Borsch, *Off Limits* (2006), CD liner notes.

Example 4.15: *Brat* by Dennehey; bars 199-201

Other sound material used in the accompaniment includes electronically created timbres which morph, and alto and paetzold recorder sounds which have been recorded by professional performer Susanna Borsch.[91]

One compositional technique which has proved effective and can be applied in many different ways and in different contexts is the blurring of cause and effect of sounds from the audience's perspective. This idea holds the potential to engage the listener very well when used skilfully.

> When electronics are performed in real-time like instruments and combined with instruments... two worlds are brought together in a theatre of transformations. No-one listening knows exactly what is instrumental and what is electronic anymore.[92]

Many composers including Roderik De Man, an electroacoustic composer who often writes for recorders and electronics, deliberately try to blur the lines between cause and effect in electroacoustic music with live instruments, "so at some points you do not really know

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[91] The work was commissioned by and dedicated to Susanna Borsch. It appears on her album *Off Limits*.

[92] Jonathan Harvey, "The Metaphysics of Live Electronics" *Contemporary Music Review* 18, no. 3. OPA (Overseas Publishers Association, 1999: 80). From *Aesthetics of Live Electronic Music*. ed. by Marc Battier (Harwood Academic, 1999), 80.

who is doing what."[93] This is just one of the many ways to integrate acoustic and electronic components within a work.

> The problem with all these things (different things you can do with electronics and visuals) is how to integrate these electronic concepts into instrumental music. You hear many examples, it is ok and it is nice what they do, but it is not integrated and it remains someone playing here and someone doing the electronics there. It is really rare when all the elements come together.[94]

The blurring of cause and effect from the perspective of the listener is usually done in one of two ways. The first is when instrumental sounds of the same type and pitch as the live performer are included in the pre-recorded material. The perception of the cause and effect of sounds is always confused when the pre-recorded material includes samples of actual recorder sounds, especially when this pre-recorded material includes similar pitches, melodic movements, gestures, and tones also present in the acoustic part.

Material is sometimes blurred to such an extent that it becomes difficult to tell if the electronic material is created with looping and effects on the live sound, or if pre-recorded material has been introduced into the scope of sounds. Cause and effect can also be blurred when pre-recorded instrumental sounds are employed to mimic electronic effects. In example 4.16 the top line is played by the live player and the lower lines show the fixed media content.

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[93] Clements, *Interview with Roderik de Man*, (2013).
[94] Clements, *Interview with Roderik de Man*, (2013).

Example 4.16: *Brat* **by Dennehey; bars 153-155**

The above method of confusing cause and effect from the listener's perspective involves the layering of recorders with similar melodic material, almost in a canon (in fact a perfect canon at this point in the piece); this technique is very effectively utilised in *Brat*.

Another method of integration creates the auditory perception of an electronic delay on the live sound, partly due to the canonic nature of the material played by both recorders, and partly due to the extremely fast tempo and close entry points. Interestingly, an actual live electronic delay on the sound would be much easier to execute from the performer's perspective! Example 4.17 shows the entry of a recorder in the fixed media accompaniment (at figure "L"), and the resulting impression given to the audience is that the live player has triggered these sounds, when in fact the parts are not affected by one another at all. This creates an excellent illusion of interaction between live performer and fixed media.

Example 4.17: *Brat* **by Dennehey; bars 81-82**

Electronic components are considered to be instruments in their own right when they move independently from acoustic parts in some sort of counterpoint. Donnacha Dennehy's *Brat*[95] features an electronic component which functions in this way throughout most of the work. To begin with, the electronic material fits together in blocks of different ideas, a structural approach reminiscent of the old methods of cutting and sticking together of tapes used in early electroacoustic music with tape recorders.

Electronic sounds in *Brat* are generally treated like instrumental sounds, in that they revolve around the world of discreet values. Pre-recorded Paetzold recorder sounds are also used in an ensemble which plays in parallel to mimic the effect made by a harmonising pedal.

There are often very precisely timed moments incorporated into music for recorders and tape. This requires great skill of the live performer, as he or she must time entries perfectly to create the illusion of interaction. *Brat* features numerous entries of the live recorder and electronic parts which, when successfully executed, create a convincing connection between tape and recorder parts.

The recorder part in *Brat* reflects the inhuman nature of electronic devices as it moves at a seriously fast pace for the recorder player and requires stamina to reach the end of the piece at the same time as the tape part. The mere presence of a lyrical melody makes reference to familiar connections in the mind of the listener, as it reminds people of the world of instrumental music. The live recorder plays only pitched material in *Brat*; often the line is melodic in nature and includes many gestural figures.

The pre-recorded material by the end of the piece includes all sources previously used in the fixed media. This creates a culmination of ideas; we hear the rhythmic recorder

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[95] Borsch, *Off Limits*, (2006), Track 2.

ensemble, the retro-tape sounds in a pulsing rhythm, the morphing continuous electronic timbre, and live recorder sounds which seem to have assimilated with electronic tones. The recorder plays a passage of short, fast double tonguing which follows the sentiment of the tape sounds featured throughout the work, and the effect of the layering provides an intensity of texture and a dramatic finish to the work.

Brat can be seen to represent a struggle between electronic and instrumental worlds; these two worlds seem distant from one another in the beginning, but all aspects of the pre-recorded material and of the live instrumental part have been integrated by the end.

Chapter 5: Fixed Media, with a Difference...

Bird's Paradise ~ Cheil Meijering   (1954 -)

Soprano, Alto, and Tenor Recorders (2 players) with Fixed Media (2005/2008)

Bird's Paradise was commissioned by Miako Klein, a recorder player who is German born and of Japanese descent; elements of her cultural background are integrated into this electro-popular influenced work, including a Japanese song from her childhood.[96] Composer Cheil Meijering describes Miako as a "peculiar bird, beside the highway of life, picking her own grains of life."[97] Meijering's impression of Miako playing the recorder together with his interest in her, provide inspiration for this unusual work.

Electronics

Microphones are required to amplify the sound of each recorder player, and the fixed media accompaniment can be projected into the space in the same way as discussed from page 30.

Recorders

Both players will need soprano, alto and tenor recorders. Performers are often not allowed much time to swap instruments, therefore it is useful to place recorders on a table or other elevated surface where they are easily accessible.

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[96] Cheil Meijering, *Bird's Paradise*. (Edition Tre Fontane (Ronald Brox), Münster/Germany, 2008), liner notes.
[97] Meijering, *Bird's Paradise* (2008).

Performance notes

Meijering has created a work which sounds quite different from many electroacoustic works with recorders. For this reason *Bird's Paradise* is an excellent addition to an electroacoustic concert program. The strong pop influence can be heard in the use of drum sounds, electric guitar, sampled vocal sounds, lyrical melodies, funky tunes, and synthesised chordal accompaniments.

Part 1

The two recorders alternate between playing gestural flourishes and slower, more lyrical passages.

