

April 25, 2003  
Draft 1.0

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The University of Arizona  
Degree sought: Doctor of Musical Arts  
Major: Clarinet Performance  
Minor: Music in General Education

## **Proposal for Lecture-Recital Document**

“I have read this proposal and believe it is ready for consideration by the Graduate Committee.”

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Major Professor, Mr. Jerry E. Kirkbride Date

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Committee Member: Dr. Kelland Thomas Date

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Committee Member: Dr. William Dietz Date

## PROPOSED TITLE

“Analysis and Performance of Interactive Electroacoustic Works for Clarinet and Obsolete Technology”

## INTENT AND SCOPE OF STUDY

My proposal is to analyze the electronically generated musical elements of four works for clarinet and interactive electronics for which the original equipment or technology is no longer available. This project will encompass a written document and lecture-recital. The written document will include 1) a brief overview and definition of interactive electroacoustic music, 2) a detailed written analysis of the electronic components of four works for clarinet and now-obsolete interactive technologies, and 3) a description of the process of re-creating two of these works for the lecture-recital using updated technology (for which the analysis in section 2 will serve as a guide).

The four works I will analyze are: Thea Musgrave’s *Narcissus, for Solo Clarinet in Bb with Digital Delay* (1987), Bruce Pennycook’s *Praescio IV, for clarinet and MIDI-Live System* (1990), Richard Boulanger’s *from Temporal Silence* (1989), and Cort Lippe’s *Music for Clarinet and IRCAM Signal Processing Workstation (ISPW)* (1992).

This analysis will take the form of detailed descriptions of the various sound synthesis and processing algorithms, human-machine interactions, control structures, and event sequences that make up the electronic components of the four works under investigation. Each element of the electronic part will be examined in terms of its musical function in the piece and without regard for specific equipment that might be

used. Therefore, the purpose of this study is not to simply describe the original technology or system for which the piece was written, but rather to create a useful guide for transcription of the electronic requirements to a variety of systems or technologies either extant or yet to be invented.

The Lecture-Recital will consist of performances of Thea Musgrave's *Narcissus* (c. 17 min.), and Bruce Pennycook's *Praescio IV* (c. 12 min.), and a *viva voce* explanation of my written analysis and realization of these works.

### **STATEMENT OF PRIMARY THESIS**

Detailed, device-independent analysis of the electronic components of older works for clarinet and interactive electronics will provide a useful guide for performers creating concert realizations of such works, regardless of the technology resources currently available.

### **JUSTIFICATION**

Interactive electroacoustic works are often out of reach for performers because of their elaborate technological requirements. This barrier to performance is made more acute when not only is specialized hardware or software required to perform a given piece, but also that the specified equipment is no longer available due to technological obsolescence. As Joel Chadabe has recently pointed out:

Traditional instrumental music can be preserved through notation, first because traditional compositions are defined by elements which can be notated, and, second, because traditional instruments are played in standard ways. Since electronic instruments are not played in standard ways, and further, since rapid changes in technology lead to a steady turnover of electronic instruments, notation can not serve as a way of preserving

performances of electronic sounds. ... electronic performance can be preserved by describing the sounds themselves so that they can be performed on any appropriate instrument, by using current technology, or by updating the composition itself, and ... *such approaches can be artistically viable if the performer understands the composer's intentions.*<sup>1</sup> [italics mine]

Thea Musgrave's *Narcissus* is notated very specifically for a now-obsolete digital delay system. This fact causes ambiguity when directions in the score are applied to other equipment. Several authors have discussed the use of technology in Musgrave's *Narcissus* and the practical issues involved in performing it. Diane Boyd presents a thorough analysis of the dramatic aspects of *Narcissus*, and the impact of the *Narcissus* story on the compositional process and use of digital delay.<sup>2</sup> Patricia Spencer, a co-commissioner of the work, has described the musical integration of technology and the effect of technology on Musgrave's compositional process.<sup>3</sup> Bruce Bullock and Ron Burns have described an actual performance realization of the clarinet version of *Narcissus* using their own digital delay processor.<sup>4</sup> While these articles provide helpful insights, none provides a systematic and thorough explanation of the digital delay effects or their implementation.

