PERFORMANCE PRACTICE OF INTERACTIVE MUSIC FOR CLARINET AND COMPUTER WITH AN EXAMINATION OF FIVE WORKS BY AMERICAN COMPOSERS

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Since the development of interactive music software in the 1980s, a new genre of works for clarinet and computer has emerged. The rapid proliferation of interactive music resulted in a great deal of experimentation, creating a lack of standardization in both the composition and performance of this repertoire. In addition, many performers are reluctant to approach these works due to unfamiliarity with the genre and its technical and musical considerations. Performance practice commonly refers to interpretation of a written score, but the technology involved in interactive music requires a broader definition of performance practice; one that also addresses computer software, coordination between the performer and computer system, and technology such as microphones and pedals. The problems and potential solutions of interactive music performance practice are explored in this paper through review of the relevant published literature, interviews with experts in the field, and examination of musical examples from works for clarinet and computer by Lippe, May, Pinkston, Rowe, and Welch. Performance practice considerations of interactive music fall into the categories of notation, technology, collaboration, interpretation, and rehearsal. From the interviews and the literature, it is clear that the performance of interactive music requires specific knowledge and skills that performers may not encounter in other genres of contemporary music, including microphone technique, spatialization, sound processing, and improvisation. Performance practice issues are often mediated by close collaboration between performers and composers, but they can inhibit the accessibility of these works to new performers, and may be detrimental to the long-term viability of interactive music. Recommendations for resolving these issues are directed at both composers and performers of interactive music. A listing of over one hundred interactive works for clarinet and computer is also included.

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CHAPTER 1

INTRODUCTION

Since the development of interactive music software in the 1980s, a new genre of works for clarinet and computer has emerged. The rapid development and proliferation of interactive music has resulted in a great deal of experimentation, creating a lack of standardization in both the composition and performance of this repertoire. In addition, many performers are reluctant to approach these works due to unfamiliarity with the genre and its technical and musical considerations.

For the purposes of this study, "interactive music" is defined as music for one or more performers and interactive system, described by Robert Rowe as a system "whose behavior changes in response to musical input."[1] This refers primarily to music for performer and computer, excluding music for instrument and tape/CD, and music in which the technology is not truly interactive (delays and other hardware-type effects). While many interactive works also involve multimedia elements such as dance and video,[2] this project focuses on interactive works for acoustic instrument and computer.

Performance practice commonly refers to interpretation of a written score, but the technological developments involved in interactive music require a broader definition of performance practice—one that also addresses computer software, coordination between the performer and computer system, and technology such as microphones and pedals. The purpose

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[1] Robert Rowe, *Interactive Music Systems: Machine Listening and Composing* (Cambridge, MA: MIT Press, 1993), 21.

[2] Mary Alice Druhan has discussed multimedia works for clarinet extensively in her doctoral dissertation ("A Performer's Guide to Multimedia Compositions for Clarinet and Visuals: A Tutorial Focusing on Works by Joel Chadabe, Merrill Ellis, William O. Smith, and Reynold Weidenaar," D.M.A. diss., Louisiana State University, 2003).

of this project is to identify the problems and potential solutions of interactive music performance practice through the following methods: 1) review of the relevant published literature, 2) interviews with experts in the field, and 3) examination of musical examples from several significant works for clarinet and computer.

CHAPTER 2

BACKGROUND AND CONTEXT

To discuss interactive music in its current state and to make informed decisions about its performance, it is necessary to consider its historical background, recent developments, and compositional practices. For the purposes of this paper, a basic history of electronic music provides background for a discussion of the development of interactive music.[1] Next, context for interactive music performance practice is provided through an examination of aspects of interactive music composition, including models of interaction, compositional techniques, and interactive music software.

Historical Background of Interactive Music

The Development of Electronic Music

In the twentieth century, the convergence of a series of technological developments and new concepts in musical thought gave rise to electronic music. Even before Schoenberg developed the idea of twelve-tone music in the early 1920s, some composers were envisioning music in which timbre, not pitch, was of utmost importance. In the years 1910 to 1916, Varèse, Busoni, and the Italian Futurists began calling for a new form of musical expression including noise, environmental sound from nature and machines, and exploration of all possible timbre variations.[2] This period also saw the development of early electronic instruments such as

[1] For a more detailed examination of the history of electronic and computer music, see: Joel Chadabe, *Electric Sound: The Past and Promise of Electronic Music* (Upper Saddle River, NJ: Prentice-Hall, 1997); Peter Manning, *Electronic and Computer Music*, rev. and expanded edition (New York: Oxford University Press, 2004); Roger T. Dean, ed., *The Oxford Handbook to Computer Music* (Oxford: Oxford University Press, 2009).

[2] Chadabe, *Electric Sound*, 2-3; 58-59, Manning, *Electronic and Computer Music*, 3-16.

Thaddeus Cahill's Telharmonium, an early synthesizer built in 1901; and Leon Theremin's "aetherphone" (theremin), invented in 1920.[3] John Cage also began experimenting with found sounds by using phonograph turntables and radios in his *Imaginary Landscape* series (1939-1952).[4]

The development of the magnetic tape recorder gave composers, for the first time, the ability to bypass the performer and the instrument to work directly with sound itself.[5] The earliest magnetic tape recorder appeared in 1935, and by 1950 the technology had improved considerably, allowing for stereo recording and splicing (editing) of the tape.[6] Centers for the creation of electronic music (primarily tape music) were soon established in France and Germany, with two distinct approaches emerging. The French, led by Pierre Schaeffer in Paris, developed *musique concrete*, composition using manipulation and juxtaposition of taped environmental sounds. Meanwhile, Stockhausen in Cologne pioneered *elektronische Musik*, an approach that was influenced by serialism and focused on synthesis and processing of electronic sound. Both the Paris and Cologne studios began experimenting in the early 1960s with the newly developed multichannel tape recorders, which in conjunction with multichannel loudspeaker systems allowed for spatialization of sound.[7] These approaches continued to influence thought about the creation and aesthetics of electronic music throughout the rest of the twentieth century.

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[3] Ibid., 6-8.
[4] Ibid., 24-26.
[5] Douglas Keislar, "A Historical View of Computer Music Technology," in *The Oxford Handbook to Computer Music*, ed. Roger T. Dean (Oxford: Oxford University Press, 2009), 16.
[6] Chadabe, *Electric Sound*, 29-31.
[7] Spatialization refers to the projection of distinct sounds from different loudspeakers; see the Glossary in Appendix C for more complete definitions of this and other technical terms.

By 1960, electronic music was being created at studios around the world, most notably at institutions in the United States, Italy, Japan, and Argentina.[8] Many composers found performance of tape music alone in a concert setting to be lacking, and so efforts to combine the sound world of electronic music with live performers resulted in the creation of new genres and new roles for performers. Some works combined acoustic instruments with tape, such as Varèse's *Déserts* for winds, percussion, and electronic tape (1949-54); Bruno Maderna's *Musica su Due Dimensioni* (1958) for flute, percussion, and tape; and Davidovsky's *Synchronisms* series beginning in 1960. The earliest clarinet work in this genre was William O. Smith's *Duo for Clarinet and Tape* (1960). The genre of music for instrument and tape was an important predecessor to interactive music, and many composers continue to create works for this medium.

The 1960s, 70s and 80s brought increasing experimentation with the live performance of electronic music using a variety of technologies. Tape delay systems, ring modulators, contact microphones, and modules for effects such as tremolo, reverberation, and phasing were all employed together with acoustic instruments during this period.[9] Clarinet works in this category include Morton Subotnick's *Passages of the Beast* (1978) for clarinet and "electronic ghost score" and William O. Smith's *Asana* for clarinet and electronics (1985).

Most of these works for instrument and live electronics were not truly interactive; that is, the performer could make decisions based on the sound of the electronics, but the responses of the electronics were static and predictable. In the hands of a good performer, music for instrument and tape could *sound* interactive; but the performer was powerless to actually influence the tape, and the interaction was only an illusion. However, some early ventures used

[8] Chadabe, *Electric Sound*, 42-65.
[9] Gordon Mumma, "Live-Electronic Music," in *The Development and Practice of Electronic Music*, ed. Jon H. Appleton and Ronald C. Perera (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1975) 294-300.

complex electronic circuitry to establish methods of interaction even without computers, such as Gordon Mumma's *Hornpipe* (1967), and Salvatore Martirano's "interactive composing instrument" the SalMar Construction (1972).[10]

Computer Music and Interactivity

Computer technology revolutionized the field of electronic music in the 1980s, and created a wealth of new possibilities for interactive music. The signal processing previously accomplished with *hardware* in the 1960s and 70s began to be possible with *software*, with greater speed and flexibility, and more options. As Keislar described, "[t]he computer offered not only unlimited textural complexity and arbitrarily complicated yet precise rhythms but also unprecedented control and resolution in parameters such as pitch, timbre, and spatial location."[11]

Experiments with computer music began with expensive, slow computers at a few research institutions such as Columbia University, Stanford University, and Bell Labs.[12] Computer music pioneer Max Mathews, working for Bell, developed the first software for digital sound synthesis (creation of sound) and signal processing (manipulation or transformation of sound) in the late 1950s,[13] and the GROOVE system (1967) for computer control of an analog synthesizer. Many other engineers and programmers worked on early software for the creation and manipulation of music, but access to these early systems for composers was limited due to their cost, size, and the technical expertise required.

It was not until the 1980s that the advent of the personal computer and commercially available music software allowed musicians and programmers to work on their own, without the

[10] Todd Winkler, *Composing Interactive Music: Techniques and Ideas Using Max* (Cambridge, MA: The MIT Press, 1998), 12; Joel Chadabe, *Electric Sound*, 291.
[11] Keislar, "A Historical View of Computer Music Technology," 21.
[12] Winkler, *Composing Interactive Music*, 11.
[13] Manning, *Electronic and Computer Music*, 187-188.

aid of large institutions.[14] In 1982, an association of audio equipment manufacturers developed the MIDI (Musical Instrument Digital Interface) protocol for hardware and software so that devices could easily communicate musical information to each other.[15] The combination of MIDI and the personal computer made possible the development of interactive music software systems such as Robert Rowe's Cypher, Karla Scaletti's Kyma, and Miller Puckette's Max.[16]

Miller Puckette's Max software (named after Max Mathews) was first developed in the 1980s at the Institute de Recherche et Coordination Acoustique/Musique (IRCAM) in Paris, and has become the most popular software for creating interactive music. Puckette initially created the program as control software for IRCAM's 4X synthesizer, enabling composers to digitally synthesize sound in real-time (fast enough for live performance) and utilize score following to coordinate the live performer and computer.[17] The 4X was used to compose and perform the first generation of interactive compositions, including Pierre Boulez's *Repons* (1981) for chamber ensemble, six soloists, and live electronics; Robert Rowe's *Hall of Mirrors* for bass clarinet and the 4X real-time system; and Philippe Manoury's *Jupiter* (1987) for flute and live electronics.[18] This period also saw the development of score following programs, which provided new, flexible methods of coordination between the live performer and the computer.

In 1990, Opcode Systems released an commercial version of Max that was refined and expanded by David Zicarelli, allowing composers to create custom music software without knowledge of low-level programming languages such as C.[19] Around the same time, developments in computer processor technology led to the creation of the IRCAM Signal

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[14] Winkler, *Composing Interactive Music*, 14.
[15] Manning, *Electronic and Computer Music*, 266-267.
[16] Winkler, *Composing Interactive Music*, 16.
[17] Ibid., 16-17.
[18] Rowe, *Interactive Music Systems*, 21.
[19] Chadabe, *Electric Sound*, 209.

Processing Workstation (ISPW) in 1991, which ran on the NeXT computer.[20] Less expensive than the 4X, but still cost-prohibitive for many institutions, the ISPW was an important development in interactive music.[21] Cort Lippe's *Music for Clarinet and ISPW* was a landmark work that utilized the ISPW and Puckette's expanded version of Max, and it will be discussed in detail in Chapter 3.

Max continued to be revised and expanded, and in 1997 a new version was released with an additional component called MSP (Max Signal Processing) that enabled composers to synthesize and process digital audio in real-time.[22] Max/MSP has been continually adapted to subsequent computing platforms, and has been widely used due to the development of relatively inexpensive personal computers that can run complex audio operations at very high speeds. More recent developments include the integration of Jitter (graphics processing software) into Max/MSP, and Puckette's creation of Pure Data (Pd), which is free, open-source software that is very similar to Max/MSP. With the increased portability of laptop computers, the possibilities for collaboration provided by the Internet, and further developments in interactive software, there has been a proliferation of interactive works in recent years by composers around the world.

Interactive systems can now be designed to use a multitude of types of information as sources of input to create and influence a live performance. Some composers and performers are exploring new or altered instruments, sensors or video tracking to gather information about physical gesture, or even data from satellites and biofeedback. Some create multimedia works combining music with video, dance, lighting, and a variety of other media. Presentation formats range from concert settings to gallery installations to virtual improvisation environments, and the

[20] Manning, *Electronic and Computer Music*, 366-367.
[21] Winkler, *Composing Interactive Music*, 18.
[22] Manning, *Electronic and Computer Music*, 367-368.

Internet enables collaboration and real-time performance from and between people around the world. For this paper, the focus will remain on one of the most established and popular subsets of interactive music: works for live performer of an acoustic instrument and computer.

Interactive Music Composition

While it is difficult to make generalizations about form and style in interactive music due to the great amount of structural experimentation, we can define possibilities for models of interaction between computer and performer, and typical roles of the performer, computer, and composer. Additional information about compositional or programming techniques and the software used to create interactive music can complete the picture and provide the basis for a discussion of performance practice.

There has been a proliferation of interactive works since the year 2000,[23] and for a variety of reasons. Interactive composition offers the combination of the best human qualities of a live performer (gestural nuance, stage presence, character) with the best machine qualities of a computer (infinite sound possibilities, instant sound processing, rapid calculations). As Winkler observes, "Ironically, computer music, with its unlimited capacity for creating new sounds, lacks the very physical limitations of playing techniques and sound producing mechanisms that are responsible for producing such richness and character in acoustic music."[24] Thus, the electronics can extend the sound world of the live performer, while the performer can communicate musical understanding to the audience, eliminating the detachment and isolation of the typical

[23] See Appendix B for a list of works for clarinet and computer.
[24] Winkler, *Composing Interactive Music*, 34.

electroacoustic performance.[25] The philosophical territory explored by interactive composition is a fundamental theme of life in the twenty-first century: the question of the nature of our relationship to machines, computers, and artificial intelligence systems.[26]

Paradigms and Models of Interactivity

> Interactivity comes from a feeling of participation, where the range of possible actions is known or intuited, and the results have significant and obvious effects, yet there is enough mystery maintained to spark curiosity and exploration.[27]

In interactive music, the computer and performer can take on a variety of roles and relationships. Several different paradigms can be used to describe the way interactivity works in a piece of music: it can be strong or weak, it can follow established models from acoustic music, and it can reverse or blend the traditional roles of composer and performer. These paradigms can help performers to comprehend and classify interactive works and make informed decisions about their interpretation and performance.

"Weak" interactivity refers to a system that merely reacts in a pre-determined way to an input—a computer program that does little more than add delay or reverberation, for example.[28] At the other end of the spectrum, "strong" interactivity describes a system that is highly autonomous, with artificially intelligent qualities. Stronger interaction often corresponds with greater structural freedom or indeterminacy. Indeed, many strongly interactive systems function as environments for improvisation or "meta-musical environments" and are more frequently

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[25] Rowe, *Interactive Music Systems*, 5; Guy Garnett, "The Aesthetics of Interactive Computer Music," *Computer Music Journal* 25 (Spring 2001): 32.
[26] Brian Belet, "Live Performance Interaction for Humans and Machines in the Early Twenty-First Century: One Composer's Aesthetics for Composition and Performance Practice," *Organised Sound* 8 (December 2003): 306.
[27] Winkler, *Composing Interactive Music*, 3.
[28] George Lewis, "Interactivity and Improvisation," in *The Oxford Handbook to Computer Music*, ed. Roger T. Dean (Oxford: Oxford University Press, 2009), 460.

experienced in an installation or other format than in a concert performance.[29] Most interactive works fall on a continuum between these two extremes, with variation in the strength of the interactivity in different sections of the piece.

Depending on who or what controls various aspects of the piece, the performer, computer, and composer can take on a variety of roles. One of the primary differences between interactive music and music for instrument and tape is that in interactive music the performer has greater temporal control over the work, sometimes taking on the role of "conductor" by advancing the computer through the score by obvious means (such as a pedal) or hidden means (as when the computer follows the performer's tempo or pitch).[30] The performer can also take on "composer" responsibilities, especially when given opportunity for improvisation or control over form.

The composer of interactive music can often take on the role of "conductor" (or perhaps "accompanist"), advancing the computer through the piece from onstage or at the mixing console. At the mixing board, the composer can also "perform" the piece by controlling the levels and/or spatialization of sound. Of course, the world of interactive music has many composer-performers such as clarinetists Burton Beerman and Joseph Butch Rovan, who write and perform their own works.

Depending on the level of control and autonomy given to the computer, it can serve as "instrument," "performer," "conductor," and/or "composer," with these roles often blending or changing over the course of a piece.[31] Rowe has distinguished between an *instrument* paradigm, in which the computer acts as an extended musical instrument, and *player* paradigm, in which

[29] Cort Lippe, "Real-Time Interaction Among Composers, Performers, and Computer Systems," *SIG Notes* (Information Processing Society of Japan) 123 (2002), 4.
[30] Winkler, *Composing Interactive Music*, 23-24.
[31] Lippe, "Real-Time Interaction," 2.

the interactive system acts as an "artificial player."[32] In a weak interactive system, the computer often functions as simply an extension of the human performer, transforming or adding effects to the sound in a predictable manner.[33] With greater autonomy and unpredictability, the computer begins to resemble a separate performer, and takes on various traditional performance roles.[34] Some compositions place the performer and computer into a soloist/accompaniment role, where the electronics function as a single accompanist or even an entire orchestra of sounds. The chamber music model suggests shared control and reciprocal influence, while the jazz combo model incorporates improvisation and spontaneous reaction—traits often found in interactive works.[35] Strong interactive systems, such as George Lewis's *Voyager*, can be compared to free jazz improvisation.[36]

Within these roles, the performer and computer can have a variety of personalities and relationships. The two entities can be collaborative, confrontational, independent, or supportive, for example. Because the roles of the performer and computer are so flexible in interactive music, it is important that the roles and responsibilities of the performer are clearly explained by the composer and understood by the performer in any given piece.

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[32] Rowe, *Interactive Music Systems*, 8.
[33] This model of "computer as extension" can describe most early works for instrument and live electronics, due to the passive nature of the analog effects modules.
[34] Simon Emmerson, "Combining the Acoustic and the Digital: Music for Instruments and Computers of Prerecorded Sound," in *The Oxford Handbook to Computer Music*, ed. Roger T. Dean (Oxford: Oxford University Press, 2009), 168-170.
[35] Winkler, *Composing Interactive Music*, 25-26.
[36] Ibid., 26-27.

Techniques and Terms for Interactive Music

Rowe and Winkler have written detailed guides to compositional techniques in interactive music.[37] As will be addressed in Chapter 2, some performers have a thorough understanding of these techniques and/or are composers themselves, while others prefer to leave the programming to the composers. Here, several techniques and terms will be explored; these concepts are common in interactive music, but unfamiliar to most performers of traditional instruments.

Rowe's *Interactive Music Systems* is a seminal work that has influenced much of the discussion of interactive music since it was written in 1993, and Rowe's framework for classification of interactive computer systems will be briefly summarized here. First, Rowe draws a distinction between *score-driven* systems, which compare musical input to a stored score, and *performance-driven* systems, which do not have a stored representation of the score.[38] Next, Rowe describes the system's response methods as being *transformative*, *generative*, or *sequenced*. A transformative response uses the input from the instrument and transforms it, a generative response creates new sound in response to input, and a sequenced response plays back prerecorded or stored music. For example, consider an interactive system that "listens" to a clarinet phrase, following along through use of pitch tracking (analysis of input frequency) and comparing it with stored instructions, then recognizes the end of the phrase and responds with a version of the phrase shifted up an octave. This system would be classified as a score-driven program with a transformative response.

[37] Rowe, *Interactive Music Systems*; Rowe, *Machine Musicianship* (Cambridge: The MIT Press, 2001); Winkler, *Composing Interactive Music*.
[38] Rowe, *Interactive Music Systems* 6-7.

Score following is used in interactive compositions for the purpose of coordinating the interactive system with the live performer. It is effectively a method for the computer to "listen" to the performer and follow them through the score, automatically changing behavior in different sections of the piece if desired. The computer can be programmed to listen for onset time (used to detect tempo), amplitude envelope (dynamics or shaping of the note), and/or pitch.[39] In addition to score following, synchronization between the computer and the performer can be achieved by using a pedal to advance the computer through its "score," having a technical assistant follow along and advance the computer, or other methods. The performer can often choose which method they prefer, so these methods are examined in more detail in Chapter 2.

Interactive Music Software

While many different systems have been created for the purpose of live signal processing for interactive music, Max/MSP is the most popular. For many composers and performers, Max/MSP has become synonymous with interactive computer music. However, many other options exist, each with its own advantages and disadvantages. Before discussing performance practice of interactive music, it is helpful to review the basic characteristics of the most common interactive music software systems.

Interactive music software can be divided into two groups: *object-oriented* and *linear*.[40] Object-oriented interfaces, such as Max/MSP and its open-source counterpart Pure Data (Pd), are visually oriented and have graphical objects that can be manipulated and connected.[41] Max/MSP and Pd are also referred to as graphical patching languages, since the visual component emulates

[39] Charles Dodge and Thomas A. Jerse, *Computer Music: Synthesis, Composition, and Performance* (New York: Schirmer, 1997), 413.
[40] Ivica Ico Bukvic, "RTMix – Towards a Standardised Interactive Electroacoustic Art Performance Interface," *Organised Sound* 7 (December 2002), 276-278.
[41] Ibid., 276-278.

the patch cords that historically connected various components of a modular analog synthesizer.[42] In fact, the software for a specific piece is often referred to as a "patch," referring to the "collection of interconnected objects."[43] Linear interfaces, such as Csound, involve a programming language with lines of code, making them less accessible for people unfamiliar with line-level programming.[44] The graphical, object-oriented languages allow composers and performers to create and use interactive music software with less technical expertise required.

Robert Rowe has written extensively about his program Cypher, another system with a graphical user interface. Cypher is a performance-driven system that has a "listener," which analyzes musical input by using MIDI data, and a "player," which creates and plays back musical material.[45] According to Chadabe, the listener can analyze "register, dynamics, vertical density, horizontal density, and articulation."[46] The result is a virtual musical partner with a certain level of artificial intelligence. George Lewis has achieved similar traits with his Voyager program, although Voyager is intended for use in improvisational contexts, while Rowe uses Cypher along with notated pieces such as his *Shells* for tárogató or bass clarinet and computer.

Carla Scaletti's Kyma also has a graphical user interface, although it provides "multiple ways to view and manipulate data."[47] Created in 1986, Kyma is different from most other software for interactive music in that it also has a hardware component for fast, efficient audio processing. Up until the early 1990s, external hardware was necessary for processing due to the limitations of personal computers; now, real-time digital signal processing can be achieved with

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[42] Keislar, "A Historical View of Computer Music Technology," 27.
[43] Rowe, *Interactive Music Systems,* 26.
[44] Bukvic, "RTMix," 276-278.
[45] Rowe, *Interactive Music Systems*, 39.
[46] Chadabe, *Electric Sound*, 314.
[47] Carla Scaletti, "Computer Music Languages, Kyma, and the Future," *Computer Music Journal* 26 (Winter 2002), 73.

the processors on a common laptop.[48] However, Kyma continues to offer a system with a hardware component now called the Pacarana (formerly the Capybara). This system's powerful processing and flexibility make it the software of choice for many interactive composers, despite its considerable price (currently $4402 for a professional Kyma X system).[49]

Summary

Based on the reviewed literature in this chapter, it is clear that interactive music has a unique history—and a burgeoning tradition of its own—that can inform performances of this music. The new possibilities for sound production and composition are exciting, but bring about new challenges for performers. In addition to the software discussed above, interactive music is being created with a variety of other programs, such as C++, Chuck, and SuperCollider, not to mention the many earlier software systems that have already become obsolete. These new technologies have rapidly developed, and with them, new concepts and terminology. In a genre with so many new ideas and such confusion of traditional musical roles, how should performers approach their new set of tasks? What knowledge and skills are necessary for performance of interactive music? The next chapter is dedicated to answering these questions.

[48] Bukvic, "RTMix," 276.
[49] Symbolic Sound Corporation, *Symblic Sound Kyma*, 2010 [online].

CHAPTER 3

PERFORMANCE PRACTICE OF INTERACTIVE MUSIC

The following chapter will explore the performance practice of interactive music with an emphasis on common problems and potential solutions for performers. The conclusions and recommendations presented here are supported by review of the relevant literature and interviews with performers who specialize in interactive music.

Description of Interview Process

In order to gather information about performance of interactive music from professionals in the field, an interview process was undertaken. First, a list of clarinetists who perform interactive music was compiled based on published recordings, recommendations from colleagues, and performer repertoire information gathered from online sources. The list was limited to clarinetists from or working in the United States, for ease of communication as well as lack of reliable information about clarinetists who perform interactive music in other parts of the world. Twelve performers were contacted via e-mail to ask for their participation, and of these nine responded. The interviews were conducted in the form of an online questionnaire created using Google Forms, which required the survey to be completed in a single session. All respondents gave permission to use their names and publish their responses. Results were collected over the course of several weeks, and then each performer received a copy of his or her responses to allow for editing, if desired.

The following performers completed the interviews:

- Burton Beerman (Bowling Green State University; composer and clarinetist)
- Laura Carmichael (USA/The Netherlands; composer, solo artist and member of Duo X)

- F. Gerard Errante (Norfolk State University professor emeritus; composer, solo artist and member of Clarion Synthesis)
- D Gause (College of Southern Nevada; member of Clarion Synthesis)
- Marianne Gythfeldt (Norway/University of Delaware; solo and chamber artist)
- Esther Lamneck (New York University; solo artist and member of the Tornado Project)
- Michael Lowenstern (Manhattan School of Music; composer, solo bass clarinet artist)
- Pat O'Keefe (University of Wisconsin – River Falls; solo and chamber artist, member and artistic director of Zeitgeist)
- Joseph Butch Rovan (Brown University, composer and clarinetist)

Additional information about the interactive music performance experience of each clarinetist can be found in Appendix A, which includes the full text of the interview responses.

Introduction

Discussions of performance practice typically seek to explain aspects of a style or genre that may be unfamiliar to those outside of the tradition, and to instruct performers on how to realize the work as the composer originally intended. For works in the Western music tradition of the past several hundred years, performance practice is primarily concerned with historical context and interpretation of a written score, and the focus is on decoding the notation as well as understanding the variations of rhythm, ornamentation, timbre, and expression that are not notated.