Example 5.1a: *Bird's Paradise* by Meijering;[98] part 1, bars 6-8: gestural flourishes

Example 5.1b: *Bird's Paradise* by Meijering; part 1, bars 15-21: lyrical melody

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[98] Chiel Meijering, *Bird's Paradise* (Edition Tre Fontane [Ronald Brox]: Münster/Germany, 2008).

Due to the amount of unison in this work, accurate tuning between the two recorder parts is very important. And the presence of a constant pulse in the first movement is helpful for the performer, as their place in the music is clearly recognisable, therefore no click track or visual timer is needed.

Fast articulated passages evoke reference to the composer's impression of recorder player Miako Klein, for whom the piece was written, as a bird picking along the highway of life. Examples 5.2a and 5.2b show the "bird's picking" effect, created by the extremely fast speed of the figures, in which each note should be articulated.

Example 5.2a: _Bird's Paradise_ by Meijering; part 1, bars 28-29

Example 5.2b: _Bird's Paradise_ by Meijering; part 1, bar 51

Tenor and soprano recorders play in octaves along with the Japanese melody sung in the fixed media accompaniment. To blend with the voice the live performers can use vocal

tract and mouth shape to mimic the sung syllables, while also using consonants as a guide for articulation of the beginning and end of each note. The words are written underneath both recorder parts for the performer's convenience (example 5.3).

Example 5.3: *Bird's Paradise* by Meijering; part 1, bars

Part 2

Wear wings on your shoulders like if you are birds and high-heeled boots with spurs. Recorders amplified, if necessary.[99]

The material for the pre-recorded accompaniment in part 2 includes a string orchestra and a piano. For this reason the movement gives the impression of an acoustic work for instrumental ensemble, in which most of the parts have been pre-recorded. There are some electronically created sounds heard along with instrumental sounds in the fixed media accompaniment, but these are blended well with the instrumental sounds and the piano remains a focus for the ear throughout the movement.

Timbre is a feature of the second part of *Bird's Paradise*. The composer frequently combines piano with tenor and alto recorders in unison and in octaves, and when in unison

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[99] Meijering, *Bird's Paradise* (2008), liner notes.

the recorders have often have different articulations (one slurred and the other staccato) and/or slight differences in rhythm. This creates an interesting effect, almost as if the recorders exist to enhance one another rather than to work independently.

Example 5.4: *Bird's Paradise* **by Meijering; part 2, bars 10-12**

Example 5.4 shows the different articulations and an emphasis placed on the G on beat 1 of bar 11; the first recorder player is heard to be playing the melody and the part underneath strengthens the melody in unison, except certain notes are held in the second recorder part, allowing this player to blend with the fixed media as well as the other live recorder. Slightly different rhythms and articulations are given to each live recorder in example 5.5, which again creates a dynamic effect on important beats and tones in the melody:

Example 5.5: *Bird's Paradise* **by Meijering; part 2, bars 22-24**

Another dimension is added to this effect with the use of two different sized recorders, the alto and tenor, both of which have slightly different acoustic properties due to the specific register of each instrument being exploited.

Example 5.6a: *Bird's Paradise* **by Meijering; part 2, bars 61-63**

Example 5.6a shows alto and tenor recorder parts in unison; the alto is playing in the middle of the alto range, and the tenor is at the top of its comfortable range. This means the tenor recorder will sound much louder and will have a more grainy tone than the alto, due to the faster and more forceful airstream required to play in that register on a tenor recorder. Example 5.6b shows another context where the recorders are reinforcing each other's sound in different registers.

Example 5.6b: *Bird's Paradise* **by Meijering; part 2, bars 44-48**

In example 5.7 the gestures in the recorder parts feed into each other, resulting in one long gesture thrown between the two players. The timing of this section is important, as no break should be heard in the (seemingly) continuous gesture.

Example 5.7: *Bird's Paradise* **by Meijering; part 2, bars 19-20**

The triplets played by the piano in the fixed media are the main point of reference for the timing of entries and rhythms in part 2. Because the accompaniment is very soft in this movement, however, timing can still be a problem; the performer may not always be able to hear a rhythmic element in the accompaniment over their live recorder sound, and it can be

tempting to follow your live partner on stage rather than both listen to the accompaniment for dictation of the tempo.

Of all three parts this is the least likely to be performed on its own due to the ambiguity of the ending (shown in example 5.8). It is a startling and abrupt finish after the comparatively tranquil resolution of the preceding section!

Example 5.8: *Bird's Paradise* **by Meijering; part 2, bars 66-71**

Part 3

The fixed media for the third and final part of *Bird's Paradise* features instruments such as brass, drum kits, and electric guitar; this creates an ensemble which is truly pop-inspired. Incredibly fast passages played by the live recorders are alternated with funky tunes and beats in a frenzy which engages and excites the listener. The following passage (example 5.9) is typical of the third part of *Bird's Paradise*, with precisely written out articulations and interesting rhythmic combinations.

Example 5.9: *Bird's Paradise* by Meijering; part 3, bars 47-48

The sheer speed of the final movement of *Bird's Paradise* ensures a huge challenge for both performers. The triplet section beginning at bar 33, for example, is very difficult at a tempo of crotchet = 120. This writing is reminiscent of passages in *Brat* which are so technically difficult that they give the live instrumental part an inhuman quality through the adoption of techniques beyond human capabilities. The section from bar 33 of the third movement in *Bird's Paradise* is barely possible for the live performers; the increase in tempo makes the tonguing and fingering for this section almost impossible. In a way this is a clever method of integration of live and electronic elements, in that the instrumental parts are seemingly not bound by the confines of human capabilities, and so are behaving like electronic instruments.

The execution of this section in performance is aided by the presence of slightly longer notes, and of short rests, to punctuate sections of semi-quaver triplets; these rhythmic differences can be used as anchor points for the live players in performance (example 5.10).

Example 5.10: *Bird's Paradise* **by Meijering; part 3, bars 33-35**

The main challenge for both recorder players is the execution of the many virtuosic passages of music while simultaneously remaining in sync with the fixed accompaniment, a task complicated by the presence of a second live instrumentalist.

Example 5.11: *Bird's Paradise* **by Meijering; part 3, bars 64-68**

The cool and funky tune in example 5.11 could be reminiscent of tunes from popular shows such as Peter Gunn, James Bond, or other themes they might know. This will help the audience's unconscious comprehension, and subsequent appreciation of the music. Female

vocal and breathing sounds form part of the fixed media, and spoken male voices are also sampled. This provides a direct link with human activity and therefore aids comprehension of the music.