Bruce Pennycook's *Praescio IV* is part of a series of compositions, written between 1989 and 1993 at McGill University, using his custom-designed "MIDI-

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<sup>1</sup> Joel Chadabe, "Preserving Performances of Electronic Music." *Journal of New Music Research*, 30, no. 4 (2001): 303.

<sup>2</sup> Diane Boyd, "The Dramatic Aspects of Thea Musgrave's *Narcissus* for Solo Flute and Digital Delay (1987)," DMA Dissertation, University of North Texas, Denton, TX (1996).

<sup>3</sup> Patricia Spencer, "The Musical Shape of Technology," *The Flutist Quarterly* 19, No. 3 (Spring 1994): 47-51.

<sup>4</sup> Bruce Bullock and Ron Burns "A Performance Realization of Thea Musgrave's *Narcissus* for Amplified Solo Clarinet and Digital Delay." *The Clarinet* 22, no. 4 (1995): 48-49.

Live” interactive computer music system, described in the *Computer Music Journal*.<sup>5</sup> Since that time, the MIDI-Live software has fallen out of use, and any new performance will require updated software. To date, no formal analysis of the musical processes executed by the software has been published. Pennycook has expressed his willingness to work with me on such an analysis and new performance realization of *Praescio IV*.<sup>6</sup>

Richard Boulanger’s *from Temporal Silence* has been performed in several incarnations: as a work for clarinet and tape, clarinet and MIDI sequences, and clarinet and live Radio Baton (an electronic instrument played by the composer). No analysis of this work has been published so far. Boulanger has indicated his desire to “make it a more stable and performable work” and has agreed to work with me in accomplishing this task.<sup>7</sup>

Cort Lippe’s *Music for Clarinet and ISPW*, was written for a system that is no longer in use or manufactured (NeXT-based ISPW processor and Max/FTS software). No generalized analysis of the work exists so far.<sup>8</sup> Published articles that mention this piece and the ISPW system for which it was developed, such as those by Lippe and Miller Puckette, are concerned primarily with the technical details of the signal processing software (Max and FTS) and not with the actual musical processes, events, and interactions contained in the score.<sup>9</sup>

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<sup>5</sup> Bruce Pennycook, “Machine Songs II: The *Praescio* Series – Composition-Driven Interactive Software.” *Computer Music Journal* 15, no. 3 (1991)

<sup>6</sup> Bruce Pennycook, email to the author, April 5, 2003.

<sup>7</sup> Richard Boulanger, email to the author, March 28, 2003.

<sup>8</sup> Cort Lippe, email to the author, March 27, 2003

<sup>9</sup> See Cort Lippe and Miller Puckette, “Musical performance using the IRCAM Workstation,” *Proceedings of the International Computer Music Conference*,

## ORGANIZATION

- I. Introduction
- II. Overview of Interactive Electroacoustic Music and Performance Practice
- III. Analysis of Technology Components in Four Works for Clarinet and Interactive Electronics
  - A. Thea Musgrave: *Narcissus*, for B-flat Clarinet and Digital Delay (1987)
  - B. Bruce Pennycook: *PRAESCIO IV* (1990)
  - C. Richard Boulanger - *From Temporal Silence* (1989)
  - D. Cort Lippe - *Music for Clarinet and ISPW* (1992)
- IV. Performance Realizations – A Description of the Process, Techniques, and Equipment Used in Preparing the Lecture-Recital.
  - A. Musgrave: *Narcissus*
  - B. Pennycook: *Praescio IV*
- V. Conclusions
- VI. Appendix A: Selected List of Works for Clarinet and Interactive Electronics
- VII. Appendix B: Source Code of Software Interfaces for Works Performed on the Lecture-Recital.

## METHODOLOGY

The following is a sample of the type of analysis I intend to conduct. My model is Thea Musgrave's *Narcissus*, for Solo Clarinet in Bb with Digital Delay (1987, rev. 1989).

*Narcissus* was written in 1987, as one of four works in a Consortium Commissioning Grant from the National Endowment for the Arts, for flutists Wendy

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International Computer Music Association, (1991); Miller Puckette, "Combining event and signal processing in the Max graphical programming environment," *Computer Music Journal* 15, no. 3 (1991): 68–77; Miller Puckette, "FTS: A realtime monitor for multiprocessor music synthesis," *Computer Music Journal* 15, no. 3 (1991): 58–67; Miller Puckette and Cort Lippe, "Score following in practice," *Proceedings of the International Computer Music Conference*. International Computer Music Association (1992):182–185.