The performance practice of interactive music begins with the score, but extends into the realms of software and hardware, personal relationships and collaborations of living people, aesthetic values of electroacoustic music, and physical considerations. Interactive works often

charge the performer with control of many different factors, including form, motivic material, pacing and coordination with the computer, and creation and manipulation of acoustic and electronic sound. Violinist Mari Kimura's opinion, also expressed by several of the clarinetists interviewed, is that "a performer is accountable for *all* the sound that the audience hears—even the electronic sounds that might not be directly under the performer's control."[1] And Pennycook has noted the variety of roles of the performer: "The player becomes conductor, system manager, console and lighting operator, and in some cases originator and manipulator of the musical materials of the work."[2] These responsibilities are foreign to performers who are accustomed to interpreting works of the eighteenth and nineteenth centuries, and go well beyond even what most twentieth-century composers asked of performers. Such variety of responsibilities merits a unique approach to performance practice for the genre of interactive music.

F. Gerard Errante, one of the foremost authorities on music for clarinet and electronics, has described the clarinet as "particularly well suited" for combination with electronics, due to its range, flexibility, and variety of sound possibilities.[3] A number of American clarinetists are frequent performers of interactive repertoire, and these specialists were a valuable resource in the formation of the ideas about performance practice presented here. While the following discussion is rooted in the experiences of clarinetists, it is relevant for all instrumentalists and vocalists, and much of it is applicable to music for instrument and tape as well as interactive music.

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[1] Mari Kimura, "Performance Practice in Computer Music," *Computer Music Journal* 18 (Spring 1995), 65

[2] Bruce Pennycook, "Live Electroacoustic Music: Old Problems, New Solutions," *Journal of New Music Research* 26 (1997), 72.

[3] F. Gerard Errante, "Electro-Acoustic Music for the Clarinet - Part I," *ClariNetwork* (Fall 1984), 14.

In the literature, the challenges of performing interactive music have been mentioned in sources about interactive composition, and explored in more detail by performers such as Errante,[4] flutist Elizabeth McNutt,[5] and violinist Mari Kimura.[6] It seems that performers either specialize in interactive music (in which case they have much experience and little need for a guide) or avoid it completely. It is hoped that this discussion will fill the void, serving as a resource for performers who wish to try interactive music and offering new perspectives and solutions for experienced performers. These performance issues range from the practical to the abstract, and may at times seem overwhelming. The discussion, though, is intended to present potential solutions as well as problems, and decisions along with their potential ramifications, in the hopes that interactive music can become more accessible to performers and more engaging for audiences.

This discussion of interactive music performance practice covers the following topics:

- Notation and instrumentation (score, interface, and instrumentation)
- Technology (hardware, clarinet equipment, amplification, loudspeakers, software, coordination and control of computer)
- Composers and collaboration (collaboration, obsolescence)
- Interpretation (sound and space, expression, algorithmic composition, audience perception, form and structure, improvisation)
- Rehearsal, performance, and recording (rehearsal, venue, recording)

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[4] F. Gerard Errante, "The Electric Clarinet: Part II," *The Clarinet* 32, no. 3 (June 2005), 68-71.
[5] Elizabeth McNutt, "Performing Electroacoustic Music: A Wider View of Interactivity," *Organised Sound* 8 (December 2003), 297-304.
[6] Kimura, "Performance Practice"; Mari Kimura, "Creative Process and Performance Practice of Interactive Computer Music: A Performer's Tale," *Organised Sound* 8 (December 2003), 289-296.

Notation and Instrumentation

The Score

The notation of interactive music has many of the same elements as much twentieth-century music: performers must read and understand graphic notation, complex rhythms, extended techniques, nonlinear structures, and more. The problem of notation of the computer part, though, is unique to interactive music. Elizabeth McNutt described the situation as follows:

> Performers need to have a reasonable idea of what sounds they will hear and how to work with them, yet explanations of the technology involved seldom accomplish this goal. Scores of electronic music are often vague about the sounds and relationships they represent, or else explain them in terms most useful to engineers.[7]

How should composers notate the electronics, especially when they vary from performance to performance?

Least helpful to the performers interviewed were scores in which little to no information about the computer part is given, which is often the case in interactive music as revision (or even completion) of the software can be in ongoing even after the performer receives the instrumental part. When the computer part is notated, it may appear as staff notation, graphic notation, or text descriptions of computer activity. From the interviews, it appears that performers do not have a strong preference for any one method of notation, but prefer the method or combination of methods that is most clear and useful for each individual piece.

Several systems have been developed for graphic notation of electronic sounds, for purposes of documentation and analysis. Building on the procedures of graphic notation for acoustic music that were established earlier in the twentieth century, efforts have been made to notate electronic sounds using shapes and symbols. Denis Smalley's "spectromorphology," first described in 1986, is a method of graphically depicting the pitch and timbre of sounds as they

[7] McNutt, "Performing Electroacoustic Music," 298.

change through time.[8] This idea continues to be developed by researchers such as Kevin Patton, who has created a standardized system of "morphological notation" for interactive music.[9] Other useful methods include staff notation of pitched material and verbal descriptions of computer actions and processes. Composer and clarinetist Joseph Butch Rovan also mentioned the difficulty of notating physical gestures, which are sometimes used along with sensors as a method of controlling the computer in interactive music. Composers and analysts have yet to agree on a single universal system, but notation of electronic music is currently a topic of much discussion and research.

Several performers made a distinction between the complete score and the performance part. Laura Carmichael explained, "I like to have a study score with as much information as possible in it. My performance score may be much more sparse or condensed for fewer page turns." Creation of a performance score is an important step that composers often do not consider. A complicated stage setup with pedals may require a performer to remain stationary, using only one or two stands; but too many page turns can be burdensome, and there is always the possibility of accidental amplification and processing of page noise. The musical end result will benefit from a condensed performance part with only crucial cues and information, and performers are often willing to work with the composer in the creation of such a part.

Further complicating the situation is the fact that there may not be a definitive, published "score" for a given piece. Because composers often work in collaboration with performers to create interactive works, scores frequently lack information that may have initially been

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[8] Denis Smalley, "Spectro-morphology and Structuring Processes," In *The Language of Electroacoustic Music*, ed. Simon Emmerson (New York: Harwood Academic Publishers, 1986), 61-93.

[9] Kevin Patton, "Morphological Notation for Interactive Electroacoustic Music," *Organised Sound* 12 (August 2007), 123-128.

transmitted in person or through e-mail. Both the score and software may undergo constant revision, not just for updating outdated technology but even for individual performances, as hall acoustics or changes in equipment may require last-minute revisions of software. Performance materials are rarely published and usually must be obtained directly from the composer, who may or may not be prepared to assist a new performer with learning and performing the piece. These issues can be addressed through better documentation, more instructive technical notes, and increased availability of performance materials online, including not just the score and software, but also audio and video recordings and diagrams of wiring and stage setups.[10] Pennycook has asserted that if interactive works are to become more mainstream, "it is incumbent upon the composer to prepare high quality performance materials which simplify and streamline the learning process."[11]

The Interface and Software

In interactive music, the notated score often only tells part of the story; the rest of the "score" is often hidden inside of Max patches and lines of code. The program for a given piece may be incomprehensible to a performer unfamiliar with the inner workings of the software—or it may even be incomprehensible to everyone but the composer. The interface (the main software screen used to run the program) can range from being extremely intuitive and accessible to nonexistent. In addition, the variety and complexity of software systems discussed in Chapter 1 encourage composers and performers to specialize in only one system. According to Bukvic,

> To this day, the lack of a comprehensive, standardized and easy-to-use interface has made it not only difficult for composers to work within this medium without being hindered by technical limitations, but has also warranted a lack of transportability and

[10] Pennycook, "Live Electroacoustic Music," 81.
[11] Ibid., 74.

> performability, as well as stalled development of any kind of aesthetics upon which an interactive work could be criticized.[12]

Due to the pervasive use of systems such as Max/MSP, Pd, and Kyma, it appears that such standardization is yet to be achieved. Interactive music composers continue to embrace new software, and it appears possible that the future may actually bring increased variety of systems with better compatibility *between* systems, rather than a single standardized system.

There are several steps composers can take to create a pleasant and functional interface, regardless of the software used. Winkler outlined seven principles of interface design:

> 1. Design for the activity of the user (not the capability of the machine).
> 2. Isolate and display relevant information.
> 3. Have easy and logical access to controls needed at the moment
> 4. Hide undue complexity; show only what counts.
> 5. Make it intuitive, using obvious gestures, images, or words.
> 6. The computer should respond naturally to user input.
> 7. Know the user. Think of the user's experience while running a program, considering experience, training, and psychology.[13]

These principles may seem obvious, but composers are often more intent on musical issues and basic functionality than on appearance and usability, especially if they assume that they will be the only person to use the software. A small amount of attention to the user interface can make a world of difference to the performer or technician who attempts to rehearse and perform an interactive piece.

Instrumentation

Most interactive works are scored for a solo instrument and computer, and for good reason. First, with each additional performer the logistics of performance (equipment, rehearsal, etc.) become more complex. Second, the sheer density of sound produced by multiple performers with live sound processing has the potential to become overwhelming and chaotic.

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[12] Bukvic, "RTMix," 276.
[13] Winkler, *Composing Interactive Music*, 111.

The computer allows the solo performer to become polyphonic, reducing the necessity of other performers.[14] Still, some composers and performers have successfully explored the possibilities of having two or more performers interact with the computer. The Tornado Project (Elizabeth McNutt, flute, and Esther Lamneck, clarinet) and Clarion Synthesis (F. Gerard Errante and D Gause, clarinets) have both commissioned multiple works for two performers and computer. Also, large ensembles can work well in improvisational contexts as long as appropriate control structures are designed.[15]

Some solo interactive works have flexible instrumentation, so the solo instrumental part can be performed without the electronics if desired (such as the works of Silvio Ferraz, for example).[16] Roger Reynolds has created multiple versions of his interactive percussion piece *Watershed*, including a version with chamber orchestra and a solo interactive percussion version with or without spatialization. Chapman Welch's *Moiré* is written for solo clarinet, computer, and optional supporting ensemble, allowing the performer to play alone with computer if it is not feasible to include the ensemble. Such flexibility of instrumentation can encourage more performances and reduce logistical challenges.

Technology: Hardware, Software, and Equipment

The technology involved in interactive music presents a significant challenge for performers, and it is the factor that deters many from approaching the genre. In a complex system of hardware and software, technological concerns have the potential to overshadow the

[14] Simon Emmerson, *Living Electronic Music* (Aldershot, Hants, England: Ashgate, 2007), 113-114.
[15] Rowe, *Machine Musicianship*, 308-310.
[16] Xenia Pestova, "Models of Interaction in Works for Piano and Live Electronics" (D.M.A. diss., McGill University, 2008), 26.

music. McNutt found that dealing with technology can "interfere" with the performer's ability for musical expression,[17] and Bukvic expressed the valid concern that complex technology may obscure or distract from the artistic merit of the work itself:

> [C]urrently a large number of interactive installations are like gargantuan home-made contraptions put together with 'Scotch' tape, and whose operability itself is impressive enough, something that can potentially overshadow the fact that the contraption may not be doing anything remarkable, other than 'not break.'[18]

The goal of this examination of hardware, software, and equipment, is to find potential solutions to the problems of dealing with technology, and discuss ways in which the performer can work with technology to perform authentic and musical realizations of interactive pieces.

Basic Setup

The basic hardware requirements for interactive music include a computer, an audio interface, a microphone, a pedal, and several cables. Among the clarinetists interviewed, most mentioned using a MacBook Pro with a MOTU interface, either a MOTU 828 or MOTU UltraLite. Most also mentioned at least one pedal for triggering cues, and some use other effects pedals as well. Several considered a mixer to be a part of their basic setup, while others preferred to send the signal to the mixing console of the performance hall. Michael Lowenstern and Laura Carmichael both mentioned using a touchscreen interface like an iPad or iPhone to wirelessly control the computer. Violinist Mari Kimura has also written about her "one touch" setup to minimize the visual distraction of operating the computer onstage.[19] As wireless capabilities improve, performers may increasingly choose to use wireless microphones and interfaces so that the technology can be more seamlessly integrated into the performance. The

[17] Elizabeth McNutt, "*pipe wrench*: A Recording of Music for Flute and Computer" (D.M.A. diss., University of California, San Diego, 2000), 15.
[18] Bukvic, "RTMix," 277-280.
[19] Kimura, "Creative Process and Performance Practice," 289.

cost of a high-quality setup for interactive music can be high; as an alternative to purchasing the gear, performers may be able to use the composer's equipment or collaborate with a sound engineer at their college or university.

Clarinet Equipment

For the most part, the clarinetists interviewed did not make major changes to their clarinet equipment to play interactive music. The main consideration is amplification, which will be discussed in more detail below. F. Gerard Errante, D. Gause, and Burton Beerman have utilized a specialized barrel with a contact microphone, to improve the accuracy of the signal sent to the computer for pitch tracking. Beerman mentioned using plastic reeds so that the instrument can be set up ahead of time, and Errante stated that he uses an AMT microphone mounted on a Yamaha bell, and switches to a Backun bell for acoustic pieces. Marianne Gythfeldt plays on a lighter instrument to compensate for the added weight of the microphone when attached to the clarinet; the use of a neckstrap could presumably be an alternate solution to this problem. Amplification also causes Gythfeldt to choose lighter reeds and Lowenstern to play on a darker sounding wooden bell for bass clarinet. Both of these equipment decisions probably derive from the reduced need for projection of sound when using amplification, although Esther Lamneck noted that performing with electronics contributed to her decision to perform with a more open mouthpiece facing for a bigger sound.

Software

Software is integral to performance in interactive music, but advanced technical training is often needed to achieve proficiency at a program like Max/MSP. Given that most performers lack experience with software programming, what level of familiarity should performers be expected to have with the software for the works they perform? Many of the clarinetists

interviewed were also composers who primarily perform their own works, so they described themselves as very proficient with the software. Others had limited knowledge of the software, but expressed a desire to learn more. However, performers tend to have many other concerns that leave little time for learning about programming software, as Pat O'Keefe expressed:

> Being really skilled with that element, especially the various software, is like mastering another instrument, and a very complicated one. … it is enough for me, in my life, to continue to work to master the various instruments and musical styles that I already play, so I leave the mastering of the computer to collaborative partners.

Composer Cort Lippe has suggested that performers should understand the *possibilities* of different kinds of interaction, but ultimately be free to concentrate on musical issues during performance.[20] Familiarity with the functioning of the software can surely enhance a performer's understanding and interpretation of an interactive piece, but detailed technical knowledge is not necessary.

As was discussed in the previous chapter, Max/MSP is the most popular software for interactive music composition. All nine of the clarinetists interviewed had used Max/MSP, five had used Kyma, and two had used Pure Data (Pd). Other software was only mentioned by one user: Cypher, Keykit, Ableton Live, LiSA, and SuperCollider. The cost of software can be an issue, especially when a performer simply wishes to perform a piece, not to edit, but alternatives to purchasing the software do exist. Many potential performers of interactive music are students or faculty at universities where they may have access to the necessary software and hardware through the composition department. Pd is available for free, and is an increasingly popular choice for that reason. Also, a "runtime" version of Max is available for free, allowing the user to run the patch for performance, but not to make changes.

[20] Lippe, "Real-Time Interaction," 5.

One software consideration specific to Max/MSP is the specification of signal vector and I/O vector size, which indicates the sampling rate and processing for the piece. In examination of the works for clarinet and computer in Chapter 3, it was found that this specification may or may not be hard-coded into the software for each piece, causing issues when transitioning from piece to piece. This specification, if not set correctly, can cause the piece to function incorrectly or not at all. To eliminate this problem, the composer should hard-code this value into the software, or provide it in a technical note.

Microphones and Amplification

When performing interactive music, the live instrument sound is usually amplified to achieve the best blend with the electronics and balance of output levels. Another function of the microphone is to gather input for the computer for the purposes of score following or processing. Amplification and microphone selection are of utmost importance in interactive music, and the performer must be prepared to make informed decisions on these issues. Stockhausen emphasized this responsibility: "A bassoonist should know how and where his bassoon is best picked up by microphones. … As a musician, you must assume responsibility for how you sound when recorded."[21] It might be added that the performer is also responsible for the sound when it is amplified, processed, and played back through loudspeakers. This skill can be refined through work with sound engineers and experimentation with different methods of amplification.

In an earlier publication, F. Gerard Errante identified three methods for amplification of the clarinet sound: 1) a freestanding microphone, which may not pick up all notes equally due to the acoustics of the clarinet, 2) a condenser microphone attached to the clarinet—he recommended two microphones on gooseneck clips with one over the middle of the clarinet and

[21] Karlheinz Stockhausen and Jerome Kohl, "Electroacoustic Performance Practice," *Perspectives of New Music* 34 (Winter 1996), 72.

one over the bell, and 3) a contact microphone inserted into a modified barrel.[22] Each of these methods has its advantages. The freestanding microphone may be more susceptible to feedback problems, and may produce an uneven sound, but it allows the performer to vary proximity to the microphone for balance or expressive purposes. The most popular microphone among the clarinetists interviewed was a clip-on condenser microphone (or double microphone) made by AMT. These condenser microphones can provide an even sound over the range of the clarinet or bass clarinet, but do add weight to the instrument. For situations where pitch tracking or processing is of critical importance, a contact microphone may be the best choice. This requires modification of a barrel or mouthpiece to insert the microphone directly into the air column. The most popular contact microphone among clarinetists was the Barcus Berry barrel microphone, which was developed with assistance from Errante. It is no longer in production, although other barrel microphones by Poulath and Josephson (in development) may achieve similar results. Laura Carmichael described why different microphones may work better for different pieces:

> If the sound coming out is very processed, in other words, we do not hear the clarinet as a clarinet so much anymore, then having close dynamic mics with plenty of gain on them can be reliable while preventing feedback issues.
> If we want to amplify the clarinet in as "beautiful and pure" a way as possible, preserving the integrity of the acoustic sound and mixing it with processing, then it's important to have a high-quality microphone(s).

Another option mentioned by Errante and used with success by the author is a single lavalier-type condenser microphone clipped to the shirt at about the level of the thumbrest.[23] With a high-quality omnidirectional lavalier microphone, this method provides freedom of movement, an even sound with minimal worries about feedback, and does not require modifications or additions to the instrument. Any type of wireless microphone allows mobility

[22] F. Gerard Errante, "The Electric Clarinet: Part I," *The Clarinet* 32, no. 2 (March 2005), 68.
[23] Ibid., 68.

and reduces the possibility of cables crackling when moved or interfering with finger motion.[24] Also, some works, such as Russell Pinkston's *Gerrymander*, call for two microphones, an "air mic" for live recording (sampling) of the clarinet during the performance, and a contact microphone for accurate pitch tracking.

McNutt summarized the problem of microphone technique as follows: "Performers of acoustic instruments are rarely trained to work with microphones: so-called 'mic technique,' the ability to use the microphone effectively, is gained only through practice and experience."[25] The microphone, when used with finesse, can be a powerful tool for expanding sound and making very quiet sounds audible. It can also surprise and disorient performers through "disembodied" sound and amplification of "private" sounds such as breathing and key noise.[26] With experience, performers of interactive music can learn how to use the microphone to extend and reinforce the sound of the acoustic instrument.

Loudspeakers and Monitors

There are two primary approaches to loudspeaker placement for interactive music. The first approach derives from the tape music tradition, and uses sound reinforcement of the acoustic instrument in an attempt to recreate the studio sound for the performance hall.[27] In other words, the focus is on providing a stereo (or multiple channel) image in the hall, with balance between the electronic sound and the amplified acoustic sound. With this approach, the performer will typically need a monitor speaker (a speaker pointed toward the performer and away from the audience) as the main speakers are typically situated in front of them and pointing

[24] F. Gerard Errante, "The Electronic Clarinet," *The Clarinet* 17, no. 3 (May/June 1990), 18.
[25] McNutt, "*pipe wrench*," 7.
[26] McNutt, "Performing Electroacoustic Music," 298
[27] Pierre Alexandre Tremblay and Scott McLaughlin, "Thinking Inside the Box: A New Integrated Approach to Mixed Music Composition and Performance," in *Proceedings of the International Computer Music Conference* (2009), 379-386.

away.[28] Drawbacks to using a monitor include lack of control over monitor levels, and the potential for feedback.[29] Kimura recommended that the monitor be placed at an angle rather than positioned directly towards the performer to avoid hurting the performers ears with "an accidental blow of high-volume sound."[30]

The second approach takes inspiration from chamber music, in which the performer is immersed in the sound of the ensemble. This approach is described by both Pennycook and Emmerson, and calls for the speakers to be set onstage with the player, so that the performer has increased control of balance with the electronics, and the sound emanates directly from the performer.[31] With this method, the performer may not need to be amplified. Tremblay and McLaughlin have experimented extensively with loudspeaker placement for interactive music, and they proposed that to emulate the acoustic chamber music experience, loudspeakers should radiate sound rather than be directional, and their placement should be near or behind the musician(s).[32] For the audience, this method also achieves a more even sound throughout the hall, and allows the instrumental sound to emanate from the performer, rather than dislocating the sound to speakers on the extreme left and right of the stage.

Each method may be appropriate depending on the individual piece. Either way, the performer should be aware of the ramifications of loudspeaker placement. Loudspeakers are equal in importance to microphones, because an inappropriate playback system can negate the good qualities of even the best microphones.

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[28] This method is also commonly used in the performance of rock music.
[29] McNutt, "*pipe wrench*," 7-8.
[30] Kimura, "Performance Practice," 69.
[31] Pennycook, "Live Electroacoustic Music," 79; Emmerson, *Living Electronic Music*, 95.
[32] Tremblay and McLaughlin, "Thinking Inside the Box," 379-386.

Coordination and Control

In interactive music, coordination between performer and computer can be achieved through many different means. Score following algorithms (procedures for computer listening), performer listening, cues from the technical assistant, cues from the performer (via pedal), visual feedback from the computer screen, stopwatch timing, or any combination of these methods may be used. Sometimes the decision about whether to use a pedal or a technical assistant to cue the computer is left up to the performer; and a patch that calls for one method can often be easily altered to use another. Therefore, performers should be aware of the various coordination methods and how they can be used in interactive music.

Among the interviewees, one of the most popular methods of coordination with the computer was score following, in which the computer listens for pitch, tempo, and/or dynamics and uses that information to advance itself through the score. Many remarked that the use of score following was "freeing," but also unreliable. Score followers based on pitch are notoriously problematic, due in part to the complexity of the harmonic spectrum.[33] Score followers can also have difficulty functioning when confronted with extended techniques such as multiphonics, or the inevitable human error during performance.[34] The comments of Puckette and Lippe, who did important work on score following in the early 1990s, do not exactly inspire confidence in the technique:

> Even if the score follower always works in rehearsals, a musician is not infallible. It is essential that someone be on hand to follow both the musician's playing and the computer's following during a performance, ready to intervene if and when the performer and computer fall out of synchronization.[35]

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[33] Dodge and Jerse, *Computer Music*, 413.
[34] Miller Puckette and Cort Lippe, "Score Following in Practice," in *Proceedings of the International Computer Music Conference* (1992), 182-5.
[35] Ibid., 183.

When performing interactive music that uses score following, there may be a need to adjust the tone or volume for the computer "listener," and to focus on playing perfectly rather than musically.[36] Due to these issues, most interactive works use score following in combination with other methods, such as pedals or a technical assistant.

Executing cues through use of a foot pedal gives the performer more control over the piece, but presents another set of issues to contend with. In the interviews, performers generally liked the control given by the pedal, and the opportunity to create "dramatic musical timing." Pedaling can even bring an expressive physical element to the music.[37] However, it can be a challenge to operate pedals while attempting to execute technically demanding passages, and pedaling can upset the balance of a standing performer. Violinist and composer Mari Kimura stated that she refuses to use foot pedals due to physical awkwardness and visual distraction, arguing that use of a pedal undesirably telegraphs musical changes to the audience.[38] Conversely, the pedaling action may be even more distracting when there is *not* an audible change in the music after a pedal cue, as is often the case. Also, the player may accidentally hit the pedal twice, or miss a cue entirely,[39] in which case they may have to get visual data from the computer screen to deduce what happened and fix the error – all the while continuing to play the piece. In general, however, pedaling is a good solution for most performers, as long as it is used sparingly and with attention to visual impact.

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[36] McNutt, "*pipe wrench*," 13; 27.
[37] Jean Penny, "The Extended Flautist: Techniques, Technologies and Performer Perceptions in Music for Flute and Electronics" (D.M.A. diss., Queensland Conservatorium Griffith University, 2009), 104.
[38] Kimura, "Creative Process and Performance Practice," 289.
[39] Miller Puckette and Zack Settel, "Nonobvious Roles for Electronics in Performance Enhancement," in *Proceedings of the International Computer Music Conference* (1993), 136.

A good technical assistant can correct pedal or score following errors as they occur. Referred to variously as "sound engineer," "sound projectionist," "technologist," or "collaborative partner," the technical assistant also often serves as the ultimate arbiter of sound in the hall, mixing the levels and making adjustments during the piece if necessary. Performers were divided on the use of a technical assistant; Errante said, "I think it essential that the performer be able to handle all aspects of the presentation," while Pat O'Keefe felt that it depended on the performer:

> Performers like Michael Lowenstern, who are comfortable working as a solo act, will be easily capable of handling everything by themselves from the stage. Many other players won't be, so for them an assistant is best.

Even when a performer handles everything from onstage, an assistant is usually necessary to mix sound for the hall (except perhaps if the loudspeakers are placed onstage as in Tremblay and McLaughlin's "chamber music" model). According to Carmichael, the performer must then consider some important questions about the technical assistant:

> Can they read a score if it's necessary to control something from the hall? Can they run a mixer, do I trust their musical instincts, do they know/understand the kind of music I'm playing and what its sound concept is?

The "sound projectionist" for electroacoustic music, as described by Stockhausen, should have the skills of a conductor, and must "have learned his craft through long years of recording, mixing, rehearsing, and performing electroacoustic music."[40] It can be difficult to find someone with such a diverse skill set. Rather than leave themselves at the mercy of the staff in each venue, one solution is for performers to tour with a trusted technical assistant, in the tradition of acoustic performers who travel with a piano accompanist. Another highly desirable option (as indicated by the interviews) is to have the composer present to run the piece. Lamneck and

[40] Stockhausen and Kohl, "Electroacoustic Performance Practice," 83.

O'Keefe both saw the composer as a potential live collaborative partner, who can "perform" the electronics and make changes on-the-fly.

In summary, many of the players interviewed preferred to control all aspects of the performance themselves, from onstage, through score following or pedaling, with the possible exception of a sound engineer mixing in the hall. Less popular were methods of coordination that require the player to get visual data from a stopwatch or computer screen; these were seen as "cumbersome," but possibly useful in some situations. The use of a technical assistant was ideal for many performers, but only if that person is the composer or a skilled and trusted musician and sound engineer.

Composers and Collaboration

Collaboration

Interactive music is often created through collaboration between a composer and a performer. In this music, communication is necessary to even put the piece together—a performer cannot just purchase the sheet music in a store, take it home, and prepare it without assistance. The nature of interaction itself encourages communication and collaboration. Composer Paul DeMarinis wrote the following about developing an interactive instrument: "The process of making interactive art needs to be interactive. When you're making an interactive piece, you have to test it out, to continuously interact with the people who'll be using it interactively."[41] In his most recent article about music for clarinet and electronics, Errante wrote

[41] Chadabe, *Electric Sound*, 224.

that composer Andrew May views the score for interactive music as "a blueprint for a living relationship between composers and performers, the terms of which are constantly evolving."[42]

Performers of interactive music tend to embrace the spirit of collaboration in creating an interactive work. Pat O'Keefe encouraged performers to speak up: "I believe that performers have plenty to offer on the creative side of things, so I'm never shy about making suggestions, comments, and criticisms to the composer." Indeed, performers will often make a significant artistic contribution to an interactive piece. Laura Carmichael describes a successful collaboration in detail:

> Just recently Cindy Cox finished a piece for me for bass clarinet and live electronics. I asked her to try to include several elements: text, and the possibility that the piece could be constructed in such a way that I would not have to be glued to the score, so that I can move in the performance space. We looked at several possibilities, and eventually she made a piece with a modular construction in which I improvise on set material and musical ideas, which we developed together in a lot of rehearsals. She also spent six hours recording me for use of samples. Additionally, we talked a lot about what music we both liked, and what kind of atmosphere and energy I'd like to have in the piece. Grissey turned out to be a big common interest, and became a kind of musical reference for the piece. I asked for something between 6-10 minutes, and she accommodated all these requests in the end.