Example 5.12: *Bird's Paradise* **by Meijering; part 3, bars 216-230**

There is a direct reference to birds picking food along the highway of life at the conclusion (example 5.12) of *Bird's Paradise*. The recorders are the birds picking (bars 217-223), and the cars from the highway of life can be heard driving off into the distance. The rhythmic cue provided in bar 216 for the recorders' entry in bar 217 is a little inadequate; a longer, more detailed cue would be more useful than a single quaver upbeat provided by a semi-quaver triplet, especially given the previous fourteen bars rest with no distinct rhythmic beat (making counting impossible with visual timers or click tracks).
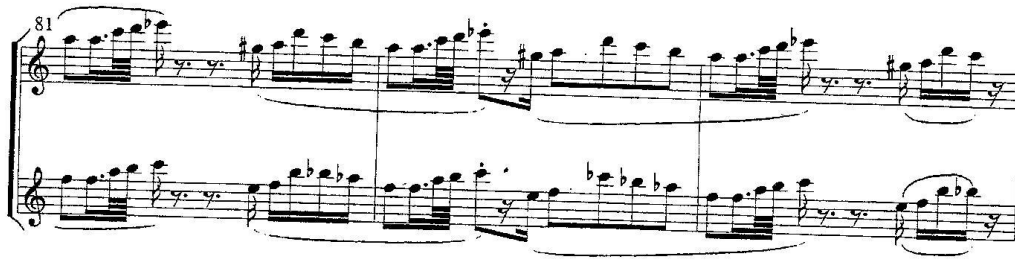
Example 5.13: *Bird's Paradise* **by Meijering; part 3, bars 81-83: A gestural melody in the recorder parts.**

In example 5.14, recorders move in and out of unison with the electronics. Points of unison with the fixed media accompaniment can be used as indication points for the performer to help stay in time with the accompaniment, and also act as good points of unification of live and electronic components from an audience perspective. The unison occurs at bar 125 (for that bar only), and again from bar 127.

Example 5.14: *Bird's Paradise* **by Meijering; part 3, bars 124-130**

Kage ~ **Roderik de Man**
(Optional Amplified) Alto in G and Fixed Media with Improvisation
(2000)

Fixed Media with Improvisation

A good way of making fixed media compositions less rigid and more interactive from the performer's perspective is to include improvised sections amongst the pre-recorded material, so that entries at certain points of the work are controlled by the performer.[100] An example of this technique can be found in Roderik de Man's *Kage*, for Ganassi Alto recorder in G with tape.

De Man separates the pre-recorded material into four tracks and instructs the performer to stop and start the tracks manually (the recording is connected to a pedal which works like a play/pause button). Pre-composed material is given for these 'paused' sections, with the option to improvise based on written material or to incorporate free improvisation if the performer prefers.

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[100] Pennycook, 200.

Example 5.15: _Kage_ by de Man;[101] bars 10-13

The addition of improvised sections gives the performer more room for creative expression and also creates more of an interaction between parts, even if only to stop and start. It gives the performer extra control and security, since they can time entries accurately and change slightly the length and tone of the piece as a whole through varied improvisation.

Electronics

Only one microphone is needed to amplify the recorder sound in _Kage_; if no microphones are available it can be performed without amplification. There are no special tapping effects as in _Click & Pitch_, but some subtle breathy tones are written for the recorder, and these are much more effective when it is amplified; indeed a larger scope of dynamics and articulations is available to the performer with the aid of microphones.

Volume of the fixed media (CD) should be reasonably loud as there are many softer sounding morphing timbres created as underlay to the recorder part. Note that there are also loud drum and shouting sounds, and distortion of these parts can occur if the volume is too

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[101] Roderik de Man, _Kage_ (Donemus: Amsterdam, 2004).

loud so there must be a balance between the two extremes of sound in the fixed media accompaniment.

Recorders

Ganassi type (Renaissance) recorders have some major distinctive differences to Baroque recorders (played widely in schools and by amateurs). The most noticeable feature of these Renaissance-type recorders is the large cylindrical bore with a flaring foot.[102] The wide bore gives the recorder a loud and sharp-edged tone, while the flared foot has the effect of slightly sharpening the notes. Finger holes are wider than on a Baroque recorder and are shaped differently on the inside as well.

The combination of a wide tapered-out bore, a wide windway, and bigger finger holes gives Ganassi type recorders a loud and confronting tone; articulations also sound sharper and can be played with more severity. This is useful in *Kage* for the wide range of dynamics, which are easier to achieve with the extra potential for shading of the larger finger holes. Playing on a Ganassi also means the tongue can be quite loud and harsh and the sound can be loud and closer in timbre to that of the Shakuhachi, a Japanese flute used in the pre-recorded material accompanying the performer.

Performance notes

This is a very approachable work as it involves minimal electronic use, with the option to perform without microphones (although the integration of electronic and acoustic parts will be greatly aided if amplification is used).

Kage is a Japanese word meaning *shadow* or *reflection*. This describes the relationship between recorder and fixed media in the work; at times the recorder is a shadow

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[102] Martin, 49.

of the pre-recorded material, and other times the electronics function to expand and amplify the recorder.

Instruments from the Japanese Nô theatre form most of the accompaniment, including drums, vocal sounds, and low and high pitched flute-like tones.[103] The presence of traditional Japanese instrumental sounds in the fixed media makes mimicry much easier for the recorder player. Effects such as breathy articulations remind the listener of the breathy tones of the shakuhachi, and different vibrato effects (as in example 5.16) and harshly accented articulations are similar to those used in the electronic accompaniment. For these reasons the live and electronic parts can be integrated very successfully in performance.

Example 5.16: _Kage_ by de Man; bars 7-9

The work begins with an immediate reflection or shadow of the shakuhachi sound by the recorder (as seen in example 5.17). Labium glissando (and vibrato) gives the opening a feeling of instability, as the note wavers in pitch and ideally in timbre as well. Timbral change can be achieved by changing vocal tract shapes to mimic spoken vowels, which can then change; for example "oo-ee-aa-uu" will create a sort of opening or swelling of the sound, as more upper harmonics are added with increasing opening of the vocal tract. This

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[103] High pitched tones are reminiscent of the nohkan used in Japanese Nô drama.

creates a kind of ambiguity in sound as the recorder player seems to search for the desired

tone while chasing the electronically created and held pitch of D.

Example 5.17: *Kage* by de Man; bars 1-6

Elements for improvisation are given, as well as an example of an improvisation the

performer can choose to play if desired. The elements include special effects (labium

glissandi around D, fluttertongue, breath vibrato, fast staccato, irregular dynamics) and

certain melodic intervals which reflect intervals in the fixed media, and also which are

present throughout the piece. If used when improvising, the melodic and rhythmic figures

suggested will function to unify the improvised section with the rest of the work.

Example 5.18: *Kage* by de Man; bars 10-15

Although the composer suggests it is vital for the performer to have a visual counter or clock in order to time entries with the fixed media part, it is one of a few pieces in which this is not necessarily needed. This is due to the notation (of sorts) of cues for the electronic part in the recorder part (example 5.19), and the fact that there is no displacement of time due to the marking of crotchet = 60.

