

The Orchestra and Electroacoustic Music: A Challenging Mix

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Presented at the 2007 Pacific Northwest Chapter Meeting of the College Music Society at Boise State University

This document available electronically at <http://samhamm.com/papers/cms-boise-2007.pdf>

ABSTRACT

Since its origins in the aristocratic European courts of the sixteenth and seventeenth centuries, the orchestra has held an eminent position in Western art music. Due to its sheer magnitude and its unparalleled sonic flexibility, skill in writing original and ambitious music for the orchestra is a common, if myopic, measure of the quality and relevance of a composer's output.

The orchestra has maintained its esteem as the twenty-first century opens. Eighteen of the past twenty-five Pulitzer Prizes in Music have been awarded to orchestral compositions. But all is not well: cultural shifts and financial constraints are reducing both the size of audiences for orchestral art music and the number of viable ensembles. It is a complicated problem with many differing opinions as to its origins and solutions.

By the end of the twentieth century, technological advancements provided new means of producing music. Developments in electronic instruments, recording technology, and computers have each been hailed as an impetus for future music. New genres of art music have emerged from these sources, known by varying terms: electroacoustic music, electronic music, computer music. In addition, technology has built new bridges between art music and popular music, leading to exchanges of ideas, techniques, and instrumentation.

Interchange and interplay between the orchestral "old style" and the electroacoustic "new style" were inevitable during the twentieth century. New problems and questions emerged that were philosophical, aesthetic, and practical. What is the artistic validity of music that combines such different traditions and concepts? Is the ability to make an artistic statement enhanced or compromised? What logistical issues exist in arranging and producing performances of these works? There are many more questions, and they all remain pertinent in the present.

INTRODUCTION

Study of electroacoustic music for the orchestra leads to the identification of several dichotomies, and the exploration and examination of these basic contrasts serve as unifying concepts throughout this entire study. Two dichotomies, however, are dominant: old versus new, and stage versus studio. This document examines these concepts within the framework of the three main behaviors of music: creation, dissemination (via live performance, recorded media, or broadcast) and reaction.

Old Versus New

First, and most obvious, is the contrast between old and new. Orchestral music is steeped in tradition, and the gravity of its history is very strong – and growing stronger. In contrast to the growth and innovations in the makeup of the ensemble during the eighteenth and nineteenth centuries, the twentieth century orchestra changed very little. Indeed, during this time the orchestra transformed into an institution that was categorically resistant to change and innovation; whether the cause is aesthetic, economic, or something else, I hope this is a matter that future scholars will investigate. The following passage from the second edition of *The New Grove Dictionary of Music and Musicians* offers an assessment of the current situation:

Of the many new musical instruments that were invented during the late 19th century and the 20th, almost none has found a place in the modern orchestra. Saxophones, cornets, flugelhorns, and Wagner tubas made brief appearances, then vanished largely. Electronic instruments like the Theremin, the Ondes Martenot, the Moog synthesizer and the electric guitar have been used, sparingly, usually as novelties or for special effects. Tape recorders and computer-generated and/or altered sounds have not moved beyond the status of experiments.

Although I fundamentally disagree with the suggestion that orchestral works utilizing electroacoustic materials are mere “novelties” or “experiments,” this passage does reflect a truth so pervasive that it not only affects the operations of orchestras but also colors scholarly writings on the subject.

Thus, the orchestra, as an “old” institution, is resistant to the introduction of “new” materials in both instrumentation and literature, including instruments that are central within other styles and genres. For instance, the saxophone, which is now used in a variety of musical styles and has been in existence for more than 160 years, has gained little acceptance in orchestral music. Resistance appears more systemic than anecdotal.

Stage Versus Studio

In addition to the old/new contrast, there is a significant difference between the fundamental musical and social experiences of orchestral music and electroacoustic music. It is a daunting challenge to bring these disparate elements together for a unified artistic purpose.

The process of making orchestral music involves many people; a composer creates a composition, and a conductor and musicians are required to realize the work. Also, sizable and influential administrative bodies usually oversee the operations of an orchestra. The size of the concert audience for orchestral music is, relatively speaking, large: performances must be presented in halls with stages sizable enough to accommodate an orchestra, and often have seating for audiences approaching or exceeding a thousand people. The financial resources required to operate these facilities place an obligation upon the management of the orchestra to program and perform works that fill as many seats as possible. The number of people involved, and the cultural traditions and expectations of the social event of stage performance (such as bright lights, applause, and celebrity) make it easy to recognize that the entire activity of orchestral performance is extroverted in nature.