From the experiences of the clarinetists interviewed, it appears that successful collaboration with composers requires good communication, mutual respect, meeting in person as much as possible, and openness to experimentation. By seeking out opportunities for collaboration, performers can help to create interactive works that are tailored to their strengths and creative direction.

Obsolescence

In his presciently titled article "Who Will Turn the Knobs When I Die?," composer Bruce Pennycook commented that in the "vast majority" of interactive works, "few performances have

[42] Errante, "The Electric Clarinet: Part II," 54.

occurred without the presence of the composer."[43] Luckily, most composers of interactive music are still living, and they are happy to attend performances and respond to e-mails from performers with questions about their works. They can update their Max patches to the newest version of the software upon request, modify their program to work with new hardware, and fix software issues as they occur. One of the major considerations of performing interactive music (and all electroacoustic music) is how to ensure that these pieces can continue to be performed in the future, despite constantly evolving technology and the inevitable passing on of the composer and original performer. Clarinetist David Wetzel has proposed a model for the conservation of interactive repertoire that involves text descriptions and diagrams of "the functions, human-machine interactions, interactive and automated controls, synthesis and processing algorithms, and musical effects of the interactive system," independent of any proprietary software that may eventually be obsolete.[44] While the responsibility of preservation would seem to fall to the composers themselves (or perhaps musicologists), performers of interactive music should at least be aware of this situation. It would be most unfortunate if this growing body of interactive repertoire was allowed to fall into obsolescence.

[43] Bruce Pennycook, "Who Will Turn the Knobs When I Die?," *Organised Sound* 13 (December 2008), 199.
[44] David Wetzel, "A Model for the Conservation of Interactive Electroacoustic Repertoire: Analysis, Reconstruction, and Performance in the Face of Technological Obsolescence," *Organised Sound* 11 (December 2006), 275.

Interpretation

Interpretation is at the heart of the concept of performance practice, and the interpretation of interactive music begins with many of the same skills as in more traditional genres. McNutt wrote:

> In working with technology, I use my musical sense just as I would in any other type of chamber music: shaping and coloring phrases to suit the changing harmonies in the accompaniment; intensifying dramatic dissonances, suspending or prolonging musical tension; and moving faster if I feel my "ensemble" pushing me.[45]

Interactive music also involves elements not included in the "classical training" of most performers, such as improvisation, nonlinear form, and the historical tradition of electroacoustic music. An understanding of these elements can help the performer to make informed and creative decisions about the interpretation of interactive music.

Sound and Space

Electroacoustic music has its own aesthetic values that are likely unfamiliar to most performers. Timbre, texture, and space are often of greater importance than pitch and rhythm, and can be important aesthetic and structural elements in an interactive piece. A performer's familiarity with such elements (or lack thereof) can greatly influence the effectiveness of the resulting performance.

There is an apparent dichotomy in the sound world of interactive music for clarinet and computer: the computer allows for infinite variations in timbre and pitch, while the clarinet is anchored (by acoustics and tradition) to the twelve tones of the Western scale, played with a single fixed "clarinet" timbre. Indeed, instrument manufacturers and performers typically strive to achieve the most even timbre and intonation possible.[46] Composers may choose to exploit and

[45] McNutt, "*pipe wrench*," 16.
[46] Emmerson, *Living Electronic Music*, 104.

heighten the contrast between clarinet and computer, or they may strive for ambiguity and combination, by having the clarinetist use extended techniques to achieve a greater variety of timbre and flexibility of pitch. According to Horenstein, the sound possibilities of an acoustic wind instrument can be expanded through "increased use of throat movements, palette shifting, tongue placement, teeth position, oral cavity transformation, and embedded vocal effects."[47] These extended techniques for clarinet, as well as quarter-tone and multiphonic fingering possibilities, have been documented by Rehfeldt and Richards.[48] Collaboration with composers can provide an environment for performers to experiment with these techniques.

Amplification, processing, and other considerations can affect the performer's approach to sound. Amplification allows very quiet sounds such as breathing and key clicks to be heard and processed, opening up new avenues for expressivity. Its effects may also be undesirable at times; Carmichael related that to get a clean articulation might require using less air in the attack than in acoustic music, because of the audibility of the air noise. Burton Beerman mentioned that in interactive music, he uses vibrato more frequently, and incorporates styles such as klezmer and jazz into his playing. Interactive works range over a wide variety of styles including rock, jazz, classical, new age, and traditional music of various nationalities, so familiarity with (or willingness to explore) these styles is a great asset for the performer of interactive music.

In interactive music, the texture can become extremely dense and chaotic at times, due to the layers of computer sound and processed instrumental sound. The performer may feel

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[47] Stephen Horenstein, "Interactive Works: New Problems and Potentials," in *Proceedings of the International Computer Music Conference* (1995), 165.
[48] Philip Rehfeldt, *New Directions for Clarinet* (Lanham, MD and Oxford: The Scarecrow Press, Inc., 1994); E. Michael Richards, *The Clarinet of the Twenty-First Century* (Clinton, NY [Hamilton College]: by the author, 1992).

insignificant or powerless, and Horenstein has suggested that deep concentration and "enhanced hearing" could alleviate such feelings.[49] Steven Schick, renowned interpreter of new music for percussion, described this problem of "information management" in George Lewis' *North Star Boogaloo*: "It pushes the percussionist towards a multifaceted interpretation in order to bridge the large number of disparate elements in the piece."[50] In such dense textures, the performer should attempt to develop an idea of how many things are happening in each moment, and how the elements are related.[51]

Another potentially disorienting feature for the performer is spatialization. In interactive music, as with computer music in general, sound is often diffused through an array of speakers to manipulate the spatialization of the sound. This diffusion is achieved by using multi-channel audio, and sending the different channels to different speakers to "position a sound in the perceived space."[52] Diffusion can even be performed live by a sound engineer at the mixing board. Thus, performers are confronted not only with an amplified version of their sound, but one that may be moving around the room. For the audience, this has the effect of dislocating the performer's sound from the visual image of the performer onstage. The performer must contend with this extra layer of manipulation of sound, although they cannot hear it through the monitor. In some cases, the performer even has the responsibility for decisions about spatialization, such as in Mario Lavista's *Canto del alba*:

> The composer suggests light amplification, leaving the system of diffusion up to the performer. A surround system would give a feeling of actually being in the forest space;

[49] Horenstein, "Interactive Works," 165.
[50] Steven Schick, *The Percussionist's Art: Same Bed, Different Dreams* (Rochester, NY: University of Rochester Press, 2006), 73-74.
[51] Ibid., 194.
[52] Keislar, "A Historical View of Computer Music Technology," 17.

> a detached sound field would invoke a more separate space, distant from the listener, belonging only to the player.[53]

If a piece calls for spatialization, the performer (and/or technical assistant) may wish to experiment in a hall with four or more speakers to determine the effects of different diffusion techniques.

Interaction as a Means for Expression

The dynamics between the live performer, the manipulated sound of the acoustic instrument, and the computer-generated sound provide a new means for expressivity.[54] Laura Carmichael described some possibilities for expressive decisions in interactive music:

> Just like when you are playing with a piano, you may try to evoke bells, or singing, or a percussive counterpoint, when playing with electronics, you may need to expand your sense of musical function. Are you foreground or background? Should you be overpowered here, or fight for it? Is the articulation meant to be very harsh so you should make that even stronger? What is the character of the music, what are the references?

Similarly, McNutt described interpretive decisions such as "omitting vibrato during delay loops to produce a 'smoother' sound" and "carefully articulating and separating events during live sampling for maximal clarity."[55]

Awareness of the sound processing and the computer actions can be crucial to such decisions about interpretation. No professional would attempt to perform a concerto or sonata without basic knowledge of the score; in interactive music, according to Pestova, performers should "approach learning the electronic part in the same way as learning the orchestral part of a concerto or the parts of his or her chamber music partners."[56] Much of the "score study" in interactive music can be accomplished by playing through the piece with electronics, making

[53] Penny, "The Extended Flautist," 61.
[54] Ibid., 43.
[55] McNutt, "Performing Electroacoustic Music," 298.
[56] Pestova, "Models of Interaction," 13-14.

note of the transformations or reactions of the computer, and experimenting extensively with improvisational environments. Even if the composer has notated very little about the computer part in the score, this method will familiarize the performer with the actions of their invisible partner.

Algorithmic composition

The "personality" of these computer systems is typically created through the use of an algorithm, and a basic understanding of algorithms can be useful for performers. An algorithm is, simply put, a set of rules or steps for completion of a task. Although computer software is a new development in music history, composers have used algorithms in composition at least since 1026, when Guido D'Arezzo used a type of algorithm to compose music for a text by assigning a set of vowel sounds to a set of specific pitches.[57] As an example from interactive music, score following (in which the computer analyzes sonic input, finds its place in a score, and reacts accordingly) could be described as one type of algorithm. With today's personal computers, rules-based and probability-based composition can be taken to extremely complex levels, where the algorithm can seem to have its own personality. Especially in improvisational contexts, the performer can get to know the system almost as if learning how to perform with a human partner:

> …[A] player must work to learn the personality of the computer algorithms in order to engage in a dialogue with the computer, and the computer music may, in turn, "learn" the musical personality of the performer, incorporating his or her human idiosyncrasies and the subtleties of playing style.[58]

[57] Gareth Loy, "Composing with Computers—A Survey of Some Compositional Formalisms and Music Programming Languages," in *Current Directions in Computer Music Research*, ed. Max V. Mathews and John R. Pierce (Cambridge, MA: The MIT Press, 1989), 297

[58] Winkler, *Composing Interactive Music*, 33-34.

Audience Perceptions

In interactive music, the listener may be unable to determine the true source and/or cause of the sounds they are hearing. Even if the performer triggers events, the listener may not perceive the connection; conversely, causality can be implied and heard even when it does not exist.[59] The performer can use this ambiguity for expressive purposes by emphasizing certain triggers and relationships through physical gestures, or purposely deemphasizing them by blurring the sound worlds of computer and performer.[60] Kimura expressed enjoyment with "creating an interactive system such that the audience can ALMOST guess what the interaction is, but not quite."[61] Again, performers must be familiar with the triggers and relationships in a piece to communicate these elements of cause and effect to the audience.

Form and Structure

Many of the processes and gestures used in interactive music also appear in more traditional acoustic music, although the actual sounds themselves can be quite different. In tonal music, dissonance and consonance often propel music towards a goal, giving it inertia and direction. Computer music composers can achieve similar goal-oriented structures by using processes such as acceleration/deceleration, crescendo/decrescendo, ascending/descending pitch, and increasing/decreasing density.[62] Form in interactive music can also be created through the drama of interaction between characters, such as the performer and the computer.[63]

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[59] Emmerson, *Living Electronic Music*, 93.
[60] Penny, "The Extended Flautist," 105.
[61] Kimura, "Creative Process and Performance Practice," 292.
[62] Francisco Kröpfl, "Experiences and Reflexions on Electroacoustic Music," in *Aesthetics and Electroacoustic Music*, International Academy of Electroacoustic Music/Bourges (Paris: Actéon-Mnémosyne, 1996), 63.
[63] Winkler, *Composing Interactive Music*, 28.

Indeterminacy is a key twentieth-century innovation in form, and it appears in interactive music through randomness in the computer part and improvisation or nonlinear elements in the performer part. Interactive works can allow the performer to make decisions about form by choosing a path through a nonlinear structure. These structures give the performer a great deal of creative freedom to determine the shape and form of a work.[64] In these cases, the performer may carefully craft the structure ahead of time, or make spontaneous choices during the performance.

Improvisation

Interactive music offers a new "meta-level" for composition, in which the composer can create an environment or structure for the computer and the human improviser.[65] This method leaves the performer with a great deal of freedom, but also responsibility for the end result. Many performers relish this opportunity; nearly every clarinetist interviewed enjoys improvising in interactive music, saying it gives them a "voice" and allows them to express their personal musical "language." Of course, the expert improviser learns about the interactive system and uses the "personality" of the system to inform the improvisation. Pat O'Keefe explained, "…as I learn how my sound is being altered, I can begin to play in such a way as to create certain textures, as I learn to predict how the computer will transform my sound." While some pieces are purely improvisatory, interactive works often contain a mix of notated music and improvisation.

Improvisation can also be an important part of collaboration, as when a performer's improvisations inspire the composer's ideas for the computer part, or perhaps become notated in

[64] Ibid., 31.
[65] Robert Rowe, "The Aesthetics of Interactive Music Systems," *Contemporary Music Review* 18, pt. 3 (1999), 85.

the resulting piece. Additionally, improvisation in interactive music is not limited to the instrumental part; the composer may improvise the electronics as well, manipulating the system in real-time during the performance.

The interpretation of interactive music is an essential aspect of performance practice that varies widely depending on the piece. Penny offered a few abstract strategies for finding and expressing meaning in interactive music:

> Finding the essence of a sound or movement, developing ideas through repetition, skirting around the edges and constructing new paths to follow, establishing interconnections between sounds, motion and projection, or immersing oneself in the sound of one note ultimately leads to fruition in the search for cohesion and meaning.[66]

Ultimately, as Pat O'Keefe said, interpretation should arise from "the demands of the music itself." With the variety of works within the interactive genre, performers should approach each new piece as a puzzle to be solved, or an experiment to be undertaken.

Rehearsal, Performance, and Recording

Rehearsal

Rehearsal of interactive works is different for each piece, but the performers interviewed generally agreed that it begins with technical mastery of the clarinet part and simply getting the computer part working. Carmichael recommended to "[e]xpect at least a couple of rehearsals to be focused on technical solutions: microphones and if the signal is triggering everything it needs to, adjusting the levels, getting used to looking at the screen and your score…" Many performers also recommended studying the electronics away from the clarinet if possible, unless the electronics are totally dependent on the clarinet's input. Once the player begins rehearsing with the electronics, it is important to replicate the performance setup as much as possible in order to

[66] Penny, "The Extended Flautist," 106.

rehearse the physical elements of the piece, including pedals, page turns, and microphone placement.

Some pieces are designed for the computer to move sequentially through each section, and the performer may not be able to start from just anywhere in the piece. Also, depending on the level of notation of the computer part in the score, the performer may not be able to discern whether the patch is working correctly. Rehearsal features built into the patch can greatly help to facilitate rehearsal; some composers use a built-in metronome (click track) that can be adjusted and turned on or off for rehearsal purposes. Changing manual computer cues to foot pedal triggers can be a useful (and relatively simple) modification of the patch, allowing the performer to rehearse without a technical assistant.

Ideally, the performer will be able to rehearse with the software, but sometimes this is not possible. The performer may not have the hardware and software required, or the composer may not have a working copy of the software to send to the performer. Depending on the independence of the computer part in relation to the clarinet part, this situation can be anywhere from mildly inconvenient to seriously detrimental to the eventual performance of the piece. In such situations, the performer must prepare the solo part as thoroughly as possible, so that during the dress rehearsal the focus can be on coordinating with the electronics and resolving technical issues.

The dress rehearsal for an interactive concert can be stressful and hectic, and the performer will benefit from planning ahead as much as possible. Carmichael recommended contacting the venue in advance about the technical aspects of the setup and the amount of time for the sound check and/or dress rehearsal. The performer should also be prepared to spend a large part of the dress rehearsal dealing with the technology, as practical issues often take

precedence over musical concerns.[67] In the dress rehearsal, the composer or assistant may be more focused on "crashing computers, skipping disks, unreliable software, bad cables, feedback, noise, and clipping" than on musical aspects and performer concerns.[68] McNutt suggested "starting the sound check from the stage" to make sure that the performer is satisfied with their sound in the hall and their monitor levels.[69] Playing the softest and loudest parts of a piece will help the assistant check balance in the hall.[70]

If the dress rehearsal is not on the day of the concert, or if the setup cannot be left in place, there must be another sound check just before the concert. The sound check is of utmost importance in this music, and ideally it can be accomplished before the audience enters the hall; at times, though, it is necessary to check microphones and levels after coming onstage for the performance. In this case, performers might consider using Kimura's method of using a "tuning" patch that also serves as a discreet sound check. These rehearsal considerations may seem overly detailed, but if they are overlooked the performance can truly suffer.

Venue

Just as the acoustics of the hall can affect a performer's approach to acoustic music, it also affects decisions about performance of interactive music. Kimura has done extensive research on the effects of various types of performance halls on sound, and has found that high frequencies are absorbed by the presence of the audience and high levels of humidity, and a live hall can cause the microphone to pick up too much sound, affecting the pitch tracking of the

[67] Ibid., 54.
[68] McNutt, "Performing Electroacoustic Music," 297.
[69] Ibid., 298.
[70] Kimura, "Performance Practice," 71.

computer.[71] The levels may need to be adjusted for each performance hall; these can often be saved as presets along with the patch.

Recording

Recording interactive music, according to Belet, "presents only an isolated aural snapshot of one version of the composition."[72] McNutt has written extensively on the issues of recording interactive music; it is possible for a composer, for example, to take a complete recording of the instrumental part and use it to create a realization of the electronics, but this effectively eliminates the "interactivity" of the piece.[73] Recording a live performance or complete studio performance would certainly be preferable.

Summary

From the interviews and the published literature, some universal conclusions can be drawn despite the variety of approaches to the performance practice of interactive music. Performers desired to see detailed notation of the computer part in scores, but indicated a need for the creation of condensed performance parts showing only crucial information. Attention to design of the software interface was seen as an often-neglected aspect of the score that can have ramifications for both performer and technician. Performers described a variety of setups, but most use a laptop running Max/MSP, a MOTU interface, and at least one pedal; choice of microphone and method of loudspeaker placement largely depended on individual preference and the requirements of individual pieces. The level of performer experience with software varied widely, and greater proficiency with technology generally corresponded with a preference

[71] Ibid., 64-75.
[72] Belet, "Live Performance Interaction," 312.
[73] McNutt, "*pipe wrench*," 44-48.

to control more aspects of the music from the stage. The interviews and literature indicated that the interpretation of interactive music requires specific knowledge and skills that performers may not encounter in other genres of contemporary music, including microphone technique, spatialization, sound processing, models for interaction, and improvisation. Performers also noted several rehearsal considerations unique to interactive music, including difficulty rehearsing with the software as well as dedication of time for rehearsal of the technological aspects of the piece. These performance practice issues are often mediated by close collaboration between performers and composers, but they can inhibit the accessibility of these works to new performers, and may be detrimental to the long-term viability of interactive music.

CHAPTER 4

EXAMINATION OF SELECTED WORKS FOR CLARINET AND COMPUTER

The performance practice issues that were discussed in the previous chapter will here be applied as they relate to five interactive works for clarinet and computer. These works were chosen for several reasons. Considerations included: historical and/or musical significance of the work or composer, variety of software platforms, variety of models of interaction, diversity of performance issues, availability of performance materials, number of performances and recordings of the work, and ease of communication with the composer. Only composers in the United States are represented, for ease of communication as well as to focus this project on the highly active and innovative American trends of research and composition in interactive music.

The pieces are discussed in chronological order according to the date of composition:

- Cort Lippe's *Music for Clarinet and ISPW* (1992/1999) is one of the earliest interactive works for clarinet, and represents a work that has been updated over time to work on new platforms. Lippe is a prominent figure in research in interactive music, and this particular work has been discussed in several academic papers and in David Wetzel's dissertation.
- Russell Pinkston is professor of composition at the University of Texas at Austin where he has taught many of the American composers writing interactive music today. His *Gerrymander* (2002) involves live sampling of the clarinet and different microphones for recording and pitch tracking, and has a remarkable user interface.
- Andrew May is director of the Center for Experimental Music and Intermedia at the University of North Texas, and his *Chant/Songe* (2004) represents innovative use of score following in combination with pedal cues.

- Robert Rowe is one of the foremost writers on interactive music. His *Cigar Smoke* (2004) was written in C++, and contains environments for free improvisation alternating with notated material.
- Chapman Welch's *Moiré* (2008/2010) was written for the author and provides for a first-person look at collaboration. It also exhibits flexible instrumentation and a variety of improvisation techniques.

Each of these works has been recorded on CD, and most have been performed by more than one clarinetist. All except Rowe's *Cigar Smoke* were written using Max/MSP; this is a result of both the popularity of Max/MSP and the author's own lack of access to Kyma and other systems. The following discussion is not intended as a detailed analysis, theoretical or otherwise. Nor will it address such issues as extended techniques, selection of multiphonics, and other general twentieth-century performance practice concerns. Instead, this examination of works for clarinet and computer will examine the notation, the nature of the interaction, and other salient features of each work as they relate to the performance practice of interactive music.

Cort Lippe - *Music for Clarinet and ISPW* (1992)

Cort Lippe's *Music for Clarinet and ISPW*, written for Esther Lamneck, is an example of a work that has changed over time to reflect the technological developments and trends of interactive music. Initially written for the ISPW (IRCAM Signal Processing Workstation) using Max-FTS software, the work was revised in 1999 by Lippe for Max/MSP.[1] It uses a score-driven interactive system that employs various types of signal processing, including granular

[1] Wetzel, "A Model for the Conservation," 281.

sampling, harmonization, reverb, and spatialization.[2] The software primarily listens for pitch and amplitude, using these factors to control multiple variables.[3]

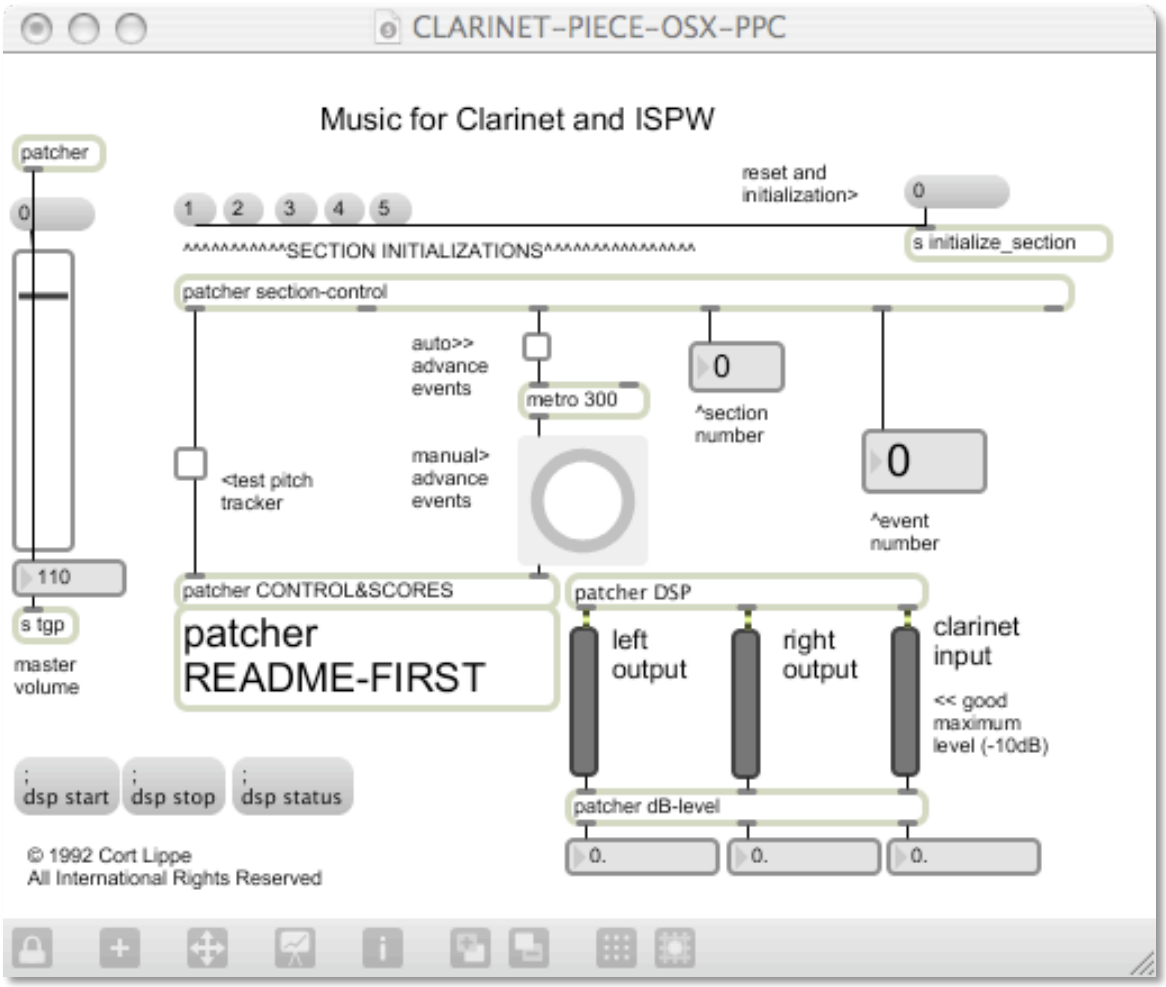

Figure 1. Main window of *Music for Clarinet and ISPW*.[4]

Figure 1 shows the main window for *Music for Clarinet and ISPW*; clearly, the user interface has not been designed for a performer who is unfamiliar with Max. The distinction between section number and event number may be confusing, and in rehearsal it is unclear

[2] Cort Lippe, "A Composition for Clarinet and Real-Time Signal Processing: Using Max on the IRCAM Signal Processing Workstation," *Proceedings of the Tenth Italian Colloquium on Computer Music*, Milan (1993), 429.
[3] Wetzel, "A Model for the Conservation," 281.
[4] Cort Lippe, *Music for Clarinet and ISPW*, 1992; rev. 1999.

whether to press the "reset and initialization" button or the button with the number of the section one wishes to initialize. The "manual advance events" button does exactly that (manually advance events), but the "auto advance events" button does not turn on score following, as one might expect, but rather advances the events rapidly in sequence to easily move to the next section in rehearsal. These are aspects of the patch that can be determined through trial and error, consulting a technical assistant, or contacting the composer himself.

The notation of the computer part in *Music for Clarinet and ISPW* is nonexistent, except for some sporadic text descriptions (see Fig. 2). The text descriptions primarily inform the performer how long to hold fermatas. Thus, it is up to the performer to listen and study the electronic part and experiment with the processing to understand how the computer part functions. (Contacting the composer with questions is also an excellent option.) Additionally, some documentation and technical notes are found in the actual patch instead of in the score, so the performer must be sure to explore the patch in order to find all pertinent information.