Example 5.19: *Kage* by de Man; bars 22-24

Adequate rehearsal with the CD will ensure the performer knows cues and listens for them, similar to playing in an ensemble or orchestra where the musician learns how the music sounds and where their part fits into the whole. This kind of performance creates a more convincing interaction between live performer and electronic component.

Example 5.20 shows a spoken sound "hijooh", and the large black spot at 00.02 is a drum sound. Similar notation of what is happening in the electronic accompaniment is used throughout the piece; different sized circles are used for drum sounds, indications of activity to listen for, such as the marking "flutes" in bar 18 and bar 20 occur regularly. The composer has provided a sort of graphic representation of the electronic part so the performer is able to follow.

Example 5.20: *Kage* by de Man; bars 19-21

Percussive effects from bar 38 (example 5.21) include turning the recorder on its side in mimicry of a transverse flute; these and other vocal effects add to the theatrical nature of this section of *Kage*.

Example 5.21: *Kage* **by de Man; bars 37-42**

Chapter 6: Live Electronics with Sound Engineer

Pipistrelli Gialli ~ Benjamin Thorn
Amplified Basset Recorder and Live Electronic Effects
(written 1985)

Electronics

Due to the ever changing nature of technology, works written 10+ years ago involve devices which are now obsolete and so new solutions must be reached in order to keep this older repertoire alive. Fortunately the newer technology is usually capable of more effects than the old, rather than the reverse. Some aesthetic factors are removed over time though, as aesthetics of the original electroacoustic movement partially developed due to restrictions in equipment capabilities, and the commonality of the precise control over minute parameters of sound by the composer.[104] If the electronics originally required for performance are out of production or not available, the parameters of electronics can be designed and controlled during performance by a skilled technician.

In the preparation of *Pipistrelli Gialli* it was difficult to find delays which accommodated the requirements of the piece; in depth knowledge of MAX/MSP[105] was needed to achieve the 5 second delay, as this was a much longer delay than is usually required. Using the old reel-to-reel tape technology, the long delays were relatively easy to arrange, but complications which arise in the adaptation process mean that a performer with no experience in MAX/MSP software will not be able to work this out on their own. Live

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[104] For more on the development of aesthetics in relation to electronic equipment, see Peter Manning, "The Significance of Techné in Understanding the Art and Practice of Electroacoustic Composition", *Organised Sound,* 11 (2006): 81-90.

[105] MAX/MSP is programming software that allows the performer to control sound effects, visuals and audio applications through the creation of "patches". A patch is constructed using various effects in combinations specified by the composer.

electronic effects in this piece include delays, varying degrees of distortion, and panning of the sound between speakers.

From the performer's perspective this process of creating and altering sounds through software can be exciting and tempting to delve into, but generally speaking instrumental performers who enter into the world of electronic programming tend to stay in that area. This is not surprising given the amount of time and dedication it takes to successfully operate the software.

The ensemble of recorder player and sound technician can be very rewarding, especially from the performer's perspective. The acoustic performer is not required to learn much new information about the technology, as they have an expert to operate devices and to make sure nothing malfunctions during performance. In the event something does go wrong, the technician can hopefully fix the problem with little disruption from the audience's perspective.

Although audio technicians/sound engineers are often placed behind screens or backstage,[106] they are in fact an important part of the performance, and in most cases could be on the stage with their acoustic counterpart. This physical presence of technology will give the audience a better idea of what is actually going on in the creation of the sounds they are hearing. There is arguably some mystery to a performance with only the acoustic instrumentalist visible, and this could create an interesting effect in some contexts, but it can also be effective to place the electronic technician in a performance role on stage so the two musicians are able to interact with each other similar to members of a chamber ensemble. This physically close arrangement is very beneficial to the performance of *Pipistrelli Gialli* when a sound engineer is in control of the effects. The visual interaction between two live

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[106] Eric Lyon, "A Computer Music Retrospective", *Organised Sound,* 13 (2008): 209-16.

performers is more engaging from the audience's point of view, and also makes the synchronisation of effects being triggered and timed entries more precise.

Recorders

A Baroque basset recorder is used in *Pipistrelli Gialli*, however due to the nature of the electronics (no pre-recorded material, only reflections and distortions of the recorder's sound) another basset may be used (Renaissance, Paetzold) for certain sections of the work. If a Paetzold is used there would be an added percussive element (key sounds would be heard through the microphone), which would be interesting to explore; the Paetzold recorder could make the work more technically challenging though, as the very quick figures in the highest range of the basset would be difficult to sound clearly on a Paetzold. Some special effects in the third movement are not possible on the Paetzold due to the square keys, so the complete work (three movements) cannot be performed without a Baroque basset. For more information on the basset recorder, including a list of solo repertoire with some electroacoustic works, refer to Alicia Crossley's "The Development of Solo Bass Recorder Repertoire in the Twentieth Century".[107]

Performance notes

The name *Pipistrelli Gialli* means "yellow bats". The effect of bats flying is created in the opening movement with short gestures which are repeated back on the delay, before decaying slowly. As the recorder part becomes denser the layering effect creates an interesting texture which is then bounced around the room as if in a bat cave.

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[107] Alicia Crossley, "The development of Solo Bass Recorder Repertoire in the Twentieth Century" (M. Mus. diss., University of Sydney, 2010).

Example 6.1: *Pipistrelli Gialli* **by Thorn;**[108] **page 1, systems 4-6**

For convenience Thorn has marked the score with dashes to indicate the placement of each second in time, thus clarifying where each gesture should fall within the second (example 6.2). This is very useful for the performer as no timer is needed. Of course the purpose of the markings is probably to help the performer stay together with the reel-to-reel tape and to stop and start it recording at appropriate times, but nevertheless it aids the performer with a modern electronic setup in giving a precise version of the intended music.

Example 6.2: *Pipistrelli Gialli* **by Thorn; page 1, systems 1-2**

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[108] Benjamin Thorn, *Pippistrelli Gialli* (Orpheus Music: Australia, 2000).

The first movement is initially heard as being gesture-carried, as the basset recorder has many short and longer gestural figures to express (example 6.3a). There are recurring motifs and tonal themes throughout the movement; examples are given of some motifs which occur in the beginning (example 6.3a), and return at the end of the movement (example 6.3b).

Example 6.3a: *Pipistrelli Gialli* **by Thorn; page 2, systems 2-3. Motifs in the beginning.**

Example 6.3b: *Pipistrelli Gialli* **by Thorn; page 4, systems 4-5. Motifs at the end in different combinations.**

Due to the layering of these gestures, however, the movement can also be heard as an experiment in texture. The texture constantly shifts along with the relative density of melodic gestures in the recorder part, and distortion and panning create confusion from a listener's perspective. The use of held multiphonics and trilled glissandi (example 6.4) complicates the

texture further, and the multiple delays on the recorder's sound ensure there is not much punctuation to this constantly morphing texture.