Rolfe, Harvey Sollberger, Patricia Spencer, and Robert Willoughby. It is published by Novello Music, and was transcribed for clarinet by the composer.<sup>10</sup> Musgrave's work is programmatic, portraying through the music of the solo instrument and its digital reflection the Greek myth in which Narcissus drowns trying to grasp his own mesmerizing image in a pool of water.

The electronics required for performance are notated for a particular model of digital delay equipment, the Vesta Koza DIG 411, which is no longer available. This poses unusual challenges for realization in performance. However, the electronics can be broken down into three basic parts: 1) a sound reinforcement system (microphone, amplifier, and loudspeakers), 2) the digital delay system (creating echo effects with several variable parameters), and 3) a control interface (foot switches and pedals used to change delay settings during performance). The following is a brief discussion of the two components most affected by technological obsolescence: the digital delay system and the control interface.

### **Digital Delay System**

A digital delay is a standard effect found on most commercially available signal processing equipment. In its basic form it creates a simple echo – the input signal is played back after a specified time interval, usually expressed in milliseconds, has elapsed. Various manipulations of the delay can produce interesting sonic results, some of which are called for in *Narcissus*.

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<sup>10</sup> Spencer, "The Musical Shape of Technology," 47.

Six digital delay parameters must be controlled during performance: time, feedback, modulation, hold, volume, and bypass. The following is a description of two of these parameters as they are used in the score: feedback and modulation.

*Delay feedback.* Delay feedback is indicated in the score according to specific Vesta Koza Dig 411 settings; values are indicated from 0 to 6 (on a scale from 0-10). Musgrave describes feedback settings as controlling the “number of repeats” in the delay. This should not imply that these repeats are discrete repetitions of a musical phrase. In fact, a standard digital delay with variable feedback routes an attenuated portion of the delayed signal (usually scaled from 0-100 %) back to the delay inputs. The result is that sound repeating in the delay gradually diminishes in volume as less and less of it is fed back each time. Though it would be interesting and informative to test the actual effect of these settings using the original equipment, they most likely indicate feedback gain from 0 to 60% of the original signal, with each number on the dial representing a 10% increment.

**Figure 1 - Delay Feedback**

In the passage shown in Figure 2, delay feedback creates a fairly thick texture. The “shimmering sunlight” and “rippling water,” referred to by the program text, are expressed in the accelerating and ascending arpeggios, which continue to repeat as it fades away.

*Modulation.* The modulation effect is not clearly defined in the score or in any other published article to date concerning this work. According to clarinetist F. Gerard Errante (who assisted the composer in designing the electronic effects), “the modulation effect is meant to be a gradual, ‘undulating’ pitch transformation, like a slow, wide vibrato.”<sup>11</sup> Vibrato of this sort can be achieved by continuously varying (modulating) the delay time by a small amount, similar to a typical “flange” effect.<sup>12</sup> Alternatively, some digital delay systems offer a pitch-shifting effect that can be placed under low frequency oscillator (LFO) control.

The score indicates that “[m]odulation *speed* remains at 0 throughout, modulation *depth* ranges from 0 – 10 (0 – 3 [*sic*] used).”<sup>13</sup> No indication is given as to what a speed of 0 might be, or precisely what a depth of 0 – 10 is either. If speed is the LFO frequency, it must certainly be very low indeed (judging from the specified value ‘0’ on a scale of 0 – 10), probably significantly less than 1 Hz. Depth (the amount of pitch variation) likewise is left (in the absence of the original equipment) to the imagination and taste of the performer. Because the score indicates depth values of 0, 1, and 2 on a scale of 0-10, one can assume that this effect is intended to be subtle.