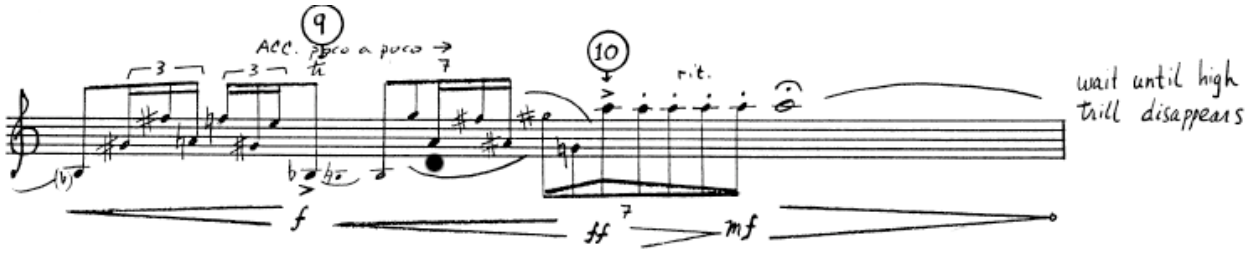

Figure 2. Notation in *Music for Clarinet and ISPW*.[5]

The relationship between performer and computer in this work is defined by Lippe in his program note: "Musically, the computer part is not separate from the clarinet part, but serves rather to 'amplify' the clarinet in a multitude of dimensions and directions."[6] Accordingly, the

[5] Lippe, *Music for Clarinet and ISPW*.
[6] Ibid.

performer should approach this piece as a solo with computer extension, rather than as a duet or chamber music model.

Music for Clarinet and ISPW initially used a score-following algorithm developed by Lippe, and it was a significant work (17 minutes in length) composed at a time when the electroacoustic music community was highly interested in such developments. This excitement about the potential of score following is evidenced by the publication of several papers related to the piece[7] and performance of the work at numerous electroacoustic music festivals in the years following its composition, including at the 1993 SEAMUS (Society for Electroacoustic Music in the United States) festival and the 1994 International Computer Music Conference. In the program notes to the score, Lippe writes:

> Technically, the clarinet pitches are tracked by the computer as the performer plays. This pitch information is sent to a "score follower", which allows the computer to follow the player's performance by comparing it to a copy of the score which is stored in the computer. At specific points designated in the score, electronic events are triggered by the score follower.[8]

It is therefore surprising to find these notes in the documentation for Lippe's Max patch for the piece:

> During the performance you must click all the events to advance them by hand in time while the musician is playing unless you *dare* to use the score following. *It is highly recommended you NOT use score-following.* During the performance the events should be advanced by hand in time while the clarinet player is playing.[9]

Clearly, the composer's attitude toward score following has changed since the work was composed. Lippe explains that the score follower worked correctly about 95% of the time, so rather than spend a great deal of time working to get it to work 99% of the time (and still requiring a technical assistant to monitor the computer), he decided that manual cues were a

[7] Lippe, "A Composition for Clarinet;" Puckette and Lippe, "Score Following in Practice."
[8] Lippe, *Music for Clarinet and ISPW*.
[9] Emphasis mine; Ibid.

more secure way to coordinate the performer and computer. Score following also fell out of favor in future works due to his interest in extended techniques, and the complications of having the computer "listen" for them.[10] Of the similar situation with Lippe's *Music for Flute and Computer* (1994), Elizabeth McNutt writes that "Lippe has wisely recognized where score following was a useful feature, and where it raised a barrier between the performer and the work."[11] When performing the piece without score following, sound quality (rather than pitch tracking) should be a primary concern in microphone choice, as so much of the computer sound is dependent on the input of the clarinet sound.

Another feature of *Music for Clarinet and ISPW* that has changed since its composition in 1992 is the live sampling of the performer. Originally, the only sound sources for the computer part were samples recorded live during the performance of the piece.[12] This idea seems to have worked better in theory than in practice. The live recording was abandoned due to inconsistency of recording quality during live performance, although Lippe has indicated that this problem could possibly be mitigated through use of a dedicated microphone for live recording.[13] The current revision of the piece replaces the live samples with eight pre-recorded samples, each ten seconds long, although live digital signal processing is still used.[14] It is important to note that many composers successfully use score following and live sampling today; in the case of this piece, Lippe preferred the sonic result he achieved by eliminating the unpredictability of score following and live sampling.

[10] Cort Lippe, personal e-mail to the author, 2009.
[11] McNutt, "Performing Electroacoustic Music," 301.
[12] Lippe, "A Composition for Clarinet," 430.
[13] Lippe, personal e-mail to the author, 2009.
[14] Wetzel, "A Model for the Conservation," 281.

Russell Pinkston – *Gerrymander* (2002)

Russell Pinkston's *Gerrymander* was written in 2002 for F. Gerard Errante. The interface for *Gerrymander* is very intuitive and visually appealing for the performer (see Fig. 3). All items are labeled clearly, and it has visual indicators for levels, pedals, and recording. Most importantly, the message window at the top informs the user of the current state of the program, and what action the program is waiting for, eliminating any guesswork on the part of the user. During performance, this message window indicates the status of the program and which cue it expects to receive next.

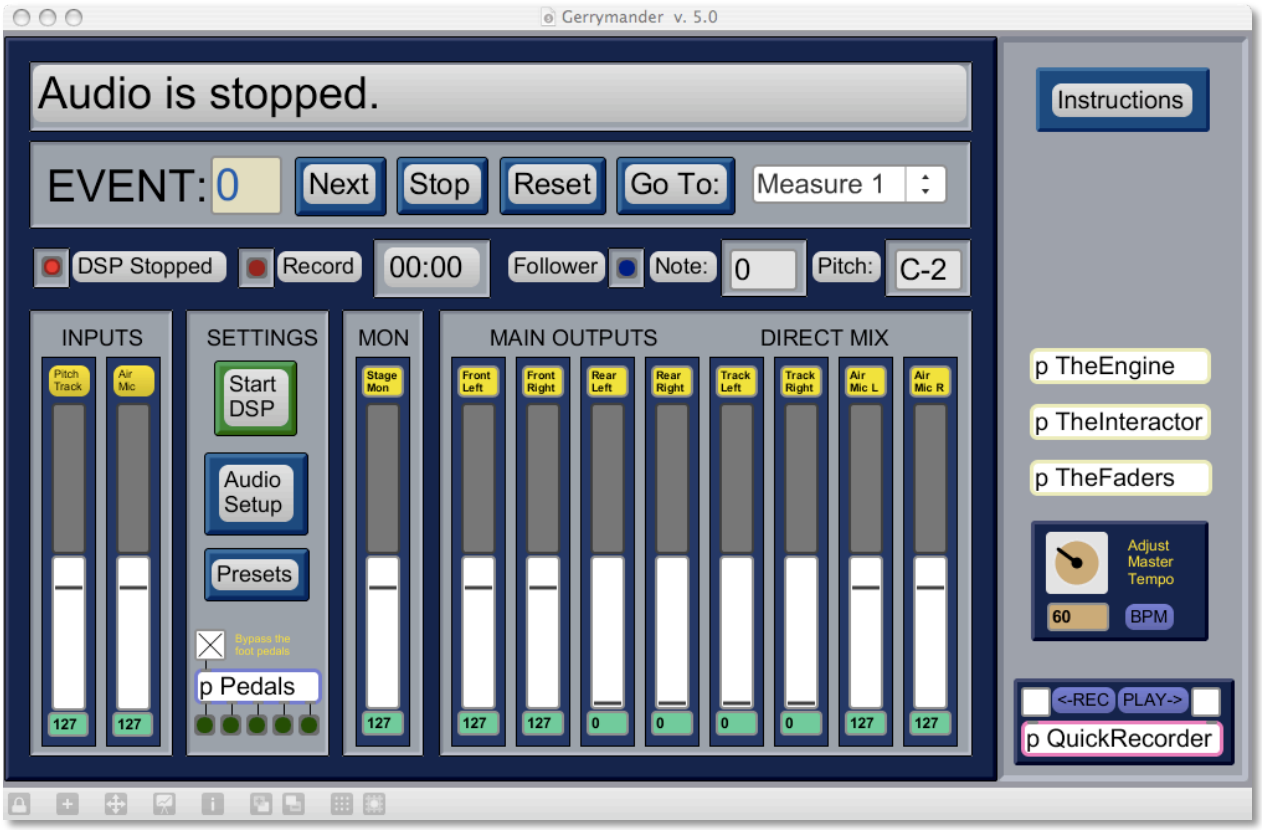

Figure 3. Main window for *Gerrymander*.[15]

[15] Russell Pinkston, *Gerrymander*, 2002.

In addition to the approachable interface, Pinkston has created a score with thorough notation of the computer part throughout the piece (see Fig. 4). Some of this notation shows the computer part on a separate staff, and in other places it verbally describes the processing of the computer (or the sonic result). Even a simple note under a measure such as "Computer adds glissing effects" helps to inform the performer about the composer's intentions, and judge whether or not the piece is working correctly.

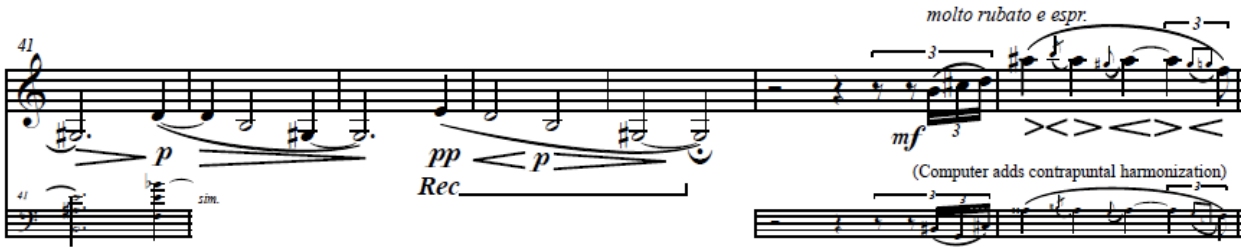

Figure 4. Notation in *Gerrymander*.[16]

The above excerpt from *Gerrymander* also shows the "Rec___" indication, showing the clarinetist when to depress the pedal for recording live samples of the clarinetist. These segments are used later in the piece for processing. The drawback to this method is that when rehearsing the piece, it is not recommended to start at either of the last two sections of the piece (3 and 4) until sections 1 and 2 have been played, because the samples must be previously recorded and stored. Pinkston has built a helpful rehearsal feature into this patch: a "QuickRecorder" that can record a take of the clarinet part—useful in order to work out technical issues without tiring the performer.

The "record" pedal is the only pedal *required* for *Gerrymander*, although Pinkston has designed the program for use of a MIDI foot pedal with four MIDI program change buttons, and a separate sustain pedal and volume pedal. This setup was created specifically for Errante, as he

[16] Ibid.

prefers to run all software for the pieces from the stage as he performs. For a performer with a technical assistant, it is probably easier to bypass the "stop," "mute," "alt/jump," and "next" pedals and have the assistant use keystrokes instead. This reduces the pedal setup to the one sustain pedal required for recording samples during the piece.

Errante's onstage setup gives him sole control over cueing the computer. Therefore, in a work like *Gerrymander*, Errante is simultaneously playing the clarinet part; operating separate foot pedals for cueing, recording, and mixing output levels on the fly; monitoring the computer's "current event" number, and correcting errors if they occur. It may be beneficial in some ways to have such total control over the performance, but some performers might prefer a technical assistant to take responsibility for correcting cue errors and mixing output levels. After all, the assistant in the hall is in a much better position to hear the balance and is not preoccupied with performing the solo part.

In *Gerrymander*, Pinkston calls for two separate microphones: an "air mic" for best quality recording of samples, and a "pitch tracking mic" (contact microphone) for more accurate score following. Due to the unique acoustics of the clarinet, a contact microphone may be less likely to have errors in pitch detection than a freestanding microphone. However, the piece can be performed with one microphone if the performer does not have a barrel microphone; special attention will just need to be given to the computer part to make sure the pitch tracker is working correctly.

The fourth section of *Gerrymander* is marked "Free Section – Ad Lib Optional," giving both the performer and the technician the opportunity to deviate from the notated part and improvise if desired. The person controlling the computer has the option of cueing in computer "riffs" (which are somewhat unpredictable). In a setup like Errante's, he could trigger these riffs

with a pedal as a part of his improvisation. If a technical assistant is used, the free section becomes a three-way improvisation between clarinet, technician, and computer. Pinkston includes extensive notes about the free section in the score, describing the computer actions and providing guidelines for the clarinet improvisation: "The improvisation may include some fast, virtuosic material, but it should never be too loud, too long, or too intense."[17] Such detailed notes and the option for improvising make *Gerrymander* a very approachable and rewarding piece for performers and technicians.

Andrew May – *Chant/Songe* (2004)

Andrew May's *Chant/Songe*, (2004) also written for Errante, uses a combination of score following and pedal cues to advance the events of the piece. Like the revised version of *Music for Clarinet and ISPW*, *Chant/Songe* uses prerecorded sound files that sound as if they could have been recorded and processed live. *Chant/Songe* also uses live sound synthesis and processing; the clarinet sound controls a "bank of resonant strings" that add resonance throughout the piece.[18] The intended effect is that of "a duo between the clarinetist and a dream version of himself."[19]

The interface for *Chant/Songe* is fairly clean and self-explanatory, although the differentiation between "event," "cue," and "section" may be confusing at first. Some helpful rehearsal features are built into the patch, such as the ability to enter an event number and begin

[17] Ibid.
[18] Andrew May, personal e-mail to the author, 2009/2010.
[19] Andrew May, *Chant/Songe*, 2004.

at that event.[20] Also, May has included an option to run the electronics in fixed time, with or without a metronome, for study and rehearsal purposes.

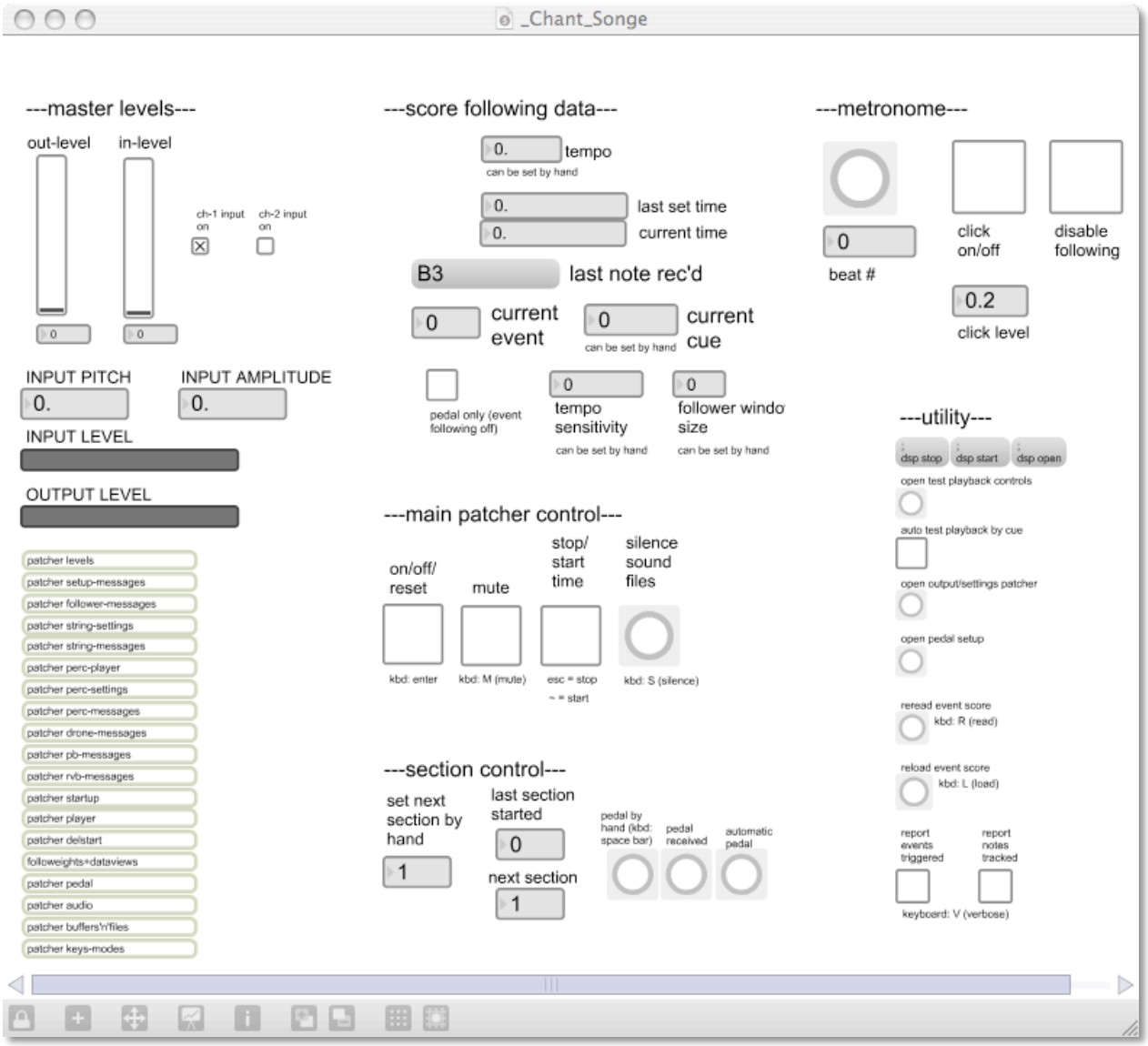

Figure 5. Main window of *Chant/Songe*.

[20] Ibid.

Chant/Songe does not have any notation of the computer part, aside from several fermatas marked "computer solo" (see Fig. 6). In this piece, however, it is not crucial to coordinate cues exactly between computer and clarinet; rather, the "ghostly ensemble" follows and intertwines with the clarinet part of its own accord. May explains: "Pedal cues are provided throughout the piece, but in normal practice the performer should only hit the pedal at the beginning of the piece and after each of the computer solos."[21] The computer can usually self-correct any score following errors, but the performer can also use the additional pedal cues for this purpose if necessary.

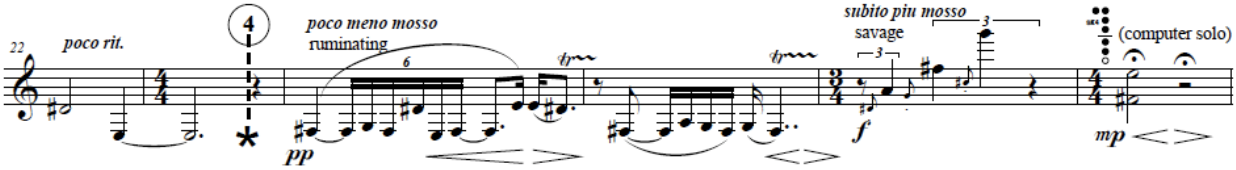

Figure 6. Notation in *Chant/Songe*.[22]

The score following in *Chant/Songe* uses an unusual approach, described by May as follows:

> The approach to time in *Chant/Songe* is fundamentally different than that of traditional score following, and attempts to reverse-engineer acoustic chamber music practice. Rather than waiting for each successive event to trigger its responses, the computer counts time continuously in tempo, as musicians do. This is based on one of the first anticipatory score following algorithms to be used in a work of interactive computer music; this system tracks correlated patterns of pitch and rhythm, and recalculates the tempo each time a new event is matched. It also includes an algorithm for resetting the computer's synchronization with the performer when the computer decides it is "lost."[23]

Because this score follower relies on tempo, the clarinetist must be sure to practice with a metronome. However, May has written the piece in such a way that the performer can still use a good amount of *rubato* without worrying that the score follower will lose track of the clarinet

[21] May, personal e-mail to the author, 2009/2010.
[22] Ibid.
[23] Ibid.

part.[24] *Chant/Songe* calls for a barrel microphone, but other microphones should work as long as they can pick up a strong signal for the score follower without feeding back.

Much of the interpretation of this piece lies in the numerous moods indicated in the score: "calling," "flowing wildly," "savage," "distraught." In all, nearly sixty different markings occur in the piece, taking the performer through a schizophrenic montage of characters. This presents an interesting opportunity for expression, but also a challenge to communicate a coherent larger form incorporating numerous sudden changes of character. *Chant/Songe* does have larger sections; it begins at a tempo of 56, moves to a dance section with a tempo of 63, and ends with a slower section at 52 with longer note values. The performer will benefit from listening for this larger form and adjusting the interpretation of the short-lived moods accordingly.

Robert Rowe – *Cigar Smoke* (2004)

Robert Rowe's *Cigar Smoke*, written for Esther Lamneck, is an example of a piece that has not been designed for use without the composer's assistance. In the past, Rowe has worked directly with the performers on this piece, so he has not compiled any technical notes or other documentation.[25] The software for *Cigar Smoke* was written in C++, but the user does not need to know C++ programming as Rowe has created an application called "Cigar" that brings up the interface below and runs the piece.

[24] Errante, "The Electric Clarinet: Part II," 54.
[25] Robert Rowe, personal e-mail to the author, 2010.

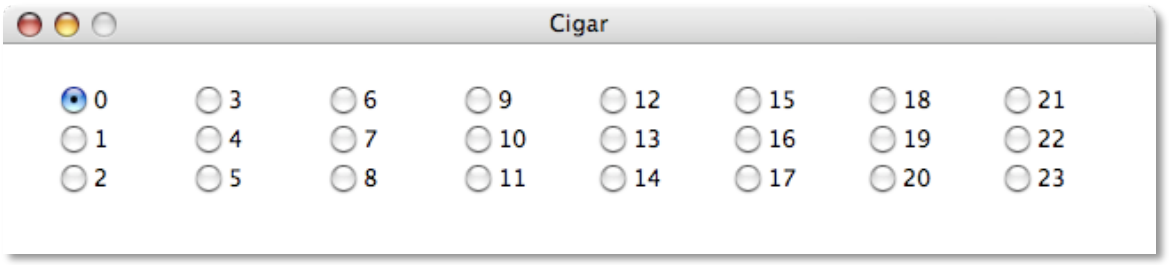

Figure 7. Interface for *Cigar Smoke*.[26]

This interface is clearly very minimal, with no information about input/output levels or the state of the software (except which cue it is currently executing). It is therefore necessary to monitor levels using external software. If the composer is not on hand to answer questions, the configuration of outputs and inputs must be discovered through trial and error. Because the user has no access to the inner workings of the software, it is impossible to make modifications. However, the simplicity of the program has its benefits: the piece can be started and advanced with one keystroke, and there are no complex patches and subpatches to decipher as with some pieces written in Max/MSP.

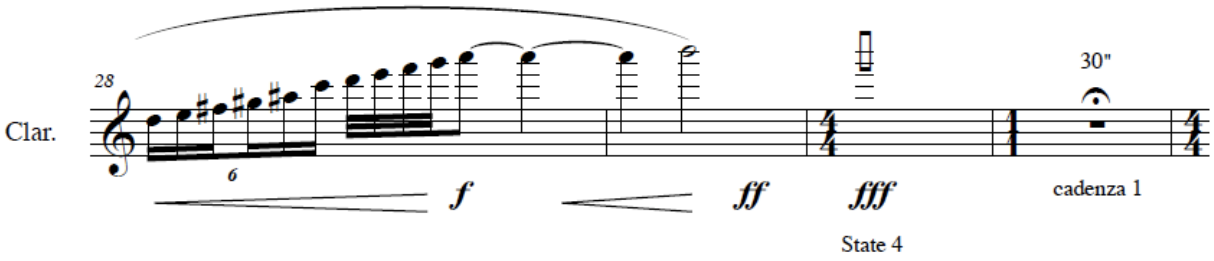

Figure 8. Notation in *Cigar Smoke*.[27]

Figure 8 shows an example of notation in *Cigar Smoke*, including one of the three cadenzas in the piece. The computer part is not notated, and the only indication for coordination of the computer is the marking "State 4," showing that the program should be advanced to the

[26] Robert Rowe, *Cigar Smoke*, 2004.
[27] Ibid.

fourth cue. The cadenzas are meant as an opportunity for free improvisation on the part of the performer,[28] and in each cadenza the computer reacts differently to the clarinet input. Even if the performer had access to a written description of the computer actions during these cadenzas, extensive experimentation would be necessary to gain an understanding of the "personality" of the computer and to explore possibilities for improvisation.

The program note included in Esther Lamneck's CD recording of *Cigar Smoke*, while not included in the score, is crucial to the performer's (and the audience's) understanding of the piece:

> The title refers to a large-scale work I envision based on the story of a different composer living under an occupation who steps outside for a smoke and is mistakenly shot by a nervous soldier (as happened to Anton Webern). This music would accompany the moment when the composer begins to idle outside.[29]

Such programmatic context provides inspiration especially for the free improvisations: the performer can attempt to depict the haze of smoke, the nervousness of the soldier, and perhaps a sense of impending doom. The electronics can aid in the expression of moods and characters, once the performer learns how to manipulate and provoke their invisible partner.

The description of the lack of technical notes, computer notation, and interface information in *Cigar Smoke* is not meant to be a criticism of the piece; many interactive works exhibit similar deficiencies of documentation. Rather, this piece serves as an illustration of what a performer can expect from interactive works that are designed to be learned in the composer's presence, in a collaborative manner. Of course, the issue of obsolescence is even more prescient with these works, as they are not only dependent on specific technologies but also on the availability of the composer to answer questions and make modifications to the software if

[28] Rowe, personal communication, 2010.
[29] Esther Lamneck, *Cigar Smoke* (innova 673, 2007), compact disc.

necessary. It is the experience of the author that composers usually have intentions to make their works accessible and well-documented for performers, but are inhibited by time constraints and a lack of demand on the part of performers.

Chapman Welch – *Moiré* (2008, rev. 2010)

Chapman Welch's *Moiré* is a work for solo clarinet, interactive electronics, and chamber ensemble (originally flute, viola, harp, piano, and percussion) that was written in collaboration with me in 2008. I met with the composer several times as the piece was in progress, and I have performed it several times both with and without the ensemble. This experience allows me to describe the performance issues of learning and performing *Moiré* from a more personal perspective.

Welch's inspiration for the piece came in part from the *shehnai* playing of Indian virtuoso Bismallah Khan. The *shehnai*, a conical single-reed instrument, allows for much bending of pitch, and Bismallah Khan plays with a great deal of ornamentation. Welch gave me a CD to listen to, and we did a recording session in which I played some of his sketched material as well as some timbral/multiphonic effects I had been exploring through manipulation of voicing and embouchure. Some of this recorded material was used to create sound files that were triggered during the piece, and some was actually notated in the final clarinet part. This type of process is common in interactive music, where the composer works directly with the performer at different stages of the composition of the piece. The performer's task is often to assist the composer in discovering clarinet sounds, techniques, and notation that fit with the composer's creative direction for the piece.

Moiré is written for solo clarinet, interactive electronics, and *optional* chamber ensemble, so that the performer has the option of playing the piece without the ensemble. This flexible instrumentation works in *Moiré* because the ensemble part is minimal and serves primarily as accompaniment or background. The clarinetist can adjust for the missing ensemble by increasing the density of sound in the improvised sections and altering the timing of fermatas. The flexibility of instrumentation has given me the freedom to program this work on concerts when the ensemble would have been unavailable, leading to more performances of the work.

When I premiered *Moiré*, I had only one rehearsal with the electronics prior to the dress rehearsal the day of the performance, at a personal meeting with the composer. The dress rehearsal was my first time playing with the conductor and chamber ensemble, so my preparation for the performance was based on the clarinet part, notes from the composer, and a recording of a MIDI rendition of the piece. In such situations (common in interactive music performance), the performer must prepare the solo part as thoroughly as possible, so that they can focus on coordinating with the electronics and resolving technical issues at the hectic, last-minute dress rehearsal that often ensues.