Example 6.4: *Pipistrelli Gialli* by Thorn; page 3, systems 6-7

The second movement is characterised by sustained multiphonics with a 'cathedral' reverberation. Delays are used again to create a texture which slowly changes with each new recorder tone, and multiphonics are used very cleverly by Thorn in this movement; tonal relationships can be heard between multiphonics, and the way they layer each other with the aid of delay creates a tonally pleasant effect. This is surprising given the inherent dissonance in multiphonics on the recorder, and is a good example of how multiphonics on larger sized recorders sound less harsh and can be manipulated to create calming effects.

Thorn uses multiphonics in an exposed solo melody in the middle of this movement, a technique not often employed in such a gentle, lyrical setting. This is challenging for the performer as the normal tones must sound as if they belong with the harsher multiphonics, and vice versa.

Example 6.5: *Pipistrelli Gialli* **by Thorn; page 6, systems 1-2**

The third and final movement of *Pipistrelli Gialli* is composed almost entirely of special effects. An interesting effect of "burbles" is used to create the opening texture, achieved by covering the thumb hole of the basset and sliding fingers over the holes at the front of the recorder (example 6.6). The presence of this particular technique excludes the possibility of playing the whole piece on a Paetzold, as the large square keys prevent the running of fingers over holes.

Example 6.6: *Pipistrelli Gialli* **by Thorn; page 6, systems 2-3**

Multiphonics, fluttertongue, and rapidly moving trills are present throughout, making this movement particularly engaging for the audience to watch.

Chapter 7: Live Electronics in Performance

Kubb Funk! ~ Göran Månsson (1967 -)
Contrabass Paetzold and Live Electronics
(Unpublished - Released 2006)

Electronics

Microphones should be placed in two locations: one above the fipple of the Paetzold pointing into the hole, and the other pointing towards the middle of the instrument to amplify the sound of the keys.

Live electronics can be controlled by the performer via one or more foot pedals, depending on the requirements of the work in question. *Kubb Funk!* is an excellent piece for the introduction of the use of foot pedals in performance. This is because only one live effect is required to be switched on and off during the work: that of an octave doubling; when the pedal is switched on the performer's sound will be reproduced in parallel one octave below the pitch played.

A pedal designed specifically for octave pitch shifting can be used, or a harmonising pedal may be suitable if it has the ability to use only one extra voice, set at the interval of an octave (some pitch shifters will not shift that far); settings for the effect will differ with each pedal.

Performance notes

Swedish composer Göran Månsson has created this charming work for solo contrabass Paetzold recorder and live electronic effects. Effects are administered by the

performer via a pedal which is attached to a patch which alternates an octave doubling with reverberation.

The sound of the large square keys clacking on the Paetzold is used as a special effect in *Kubb Funk!*, a feature of this recorder not possible on other models from the Renaissance and Baroque periods. Other special effects include multiphonics and optional fluttertonguing (in improvised sections). Key clacking is not random in this case, but is specifically notated to be played with certain fingerings which later become heard audibly as the main funky theme.

Example 7.1 shows the notation of finger movements creating subtly pitched clacking sounds, amidst gradually increasing numbers of pitched tones in rhythm.
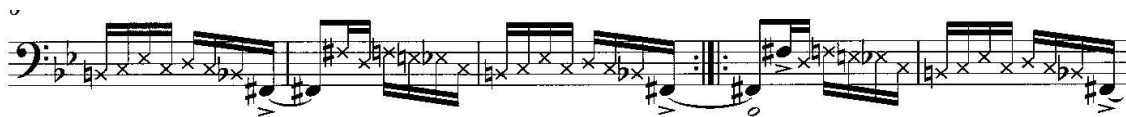
Example 7.1: *Kubb Funk!* by Månsson;[109] bars 6-10

The composer gives the option to improvise in certain sections, but has also written a section which can be played from the score instead; this written out section can also be used as inspiration for the basis of an improvisation. For the performer's convenience, fingering suggestions are included in the introductory score notes for the pitched multiphonics.

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[109] Göran Månsson, *Kubb Funk!* (Unpublished, 2006).

Example 7.2: *Kubb Funk!* by Månsson; bars 88-90. The suggested fingering for the multiphonic in bar 88 is (01245), and in bar 90 is (0123467).[110]

Kubb Funk! is made up of percussively articulated passages, often doubled at the octave, intertwined with more tuneful melodies with a full sounding reverb. Almost all small sections are repeated, some with the option of four or more repetitions; this flexibility of the work leaves room for personal interpretation, the only requirement being the consistency of the funky beat!

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[110] A numbering system is used in reference to the fingers on the recorder. Many books and references use the same system, including Walter van Hauwe.

Maní eléctrico~ Keyla Orozco   (1969 -)

Baroque Alto Recorder and Live Electronics
(2003, revised 2005)

When electronics are performed in real-time like instruments and combined with instruments... two worlds are brought together in a theatre of transformations. No-one listening knows exactly what is instrumental and what is electronic anymore.[111]

Cuban born long time established artist in Amsterdam, Keyla Orozco wrote this work which was commissioned by Amsterdam Fonds Voor de Kunst and written for recorder player Susanna Borsch. Elements of Orozco's roots in Latin American folk music can be heard in the theme of this unusual and entertaining piece.

Electronics

Maní eléctrico[112] is a fully interactive electronic piece. Effects placed on live sounds are initiated by a set of pedals controlled by the performer which connect to pitch-shifters, octave doublers/harmonisers, different distortions, and delays. Everything electronic in this work is derived from the recorder player's sound, making it an excellent example of electronics functioning to extend the acoustic instrument. The electronics in *Maní eléctrico* function as more than just the extension of the instrument, in this case they act as an extension of the player; percussive vocal sounds in the recorder part are used to create loops and are an integral part of the recorder player's melodies and gestural figures.

A big part of the research in preparation for the performance of the piece involves learning to program and use an effects processor and looping pedals. Works with complicated

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[111] Harvey, 80.
[112] Borsch, *Off Limits* (2006), Track 8.

live effects usually include information about the electronics devices intended for use at the time of composition; the parameters specified for each single effect or patch will correspond with a setting available on that particular pedal or device.

If the equipment specified in the composer's notes is available then this is ideal, but in many cases is not practical. For the purposes of this performance research a Boss GT-100 Effects Processor[113] has been used for all electronic effects and patches, in conjunction with a double looping pedal. Because this technology differs from the technology originally suggested for performance of the work, the effects and patches specified must be adapted as closely as possible to create effects similar to those heard in the original performance.

Information on the parameters of each device originally specified can be found with a simple internet search for the manual; certain parameters available on the pedal recommended for use can then be programmed into a patch on another device. The information on parameters of the pedal originally intended for use is vital, especially when settings such as "MAX input level" are used; without knowledge of the limitations of the device "maximum" could mean any level of the effect in question.

Settings and parameters can vary greatly between effects units and pedals, and a large range of different brands are available. The unit chosen for this research can be programmed to trigger singular effects and also patches for performance. A patch is different from a singular effect (such as reverb, delay, or octave doubling), in that it is programmed (usually by the performer, or a technician with the aid of software such as MAX/MSP) to be a combination of singular effects, creating an overall effect which is labelled a 'patch'.