The modulation effect is applied at the end of the piece, as the character of Narcissus drowns in the reflecting pool (“The waves surge up, the figure is shattered

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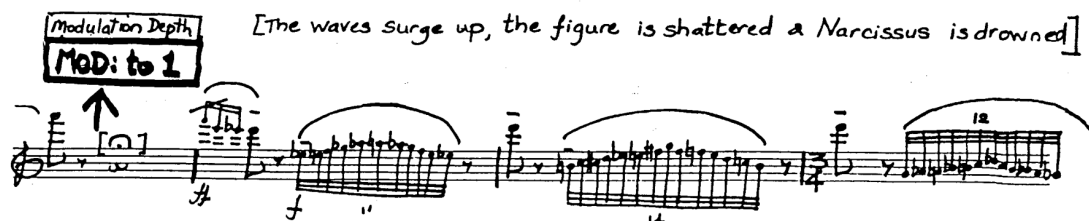
<sup>11</sup> F. Gerard Errante, email correspondence, March 9, 2000.

<sup>12</sup> Using Max/MSP software, I created a slow, glissando-like pitch-modulation of a signal fed through a delay line, by continuously varying the delay time using the output of a low frequency oscillator (0.2 - 0.5 Hz). Changes in LFO amplitude controlled the “depth” of the modulation (i.e., amount of pitch variation).

<sup>13</sup> Musgrave, *Narcissus*, 16.

& Narcissus is drowned”). From this musical/dramatic situation it seems the performer must apply a slowly oscillating pitch modulation in a way that suggests the character is sinking below the water. This is a prime example of a case in which a close examination of a working Vesta Koza Dig 411 would be extremely interesting and informative in terms of re-creating this effect as the composer heard it originally.

**Figure 2 - Modulation**

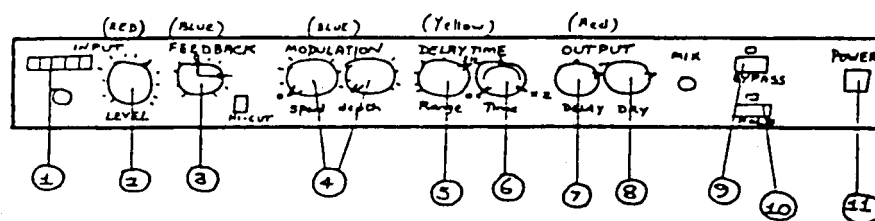


In Figure 3, the modulation effect makes its debut, portraying Narcissus’ watery demise. The short delay time in this passage ( $512 \times 0.5$ , or 256 milliseconds), creates a very close mirror of the solo clarinet, warped slightly by the oscillating pitch of the delayed signal. Delay feedback, set to 6, adds thickness to the texture.

### Control Interface

Because variable parameters must be changed during performance, an interface of some sort is necessary to control the delay system from the stage. Musgrave’s directions in the score are so specific to the Vesta Koza DIG411 that any new realization of the work will require some departure from the notation. The DIG411 had back-panel inputs for a hold pedal, a bypass pedal, and a volume pedal. On the front panel were knob controls for delay time, feedback, and modulation.

**Figure 3 - Vesta Koza DIG411 Front Panel**



Although the Vesta Koza DIG411 digital delay featured accessible knob controls for delay time, feedback level, and modulation depth, newer delay systems (whether hardware- or software-based) may not. Musgrave mentions the possibility of using a third footswitch to advance through a sequence of pre-set delay settings.<sup>14</sup> Such an arrangement allows the performer to easily change delay system parameters while remaining focused on the music. The points in the score that require changes to these three parameters are shown in table 1:

**Table 1 - Pre-programmable effects changes**

Score Event	Delay time	F/B	Mod.
1. m. 1 - "Narcissus wanders through the forest, observing ..."	512 x 0.5	0	0
2. m. 78 - "Is 'It' Still there?"		2	
3. m. 89 - "Narcissus steps back from the pool ..."	512 x 1	4	
4. m. 172 - "In the shimmering sunlight ..."		6	
5. m. 247 - "Narcissus then responds playfully, happily ..."	512 x 0.5	4	
6. m. 316 - "Narcissus anxiously questions..."		6	
7. m. 370 - "The waves surge up ... Narcissus is drowned"			1
8. m. 387 - "All that remains is a distant shimmering vision ..."			2
9. m. 398	512 x 2		
10. m. 426			1
11. m. 428 - "The vision disappears ... the forest is empty ..."			0

Therefore, eleven pre-programmed delay system changes are required, two of which require changes to two parameters simultaneously (events 3 and 5).

<sup>14</sup> Musgrave, *Narcissus*, ii.

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