Moiré has twenty-two cues throughout the piece, where the computer needs to be advanced to the next section. Initially, *Moiré* was designed so that the composer would be at the mixing board advancing the computer through the events, sometimes relying on me to give him visual cues from onstage. This method worked very well, but at times (especially when performing without the ensemble and conductor) I felt that I wanted more control over the precise timing of events, for expressive purposes. Also, the manual cue method presented a significant barrier to performing and rehearsing the work without the composer present, as a second person familiar with the score was required to be at the computer.

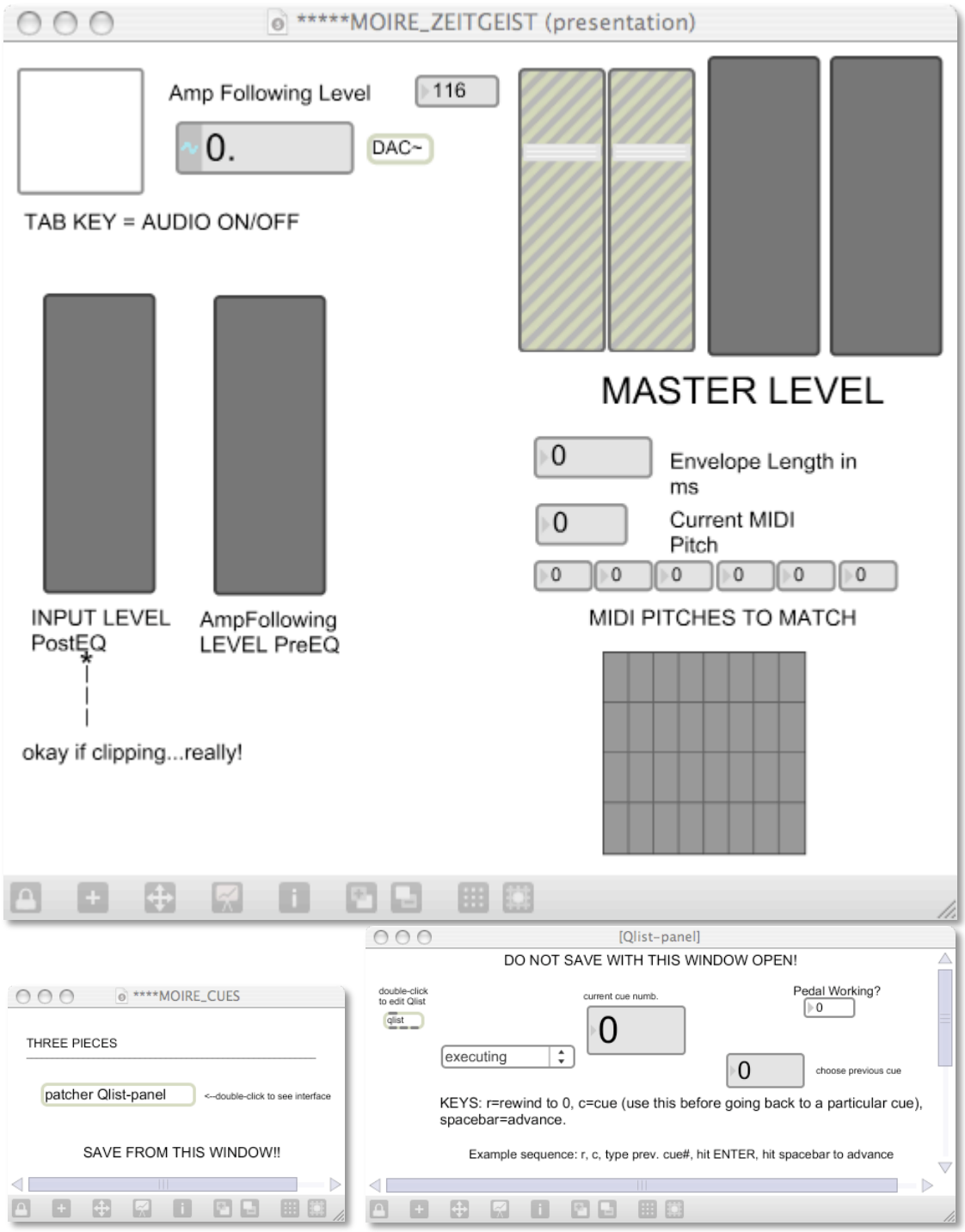

Figure 9. Interface for *Moiré*.[30]

[30] Chapman Welch, *Moiré*, 2008; rev. 2010.

In 2010, Welch designed a version of *Moiré* that could be more easily operated in his absence, and he sent me the software so that I could rehearse with a pedal. Using the pedal for coordination brought a new feeling of temporal freedom to the piece, but required a great deal of concentration to incorporate the pedaling technique. I found myself paying attention even to the manner in which I pedaled. For a *subito fortissimo* in the clarinet part that occurred simultaneously with the electronics, I made little movement in preparation for pressing the pedal, so as not to "give away" the sudden change. In a section where the pedal cue came in between two loud computer hits, I pressed it in a more forceful and rhythmic manner. The most difficult aspect was to pedal during long glissandi up and down at the climax of the piece; I found it challenging to execute smooth glissandi while stepping on the pedal (see Fig. 10). Ultimately, while pedaling gave me more expressive power in the piece, the number and timing of the pedal cues made it more difficult to focus on the musical aspects of performing the piece. If given the option, I would probably prefer to perform it with an assistant or the composer advancing the cues manually.

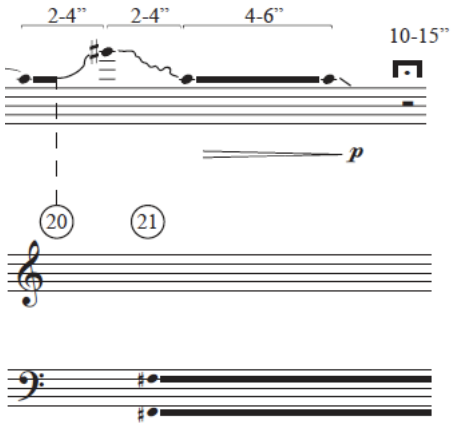

Figure 10. Pedal cues during glissando in *Moiré*.[31]

[31] Ibid.

The notation of the computer part in *Moiré* is very helpful, and Welch uses different methods of notation in different parts of the piece. Figure 10 shows a sustained computer drone depicted in staff notation, while Figure 11 shows staff notation transitioning to graphic notation, along with a text description of the computer actions. As a performer, I found this combination of methods to be informative and easy to understand.

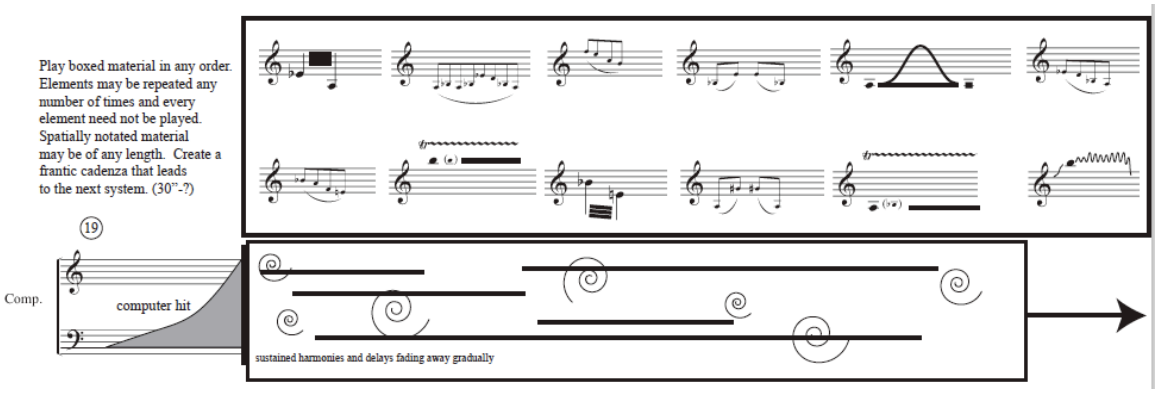

Figure 11. Computer notation and cadenza in *Moiré*.[32]

The score required frequent page turns due to the notation of the computer as well as the ensemble, so I had to create a separate performance part for *Moiré*. To do this, I copied the score, cut out the clarinet and computer staves, and taped them to several large poster boards. Performers of new music are familiar with this technique, but composers may not be aware that "extracting" an instrumental part, with cues, can be a great help to the performer. Careful concern must be given to page turns in a piece like *Moiré* due to the potential for accidental amplification and processing of page noise, as well as possible visual distraction during silences.

[32] Ibid.

Conclusion

Considering the multitude of performance practice issues involved in performing interactive music, and the distinct differences between pieces, it is no surprise that most performers choose to avoid the genre altogether. It is perceived as being too difficult, too costly, and too unfamiliar. The problems of defining interactivity itself in its myriad forms, analyzing interactive works in a theoretical and historical context, and rapid obsolescence of performance materials continue to be obstacles to the performance and research of interactive music.

These challenges are not insurmountable. In recent years, interfaces have become more intuitive and visually appealing, the cost of high-performance laptops and soundcards has decreased, free open-source software such as Pd has emerged, and the variety and sheer number of interactive works has increased. The barriers to interactive music performance have begun to come down, and it is time for a serious consideration of formal courses of instruction for interactive performance skills that could be adopted by universities and other institutions.

The literature abounds with ideas for training performers for the demands of interactive music. Horenstein's proposed curriculum for the twenty-first century performer includes instruction on pedal and triggering techniques, improvisation systems, extended techniques, and basic knowledge about digital signal processing and interactive programs like Max.[33] Emmerson calls for performers to have knowledge of "timbral nuance, level sensitivity, and inter-performer balance."[34] Keislar's redefinition of performers for the twenty-first century includes the observation that "human musicianship need not be so focused on developing physical dexterity and can focus on higher-level control with flexible mapping of gesture to sonic result."[35] Such

[33] Horenstein, "Interactive Works," 166.
[34] Emmerson, *Living Electronic Music*, 95.
[35] Keislar, "A Historical View of Computer Music Technology," 39.

training may be difficult without a standardized live performance system, as Pennycook describes; perhaps the future will bring a more universal setup for interactive music.[36] And aside from formal training programs, McNutt suggests that composers themselves have an interest "in helping performers overcome their trepidation."[37]

In a university curriculum, interactive music would ideally be taught and practiced in a collaborative effort between the composition department and vocal/instrumental studios. A course in interactive music could bring together the equipment and expertise of composition students and faculty with performers, creating an environment for learning and experimentation. It is probably unrealistic to expect that interactive music will be taught at all institutions or as a requirement for degrees in music performance, but it is certainly a valid specialization for graduate students. Institutions such as the Manhattan School of Music have begun to offer degrees in contemporary music performance; such specialized programs will surely contribute to the continuing development of interactive music pedagogy.

For performers who specialize in interactive music, the benefits far outweigh the challenges. The clarinetists interviewed indicated that performing interactive music satisfies their curiosity, broadens their expressive possibilities, provides compelling environments to explore through improvisation, and allows them to make a uniquely personal contribution to the music. The performance practice issues of this music are many, but with attention to these performance considerations on the part of composers and performers as well as continued technological developments, such benefits will surely attract growing numbers of performers to the compelling genre of interactive music.

[36] Pennycook, "Live Electroacoustic Music," 86
[37] McNutt, "Performing Electroacoustic Music," 297

APPENDIX A

INTERVIEW QUESTIONS AND RESPONSES

Dear _____,

Thank you for your willingness to participate in this survey about performance of interactive music. Your responses, along with those of several other clarinetists who have experience in this genre, will make a valuable contribution to my doctoral dissertation on the performance practice of interactive music. My goal is to use these responses to form conclusions about best practices and solutions to performance concerns for performers and composers working in this genre.

For the purposes of this study, "interactive music" is defined as music for one or more performers and interactive system, described by Robert Rowe (1993) as a system "whose behavior changes in response to musical input." This refers primarily to music for performer and computer, excluding music for instrument and tape/CD, and music in which the technology is not truly interactive (delays and other hardware-type effects).

Where applicable, please reference specific pieces, composers, or interactive systems. If a particular question does not apply to you, or if you do not wish to answer, feel free to respond with "N/A". Please allow about 45 minutes to complete the questions.

I greatly appreciate you taking the time to participate in this survey. I hope that this research project will contribute to the discussion about performance of interactive works and serve as a resource for performers and composers in the future.

Sincerely,

Rachel Yoder

University of North Texas

Burton Beerman

General

Please describe how you first became involved in performing interactive music, and what role it plays in your work as a clarinetist today.

> I am also a composer as well as a clarinetist and was doing what would be called low tech electronic music today with multiple tape recorders and plastics and slide projectors. The first digital interactive electronics was in the mid to late 80s and early 90s with the advent of MIDI. I particularly used a pitch to MIDI converter to drive sound modules (usually Yamaha Fb01 and TX81Zs at that time). I used the symbolic sound (.com) hardware today because processing is placed on external modules and not on the basic cpu. Also used Amgia computers in the 90s with a program called Mandala. A dancer stood in front of a black screen (not unlike a green screen today) and a camera placed the dancer's image in a projected virtual computer environment from the Amiga. When dancer movements crossed certain points it would trigger sound and video in the projected images.

To aid in compilation of a list of works in this genre, please list the composer and title of interactive works you have performed.

> wow, that is a tall order. I am 67 years old and have been doing this for 40 years.
> tod winkler's snake charmer
> several works by david cope and barton mc clean
> my own:
> masks
> wind whispers
> meditations
> Dayscapes
> night visions

What do you consider to be the greatest challenges of performing interactive music, as opposed to (a) acoustic repertoire and (b) music for instrument and tape?

> obvious challenges are:
> time for technical setup
> time for trouble shooting any problems with all of the setup
> having time to warm up and get into the "performance mode."
> I play so much of my own music that there are no performance conflicts and need to work with the composer, but I often did "all tech" concerts which were just extremely physically demanding.

What do you enjoy most about performing interactive music?

> not a relevant question for me; for example, I don't enjoy writing anymore than going to the dentist, but I do enjoy having written. Performance is much the same way.

The real issue is curiosity. That is the real attraction along with the community that new music attracts.

Hardware/Software/Equipment

Does interactive music affect your choice of clarinet equipment (instrument, mouthpiece, barrel, reeds, etc.)? If so, how?

I use plastic reeds. I can set the reed on the instrument then on a cl stand before the concert, then I can come out, pick it up and play it without wetting the reed. When using a contact mic I used a special barrel with the mic built into it.

What method(s) do you use for amplification of the clarinet when performing interactive music? Please include details about microphone selection and placement, and why you have made these choices.

did use barcus berry contact mic for years but never satisfied with it. Gerry Errante introduced me to a microphone (applied microphones). It attaches to the bell, then has two microphones; 1 bends into the bell and the other moves up the length of the clarinet.

Do you use different methods of amplification for different pieces? If so, why?

No, except when I had to speak outside the horn. I used an air mic on a stand for this.

If you have a typical hardware "setup" for interactive music (interface, pedals, mixer, etc.), please describe it.

I used to travel with four road cases (6 modules per case), several pedals (1 or 2 for effects units, for dynamic swells, 1 or 2 for incrementing the voice settings of voice modules. it was quite a choreography).
Today I use the capybara320 with my cl and air mic. It fits into the overhead of the airplane. Their new box is about 20% the size of this one.
It has all of the instruments, effect units and pieces as software. A notebook computer is used to load it all int the performance , but the kyma box does all of the work with its 28 dsp chips.

Which of the following interactive systems have you used? Choose all that apply: Max/MSP, Pure Data (Pd), Kyma, Cypher, Other _____

Max/MSP, Pure Data (Pd), Kyma, keykit

What is the extent of your familiarity with the software involved in the interactive works you have performed?

I started programming music, etc since 1973 with main frame computers, using a program called spitbol (an upgraded version of snobol) and especially for my own pieces I obviously am very involved with the technology.

Notation
What challenges, if any, have you faced with the notation of interactive music, either in the score or the software?

> As a composer I have to score the music and struggle with contemporary notation programs designed for more traditional music. Score is one of the oldest notation programs (ran on old pcs in dos and often still used by publishers) was the best and most flexible. Sibelius, Finale, Music Press,Lime, Pond, etc all have to be massaged to produce the notations. When playing someone else's music, studying the notation takes time away from practicing but necessary since so many pieces are so different. I might have up to 10 to 20 hours in a piece studying it before I even pick up the horn.

How much information about the computer part do you prefer to see notated in the score?

> I prefer interactive pieces in which there is a timeline and I can follow the timeline or the computer listens to the clarinet and follows it (start the next event when the clarinet plays a low E, or exceeds a certain velocity, etc).

What type of notation of the computer part do you prefer to see in a score? Choose all that apply: Staff notation, Graphic Notation, Text descriptions, None (no notation of computer part), Other_____

> Graphic notation, Text descriptions

Rehearsal/Performance
Describe your process for practicing and rehearsing interactive music, and any challenges you have encountered in this process.

> I study the piece, then learn notes first, then study the technology and what I can expect from it then slowly and patiently put it all together section by section.

Which aspects of performance do you prefer to control from on stage, and which aspects should be handled by a technical assistant? Specifically, how do you approach the issues of cueing, mixing, and starting/stopping each work?

> as I said I prefer a timeline or the computer follows me. I do not like an assistant for cues.

In your experience, what is the best method (or combination of methods) to achieve coordination between the computer and performer? Choose all that apply: technical assistant executes cues, performer executes cues via pedal, computer follows performer via score following software, performer follows computer, stopwatch timing, performer gets visual information from computer screen

computer follows performer via score following software, stopwatch timing

Please explain why you prefer the method(s) of coordination indicated in the previous question.

it is easy to follow a timeline and this is especially effective if the music is written with flexible material to allow for the performer to adapt to the timeline.
The computer following the clarinet is effective but not always accurate.

Collaboration
If interactive works have been written specifically for you, please describe the most and least successful performer/composer collaborations you have experienced. If applicable, include details about the level of input you had in the work's composition, and the process of rehearsal and performance of the work.

I write mostly for myself. I collaborate with dancers, ensembles, exetera as a composer that includes clarinet.

Please describe your *ideal* performer/composer collaboration.

I often work away from the others involved in the performance and have to share things (sound and pdf files) over the internet and occasionally get together. It is best to work as a residency when in the same place for an extended period of time.

Do you have experience with improvisation? How has this experience (or lack thereof) affected your collaborations and the resulting musical works?

Yes since I am often the composer, it allows me to tailor the works to my own technique and strengths.

Aesthetics/Interpretation
How has performing with amplification or electronics affected your concept of your clarinet sound? Have you made any conscious changes in your sound as a result of this experience?

I use a more classical sound (but not a dark symphonic sound) rather than a jazz sound. I do use vibrato a lot in situations when I wouldn't in classical music and incorporate other styles, such as ethnic (klezmer, jazz) into the playing that I wouldn't do in other music. The amplification allows very quiet effects to be heard and colored in ways that the acoustic instrument can't do.

Describe the types of interpretive decisions you typically make as a performer of interactive music. How does this skill set differ from interpretation of non-interactive repertoire?

Balance is important. Playing too loud might drive the electronics into distortion. Timing and intonation is critical and important to how the piece is organized. This should be discussed from the outset.

Do you believe that a performer of interactive music should be familiar with the history and aesthetics of computer music? Why or why not?

No but being a composer and performer it is critical.

In your experience, how important is it for the performer of interactive music to understand the actions taken by the computer? Why?

Hopefully, not at all. The electronics should be transparent and not in the way of the performer.

Laura Carmichael

General

Please describe how you first became involved in performing interactive music, and what role it plays in your work as a clarinetist today.

> As a clarinetist, I first encountered interactive music in 1992. I had just finished my undergraduate degree, and by just hanging out at UC Berkeley's CNMAT (Center for New Music and Audio Technologies) as an 'independent artist' (i.e. unpaid), I was exposed to the inner-workings of music technology. CNMAT brought together composers, performers, and engineers to develop technological and artistic systems. I collaborated with composers at CNMAT, both graduate students, visiting artists and faculty. The first work I was involved in heavily was also a piece I co-created with composer Silvia Matheus.
>
> Since then I have continued to collaborate with composers in the creation of new works as well as using interactive systems for my own creative work, namely in improvisation and the theatrical settings of concerts.

To aid in compilation of a list of works in this genre, please list the composer and title of interactive works you have performed.

> My list is too long, and I don't have compiled. I have performed dozens of works, solo, chamber, orchestra and opera, as well as improvisations, dance/theater works, and used interactive systems to control non-musical elements such as video.
> I can email you a separate list in the future.

What do you consider to be the greatest challenges of performing interactive music, as opposed to (a) acoustic repertoire and (b) music for instrument and tape?

> • The main challenge is rehearsal time-management to deal with all the technical elements, which are always demanding. There are new skills to learn, which are not always as intuitive compared to just playing an instrument all my life. I still want to focus on playing and performing, but the technology has to go smoothly for this to happen.
> • Getting a very good sound in the hall, and in rehearsals, is essential, and this requires good equipment and a good space, and good technical support.
> • Having an engineer is often necessary, which increases the budget.
> • Venues do not always accommodate a non-acoustic program.

What do you enjoy most about performing interactive music?

> • The expressive pallet is expanded, especially as a solo performer. Pieces with electronics can be very dramatic, expansive and create a completely unique atmosphere with colors and character beyond what the clarinet can do alone.
> • Pieces that are written for me are unique and personal, and I feel I can offer something to my field by fostering new work and cultivating new ways of performing.
> • It’s possible to perform in venues, like a nightclub or media arts festival, that are not

appropriate for acoustic/classical music, and I can reach a different, often younger, audience, as well as connect to the broader artistic community (new media, theater, installation).
• I also just happen to like technology and trying new things, so the 'geek' in me is also satisfied.

Hardware/Software/Equipment
Does interactive music affect your choice of clarinet equipment (instrument, mouthpiece, barrel, reeds, etc.)? If so, how?

No, I try to find microphones that capture my acoustic sounds as much as possible. That said, there are some contemporary works/sounds/techniques for which I find a more open facing of the bass clarinet more conducive, but this is not exclusively for interactive/electronic music.

What method(s) do you use for amplification of the clarinet when performing interactive music? Please include details about microphone selection and placement, and why you have made these choices.

I use an AMT System 1 microphone which clips onto the bell of the clarinet or bass clarinet. I like the sound, and having my own microphone gives me more control; this mic is also good in preventing feedback. That said, if I can perform standing in one position, and a hall has very fine microphones, I might also use mics on a stand, either one aimed toward the middle of the instrument, or two for the bass clarinet, one aimed toward the mid- upper joint and the other toward the mid-lower joint (pointing up, not down into the bell). For example, if feedback is not an issue, the AKG 414G condenser mic, set to hyper-cartiod pattern, amplifies and/or records the clarinet sound very nicely. However, if feedback is at all a concern, or more isolation is needed from other instruments, generic dynamic mics (close mics) are a better choice.

Since I am interested in staging concerts (or sometimes have to perform pieces that are spread over several music stands, and I have to walk to see it) I will usually use my clip-on mic, but would ideally use a wireless mic system when possible, if a venue has a high-quality one available (I do not own it myself at this time, it's very expensive).

I have also used a small contact mic inside the clarinet mouthpiece, by using a mouthpiece in which I drilled a hole in the side, as close to the cork joint as possible. This was for special effects related to processing a lot of air and mouth sounds, and wanting no acoustic room sound in the sound.

Do you use different methods of amplification for different pieces? If so, why?

Yes, see above, and....

If the sound coming out is very processed, in other words, we do not hear the clarinet as a clarinet so much anymore, then having close dynamic mics with plenty of gain on them

can be reliable while preventing feedback issues.
If we want to amplify the clarinet in as “beautiful and pure” a way as possible, preserving the integrity of the acoustic sound and mixing it with processing, then it's important to have a high-quality microphone(s). In the past I have even rented microphones in order to get a satisfactory sound. I would never leave it to chance of what a venue or sound engineer has.

If you have a typical hardware “setup” for interactive music (interface, pedals, mixer, etc.), please describe it.

• MacBook Pro running OSX 10.6
• Motu Ultralight audio interface
• AMT System 1 mic
• Pedal for trigger
• small keyboard used as MIDI interface for trigger pedal, when necessary; new solution for this is the MIDI Solutions interface, which I just got; it's a small box that is easy to travel with and works with the MOTU
• iPhone using Touch OSC to wirelessly control patches, change pieces, etc
• I use Ableton Live for improvisation and my own pieces, and most compositions are in MAX/msp software
• I use Junxion software, developed by STEIM to control MIDI controllers and wireless devices such as the Wii controller, which I've been working with lately
• I have several analog pedals for effects, such as distortion and loopers; these can be used independently, but can also be routed into the computer for additional input (usually use these while improvising)

If possible, I run the output cables from the audio interface directly to powered speakers, and do not need a mixer, and can control everything myself from the stage. I do have a small mixer if needed for playing with other people, but I prefer to mix digitally in the computer, setting all the levels and automating everything.

Which of the following interactive systems have you used? Choose all that apply: Max/MSP, Pure Data (Pd), Kyma, Cypher, Other _____

Max/MSP, Kyma, Ableton Live, LiSA

What is the extent of your familiarity with the software involved in the interactive works you have performed?

Moderate MAX user; I know how to find objects in order to troubleshoot, or change settings that may not be working, but I am not a developer/programmer.
Experienced Ableton Live user, making pieces and improvisational set-ups. There are MAX/msp plug-in objects that I also use here.

For a while I studied and used LiSa (developed at STEIM in the Netherlands), for live

sonic performance. It appears that the LiSa system will be phased out (obsolete) in the next years.

Notation

What challenges, if any, have you faced with the notation of interactive music, either in the score or the software?

By now I have quite a lot of experience with all kinds of unconventional, creative and non-standard notation. I cannot really separate anymore where and when I learned different kills. I think of what my teacher Harry Sparnaay said to me "never be afraid when you open a score, trust that there is always a logic to what is there, and you just have to crack the code."

There are many problems that can arise with notation; I would have to go piece by piece in details. Some generalizations though:

Page turns are important to solve, and this is usually one of the first things I do when I start to study a piece. I often cut up a score, cut out electronics score that I do not need as a cue after I learn the piece, and reduce some things in size, or enlarge others. A study score and a performance score may be different. I often write pedal cues or number cues really BIG over the score, or color code it using my own system.

I am often working with composers to develop notation that is expressive and user-friendly for the player. How a composer notates his or her ideas is a core element in the transference of the creative idea. Very often I am scribbling my own notes and cues in a score-- what I hear as an aural cue and what may be in the score may be different. I often advise composers to revise or amend their scores based on my experience. Since I am often playing new pieces, I feel this is part of the fun of interacting with a composer, and part of making pieces that may be usable to other players when the composer is not there.

How much information about the computer part do you prefer to see notated in the score?

I like to have a study score with as much information as possible in it. My performance score may be much more sparse or condensed for fewer page turns (as stated above). It's analogous to studying a piece from the score rather than just the part.

I feel it is really useful to have a detailed score in order to make sure the electronics are processing correctly. If there is something written in the score but I'm not hearing it, I know that there may be a problem in the computer system (a missing sound file, for example).

What type of notation of the computer part do you prefer to see in a score? Choose all that apply: Staff notation, Graphic Notation, Text descriptions, None (no notation of computer part), Other_____

Staff notation, Graphic notation, Text descriptions

Rehearsal/Performance
Describe your process for practicing and rehearsing interactive music, and any challenges you have encountered in this process.