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[113] http://www.ultimate-guitar.com/reviews/guitar_effects/boss/gt-100_amp_effects_processor/

Performance notes

The notation of recorder and electronics for the beginning of the work is shown in example 7.3. The squiggles of sound on the score represent the effect of a patch which includes feedback and delays, and which is triggered by the tones from the recorder part. The harsh articulation adds a slightly breathy tone and increases the effects of feedback in the patch.

Example 7.3: *Maní eléctrico* **by Orozco;**[114] **page 1, system 1**

Vocal tones, syllables, and percussive effects are incorporated into the melody in places, which brings a very animated aspect to the performance, and also requires extra practice to ensure fluidity of the music. The presence of these vocal sounds enhances the quirky nature of the work and makes it engaging to watch from an audience perspective.
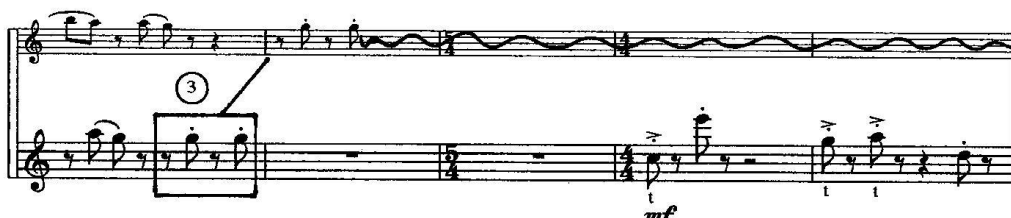

Example 7.4: *Maní eléctrico* **by Orozco; page 8, system 4**

[114] Keyla Orozco, *Maní eléctrico* (Keyla Orozco: Amsterdam, 2003).

The main challenge in the performance of *Maní eléctrico* is the execution of the complicated changes of effects, and various loops, to produce a performance which intrigues the audience while maintaining continuity. Incorporating movements of the feet (to trigger effects via pedals) with the artistic theatrical interpretation of the work is an advanced application of the use of live electronics in performance.

Maní eléctrico consists of different sections which alternate and build on previous treatment of the theme. Instrumental and vocal looping are combined with more abstract effects of feedback and delays of various lengths and even a vocal improvisation.

Rhythm is used to achieve integration in *Maní eléctrico* as is common among works in the electroacoustic genre with live instruments. The work is built on a series of rhythmic loops over which the live performer plays. Material intended for looping is presented inside a box in the score of the piece, as shown in example 7.5.

Example 7.5: *Maní eléctrico* by Orozco; page 4, system 3. First loop.

The percussive vocal sounds which are looped during *Maní eléctrico* create a clear connection with human activity using the most directly recognisable human sound – the voice. This all aids the listener's attachment to sounds, and therefore appreciation of the work. A harmonising pedal is used and vocal sounds are scored for utterance separate to the recorder, making them more clearly audible. Looped material is gestural in nature, as the

figures are short; however, when combined in a loop, the gestures run together and create a more rhythmic setting, as is the case in example 7.6.

Example 7.6: *Maní eléctrico* **by Orozco; page 4, system 5**

Individual instructions are given for each improvised section in *Maní eléctrico*. Example 7.7 shows a vocal improvisation section which includes percussive consonants and pitched vowel sounds. This section is very effective, even if the exact pitches are not sung in the desired octave. As the composer says, the harmony is the important factor.

Example 7.7: *Maní eléctrico* **by Orozco; page 9, system 1**

Since this section will be slightly different each time it is played, the accuracy of pitch will improve with each performance. This is another benefit of playing notated music with improvisation; the performer will change and develop the piece each time they play it, making repeated performances as engaging for the listener as for the performer.

The improvisation shown in example 7.8 uses a different patch to that in example 7.7; the above example is doubled at the octave below, and the sounds in 7.8 are affected by multiple delays and feedback. Due to the relative complication of the effects on the live sound in 7.8, the recorder is less exposed than in the improvisation in 7.7, but the resulting effect will automatically be layered and busier. This increases tension through expansion of the overall sound, despite the relative sparseness that comes with the use of fragments rather than a rhythmic passage.

Example 7.8: *Maní eléctrico* by Orozco; page 9, system 3

Electronic patches required for the work are described in a table at the beginning of the score and are numbered in order of their appearance. Information on the levels and parameters of each patch and effect is given in relation to devices used at the time of composition. Triggering patches and effects is identified by number in the score; when a new patch begins it must replace the previous one.

Example 7.9 shows a delay patch applied to a looped section. The section with tempo marking crotchet = 144 has two patches functioning simultaneously; if there is not a function on the device used for performance which allows this, a separate patch which includes the effects of both patches will need to be made.

The specification for the delay effect number 13 is a delay that starts "after 9 eighth notes."[115] This means the rhythm must be very strict; the looping should be rhythmic and evenly spaced, and the quaver melody should keep to this exact tempo, using only accents, rests, and the contour of the melody to shape the phrases. This will ensure the electronic delay enters is synchronized with the live performer, and creates an impressive myriad of sound in which the performer and electronics cannot be separated in sound.

Example 7.9: *Maní eléctrico* by Orozco; page 10, systems 3-5

The return of effects present in the introduction of the work, along with a set of intervals heard numerous times in the opening sections, brings the listener's ear back to a recognisable sonority. Although the performer is not improvising freely, there is some freedom to the expression of the ending (example 7.10). The performer is allowed to choose

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[115] Orozco, *Mani Electrico* (2003), liner notes.

the number of repetitions and the rate at which delays are increased, and there is some liberty given for added articulations and timing for the final effects to be triggered and fade out.

Example 7.10: *Maní eléctrico* **by Orozco; page 12, systems 1-2**

The rhythmic structure present in most of the work is contrasted with a freely timed ending. This is refreshing for the performer and the audience as creative control is given to the live instrumentalist to engage the listener one last time before the stars disappear "in the evening sky."[116]

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[116] Note at figure 17. Shown in example 7.10.

Chapter 8: Multimedia Electronics

The development of new music for recorders in electroacoustic contexts is being aided by a phenomenon currently occurring in various studios around the world. Groups and solo instrumentalists are connecting with composers and working together to create new works which take into consideration the composers' and the performers' ideas, somewhat blurring the lines between the two; often these associations have their own publishing and recording rights as well. This means they can collaborate and compose music, and then publish, perform, and record it themselves. Interdisciplinary projects including dancers, actors, and visual media artists also appear frequently in this genre.

Karnatic Lab Records[117] produces music of this collaborative nature, including *Off Limits*, a recording featuring German recorder player Susanna Borsch.[118] A significant amount of repertoire is also produced through the organisation "Visisonor", created by Jorge Isaac.[119] The following multimedia work was created by Roderik de Man in collaboration with Jorge Isaac.