Study the score without playing (I do this with any new piece)

Learn the instrumental part, at least to something like 70%

Build the set-up, get all the gear and the system running; test it A LOT before even starting to rehearse. Expect at least a couple of rehearsals to be focused on technical solutions: microphones and if the signal is triggering everything it needs to, adjusting the levels, getting used to looking at the screen and your score (make sure the things you need to see on the screen, like a counter, are big enough to see on stage), figure out the placement for everything.

Start to try sections with the electronics, because the computer's reaction may affect how I play my part and/or technology problems/levels/settings may need to be adjusted and it's important to give the composer/engineer time to do this.

I need to practice with the electronics a lot, because only then am I hearing the whole piece, and only then can I start to have musical ideas about timing, color, interacting musically the way I would with a pianist, for example. You need good sound monitoring and speakers for this; sometimes I play with headphones so I can really hear and focus on the electronics and learn the aural cues.

Section by section rehearse; use a timer/metronome to check timing;

Do run-throughs of the piece early on, even if I am just playing outlines of some of it because I can't play it all yet. It's important to keep an eye on the big picture as well as the detail and get a sense of the flow, endurance, and sections of the piece that may need to balance with each other. It's also important to 'imbed' physical cues in my memory, i.e. I need to look at the screen here, turn the page there, remember the tempo change there, trigger that pedal sooner here. I may also discover that I need to ask the composer to change settings, because volumes don't balance over the whole piece; for example, a compressor may be needed on part of the piece so that all the little noise and air sounds she/he wants can balance with the loud conventional sound.

Rehearse the physicality of the piece starting as early as possible, basically as soon as I start practicing with electronics. In other words, if I am going to be pressing a pedal to trigger sections of a piece, build my set-up so that I am integrating that from the beginning. There have been pieces I've played where the composer really had to change something in the piece or the technology because the pedals were too fast/close together to also play a very demanding technical passage at the same time because I needed to really stay grounded for it. Changing the physicality/set-up/equipment for a piece just for the dress-rehearsal or concert is a disaster waiting to happen. I think you have to practice

with all of this in place from the outset. You would never change you instrument or mouthpiece just before a concert, or go from sitting to standing; in my mind it's analogous.

Communicate with the sound engineer/venue very early on about all the technical aspects. If possible, call. People don't always read email. Make sure they have cables that are long enough, for example.

Confirm the details of the sound-check/rehearsals. Make sure there is adequate sound-check time in the hall. Make sure the engineer understands the needs, takes notes, and writes down things like levels and settings, if needed. I have had several concerts destroyed by bad sound engineers (and likewise I've had brilliant ones make me sound great), so I always try to find time to communicate with them, and make sure everything is clear, if possible.

I have a general formula that seems to have worked for me over the years: one minute of music = one hour of practice + one hour of tech rehearsal if it's with electronics.

Which aspects of performance do you prefer to control from on stage, and which aspects should be handled by a technical assistant? Specifically, how do you approach the issues of cueing, mixing, and starting/stopping each work?

I prefer to control everything from the stage if I can. In the last year I have started to start and stop every piece wirelessly using the iPhone running TouchOSC, which is controlling a 'master patch' written in MAX/msp. So I can control all starting and stopping from the stage. This is a GREAT system, and after I develop it further, I would like to share this with other performers.

Ideally, the audience is not bothered with the technology. They should just have an environment in which they can sink into an imaginative landscape. I am constantly searching for the smoothest way to make this happen.

If there is someone to trust, ideally my own engineer which travels with me, then this is a great help. Sound engineering is an art to itself, and a good one is worth the price. Several times composers of the pieces are quite adept at assisting, but not always, and they may not be able to help with pieces besides their own. Ultimately, I feel I am responsible for making it work. You do need someone with ears in the hall though, there is no way you can check the sound and play at the same time. So try to find people you can trust, and organize this in advance.

If someone is helping, they need to know what they are doing, and I need to know what they know. I.e. Can they read a score if it's necessary to control something from the hall? Can they run a mixer, do I trust their musical instincts, do they know/understand the kind of music I'm playing and what its sound concept is?

In your experience, what is the best method (or combination of methods) to achieve coordination between the computer and performer? Choose all that apply: technical assistant executes cues, performer executes cues via pedal, computer follows performer via score following software, performer follows computer, stopwatch timing, performer gets visual information from computer screen

Please explain why you prefer the method(s) of coordination indicated in the previous question.

> Technical assistant is great, because it's one less thing to physically coordinate, and if they are reliable, it's probably the MOST stable and reliable system (and there is someone monitoring the computer who can fix a mistake manually, like a skipped cue, for example); weakness is you need someone you can count on, and depending on equipment placement, they may need to sit on stage, which may or may not be alright with the atmosphere you want to create.
>
> Pedaling myself is fine, and gives independence, if I can stand in one place and play the piece. If I need to move at all spacially, this doesn't work. If I need to play really heavy technically demanding instrumental parts, I find it difficult sometimes to trigger lots of pedals simultaneously; likewise if the pedals are in awkward places rhythmically, I have to really practice this, to make sure the pedaling doesn't disturb the musical rhythm.
>
> Computer tracking the performer works great -- if it works. It's still often unstable and unreliable. The distance from the mic, the sensors, the gain, the way you play, can all affect the sensitivity tremendously. I have also performed with video tracking spacially, and this seems to work quite well.
>
> Performer following the computer can work if it fits the music; if there are tight coordination points, quick changes, or open sections with free-improvisation, it may not be so easy to follow the computer, unless the music is structured so that the player always has some reaction time AFTER the aural cue.
>
> Stopwatches usually work great, you just have to get used to going back and forth with your eyes from the score to the clock. Once I had the timer projected onto the back wall of the hall for me, really big, and this was fabulously easy to see!
>
> I look at the computer screen in quite a few of the pieces I play. It can work, again it just takes practice to coordinate it. Placement of the computer and size of the graphics are important to rehearse.

Collaboration

If interactive works have been written specifically for you, please describe the most and least successful performer/composer collaborations you have experienced. If applicable, include details about the level of input you had in the work's composition, and the process of rehearsal and performance of the work.

I've had several successful collaborations, and nowadays I prefer to almost exclusively ask for pieces from people who want to work with me during the creative process and take in some of my ideas and wishes.

Just recently Cindy Cox finished a piece for me for bass clarinet and live electronics. I asked her to try to include several elements: text, and the possibility that the piece could be constructed in such a way that I would not have to be glued to the score, so that I can move in the performance space. We looked at several possibilities, and eventually she made a piece with a modular construction in which I improvise on set material and musical ideas, which we developed together in a lot of rehearsals. She also spent six hours recording me for use of samples. Additionally, we talked a lot about what music we both liked, and what kind of atmosphere and energy I'd like to have in the piece. Grissey turned out to be a big common interest, and became a kind of musical reference for the piece. I asked for something between 6-10 minutes, and she accommodated all these requests in the end.

Another successful collaboration was with Ronal Bruce Smith, who composed a piece for bass clarinet and live electronics. I received funding from Canada Council for the Arts for his commission and the project.

I had several 'R and D' sessions with Ron, and he ended up making a very rhythmically interlocking piece with the live electronics. It took a lot of rehearsing and adjusting. Ron revised the piece twice even, after performances, tightening up the piece and adjusting some of the parameters in the electronics.

I've just blocked the negative experiences out of my consciousness. Seriously.

Please describe your *ideal* performer/composer collaboration.

Very creative, where my current musical and artistic obsessions interface with the composer's own, and foster new ideas that neither one of us would have thought about otherwise.

Lots of time together in a room messing around, trying things, experimenting, challenging each other, testing things. A kind of equality, mutual respect, where we both can give feedback to each other.

Plenty of good food and wine after rehearsals. Seriously, the personal connection is very important in the end.

Do you have experience with improvisation? How has this experience (or lack thereof) affected your collaborations and the resulting musical works?

yes, quite a bit.

Improvisation is a major influence, and has had a big impact on collaboration. I have

confidence, my own ideas, and I understand something about the processes of generating raw material, which I then love for someone else to react to. Improvising and my own systems for generating raw musical material (which I've been refining for about five years now), help in finding my own musical language which composers can borrow/integrate/ignore/contort/reinterpret.

big subject, again. But in short, I feel most of the works being written for me nowadays are very personal, though can certainly be performed by others, and are hopefully grounded in a user-friendliness for players because of the collaboration.

Aesthetics/Interpretation

How has performing with amplification or electronics affected your concept of your clarinet sound? Have you made any conscious changes in your sound as a result of this experience?

There are some sounds that can be cultivated and featured in electronics because of the amplification. For example, different kinds of air sounds, articulations, harmonics can all be much more audible, and featured elements. This means practicing a new skill set in order to capitalize on the expressive possibilities.

For example, articulation. Speed, intensity and variety are often all amplified in electronics. If you need an articulation that is very clean, sometimes you have to play with less air in the attack than may be typical in acoustic music when now one can hear it.

Describe the types of interpretive decisions you typically make as a performer of interactive music. How does this skill set differ from interpretation of non-interactive repertoire?

Big topic. It depends on the musical references. If the piece is very groovy and uses some Cuban clave as a ground, but I don't know what that is or what it sounds like, I'm not going to be able to interlock with it in the electronics and make it come across. References can come from anywhere nowadays, so we have know, or research, the origins, be they electronic or otherwise.

Likewise, there are sounds in electronics that may evoke some other colors in my playing, or another sense of timing evoked by a graphic score. Just like when you are playing with a piano, you may try to evoke bells, or singing, or a percussive counterpoint, when playing with electronics, you may need to expand your sense of musical function. Are you foreground or background? Should you be overpowered here, or fight for it? Is the articulation meant to be very harsh so you should make that even stronger? What is the character of the music, what are the references? Etc.

Do you believe that a performer of interactive music should be familiar with the history and aesthetics of computer music? Why or why not?

It's part of the history of music in general, and I think professionals should know all we can, be hungry for knowledge and experience. There is performance practice in electronic

music, like any other. While I don't think it's necessary, or even possible, to know the history to the level of a composer, engineer, or musicologist, we should know enough to get the context, and to capitalize on what our forebears have already solved or discovered. That said, I don't think lack of knowledge should be a barrier to a student trying a piece with electronics, or collaborating with a composer and learning new things by just starting to do it.

In your experience, how important is it for the performer of interactive music to understand the actions taken by the computer? Why?

It is not possible to know all the actions taken by the computer, unless you are a programmer, and most of us just don't have time for that.

But I feel we should know enough to do basic tech. I.e. start and restart the computer, program, interface, build a set-up and turn things on in the right order. Be able to rehearse on your own, get comfortable in the environment.

Ultimately we should know enough to not panic in the face of something not working, and we should also know a couple of good jokes for the moment the computer fails and we don't know how to fix it, while hopefully the real techies come to the rescue.

F. Gerard Errante

General

Please describe how you first became involved in performing interactive music, and what role it plays in your work as a clarinetist today.

> I was fortunate to have been brought up in New York City in the '60's and was able to hear a great deal of new music, some of it from the relatively newly created Columbia-Princeton Electronic Music Center. While working on my DMA at the University of Michigan, I performed with the Contemporary Directions Ensemble and was further exposed to all sorts of new music. Upon moving to Norfolk, Virginia to begin a career of college teaching, there was a dearth of interest in new music so I decided to perform myself and that's how I began to become involved with electronic music. In working with various composers and performing at many conferences and festivals such as the now defunct Electronic Music Plus, I moved more and more into the use if interactive music. I enjoy working with electronic extensions though by no means do I perform exclusively with electronics.

To aid in compilation of a list of works in this genre, please list the composer and title of interactive works you have performed.

> There are far too many to list here. For a partial, albeit quite dated listing, please see my web site at fgerrante.org

What do you consider to be the greatest challenges of performing interactive music, as opposed to (a) acoustic repertoire and (b) music for instrument and tape?

> Ideally, the composer should be able to provide a performer who is not adept in the electronic medium with clear, simple instructions for performing the composition. On occasion, the complexities are so great as to require the presence of the composer. I prefer to be self-sufficient, though on occasion the use of interfaces and foot pedals can possibly detract from the music making. In all instances, I believe the attention should be on the music and not the technology. Performing with "tape" of course is easier as the electronics are immutable and therefore the performer can concentrate on coordination rather than operating electronics in a real time situation.

What do you enjoy most about performing interactive music?

> As mentioned in the previous question, pre-recorded electronics or "tape" is immutable and therefore lacking in flexibility. The immediacy of performing interactive music and the control of events allows for much greater variety in multiple performances.

Hardware/Software/Equipment

Does interactive music affect your choice of clarinet equipment (instrument, mouthpiece, barrel, reeds, etc.)? If so, how?

I use the same equipment for playing interactive music or any new music as I use for more conventional music. The only difference is in the microphone. I use an AMT mic on the bell. In this case, I use my Yamaha bell and then can switch easily to my Backun bell if I am playing acoustic music on the same concert. In addition, a barrel contact mic appears to be superior than the AMT mic for tracking. For pieces that require accurate tracking, I will use my old Barcus Berry mic in as Accubore barrel in conjunction with the AMT mic used for amplification.

What method(s) do you use for amplification of the clarinet when performing interactive music? Please include details about microphone selection and placement, and why you have made these choices.

This is addressed in the previous question. The AMT mic with isolation rings to reduce handling noise was made for me by the developer, Marty Paglione many years ago and has held up well.

Do you use different methods of amplification for different pieces? If so, why?

Also addressed in the previous question. AMT condenser mic for amplification; Barcus Berry contact mic for tracking.

If you have a typical hardware "setup" for interactive music (interface, pedals, mixer, etc.), please describe it.

MacBook Pro computer
Mackie 1202 mixer
MOTU 828 computer audio interface
Yamaha MFC1 foot pedal
Audio-Technica M2 monitor system with earbuds

Which of the following interactive systems have you used? Choose all that apply: Max/MSP, Pure Data (Pd), Kyma, Cypher, Other _____

Max/MSP

What is the extent of your familiarity with the software involved in the interactive works you have performed?

Not great. I've often joked about "PhD" electronics, PHD meaning "push here, dummy". As mentioned above, I believe it is the job of the composer to make his/her piece accessible to as many performers as possible. That being said, the interested performer should acquire some basic knowledge. I own Max/MSP and can do some basic programming. I also have spent many hours in editing sounds on various effects units.

Notation

What challenges, if any, have you faced with the notation of interactive music, either in the score or the software?

> Most scores have been quite clear even when using unconventional notation such as when using spatial notation, to avoid the use of sharps and flats, a filled in note head means a half step higher. On occasion, there are inconsistencies in a Max patch, for example, an X in a box means it is active, or not active.

How much information about the computer part do you prefer to see notated in the score?

> Unless totally necessary for performance, generally not a great deal of information. Often, I will write in cues when necessary. On other occasions, I will request a full score plus a part with only necessary cues. In many cases, I will work with a composer to help create such a part.

What type of notation of the computer part do you prefer to see in a score? Choose all that apply: Staff notation, Graphic Notation, Text descriptions, None (no notation of computer part), Other_____

> Staff notation, Graphic notation

Rehearsal/Performance
Describe your process for practicing and rehearsing interactive music, and any challenges you have encountered in this process.

> There is no single standard and the process may alter from piece to piece. However, as a general rule, I prefer to learn the notes first. I will then listen to the electronic portion with the score, attempting to imagine the clarinet part in my head. Then the process of integrating the parts begins. In some cases, however, when the electronic part is totally dependent on the clarinet part, it is necessary to work with both components concurrently.

Which aspects of performance do you prefer to control from on stage, and which aspects should be handled by a technical assistant? Specifically, how do you approach the issues of cueing, mixing, and starting/stopping each work?

> As mentioned above, generally I prefer to control everything myself. I usually have a table to my left that holds the laptop, interface, perhaps wireless transmitter if not using monitors, and any effects units that may be used. I will often have a mixer as well. In most cases, the composition can be started and stopped by means of a foot pedal. That being said, it is often comforting to have the composer on hand to run things. Of course this is not always possible, especially with touring, so I think it essential that the performer be able to handle all aspects of the presentation.

In your experience, what is the best method (or combination of methods) to achieve coordination between the computer and performer? Choose all that apply: technical assistant executes cues,

performer executes cues via pedal, computer follows performer via score following software, performer follows computer, stopwatch timing, performer gets visual information from computer screen

> performer executes cues via pedal, computer follows performer via score following software

Please explain why you prefer the method(s) of coordination indicated in the previous question.

> A question of control and convenience. It is not always possible to have a technical assistant available so, as explained above, I believe it to be a better solution where possible, to have the performer in control of the performance. With that philosophy, if possible having the computer follow the performer is preferable and provides more flexibility in performance. Attempting to perform while getting visual information from the computer screen is often cumbersome and difficult.

Collaboration

If interactive works have been written specifically for you, please describe the most and least successful performer/composer collaborations you have experienced. If applicable, include details about the level of input you had in the work's composition, and the process of rehearsal and performance of the work.

> It is difficult to speak in absolutes of best and worst. Certainly one of the best experiences has been with Russell Pinkston who composed a work for me called "Gerrymander". We were able to work together from the beginning and I was able to give him feedback on both clarinet and electronic parts of the work. His Max patch, though undergoing many transformations, always worked, and his explanations to the performer were always clear. This is a composition that utilizes interactive electronics in a sophisticated manner, yet can be executed by a performer with no technical expertise. On the other side of the coin, I fortunately have had no disasters. In one case, many years ago, I had an instance of a performance at a CMS conference with a composer where the electronics did not work and we had to cancel the performance.

Please describe your *ideal* performer/composer collaboration.

> A simple give and take. Perhaps my best recollection is working with Judith Shatin on a work she eventually titled "Sea of Reeds". We spent a fun afternoon with my showing her a wide variety of "tricks" – multiple sounds, extensions in the end of the clarinet, etc. She incorporated these in a very musical way and would send me copies of her progress which I would play and return with comments. The result was an intriguing work that was fun to play and, I hope, to hear.

Do you have experience with improvisation? How has this experience (or lack thereof) affected your collaborations and the resulting musical works?

I my earlier life I played more saxophone than clarinet, and although was not a great jazz player, I did support myself for a time by playing gigs which of course required improvisation. I believe that this experience has been a help even in playing strictly notated music as it helps bring a freedom to the printed page. Of course improvisation used to be a part of "classical" musician's stock in trade and I believe should be encouraged in the training of all musicians.

Aesthetics/Interpretation

How has performing with amplification or electronics affected your concept of your clarinet sound? Have you made any conscious changes in your sound as a result of this experience?

No conscious changes in sound have been made as a result of working with electronics. Musicality above all is important, and unless specifically called for, there is no cause for performing with an ugly sound.

Describe the types of interpretive decisions you typically make as a performer of interactive music. How does this skill set differ from interpretation of non-interactive repertoire?

Perhaps most important for all kinds of musical experience is to listen actively. Especially if one is controlling all aspects of the piece, it may take time for certain actions to unfold, or perhaps critical cues might instigate an action on the part of the performer. Of course accuracy is always important especially if score-following is utilized. In this case, there might be the possibility if a certain note is played incorrectly, then the next electronic portion may not be triggered.

Do you believe that a performer of interactive music should be familiar with the history and aesthetics of computer music? Why or why not?

Such information is always helpful for all music. It is most important for the performer to be aware of stylistic conventions of whatever period of music is being performed.

In your experience, how important is it for the performer of interactive music to understand the actions taken by the computer? Why?

Harkening back to my "push here, dummy" comment above, in most cases, I don't believe that it should be necessary for the performer to have intimate knowledge of all the computer operations. On the other hand, as the cliché goes, knowledge is power. If during a rehearsal or performance, Murphy's Law (anything that can go wrong, will go wrong) comes into play, then understanding what the computer is doing (or not) will be most helpful.

D. Gause

General

Please describe how you first became involved in performing interactive music, and what role it plays in your work as a clarinetist today.

> I became involved in performing interactive music as a logical "next step" from works for clarinet & tape, and works for clarinet & electronics. Interactive electronics is not my exclusive genre, as composers are still actively writing in the older fashions as well. I enjoy the interactive sense as it diminished the "music minus one" feel.
>
> In 2004, I approached Andrew May and asked about the possibility of his composing a duo composition utilizing MAX/MSP in an interactive fashion. At that point, there were only solo pieces utilizing MAX/MSP to my knowledge. Andrew created the beautiful "Wandering Through the Same Dream" for Clarion Synthesis (my duo with Gerry Errante). At that time, I thought this could be the first piece for MAX & duo. Fast forward to spring of 2005, when I visited IRCAM in Paris and heard a chamber ensemble performing with MAX! …only in Paris…..

To aid in compilation of a list of works in this genre, please list the composer and title of interactive works you have performed.

> These are some of the MAX/MSP works written for Clarion Synthesis:
> Wandering Through the Same Dream – Andrew May
> Synthecisms No.7 - Brian Bevelander
> Sugar Touch – Craig Walsh
> Syncretic Resonances - Anthony Cornicello
> Touché – Christopher Hopkins

What do you consider to be the greatest challenges of performing interactive music, as opposed to (a) acoustic repertoire and (b) music for instrument and tape?

> The technical requirements are more intense, for sure. Along with deeper technology comes an enriched possibility of system failure! Interactive music requires my triggering events, so that is another level of involvement for the performer.

What do you enjoy most about performing interactive music?

> Some people bungee jump; I like to perform interactive music!

Hardware/Software/Equipment

Does interactive music affect your choice of clarinet equipment (instrument, mouthpiece, barrel, reeds, etc.)? If so, how?

> Only in the sense of what I need to amplify the clarinet. Some pieces react better to a mic in the air column, so then the Barcus Berry system (with its own barrel) trumps my Backun (sorry, Morrie!).

What method(s) do you use for amplification of the clarinet when performing interactive music? Please include details about microphone selection and placement, and why you have made these choices.

> If the piece requires amplification from the barrel, then Barcus Berry. Otherwise, I prefer my AMT even though it adds weight to the instrument and more cables to get tangled in

Do you use different methods of amplification for different pieces? If so, why?

> discussed above

If you have a typical hardware "setup" for interactive music (interface, pedals, mixer, etc.), please describe it.

> MacBook Pro computer
> Mackie 1202 mixer
> MOTU 828 computer audio interface
> Yamaha MFC1 foot pedal
> Audio-Technica M2 monitor system with earbuds

Which of the following interactive systems have you used? Choose all that apply: Max/MSP, Pure Data (Pd), Kyma, Cypher, Other _____

> Max/MSP

What is the extent of your familiarity with the software involved in the interactive works you have performed?

> I'm strictly a user, tho a wanna-be programmer.

Notation
What challenges, if any, have you faced with the notation of interactive music, either in the score or the software?

> There is no standard way of notating the screen in the software, and that is not really a bad thing. It just boils down to the composers' preferences and the performers' abilities to adapt.

How much information about the computer part do you prefer to see notated in the score?

> That will change from composition to composition, depending on what cues and "hooks" serve me best for ensemble work.

What type of notation of the computer part do you prefer to see in a score? Choose all that apply: Staff notation, Graphic Notation, Text descriptions, None (no notation of computer part), Other_____

> Staff notation, Graphic notation, Text descriptions, Again, this will change from composition to composition.

Rehearsal/Performance
Describe your process for practicing and rehearsing interactive music, and any challenges you have encountered in this process.

> As is the process for practicing conventional music, one's own part must be technically mastered. The performer must be aware of how her/his part integrates with the computer. It is also helpful to work with the composer to have an insight as to what hopes the composer had for the sounds and the resulting fabric. The rehearsal process is the final carving of the block so as to share all of this with the audience.

Which aspects of performance do you prefer to control from on stage, and which aspects should be handled by a technical assistant? Specifically, how do you approach the issues of cueing, mixing, and starting/stopping each work?

> These variables depend on the venue and the technical ability of the available sound crew. Leaving nothing (or as little as possible), to chance, I prefer to take care of all of the above. When a composer is available to assist with the mixing, I am delighted!

In your experience, what is the best method (or combination of methods) to achieve coordination between the computer and performer? Choose all that apply: technical assistant executes cues, performer executes cues via pedal, computer follows performer via score following software, performer follows computer, stopwatch timing, performer gets visual information from computer screen

> performer executes cues via pedal, computer follows performer via score following software, performer follows computer, stopwatch timing

Please explain why you prefer the method(s) of coordination indicated in the previous question.

> Again, it depends on the piece and its requirements.

Collaboration
If interactive works have been written specifically for you, please describe the most and least successful performer/composer collaborations you have experienced. If applicable, include details about the level of input you had in the work's composition, and the process of rehearsal and performance of the work.

Please describe your *ideal* performer/composer collaboration.

Good question. Mutual respect comes first to mind. Similarity of creative path is a second consideration. There must be lots of open communication and a willingness to try with an open mind. Just as the performer must realize that the creation process takes time, the composer must realize that the learning process takes time as well. It is so unfair to all parties to get the music (or the new patch) a day or so before the performance.

Do you have experience with improvisation? How has this experience (or lack thereof) affected your collaborations and the resulting musical works?

I have had extensive improvisation experience and feel that gives me freedom from the fear that many non-improvisers deal with.

Aesthetics/Interpretation

How has performing with amplification or electronics affected your concept of your clarinet sound? Have you made any conscious changes in your sound as a result of this experience?

I have not made any conscious changes in my sound – I still continue to strive to sound like a clarinet player.

Describe the types of interpretive decisions you typically make as a performer of interactive music. How does this skill set differ from interpretation of non-interactive repertoire?

For me I do not sense a huge difference.

Do you believe that a performer of interactive music should be familiar with the history and aesthetics of computer music? Why or why not?

YES. These things do not exist in a vacuum!! It is as important as being familiar with music history when playing "traditional" music

In your experience, how important is it for the performer of interactive music to understand the actions taken by the computer? Why?

I think understanding the actions is important, but not the ability to create the actions. The computer holds a role of co-performer, and perhaps can be looked at as an accompanist of sorts. The soloist must know what the accompanist is playing, but not necessarily know how to play it.

Marianne Gythfeldt

General

Please describe how you first became involved in performing interactive music, and what role it plays in your work as a clarinetist today.

> As a musician involved in contemporary music, I was inevitably asked to perform pieces using electronics; first came the tape pieces, followed by interactive computer pieces. Most of these projects took place within academia (Harvard, Princeton, Columbia students and composer concert events) and at June in Buffalo, and with Ensemble Sospeso

To aid in compilation of a list of works in this genre, please list the composer and title of interactive works you have performed.

> Chamber Pieces by Joshua Fineberg
> Zack Settel, Solo Piece for clarinet, Bass Clarinet and Max/MSP
> Lars Graugaard - Concealed Behaviours, for Bass Clarinet and interactive Computer
> Gythfeldt/Pigford - Revolve

What do you consider to be the greatest challenges of performing interactive music, as opposed to (a) acoustic repertoire and (b) music for instrument and tape?

> The technology of the set-up can be volatile. So, it is difficult to replicate exactly how the piece will run from one space to the next (Speakers, acoustics, and distances between devices always change.
> It is extremely difficult to prepare oneself sufficiently for the performance. Much of the dynamics between performer and the output of the computer-generated sound is going to feel and sound different from rehearsal space to performance space. It takes away the performer's ability to predict anything in an intuitive way. There are always many surprises in the performance, and that takes away from the performer's artistic control.

What do you enjoy most about performing interactive music?

> I enjoy most the variability of sound-color and the endless possibilities for newfangled interactions. I love the feel of amplified sound.