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[117] http://www.karnaticlabrecords.com/
[118] Susanna Borsch, "Off Limits." Karnatic Lab Record Label, 2006.
[119] http://www.visisonor.org/VisisonorORG/About.htm

Marionette ~ Roderik de Man (1941 -)
Contrabass Paetzold, Tenor, and Sopranino Recorders (1 player) with Fixed Media Accompaniment, Live Electronic Effects, and Visual Projection
Video by Marcel Wierckx
(2009)

Electronics

Marionette has a fixed media accompaniment which should be projected through a larger speaker system, above head height if possible. The live effects on the amplified recorders' sound, along with the direct unaffected sound of the live recorders, will ideally be projected through portable speakers situated behind or near to the live recorder player. The images in the video by Wierckx are intended to be projected onto a translucent screen which is placed in front of the performer on stage; this creates a silhouetted impression of the recorder player, reminiscent of a marionette puppet.

Some freedom is given for the parameter of effects in the piece. Where Keyla Orozco has been very specific with her directions for electronic patches in *Maní eléctrico*, Roderik de Man has left some creative control in the hands of the performer. For example, he gives directions for reverberation as follows:

> Medium/Long reverb (as to produce distant effect): bars 20 until 28, 36 until 47 and 76 until 85. Put variety in it.[120]

The addition of live electronic effects which can be modified at the performer's discretion gives the performer more creative control over the performance. The presence of

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[120] Roderik De Man, *Marionette* (Muziek Centrum Nederland, Amsterdam, 2009), score notes.

live effects on the recorders' sound aids the integration of electronic and acoustic parts greatly by giving the acoustic instruments more of an electronic quality to their sound.

Recorders

Recorder players typically have a collection of instruments of different sizes and models which gradually increases over time. As this practice is an inherent part of being a recorder player, by the time a performer has reached professional status he or she commonly owns more than ten instruments. Recorders are reconstructed using designs from the Renaissance and Baroque periods, and some modern designs emerged and gained popularity in the 20th century.[121]

Different makes, models and sizes of recorders have slightly different acoustical properties to each other due to variations in the dimensions of each instrument. Slight differences in acoustical properties can help the composer in selecting the appropriate instrument for a given purpose. Different models can be used to create timbral variation, played simultaneously or in succession.

Recorder player John Martin tells us "the acoustical behaviour of a recorder depends strongly on the resonance patterns of the bore and finger holes." [122] Even the slightest changes in the bore or the shape and size of finger holes will enhance some partials and suppress others, leading to differences in the timbre of the instrument.[123]

Electroacoustic composer Roderik de Man comments on the benefits of working closely with recorder player Jorge Isaac. He says it has enabled him to have a good idea of

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[121] For example Paetzold and Ehlert recorders, discussed in relation to previous repertoire.
[122] Martin, 34.
[123] Nederveen, 94.

which recorders to work with and which effects to use to achieve certain outcomes for the music; when formulating ideas for a new piece he thinks "now which recorder will I use?"[124]

The freedom to choose instruments among a collection in which the tone colour of one instrument can differ greatly from the next is a luxury unique to composers of music for recorders. The process of choosing which recorders to use at any given point in a composition fits into the mindset which is inherent in the world of electroacoustic music, where sound materials are selected for their aesthetic value in context.

Performance notes

Born in Indonesia but a permanent resident of Amsterdam, Roderik de Man writes purely instrumental music as well as electroacoustic music. De Man has a close relationship with recorder professional Jorge Isaac (Visisonor), and has composed numerous works in collaboration with him.

Marionette begins with a sopranino recorder playing erratic sounds along with an accompanying non-pitched rhythmic electronic part (example 8.1). Despite the seemingly random nature of sopranino tones, there are some tonal references and recurring gestures to aid comprehension of the music. This can be heard in the repetition of similar short and fast gestures, or an interval between two notes which serves as an auditory point of reference for the listener with repetition. This aids audience comprehension due to the natural recognition of note relationships from tonal music, and the repetition of figures/intervals during the work.

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[124] Clements, *Interview with Roderik de Man* (2013).

Example 8.1: *Marionette* **by de Man;**[125] **bars 2-4**

The electronic part in *Marionette* at times functions as an accompaniment to the recorder, and the lack of pitched material in the pre-recorded part provides a contrast to the pitched recorder. At one point in *Marionette* the electronically created sound spectrum lowers in pitch and alters its timbre in such a way as to prepare the listener for the more mellow sonorities of the tenor recorder, which enters playing a beautiful melody (example 8.2). Here the electronic and acoustic parts remain independent, but act in a complimentary way from the listener's perspective.

Example 8.2: *Marionette* **by de Man; bars 34-38**

In this section of *Marionette* the underlying soundscape transforms and creates tension, while the recorder contributes to this build up with the additions of flutter tonguing and random finger and tonguing patterns. Eventually some erratic hisses and whistles are added to the pre-recorded material making it sound more and more like the recorder part.

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[125] Roderik de Man, *Marionette* (Muziek Centrum Nederland: Amsterdam, 2009).

During *Marionette* there are reiterations of the sopranino melody from the beginning. The term "melody" is used loosely, referring to the fact that the material has similar tonal references to those heard in the opening. The notes Db, Gb, C, A, and G natural and the triplet figure in the beginning of example 8.3a, as well as the interval between A and G natural, are heard in the opening of the work (example 8.1).

In example 8.3 the tones Db and Gb are expressed enharmonically in gestural figures and A and C natural are again present. The enharmonic difference in notation would of course make no difference to the recognition of the material from the listener's perspective.

Example 8.3: *Marionette* by de Man; bars 28-30

An almost exact repetition of the melody played by the live sopranino recorder early in the piece appears again later in the work (example 8.3c).

Example 8.3c: *Marionette* by de Man; bars 76-83

The final section of *Marionette* consists of reflections and dissipations of the previous complexity of themes; sounds in the fixed media are taken from various parts of both the pre-recorded and acoustic materials used in the piece. This is an excellent technique for the end of the piece, stirring up and creating connections with the listener's short term memory of the piece as a whole.

Marionette is an exciting work for audience and performer alike. Different recorder sizes and models are used and swapped back and forth throughout, and the combination of fixed media with live electronic effects and visuals has the ability to both excite and mesmerise the live audience.

Different recorders bring with them different potentials of sound creation. The use of a contrabass Paetzold in Roderik de Man's *Marionette*[126], for example, brings the added capacity for semi-pitched tapping and clacking of the large square keys on the instrument.

A "harmonising" electronic effect – administered by Jorge Isaac – is applied to certain sections of the Paetzold melody in *Marionette*. And there are sections where the morphology of the electronic soundscape changes to include tones which sound as if they have been carried on from the live performer. This is a very effective way of connecting acoustic recorder parts with electronic material, as electronic effects are assimilating with recorder sounds, and recorder sounds are being elongated and added to the morphing electronic continuum, so each is adopting elements of the other in a sort of instrumental morphology.