Hardware/Software/Equipment

Does interactive music affect your choice of clarinet equipment (instrument, mouthpiece, barrel, reeds, etc.)? If so, how?

> Yes, f.ex. when I use my AMT mic that is attached to my clarinet, it increases the weight of the instrument quite a bit, and I lose finger-flexibility. So, I opt to play on a lighter instrument.

> I chose my reeds based on color of sound required by the music, so that would be the same for acoustic and electronic projects.

I have chosen to play on lighter reeds when I know that my sound will be amplified, but otherwise reed, mouthpiece and barrel are the same as for acoustic performance.

What method(s) do you use for amplification of the clarinet when performing interactive music? Please include details about microphone selection and placement, and why you have made these choices.

I use the AMT microphone that attaches to the soprano clarinet, because it has two mics, on on the upper-body and one under the bell. This creates the most clear and true sound of the large-ranging clarinet sound-spectrum.

For Bass, I use a standing mic pointing at the middle of the instrument, depending on the range of the piece.

Do you use different methods of amplification for different pieces? If so, why?

no, not really.

If you have a typical hardware "setup" for interactive music (interface, pedals, mixer, etc.), please describe it.

I use:

Motu Ultralite MK3 interface
FCB 1010 midi footcontroller
Line 6 DL4 digital delay and looper device (extraordinaire!)
Alesis USB mixer (that I plug in my new
2 AKG C451 microphones
MacBook Pro

Which of the following interactive systems have you used? Choose all that apply: Max/MSP, Pure Data (Pd), Kyma, Cypher, Other _____

Max/MSP, Kyma

What is the extent of your familiarity with the software involved in the interactive works you have performed?

I am learning Max now, but haven't reached the point where I have created a patch, yet. Working on it.

Notation
What challenges, if any, have you faced with the notation of interactive music, either in the score or the software?

Lars Graugaard's piece was compromised by the fact that the software depended on the composer being present to tweek the output "mix". I was never able to replicate the sound that the composer created when he was at the mixingboard. The sound profile should have worked on more of an "autopilot" for public consummtion.
Also, the multiphonics created by Henri Bok didn't work on my instrument, nor did they look like they sounded on Bok's recording of the piece. Major inconsistencies there.

How much information about the computer part do you prefer to see notated in the score?

As much as possible, but in simple terms if possible.

What type of notation of the computer part do you prefer to see in a score? Choose all that apply: Staff notation, Graphic Notation, Text descriptions, None (no notation of computer part), Other_____

Staff notation, Graphic notation

Rehearsal/Performance
Describe your process for practicing and rehearsing interactive music, and any challenges you have encountered in this process.

I try to replicate the concert situation as much as possible. And, I try to practice in different spaces for training.

Much of my practice time is absorbed in "practising" setting-up the equipment, connecting audio devices, and finding the best sound possible (eliminating hum, feedback, etc)

Which aspects of performance do you prefer to control from on stage, and which aspects should be handled by a technical assistant? Specifically, how do you approach the issues of cueing, mixing, and starting/stopping each work?

I have managed to have "fixed" mixes for individual pieces, the internal mixer to the Motu MK3 has a "mix configuration" function where you can save your mix settings, and then go back to them when you need them.

I prefer to control the cueing, starting and stopping from stage with a footpedal.

In your experience, what is the best method (or combination of methods) to achieve coordination between the computer and performer? Choose all that apply: technical assistant executes cues, performer executes cues via pedal, computer follows performer via score following software, performer follows computer, stopwatch timing, performer gets visual information from computer screen

performer executes cues via pedal, computer follows performer via score following software

Please explain why you prefer the method(s) of coordination indicated in the previous question.

> The computer following model is quite easy, because the performer is free to play as he/she pleases (As in Zack Settel's piece).
>
> The pedal executing cues gives the performer control (to take breaths) and to create dramatic musical timing in the piece.

Collaboration

If interactive works have been written specifically for you, please describe the most and least successful performer/composer collaborations you have experienced. If applicable, include details about the level of input you had in the work's composition, and the process of rehearsal and performance of the work.

> Mikel Kuehn is writing an interactive piece for me write now. So far it has involved recording sound samples of unusual and interesting tone-colors and extended techniques of the clarinet.
> Other than that, I will most likely not have input in the work's structure or compositional concepts.

Please describe your *ideal* performer/composer collaboration.

> John Link wrote a "tape-piece" for me once, and we collaborated on that together. It also involved a lengthy recording-session, and later he produced small parts of the piece for me to look at along the way.
> He was very interested in finding an idiomatic approach that would be successful in performance without watering-down the technical aspect so much so that the substance would be affected.
>
> This was a very fruitful collaboration, and we were able to program the piece several times in multiple concerts.

Do you have experience with improvisation? How has this experience (or lack thereof) affected your collaborations and the resulting musical works?

> My experience with improvisations comes from my work with Alvin Lucier and Petr Kotik (of the SEM ensemble in NYC).
> I learned to make more than simple interpretative decisions in concert through the works of the New York Composers (Christian Woolf, John Cage, Lucier, Brown).
>
> It has been a great education for me as a musician, to take part in the creation of a piece, not simply the re-creation, and sometimes it seems like the performer should probably get some kind of creative credit, and other times it is something that helps me to bond with the composer, and to create a more personal piece, with my voice more as a part of the musical landscape.

I work with a video-artist/collaborator. We perform semi-imporvised pieces using "found sound" and live sampling. It is an exciting way to create music!

Aesthetics/Interpretation

How has performing with amplification or electronics affected your concept of your clarinet sound? Have you made any conscious changes in your sound as a result of this experience?

no

Describe the types of interpretive decisions you typically make as a performer of interactive music. How does this skill set differ from interpretation of non-interactive repertoire?

no difference

Do you believe that a performer of interactive music should be familiar with the history and aesthetics of computer music? Why or why not?

not sure.

In your experience, how important is it for the performer of interactive music to understand the actions taken by the computer? Why?

This is one of the most important aspects, otherwise you relinquish all control to a second-party/technician who may or may not be there next time.

Take control, learn everything you can about the computer-technology and sound-engineering so that you can be an important member of the artistic process. Otherwise, the performer is just another device in the mix.

Esther Lamneck

General

Please describe how you first became involved in performing interactive music, and what role it plays in your work as a clarinetist today.

> I began my work with Cort Lippe in a prelude work to the composition he wrote for me : ""For Clarinet and ISPW" in the early 90's. This opportunity changed my entire approach to playing and greatly heightened my participation as a performer into one of a participant composer. The real time aspect of performance allows for this compositional freedom. The opportunity to respond to ones own sound input instantaneously can change the direction, color and intensity of any phrase. Lippe's electronics in particular allow me the greatest sense of freedom in sound exploration.

To aid in compilation of a list of works in this genre, please list the composer and title of interactive works you have performed.

> ""For Clarinet and ISPW" Cort Lippe composed for EL
>
> "Cigar Smoke" Robert Rowe composed for EL
>
> (will send complete list later to your email)

What do you consider to be the greatest challenges of performing interactive music, as opposed to (a) acoustic repertoire and (b) music for instrument and tape?

> the lack of rehearsal time to explore the sound scape in a real time setting- ie the Eelctronic Music Festivals- with limited time but great sound

What do you enjoy most about performing interactive music?

> freedom to create and interact with the electronic part, to have a chance to direct it- to improvise with it, to play with it. Great fun

Hardware/Software/Equipment

Does interactive music affect your choice of clarinet equipment (instrument, mouthpiece, barrel, reeds, etc.)? If so, how?

> initially my work with elecrtonics influenced my decision to play a more open facing for a bigger sound but that decision was also effected by the amt of new music improvisation I play as well.

What method(s) do you use for amplification of the clarinet when performing interactive music? Please include details about microphone selection and placement, and why you have made these choices.

I like an AKG 414 as it is often available and seems to remain tru to the color of the instruments- the engineers EQuing the sound can effect the sound greatly regardless of equipment.

Do you use different methods of amplification for different pieces? If so, why?

N/A depends on the hall

If you have a typical hardware "setup" for interactive music (interface, pedals, mixer, etc.), please describe it.

not really

Which of the following interactive systems have you used? Choose all that apply: Max/MSP, Pure Data (Pd), Kyma, Cypher, Other _____

Max/MSP, Pure Data (Pd), Kyma, Cypher

What is the extent of your familiarity with the software involved in the interactive works you have performed?

Just an underatanding of how patches are built and which programs produce certain possibilites

Notation

What challenges, if any, have you faced with the notation of interactive music, either in the score or the software?

nothing with notation

there is a frustration when patches don't function smoothly and there seems to always be some kind of problem- this can be frustrating

How much information about the computer part do you prefer to see notated in the score?

if there is fixed material that needs to be notated- otherwise important to be able to work with the patch to understand its possibilites and limitations

What type of notation of the computer part do you prefer to see in a score? Choose all that apply: Staff notation, Graphic Notation, Text descriptions, None (no notation of computer part), Other_____

any explantation the composer would generally say to me in the tech notes

Rehearsal/Performance

Describe your process for practicing and rehearsing interactive music, and any challenges you have encountered in this process.

learn any notated score before rehearsal with composer

Which aspects of performance do you prefer to control from on stage, and which aspects should be handled by a technical assistant? Specifically, how do you approach the issues of cueing, mixing, and starting/stopping each work?

there needs to be a great engineer to mix the sound

I prefer to have the composer run the patch should it be very comlicated

In improv settings such as though I do with Lippe he is constantly entering new sound possibilities for me through out a performance and becomes an active performer in our performances by freely moivng thru an array of patches.

In your experience, what is the best method (or combination of methods) to achieve coordination between the computer and performer? Choose all that apply: technical assistant executes cues, performer executes cues via pedal, computer follows performer via score following software, performer follows computer, stopwatch timing, performer gets visual information from computer screen

computer follows performer via score following software

Please explain why you prefer the method(s) of coordination indicated in the previous question.

there is more freedom for the performer if the computer can accurately pitch follow. If not someone needs to pedal the cues- Pedals are fine as safe guards and in some cases ok if sections need to be clearly deinfed

Collaboration

If interactive works have been written specifically for you, please describe the most and least successful performer/composer collaborations you have experienced. If applicable, include details about the level of input you had in the work's composition, and the process of rehearsal and performance of the work.

Greatest expereeinces with cort Lippe and Robert Rowe

Please describe your *ideal* performer/composer collaboration.

Lippe Lamneck

Live sound interaction improvisations for clarinet ot for my tarogato

great expereinces in all ways

Do you have experience with improvisation? How has this experience (or lack thereof) affected your collaborations and the resulting musical works?

> most composers always include improv for me so I am free to more comlpetely explore their sonic possibilites

> Improv is a great part of my language as a perfromer

Aesthetics/Interpretation

How has performing with amplification or electronics affected your concept of your clarinet sound? Have you made any conscious changes in your sound as a result of this experience?

> see previous quetion re MPs

Describe the types of interpretive decisions you typically make as a performer of interactive music. How does this skill set differ from interpretation of non-interactive repertoire?

> Since it relies on my improvisation skills and those of spontaneously altering sound and musical direction I would say it differs greatly from plaing acoustic and notated scores.Ther is so much more room for comopsitional input.

Do you believe that a performer of interactive music should be familiar with the history and aesthetics of computer music? Why or why not?

> It's interesting and good to be informed

In your experience, how important is it for the performer of interactive music to understand the actions taken by the computer? Why?

> you must underatand the sound possibilites and its improvisation possibilites in order to fully explore the patch.

Michael Lowenstern

General

Please describe how you first became involved in performing interactive music, and what role it plays in your work as a clarinetist today.

> My senior year of college (1989) marked my first experience with "interactive" music, though not in the sense it means today. I started with guitar footpedals, a microphone, and lots of feedback problems. After my return to the US following my Fulbright Year in Holland, I began my work in interactive electronics in earnest. That year, 1990, marked the first public release of Max. Between then and now, as Max evolved into Max/MSP and then again back into Max5, where it is today, i have been evolving with the program. Today, my entire concert is run by Max, and it is the foundation of every piece I write.

To aid in compilation of a list of works in this genre, please list the composer and title of interactive works you have performed.

> Interactive = live computer, not with Tape, so I will limit my answer to those titles. Besides works of my own (which are numerous!) I have played "Design for Bass Clarinet" and "Windows" by Jeff Herriott (Max); "Shells" by Robert Rowe (custom software he wrote); "Exit FTSB" by Mark Gibbons for EWI and Max. The rest are my own works. And every work between my album Ten Children (2003) and Spin Cycle (2010) has been written in Max.

What do you consider to be the greatest challenges of performing interactive music, as opposed to (a) acoustic repertoire and (b) music for instrument and tape?

> Computer instability. Simply put, it is the wild card in every performance, though I have managed this issue to have minimum impact.

What do you enjoy most about performing interactive music?

> Well, it allows me to do more by myself than would otherwise be possible with simple tape pieces or acoustic pieces.

Hardware/Software/Equipment

Does interactive music affect your choice of clarinet equipment (instrument, mouthpiece, barrel, reeds, etc.)? If so, how?

> By bell, which is wood, improves the sound going into my microphones by darkening it. Metal bells sound very brash to me when fed into a microphone.

What method(s) do you use for amplification of the clarinet when performing interactive music? Please include details about microphone selection and placement, and why you have made these choices.

Bass clarinet mics by AMT are my current choice. They attach to the bass clarinet and, in conjunction with a wireless belt pack, allow me complete mobility onstage. There are two mics attached to the instrument: one, the top mic, is a narrow cardioid pattern, the other, the lower mic, is an omnidirectional.

Do you use different methods of amplification for different pieces? If so, why?

No.

If you have a typical hardware "setup" for interactive music (interface, pedals, mixer, etc.), please describe it.

Computer, Audio Interface and a Microphone are the bare minimum. My setup extends this with the addition of a wireless mic interface, an external monitor mounted on a mic stand, an ipad to control the mac, and a footpedal I built.

Which of the following interactive systems have you used? Choose all that apply: Max/MSP, Pure Data (Pd), Kyma, Cypher, Other _____

Max/MSP

What is the extent of your familiarity with the software involved in the interactive works you have performed?

I am quite versed in Max having used it for 20 years. There are parts of the software I don't use (Jitter, for example) but for the kind of music I write, I can bang out a max patch very quickly.

Notation

What challenges, if any, have you faced with the notation of interactive music, either in the score or the software?

My feeling is that notation should be standard, and if not that, very intuitive. Reading "coded" notation which requires a notation "dictionary" is very tedious. Some composers apparently feel that it is more intuitive to limit text on the page, substituting iconography. If the icons are intuitive, great! If not, make them intuitive!

How much information about the computer part do you prefer to see notated in the score?

Depends. If it is a rhythmic-oriented piece (like the kind I write) it's not necessary. If it is more free-form, then the more notation (again, as standard as possible!), the better.

What type of notation of the computer part do you prefer to see in a score? Choose all that apply: Staff notation, Graphic Notation, Text descriptions, None (no notation of computer part), Other_____

Staff notation, Graphic notation

Rehearsal/Performance
Describe your process for practicing and rehearsing interactive music, and any challenges you have encountered in this process.

When rehearsing a new piece, I make sure the software is working properly even before I put together my instrument. I run the piece on my laptop just humming the bass clarinet part along with the electronics. It saves time with the instrument hanging from my body, and allows me to focus solely on the electronics. Then I rehearse the bass clarinet part alone, or with a metronome, until I have it as close to perfect as possible. Only then do I put the two together -- but then I run the piece over and over to be sure the software is stable. I will quit and restart the program (Max), I will restart the computer, I will run a different piece and then load the new piece to make sure there aren't any memory leaks from VST plugins or whatever -- just so that I minimize the possibility that this software crashes during a performance.

Which aspects of performance do you prefer to control from on stage, and which aspects should be handled by a technical assistant? Specifically, how do you approach the issues of cueing, mixing, and starting/stopping each work?

I prefer to control everything. That allows me to manage every aspect of the performance myself, ensures that I know the software/patch inside and out, and provides portability when traveling alone. If I need to, I will rewrite another composer's software/patch such that I can control it myself. I've done that in a few pieces.

In your experience, what is the best method (or combination of methods) to achieve coordination between the computer and performer? Choose all that apply: technical assistant executes cues, performer executes cues via pedal, computer follows performer via score following software, performer follows computer, stopwatch timing, performer gets visual information from computer screen

performer executes cues via pedal, performer follows computer, performer gets visual information from computer screen

Please explain why you prefer the method(s) of coordination indicated in the previous question.

Again, self-containment. The performer is -- and in my opinion should always be -- in control of the software. If the computer needs to make any notifications about its state to the performer, that should be part of the software.

Collaboration
If interactive works have been written specifically for you, please describe the most and least successful performer/composer collaborations you have experienced. If applicable, include details about the level of input you had in the work's composition, and the process of rehearsal and performance of the work.

I've had very little experience with other composers writing interactive music for me. But when I have, it has been a collaboration that has been very successful. When I've written for others, I try to make the software as bulletproof as possible such that I don't need to be there when it's performed. It should be easy to rehearse with, with an intuitive User Interface, and should be self-contained.

Please describe your *ideal* performer/composer collaboration.

Where both parties are empowered to contribute to the end result.

Do you have experience with improvisation? How has this experience (or lack thereof) affected your collaborations and the resulting musical works?

If a performer can improvise, and enjoys improvisation, then that should be a major consideration with the work that results from the collaboration. I tend to write for others who's playing I know well. I like the opposite to be true too -- if a composer doesn't know what I like to do, and writes a piece that isn't applicable to my style of playing or my interest, I ignore the request. I think this actually answers the question above too!

Aesthetics/Interpretation

How has performing with amplification or electronics affected your concept of your clarinet sound? Have you made any conscious changes in your sound as a result of this experience?

I haven't. I like the instrument -- in its raw, unprocessed state -- to be as much like the unamplified timbre as possible.

Describe the types of interpretive decisions you typically make as a performer of interactive music. How does this skill set differ from interpretation of non-interactive repertoire?

Actually, my interpretive decisions are similar. What I oftenfind is that performers rely on the electronics to take some of the weight off of the actual performance -- and it shows in the form of a sort of "distracted" performance in those cases. If a performer isn't 100% comfortable with the software s/he is working with, then those thoughts will always distract from the musical interpretation being processed in the brain. I just has to. So, again, comfort and practice with the software, and the confidence that brings, will allow the performer to give 100% attention to the music itself. That's my goal whenever I work on new interactive pieces.

Do you believe that a performer of interactive music should be familiar with the history and aesthetics of computer music? Why or why not?

I think a performer of interactive music should be familiar with the current state of the industry. Much like I don't need to know Morse Code to appreciate and be successful working an iPhone, I believe a knowledge of the history of computer music should be on an interest-basis. I, of course, want to know the history of computer music, because it

interests me. In this way, I think computer music is a bit different from learning Stravinsky, because in that case, you would need to know a bit about Rimsky Korsakov (his teacher) etc, etc. In my opinion, with computer music, there isn't as much of a need to know its "legacy" in order to interpret it properly. I do think there is a need to understand contemporary performance practice and that legacy -- so it's more about the music...

In your experience, how important is it for the performer of interactive music to understand the actions taken by the computer? Why?

I think I've answered this above -- EVERY performer should understand the computer/software as a requisite to performing an interactive piece. If that's not possible (and I understand that not everyone wants to do that), then having a second performer (the computer operator) who does understand the software must be present. Too often I have seen performers confounded by crashing software, a patch that doesn't load or make a sound, etc -- during a performance -- and though audiences are patient, it makes for a fairly lame concert experience. Of course, then you have to always travel with this second performer which will limit your ability to perform because these second performers also need to be booked, fly on an airplane, stay in a hotel, and be paid!

Pat O'Keefe

General

Please describe how you first became involved in performing interactive music, and what role it plays in your work as a clarinetist today.

As a performing musician, an important part of my work deals with improvisation, so much of my work with interactive electronics has been within the realm of improvised or semi-improvised music. Some of my first work with interactive electronics within an improvised context took place with composer Michael Theodore, a classmate of mine at UC San Diego, and who is now a professor at the U of Colorado.

The bulk of my work with interactive electronics has been in collaboration with composer and computer musician Scott Miller, from St. Cloud State University. I first began working with Scott about 6 years ago, and we have created many pieces together, some fully-composed, and others involving both semi-structured improvisation and free improvisation.

My work with interactive electronics is very important to me personally because I am fascinated by sound, and the timbral aspect of music has always been one of the most important aspects of music for me. Even though the clarinet is, by nature, a melodic instrument, much of my own work has dealt with extended techniques, and I've spent a great deal of time exploring the incredibly varied sound world that the clarinet is capable of producing. For me, working with interactive electronics was a natural extension of my sonic explorations of the clarinet, taking my sounds into new realms that are not possible acoustically.

To aid in compilation of a list of works in this genre, please list the composer and title of interactive works you have performed.

Arioso Doubles by Ben Broening
Moire by Chapman Welch

Pre-composed works by Scott Miller (for clarinet unless otherwise noted):
Chimeric Night
Lovely Little Monster

Improvisational works developed by myself and Scott Miller:
Arcata
Lattice VIIb
Ventriloquist
Omaggio a 1961
haiku, interrupted
Fun House (bass clarinet)
The Mirror Inside (bass clarinet)

What do you consider to be the greatest challenges of performing interactive music, as opposed to (a) acoustic repertoire and (b) music for instrument and tape?

> Making sure the technology works properly! It has certainly happened where, as the performer, you're up on stage waiting to go while the composer has to re-boot the computer system.
>
> Because of the interactive nature of the electronics, making sure that the computer is getting a good and accurate signal from the clarinet is, of course, of utmost importance, but it can also change radically from one space to the next. What works in a composer's studio can suddenly react very differently in a concert hall, and differently again in a recording studio. This involves many factors, including not only the ecology of the sonic environment in which you are located, but also how the programming is set up by the composer, the placement of microphones on the clarinet, etc. As you rehearse interactive music, you as a player become accustomed to certain responses from the computer. It becomes like just another player in a small ensemble, so you begin to expect certain responses. When those responses change, or worse, fail to happen, it can have a radical affect on your performance.
>
> In much of the improvisatory work I've done, it often comes down to issues of control. It's not just that the electronics are altering my sound, but (when applicable, depending on the programming), how can I control the way in which my sound is altered. Or, as I learn how my sound is being altered, I can begin to play in such a way as to create certain textures, as I learn to predict how the computer will transform my sound. Again, this applies mainly to improvised music.
>
> Finally, it's always good to remember that ultimately, when all is said and done, the gear is just a means to an end, and that end is delivering a good musical performance. As such, all the challenges of purely acoustic repertoire, or any other repertoire, are certainly at play in interactive music.

What do you enjoy most about performing interactive music?

> Exploration. As I mentioned above, much of the interactive music I've done is improvisatory in nature. The titles alone really tell the tale with a few of the pieces, including Fun House, and Arcata (Arcade). The electronics create, in effect, an electro-acoustic environment that I am free to explore. It allows me to discover new sonic landscapes, or extend beyond the realm of the "real" acoustic sounds that I am already familiar with.

Hardware/Software/Equipment

Does interactive music affect your choice of clarinet equipment (instrument, mouthpiece, barrel, reeds, etc.)? If so, how?

Not really. Selection of some equipment (reeds, mouthpiece, etc) is determined more by the specific piece I'm playing, or style of music (classical, contemporary, jazz, klezmer, etc), so it isn't the interactivity itself that influences my equipment.

What method(s) do you use for amplification of the clarinet when performing interactive music? Please include details about microphone selection and placement, and why you have made these choices.

I myself do not own specific equipment for amplifying my instrument, so I've usually used whatever was available, although often in my work with Scott Miller we'll use two AKG microphones (I don't recall the specific model numbers). Microphone placement is critical!! For both clarinet and bass clarinet we always use two microphones, one for the upper half of the instrument and one for the lower half. It's important to have mics that have a fairly wide field of coverage, not too focused, so as to get a good balanced signal from the entire range of the instrument.

The clarinet is a very problematic instrument to mic, both for interactive processing and recording, because the sound output of the instrument is so specifically localized to certain tone holes. I've definitely found that when the mic is placed in just the right place in front of a tone hole, when you play a note that comes out of that hole, the signal to the computer jumps way up, and any processing at the time will suddenly expand greatly, and not always in a good way. Hence the importance of getting good general coverage over the entire range.

I was recently in the recording studio, there were two close mics on the bass clarinet, and we were having a tough time getting a blended, even sound over the entire range of the instrument. Throat tone notes were clear and full, but then go over the break and the fullness and richness of the notes disappeared, and then sound was very thin. We found that moving the mic over just a few inches towards the right tone holes made a gigantic difference in the recorded sound. The same processes are in play with mic'ing for interactivity: if the mic isn't getting the correct sonic "info" in just the right way, it can have a huge impact on how the sound is transformed.

Do you use different methods of amplification for different pieces? If so, why?

Usually no. For the piece "Fun House" that I developed with Scott Miller, the electronic sound was 4-channel, not the standared 2-channel, and there was a great deal of spatialization in the amplified sound. So, for that piece, instead of two mics up and down we used two mics side by side, and as I moved around in relation to those two mics, I was able to actually move the sound around the room spatially. Other than that special need, two mics one up one down does the trick.

If you have a typical hardware “setup” for interactive music (interface, pedals, mixer, etc.), please describe it.

Not at this time, as most of the interactive work I've done was in collaboration with a computer musician, so it was normally his "setup" that we used.

Which of the following interactive systems have you used? Choose all that apply: Max/MSP, Pure Data (Pd), Kyma, Cypher, Other _____

Max/MSP, Kyma

What is the extent of your familiarity with the software involved in the interactive works you have performed?

Scott Miller works exclusively with the KYMA systerm. It has proven to be amazing powerful and flexible for the work we do, but that is really Scott's realm.

Speaking personally here, getting deep into working with electronics is quite an undertaking. I spent a summer in 1995 working at CNMAT (the Center for New Music and Audio Technology), learning everything I could about all aspects of electronic music. Being really skilled with that element, especially the various software, is like mastering another instrument, and a very complicated one. After that summer I learned that it is enough for me, in my life, to continue to work to master the various instruments and musical styles that I already play, so I leave the mastering of the computer to collaborative partners.

Notation
What challenges, if any, have you faced with the notation of interactive music, either in the score or the software?

Accurate presentation of the most useful information to the performer without being overly complicated. There is so much in any style of music that can't really be notated, and the same is true for interactive music. Much of it just comes through learning the piece and performing it.

How much information about the computer part do you prefer to see notated in the score?

Just enough to follow the meaningful events in the interactive portion of the music, without creating an overly long performance part due to an extremely detailed notational or graphic realization of the electronics.

Regarding the question below about preferences, it really depends on the individual piece and what's going on in the electronics. At different times staff notation, graphic notation, and/or a text description will be the most effective way to communicate what is happening.

What type of notation of the computer part do you prefer to see in a score? Choose all that apply: Staff notation, Graphic Notation, Text descriptions, None (no notation of computer part), Other_____

Staff notation, Graphic notation, Text descriptions

Rehearsal/Performance
Describe your process for practicing and rehearsing interactive music, and any challenges you have encountered in this process.

It really depends on the piece. For some pieces, like Arioso Doubles by Ben Broening, it was mainly a matter of just learning the notes, and then getting familiar with the sounds of the processing came quickly in just a few rehearsals.

For Chapman Welch's Moire, I personally found it had to practice a great deal away from the electronics. For me, the clarinet part in that piece is incomplete on it's own, and really needs the electronics to flesh out the piece, so I relied more on rehearsing with them in that piece.

For my work with Scott Miller, again, as so much of is was created by us together through collaboration, and much improvisation, it was not really conceivable to practice apart from Scott. An exception would be the piece "Lovely Little Monster" which is a fully-composed piece that is clearly notated and can be practiced and learned on your own, away from the computer.

Biggest challenge in practicing would be having access to the technology so you can work with and get used to it. This is easy for those with access, but clearly much harder for those who don't. I think pieces like Moire and Arioso Doubles are good for the clarinet repertoire because the composer made sure that simple software was easily available in order to do the piece.

Which aspects of performance do you prefer to control from on stage, and which aspects should be handled by a technical assistant? Specifically, how do you approach the issues of cueing, mixing, and starting/stopping each work?

As I usually work with a collaborative partner, I'm used to controlling the clarinet, and allowing my partner to control the electronics. However, during the sound-check or tech rehearsal I am very much involved in mic placement, eq'ing of the amplified sound, and setting of monitor levels (very important!!).

Cueing and start/stop again vary from piece to piece. Sometimes the cues are aural ones built into the music, but often there are visual cues between myself and my partner. For me, working with a partner in interactive music is just like playing chamber music, and he/she is another player in the ensemble, so as with all chamber music good eye contact is very important.

In your experience, what is the best method (or combination of methods) to achieve coordination between the computer and performer? Choose all that apply: technical assistant executes cues, performer executes cues via pedal, computer follows performer via score following software,

performer follows computer, stopwatch timing, performer gets visual information from computer screen

> technical assistant executes cues, performer executes cues via pedal, computer follows performer via score following software, performer follows computer, stopwatch timing, performer gets visual information from computer screen

Please explain why you prefer the method(s) of coordination indicated in the previous question.

> As you can see I checked them all, because I've used them all (in both solo interactive pieces and also ensemble pieces), and seen them all used, to good effect. I think it depends on the nature of the piece and also the player. Performers like Michael Lowenstern, who are comfortable working as a solo act, will be easily capable of handing everything by themselves from the stage. Many other players won't be, so for them an assistant is best. As to the use of a stopwatch, performer follows computer, computer follows performer, it really comes down to the demands of the music itself and which way is the best way to coordinate the activity of player(s) and computer in order to achieve the composer's intentions. It certainly can happen that several of these methods might be used in one piece.
>
> From my improvisatory work with Scott Miller, computer follows performer and vice versa are always operating, usually at the same time. Personally, performer getting info from the computer screen has always struck me as somewhat cumbersome when I've seen it done, but for certain pieces it is best, especially pieces where the performer needs to know the exact length of a given patch (I"m thinking specifically of Cort Lippe's Music for Snare Drum and Computer).

Collaboration
If interactive works have been written specifically for you, please describe the most and least successful performer/composer collaborations you have experienced. If applicable, include details about the level of input you had in the work's composition, and the process of rehearsal and performance of the work.

> For those pieces written for me, I was heavily involved from the beginning, and the pieces were developed through a long period of rehearsal, and refined through several performances. I believe that performers have plenty to offer on the creative side of things, so I'm never shy about making suggestions, comments, and criticisms to the composer. I also accept the fact that the composer can choose to ignore everything I have to say, but that won't stop me from saying it.
>
> As a musician who has been active in contemporary music for over 15 years, and who has premiered hundreds of new pieces, I think a good collaboration between composer and performer is one where there is a lot of communication between the two (and the opposite is also true: little communication often results in less-than-successful works). It's a relationship that you build, and as the composer gets to know the performer and his or her abilities, including their comfort level with technology, the music becomes tailored to

that individual. This can be very satisfying and result in music that is great to play. I think most performers will always keep an eye out to make sure that the music being written is also playable by others, so the pieces can live on their own. This to me is the heart of a great composer/performer collaboration, whether it's an interactive piece or a tape piece or just an acoustic piece. Spend a lot of time together, build a good relationship, be open (in every sense), and good things will come out of it.

Please describe your *ideal* performer/composer collaboration.

See above!

Do you have experience with improvisation? How has this experience (or lack thereof) affected your collaborations and the resulting musical works?

I have addressed this extensively in my earlier answers.

Aesthetics/Interpretation
How has performing with amplification or electronics affected your concept of your clarinet sound? Have you made any conscious changes in your sound as a result of this experience?

Amplification and electronics are two different things for me. Amplifying the clarinet can be tricky, because the sound of the clarinet is so complex that it can be hard to electronically replicate, so in certain amplified situations I may adjust my reed or mouthpiece selection to achieve the most pleasing (to me!) amplified sound. As to the electronics, I see it in two ways: 1) As I've explained earlier, I see them as an extension of my own sonic palette on the clarinet; and 2) often in improvisatory settings I will hear sounds being made by the electronics that inspire me to try to imitate them in some way on the clarinet, which then makes me play the clarinet in a new way in order to create a sound that I had not previously tried to make on my instrument.

As a teacher of mine (Anton Weinberg) often said, "sound is a function of content." The demands of the music should influence your clarinet sound. The clarinet is so incredibly flexible (we're really lucky in that regard!!), and we can make so many different sounds. I think it's important for clarinet players to be open to this flexibility and exploit it when necessary.

Describe the types of interpretive decisions you typically make as a performer of interactive music. How does this skill set differ from interpretation of non-interactive repertoire?

Again, depends on the piece and what it requires of the player. In a piece like Arioso Doubles by Ben Broening, I'll play it much the same way I'll play Brahms, shaping melodic lines with shadings of dynamics and rhythm, and these decisions are affected by what I hear in the electronics, but I don't think the interpretive decision are radically different. With Chapman Welch's Moire, as an improviser I felt a desire to be more improvisatory with the way I played certain sections, and even before I met Chapman and discussed it with him this seemed like an appropriate approach for the music.

Performer's bring a lot of creativity to the performance of any work and it's our job to do what ever we can to bring the music alive. What works for one composer piece won't work for another. While inter-active music certainly has it's own special performance issues, ultimately I think interpretative decisions are made based on the demands of the music itself, whether it's interactive or acoustic.

Do you believe that a performer of interactive music should be familiar with the history and aesthetics of computer music? Why or why not?

Yes, insofar as musicians should be cognizant of the history and aesthetics of any style of music that play. It's important to know where it comes from and the issues involved. But I don't necessarily think that an extensive knowledge of the history of computer music will make one a better performer of that music, unless you're the one writing the software. An extensive knowledge (and experience) of the performers of inter-active music would be helpful.

In your experience, how important is it for the performer of interactive music to understand the actions taken by the computer? Why?

In my improvisatory work it is hugely important. It is the very basis of the music that I am helping to create, so I need to hear and be able to react to everything the computer is doing. Do I myself need to know how the computer was able to do this? No, not for me personally, because I'm not interested in trying to replicate that myself though computer software. Just like the composer doesn't need to fully understand what I had to do physically to play that multiphonic or whatever other sound I was able to do.

In composed "solo" pieces for clarinet and electronics, as I see it the reality is this: it isn't a solo, it's a duet. Your duet partner is (depending on the situation) either a computer, or a person manipulating a computer (which in this context means they are playing an instrument). As such, like any duet, you must know what your partner is doing, so you can make great music with your partner. Do you need to understand how your partner does what he/she does? Not fully, just as you don't need to know all the ins and outs of how the pianist or the flutist or cellist etc does what they do, beyond of course those things which immediately impact how you play together (bowing, breathing, coordinating, etc). But you absolutely have to be aware of what they are doing.

Butch Rovan

General

Please describe how you first became involved in performing interactive music, and what role it plays in your work as a clarinetist today.

> I am a composer / performer, and as I began developing interactive systems, I naturally started developing them for myself. I have since written for many other performers, but I also still perform with interactive systems. My performance with such systems includes custom sensor hardware attached to my clarinets (my MiMICS system) and custom software. I use this system in performance as a solo artist or with my groups "Gray Code" and "envyloop".

To aid in compilation of a list of works in this genre, please list the composer and title of interactive works you have performed.

> I have only performed my own works -- "L'obvie / l'obtus", as well as live electronic improvisations with my groups Gray Code and envyloop. The improvisation works can be found on the CDs:
> Gray Code: "floating point" (www.circumventionmusic.com)
> envyloop: "Bleak Texas Thing" (www.cdemusic.org / EMF)

What do you consider to be the greatest challenges of performing interactive music, as opposed to (a) acoustic repertoire and (b) music for instrument and tape?

> For me the greatest challenge is first creating a system that is responsive and somewhat unpredictable, then learning how to use that system's behavior as a partner and collaborator. I am very interested in creating systems with obstinate qualities, such that the system is somewhat resistant. As a performer, this leads to a much more interesting relationship with the technology.

What do you enjoy most about performing interactive music?

> The in-the-moment reaction to the system, and adapting to its unpredictable qualities.

Hardware/Software/Equipment

Does interactive music affect your choice of clarinet equipment (instrument, mouthpiece, barrel, reeds, etc.)? If so, how?

> Since my clarinet has sensors attached, I'm now using a composite body instrument (E-flat alto clarinet).

What method(s) do you use for amplification of the clarinet when performing interactive music? Please include details about microphone selection and placement, and why you have made these choices.

I use a hypercardioid mic to avoid feedback. I use it on a stand, as opposed to mounted on the instrument, so I can work with the mic in performance to balance my own level. I run the mic signal through my own mixer, and send a line level signal to the house system.

Do you use different methods of amplification for different pieces? If so, why?

No.

If you have a typical hardware "setup" for interactive music (interface, pedals, mixer, etc.), please describe it.

Mic > mixer > laptop. Custom hardware on the horn, and custom software running on the laptop.

Which of the following interactive systems have you used? Choose all that apply: Max/MSP, Pure Data (Pd), Kyma, Cypher, Other _____

Max/MSP, SuperCollider

What is the extent of your familiarity with the software involved in the interactive works you have performed?

A lot of familiarity with the software (I write the software for the pieces I perform).

Notation

What challenges, if any, have you faced with the notation of interactive music, either in the score or the software?

As a composer, one challenge is creating a useful representation of the electronics. Also, in the case of systems that respond to physical gesture, you have the added challenge of creating notation to represent physical gestures. As a performer, reading my gestural notation has been a challenge.

How much information about the computer part do you prefer to see notated in the score?

A fair amount.

What type of notation of the computer part do you prefer to see in a score? Choose all that apply: Staff notation, Graphic Notation, Text descriptions, None (no notation of computer part), Other_____

Staff notation, Graphic notation, Text descriptions

Rehearsal/Performance

Describe your process for practicing and rehearsing interactive music, and any challenges you have encountered in this process.

> My process usually involves rehearsing + programming the software simultaneously. Also, sometimes rehearsing + compiling software for the microcontroller-based sensor systems.

Which aspects of performance do you prefer to control from on stage, and which aspects should be handled by a technical assistant? Specifically, how do you approach the issues of cueing, mixing, and starting/stopping each work?

> The only thing I usually need the in-house sound engineer to control is the balance between the live clarinet and the processing. Even this can be tricky, however, as different sound engineers have different opinions about what this balance should be. I usually want less live clarinet in the mix (an equal mix of clarinet + processing) than they do.

In your experience, what is the best method (or combination of methods) to achieve coordination between the computer and performer? Choose all that apply: technical assistant executes cues, performer executes cues via pedal, computer follows performer via score following software, performer follows computer, stopwatch timing, performer gets visual information from computer screen

> The best methods include: A technical assistant executes cues; the performer executes cues via a pedal; or the computer follows the performer via score-following software

Please explain why you prefer the method(s) of coordination indicated in the previous question.

> Different parts of a piece have different requirements. The system should be flexible.

Collaboration

If interactive works have been written specifically for you, please describe the most and least successful performer/composer collaborations you have experienced. If applicable, include details about the level of input you had in the work's composition, and the process of rehearsal and performance of the work.

> I haven't had works written for me by other composers.

Please describe your *ideal* performer/composer collaboration.

> Well, again, I write the pieces I perform.

Do you have experience with improvisation? How has this experience (or lack thereof) affected your collaborations and the resulting musical works?

> Yes, I do a lot of improvisation with interactive systems. This approach has worked very well with various groups I've performed with, including Gray Code and envyloop.

Aesthetics/Interpretation

How has performing with amplification or electronics affected your concept of your clarinet sound? Have you made any conscious changes in your sound as a result of this experience?

> The main change for me is that I've gravitated toward playing E-flat alto clarinet. I love the timbre and the way it works with the system I've developed.

Describe the types of interpretive decisions you typically make as a performer of interactive music. How does this skill set differ from interpretation of non-interactive repertoire?

> I've developed a repertoire of extended playing techniques partly as a result of playing with interactive systems. I don't actually perform non-interactive works these days, so I can't compare the two experiences.

Do you believe that a performer of interactive music should be familiar with the history and aesthetics of computer music? Why or why not?

> Yes, I think it would help. Partly to develop a vocabulary with which to converse with a composer of interactive systems. It also helps to know what is and isn't possible, and the different approaches to performing with technology.

In your experience, how important is it for the performer of interactive music to understand the actions taken by the computer? Why?

> It's important for me, because that's the only way I can explore the subtleties of the system.

APPENDIX B

LIST OF INTERACTIVE WORKS FOR CLARINET AND COMPUTER

It is not always easy to distinguish between interactive works and non-interactive works, but this listing attempts to do so. It includes only works for clarinet or bass clarinet that are interactive, excluding works with fixed accompaniment (e.g., works for clarinet and tape) and works with only simplistic electronic "effects" that could be executed with analog pedals. In addition, the list excludes interactive works for chamber ensemble of two or more players, with the exception of works for two clarinets and computer. The list is limited to *notated* works for clarinet and computer; interactive systems designed as improvisational environments, without a notated clarinet part, have not been included.

Information about these pieces was obtained through various sources including performer interviews, dissertations, published articles, recordings, and websites of composers and performers. In some cases it was unclear whether a work was truly interactive; the indication "clarinet and electronics" is particularly ambiguous. In such cases, the decision to include the piece was based on information such as the date of composition, the composer's other works, and direct communication with the composer.

A List of Interactive Works for Clarinet and Computer

Composer Last	Composer First	Title	Instrumentation	Date	Dedicatee/ Collaborator	Duration
Austin	Larry	*Adagio: Convolutions on a Theme by Mozart*	clarinet and octophonic computer music	2004-5	F. Gerard Errante	9:41
Azguime	Miguel	*No Oculto Profuso - medidamente a desmesura*	clarinet and electronics	2009		
Barrett	Natasha	*Liquid Crystal*	clarinet and live electronics (computer)	2000		12:20
Beerman	Burton	*Dayscapes*	clarinet and interactive Kyma system			
Beerman	Burton	*Meditations*	electric clarinet, interactive computer and dancers	1994		
Beerman	Burton	*Rape Poems of Francis Driscoll*	clarinet, Kyma, and dance			
Bestor	Charles L.	*About Her*	clarinet and interactive electronics	1995		5:00
Bestor	Charles L.	*Conversations with Myself*	clarinet and interactive electronics	1993	F. Gerard Errante	14:00
Bestor	Charles L.	*Music for Gerry*	clarinet and interactive electronics	2002	F. Gerard Errante	10:00
Bevelander	Brian	*Synthecisms No. 7*			Clarion Synthesis (F. Gerard Errante and D. Gause)	
Bloland	Per	*Quintet*	solo clarinet and electronics			6:30
Boulanger	Richard	*The Dark Wind*	radio baton and bass clarinet			
Boulanger	Richard	*From Temporal Silence*	radio baton and clarinet	1987/ 1991		
Boulez	Pierre	*Dialogue de L'Ombre Double*	clarinet and electronics (revised versions use computer)	1985		
Boyle	McGregor	*Midway Inlet*	clarinet and computer	2006		6:31
Broening	Benjamin	*Arioso/Doubles*	Bb clarinet and computer	2002	Arthur Campbell	7:49
Broening	Benjamin	*The Black Edge of the Moon/ Auerole Variations*	clarinet and computer	2002	F. Gerard Errante	7:00
Broening	Benjamin	*Radiance*	clarinet and electroacoustic music	2009	Arthur Campbell	10:00

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Composer Last	Composer First	Title	Instrumentation	Date	Dedicatee/ Collaborator	Duration
Burke	Brigid	*An Enchanted Aisle*	Bb clarinet, live electronics/laptop and DVD	2008		
Burke	Brigid	*High Octane*	Bb clarinet, live electronics/laptop/Electro acoustic composition and video projection	2009		
Burke	Brigid	*Island City*	Bb clarinet, live electronics/laptop and live and prerecorded video projection	2009		
Burke	Brigid	*Keys Swim*	bass clarinet, laptop and multiple live video projections	2010		
Burke	Brigid	*Memories of a Shadow*	Bb clarinet, live electronics/laptop and DVD	2007		
Burke	Brigid	*Strings*	bass clarinet, (optional piano) live electronics/laptop and DVD (notated)	2007		
Büyükberber	Oguz	*Not an Architect*	solo bass clarinet and electronics	2010		
Caires	Carlos	*Limiar*	clarinet and electronics	2002		
Carmichael	Laura and Silvia Matheus	*Day of Two Noons*	clarinet and live electronics	1998	Laura Carmichael	
Carmichael	Laura and Pamela Z	*Teeth*	clarinet and live electronics or tape/CD	1995	Laura Carmichael	
Cohen	Denis	*Ombre 2*	clarinet and electronics	2003	Chen Halevi	8:00
Cornicello	Anthony	*Syncretic Resonances*	two clarinets and live electronics	2008	Clarion Synthesis (F. Gerard Errante and D. Gause)	
Cox	Cindy	*The Shape of the Shell*	solo bass clarinet and live electronics	2010	Laura Carmichael	
Curran	Alvin	*First Octave*	clarinet and electronics	1991	David Keberle	12:45
Dudas	Richard	*Prelude for Clarinet and Computer*	clarinet and computer	2006		

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Composer Last	Composer First	Title	Instrumentation	Date	Dedicatee/ Collaborator	Duration
Edwards	Michael	*snow shoes, maupin, air conditioners, mother's, fleas, satyricon, and you (la cucaracha)*	bass clarinet and computer or tape	2001		17:12
Einbond	Aaron	*Temper*	bass clarinet and live electronics	2006		
Ferraz	Silvio	*Poucas Linhas de Ana Cristina*	Bb clarinet and live-electronics (Max/MSP)	1999		
Fineberg	Joshua	*Chamber Pieces*				
Gaussin	Allain	*Jardin Zen*	clarinet and electronics	1999		
Graugaard	Lars	*Concealed Behaviours*	bass clarinet and interactive computer	2002-3	Henri Bok	15:00
Graugaard	Lars	*Hum*	bass clarinet and interactive computer	1997	Fritz Berthelsen	12:00
Hamel	Keith	*Traces*	clarinet and interactive electronics		Jean-Guy Boisvert	
Hamm, Jr.	Samuel J.	*fixion*	B-flat clarinet and computer	2002		
Harchanko	Joseph	*Breath*	clarinet and computer	2006	F. Gerard Errante	6:30
Herriott	Jeff	*Design*	bass clarinet and electronics	2003		
Herriott	Jeff	*Instances*	clarinet and electronics	2003		
Herriott	Jeff	*window: a vision in multiple stages*	bass clarinet and electronics	2009		
Hopkins	Christopher	*Touché*	two clarinets and computer	2009	Clarion Synthesis (F. Gerard Errante and D. Gause)	
Imai	Shintaro	*Resonant Waves*	clarinet and computer	1998		10:00
Jacobs	Bryan	*Separations*	clarinet and live electronics			
Keberle	David	*Librato in Volo*	clarinet, pitch to midi, computer, & samplers	1991		
Kim-Boyle	David	*Wisps*	bass clarinet and computer	2006	E. Michael Richards	
Kleinsasser	William	*Inner Nature Persistently Emerges*	bass clarinet and computer	2005	E. Michael Richards	11:00
Krieger	Ulrich	*Do you know what heaven sounds like?*	bass clarinet, tape, live electronics	1993		

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Composer Last	Composer First	Title	Instrumentation	Date	Dedicatee/ Collaborator	Duration
lanza	alcides	*ektenes III [1995-I]*	clarinet, electronic sounds, and digital signal processing	1995	Jean-Guy Boisvert	
Libera	Matt	*Balance*	clarinet and computer using Wii balance board	2009		6:26
Lippe	Cort	*Music for Clarinet and ISPW*	clarinet and ISPW; rev. 1999 for clarinet and Max/MSP	1992/ 1999	Esther Lamneck	17:56
Lippe	Cort	*Trio for Clarinet and Two Computers*	clarinet and two computers	2002	Esther Lamneck	12:29
Lowenstern	Michael	*After the Rain*	bass clarinet and interactive electronics	1992		
Lowenstern	Michael	*Sha*	bass clarinet and electronics	2002		10:00
Malsky	Matthew	*Ancient Devices*	clarinet with Max/MSP	1999/ 2003	Double Dialog (John Bruce Yeh)	
Manganensi	Giorgio	*teatro dell'udito III*	bass clarinet and live electronics		Lori Freedman	
Matheus	Silvia and Laura Carmichael	*Myroloyi*	clarinet and live electronics	1992	Laura Carmichael	9:00
May	Andrew	*Chant/Songe*	clarinet and computer	2004	F. Gerard Errante	11:12
May	Andrew	*Wandering Through the Same Dream*	two clarinets and computer	2005	Clarion Synthesis (F. Gerard Errante and D. Gause)	
Melby	John	*Concerto No. 2*	clarinet and computer	2006	Esther Lamneck	16:30
Melo	Virgílio	*Upon a Ground II*	clarinet and electronics	2001		
Miller	Scott	*Chimeric Night*	clarinet and computer	2009	Pat O'Keefe	5:10
Miller	Scott	*Lovely Little Monster*	solo clarinet and interactive or fixed-media electronics (also available for flute, clarinet, percussion and electronics)	2009	Pat O'Keefe	7:10
Nagel	Jody	*Kaleidoscope*	clarinet and live algorithmically-generated electronic sounds	1996	F. Gerard Errante	5-20 min.
Nelson	Jon Christopher	*Gerry Rigged*	Bb clarinet and interactive electronics	2004	F. Gerard Errante	10:00

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Composer Last	Composer First	Title	Instrumentation	Date	Dedicatee/ Collaborator	Duration
Olveira	João Pedro	*Time Spell*	clarinet and electronics	2004		
Osada	Ryszard	*Capriccio*	clarinet and electronics	2005		
Pape	Gerald	*Aquarelles*	basset horn doubling clarinet, tape, and live electronics	1999		
Paradiso	Francesco	*Mediterraneo 36.2*	clarinet and electronics			
Pennycook	Bruce	*Praescio IV*	clarinet and MIDI-Live system; rev. 2004 for Max/MSP	1990/ 2004	Jean-Guy Boisvert	
Pinkston	Russell	*Gerrymander*	Bb clarinet and MAX/MSP	2002		7:00
Price	L. Scott	*Crystalline Vapor*	clarinet and computer	2010	Rachel Yoder	11:00
Raes	Godfried-Willem	*Baklava*	bass clarinet and robot orchestra	2003	Eva Vandevoorde	15:00
Raes	Godfried-Willem	*WoodStock*	clarinet and PC	2001	Michele Marelli	12:00
Rai	Takayuki	*Transfiguration*	clarinet and computer with or without interactive multimedia computer system	1999/ 2002		10:00
Ribeiro	Ricardo	*Intensités*	clarinet and electronics			
Rowe	Robert	*Cigar Smoke*	clarinet and computer	2004	Esther Lamneck	10:18
Rowe	Robert	*Hall of Mirrors*	bass clarinet and the 4X real-time system	1986		
Rowe	Robert	*Shells*	tarogato or bass clarinet and computer	1993	Esther Lamneck	8:04
Rovan	Joseph Butch	*L'Obvie / l'obtus*	clarinet, gestural controller, and interactive electronics	1997		
Sandroff	Howard	*Tephillah*	clarinet and digital audio processors	1990		17:17
Scheidt	Daniel	*Squeeze*	bass clarinet and interactive software	1990		
Settel	Zach	*Eschroadepipel*	clarinet, bass clarinet and Max/MSP	1990		7:00
Shing	Seongah	*Regress in Infinity No. 1*	clarinet and live electronics	1995/ 1996		11:00
Sidarta	Otto	*Music for Clarinet and Computer*	clarinet and computer	1995		

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Composer Last	Composer First	Title	Instrumentation	Date	Dedicatee/ Collaborator	Duration
Smith	Ronald Bruce	*Something Suspicious (small)*	bass clarinet and live electronics	2005		8:00
Thompson	Robert Scott	*Passage*	clarinet and electroacoustics	2008	F. Gerard Errante	9:00
Trbojevic	Jovanka	*Le fantôme du vent*	bass clarinet, tape, and live electronics	1998		17:00
Tüzün	Tolga	*Borderline*	clarinet and live electronics	2003/ 2006		10:00
Uehara	Kazuo	*Katarai II*	clarinet and computer	1990		
Variego	Jorge	*Giant Shapes*	prepared clarinet in B-flat/A & computer			
Variego	Jorge	*Now That You Are Here*	bass clarinet and computer			8:12
Walsh	Craig	*Sugar Touch*			Clarion Synthesis (F. Gerard Errante and D. Gause)	
Welch	Chapman	*Moiré*	solo clarinet (Bb and A), live electronics, and optional ensemble	2008/ 2010	Rachel Yoder	9:00
Winkler	Todd	*Snake Charmer*	clarinet and computer	1992	F. Gerard Errante	11:16
Yun	Seunghyun	*mm-ah-un-ee-oo*	clarinet and interactive effects processing	1995		12:00
Yun	Seunghyun	*Mirrors*	clarinet in Bb and live electronics	2006		
Ziporyn	Evan	*Walk the Dog*	bass clarinet and electronics	1992		25:00
Zwaanenburg	Jos	*Maybe Tomorrow*	bass clarinet and live electronics	1991/ 2004		8:00

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APPENDIX C

GLOSSARY

Algorithm – A set of rules or steps for completion of a specified task.

Analog signal – A continuous signal of sound information transmitted through voltages of electricity (as opposed to a digital signal).

Diffusion – The act of controlling spatialization of sound in performance.

Digital signal – A discrete signal representing sampled values of sound information transmitted through a sequence of numbers (as opposed to an analog signal).

Electroacoustic music – Music created or stored using electronic means and played through loudspeakers.

Graphical patching language – A visually oriented programming language such as Max/MSP with graphical objects that can be manipulated and connected.

Interface (audio) – In interactive music, a hardware component used to convert analog signals to digital signals, or vice versa, for integration of a live performer with computer.

Interface (graphical user) – A visual computer display created for the purpose of user interaction and operation of a software program.

Patch – A program, typically created with Max/MSP or Pd software, for realization of a specific piece of music or for accomplishing a specific process.

Pitch-tracking – An algorithm that analyzes input frequency; often used to accomplish score following.

Score following – A method for coordinating the computer and performer in interactive music through computer analysis of musical parameters and comparison with a stored representation of the score.

Signal processing – Manipulation of sound via digital or analog processes such as delay, modulation, or transposition.

Sound reinforcement – Amplification of live or pre-recorded sound for an audience.

Sound synthesis – Various methods of generating electronic sound using digital or analog means.

Spatialization – Projection of distinct sounds from loudspeakers in different locations in a performance space, usually used in conjunction with multiple channels of audio information.

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