Example 8.4: *Marionette* by de Man; bars 11-12

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[126] Isaac, Jorge. "Marionette." In *Recorders and Electronics* (Visisonor Records, 2009), Track 1.

Example 8.4 shows a passage which does not need to be played exactly as notated in a rhythmic sense; the irregularity of the rhythm can be heard in the recording by Jorge Isaac.[127] Instead of rhythmic precision, the focus of the performer can be the expression of the gestural treatment of the repeated G natural which eventually progresses to an A in bar 12. It is recommended that this kind of freedom in the interpretation of gestures should be reserved for times when the live part is not synchronized with the fixed media accompaniment.

Effects such as reverberation are employed in *Marionette* to extend the recorder's sound. This expansion of sounds often has a double function, to extend the natural capabilities of the instrument and to make the recorder sound more like an electronic instrument. This is the case in example 8.5, where there is reverberation on the recorder sound and the subsequent addition of distortion furthers the impression that the recorder is becoming electronic.

Example 8.5: *Marionette* by de Man; bars 51-58

This type of connection helps to assimilate live and electronic components so successfully as to confuse the listener's perspective of the origin of sounds in relation to their

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[127] Isaac, Jorge. *Marionette*. (In *Recorders and Electronics*). Visisonor Records, 2009.

audible consequences. In cases where the listener cannot tell whether sounds are acoustic or electronic, true integration has been achieved.

Flutter tonguing and glissandi are employed by the high pitched recorder in *Marionette* to blend with electronic sounds in an ever increasingly busy section which can be said to be very "gestural" in nature (as in example 8.6). The characterisation of the music as gestural at this point is due to both recorder and electronic parts having rapid, short figures which overlap more and more with time.

Example 8.6: *Marionette* by de Man; bars 28-30

The contrabass Paetzold is pitched so low at times, and given such harsh articulations and accents, as to create a percussive effect. From bar 63 in example 8.7 the recorder plays at the bottom of its range with an increasing percussive effect brought on by accented notes. The Paetzold melody then rises in pitch, but articulations in bar 65 do not permit this uniquely designed recorder to play in a melodious way just yet. Eventually the recorder enters with a clean tone in a range with good sound projection, and is able to play together with a fixed accompaniment (shown below).

Example 8.7: *Marionette* by de Man; bars 63-69

Marionette ends with an electronic expression of an expulsion of energy, and the recorder mimics this sentiment with descending glissandi of fluttertongue (example 8.9).

Example 8.8: *Marionette* by de Man; bars 99-102

Roderik de Man shows in *Marionette* how recorder can be employed as a melody instrument differing from sustained electronic sounds, or it can become lost amongst combinations of sine wave based melodic electronics and more erratically scrambled electronic sounds.

Conclusion

This thesis provides a guide for learning to use electronic equipment required for the performance of works selected to represent a variety of different electronic settings. Beginning with the use of simple amplification and working through fixed media, ensemble, and multimedia works, including the use of live electronic effects on the recorder's sound, the progression of repertoire facilitates the reader's knowledge of this repertoire, and most importantly, gives the performer an approachable method of introduction to the use of electronics within performance. This makes the previously daunting task of beginning to explore electroacoustic music more approachable, thereby encouraging more widespread performance of this rapidly growing body of repertoire in Australia.

Many different recorder types and sizes are demonstrated in the chosen repertoire, including modern designs such as the Paetzold. A discussion of the acoustics of the recorder also assists the performer's ability to interpret music in this new and very different genre, while also aiding composers' understanding of the recorder's unique role and huge potential for timbre variation in modern music with electronics.

Exclusions from this paper include extra transformations of the Paetzold, which have been more extensive than the mere adoption of special techniques with live effects on the raw sound of the recorder. The Paetzold's unique construction allows for the easy attachment of various electronic devices which alter the instrumental sound, as well as triggers for certain computer processes of sound and other devices which are so estranged from the original recorder sound as to change the Paetzold into a kind of keyboard operating the computer. Due to the complicated and expensive technology required to explore the repertoire, works using the Paetzold in this way have been omitted from the project. More detailed information on the

electronic Paetzold can be found in Villavicencio's article *The Electronic Recorder Explained.*[128]

Another type of recorder which was not available for use in this research is the electroacoustic recorder made by Philippe Bolton. These recorders (made in different sizes as requested) have excellent potential in the electroacoustic genre, as there is an option to attach a small microphone which Bolton has cleverly installed in the side of the mouthpiece. The microphone can also be removed and another attachment plugs the hole so the recorder can be used acoustically.[129]

The role of gesture and texture, and of audience perception in electroacoustic music is discussed in relation to the electroacoustic genre. This information is applied to the works chosen for performance to encourage dynamic and entertaining performances of electroacoustic works with recorders. The reader will gain a more comprehensive understanding of focal points and ideas which motivate composers in the genre, and therefore will be able to perform the music in a sensitive manner true to the composer's wishes. This information is very useful for performers who have no previous experience in the electroacoustic genre as it deals with performance aspects in detail, guiding the reader in their interpretation of the music by bringing their attention to key ideas which are new to electroacoustic performance.

The progression of repertoire assists the performer in learning to use and play with fixed media, live electronics, and multimedia; More complicated software which responds to the performer's playing and physical movements is used in some electroacoustic music with

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[128] Cesar Villavicencio, "The Electronic Recorder Explained", *American Recorder,* 43 (2002): 7-9.
[129] http://www.flute-a-bec.com/electrgb.html

live instruments[130] but, due to the scope of this research, works involving that advanced use of electronics are omitted from this discussion.

Software-based real time electroacoustic music is an intriguing sub-section of the electroacoustic genre, but in most cases the composer's presence is required to prepare and/or perform pieces.[131] Usually the main reason the composer's presence is required is to "oversee the installation and operation of the technologies."[132] For this reason live improvised music, and music which uses live generated scoring, is not included due to its lack of notation and reproducibility.

This resource provides information on electroacoustic music relevant to recorder players, and explanation of some different equipment (both electronics and recorders) required for the performance of selected repertoire, giving information and skills which can be learned and transferred to other works in the electroacoustic genre. Through this introduction to electroacoustic performance for recorder players, I hope to encourage further performances of electroacoustic music in Australia, and to promote the creation of new works for recorders and electronics through collaboration between performers and composers.

The quickly evolving electroacoustic genre gives the modern recorder player opportunities to reach a truly high standard of entertainment, and a performance level to match any other instrument in the concert hall. The continuing involvement of recorders and recorder players in the electroacoustic music scene will solidify the recorder's place as a truly modern instrument in a modern context.

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[130] See articles by Pennycook, Lyon, and Mari Kimura, "Creative Process and Performance Practice of Interactive Computer Music: A Performer's Tale", *Organised Sound,* 8 (2003): 289-96.
[131] Pennycook, 199.
[132] Pennycook, 200.

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