Electroacoustic music, on the other hand, is primarily the product of a studio environment, one that is very different from the stage. The most obvious manifestation of this difference is in the number of people involved. Working in the solitude of the studio, the composer carefully adjusts and refines musical materials in what is essentially a series of performances, the best of which are captured, collected, and constructed as the final product. In many cases there are no other people involved: no conductors, no performers, no administrative bodies. This process has an important effect on the art that is produced: fewer agents of production equates to fewer gatekeepers on the path between the composer and the audience. As a result, electroacoustic works that receive performances often exhibit broad ranges of competency and quality, and the requirement to communicate and express ideas effectively is not as great. Social skills, although helpful, are mostly unnecessary, as there is little or no need to convince an administration, inspire a conductor, or transmit ideas to a large body of performers. The process predominately conveys introversion, as opposed to the extroversion of the orchestra. Orchestral music, and generally any music involving live performers, thrives on spectacle as well as a certain amount of danger and uncertainty. When an orchestra creates music in the moment, with many people simultaneously executing complicated tasks in front of an audience, the potential for imprecision or error is great. Audiences respond to this energy regardless of whether they recognize it. In electroacoustic music, however, performance is more an act of presentation of a carefully created object, and many of the moments of danger have already occurred.

Furthermore, whereas orchestral music is typically performed in large concert halls, electroacoustic music is usually presented in a variety of more intimate environments. Some compositions are designed binaurally, such that the ideal listening experience takes place on headphones, for an audience of one. In public performance situations, the venues are usually much smaller than a concert hall; recital halls, art gallery installations, and small alternative spaces are the norm. This obvious disparity between the traditional performance methods of orchestral music and electroacoustic music creates a significant obstacle to composers who seek performances of works that combine the genres.

CREATION

Pre-compositional Concerns

Before creating the score for a composition utilizing orchestra with electroacoustics, a composer must confront some important preliminary issues. Resolving some of these matters beforehand can help a composer to create a more cohesive work than what is possible if the composer waits until later stages of the process. For instance, an understanding of the individual roles of the musicians and the technology, and of the relationships between the roles of each to be established in the composition, allows the composer to shape all aspects of the music with judicious foresight. In addition, awareness of the importance of musical space, whether it is an aspect of compositional design or an awareness of the limitations and possibilities of performance venues, provides the composer with crucial philosophical and physical guidelines. Lastly, a work created from a commission introduces a new set of concerns to the compositional process, simply through the introduction of another party to the activity.

Relationship Between Musicians and Technology

The relationship between musicians and technology is a potential quagmire of muddled roles and undefined responsibilities. It is advantageous for a composer to address these matters at an early stage of the compositional process. The choices the composer makes in this regard will shape many future aspects of the composition, both musically and logistically. In a paper presented at a meeting of the Information Processing Society of Japan in 2002, composer Cort Lippe made the following observations on the complexity of this relationship:

Humans have a rather complicated and intertwined conception of what is human-like and what is machine-like. We spend a great deal of time trying to discipline ourselves to perform like machines: our idea of technical perfection and efficiency is something akin to our idea of a perfectly working machine, and yet, we also have another entirely negative viewpoint towards anything human that is too machine-like. Our relationship with machines becomes more and more complex as our contact with machines increases in daily life. While I feel it is important to explain technical issues to performers in order to increase their understanding of the various kinds of interaction possible in a performance, I nevertheless attempt to offer them a certain degree of transparency in their relationship with the computer, so that they may be free to perform on stage as they would with other performers, concentrating on musical issues.

In the genre of orchestral music with electroacoustics, the concerns raised by Lippe are magnified due to the sheer number of people involved. Not only are there many people involved in some sort of relationship with technology in this genre, but the people are also involved in a variety of different roles with one another. This complicated and intricate system is of utmost importance to composers of these compositions. Addressing this matter is fundamental, and if it is not handled deftly, a composer runs the risk of creating a work that is clumsy in its construction and suffers from musical and aesthetic discontinuities.

Another manifestation of this relationship occurs on a larger scale, involving not individual musicians but entire genres. In particular, as stated by Tod Machover in a 2001 interview (Oteri, 2001b) “the people who’ve understood and capitalized on technology faster have been in the entertainment and the pop industry, and especially orchestras, of

all institutions, are lagging way behind.” Composers of concert music could learn a great deal by examining how popular music has been successful in its integration and application of technology. However, this possibility is inhibited because composers of concert music typically do not have much opportunity or encouragement to examine the styles and methods of popular music. I believe that such study could prove to be very useful to a composer seeking to integrate electroacoustic materials into orchestral music.

The Role of Space in Music

The notion of space in music can exist in a number of manifestations. For instance, temporal space on a small scale is perceived as rhythm, whereas temporal space on a large scale is perceived as form. Space can also exist in the pitch/frequency domain. One degree of space provides harmony, whereas another provides spectrum. Combination of temporal and pitch space can supply melody, harmonic rhythm, and ultimately formal structure. These features are present to some extent in nearly all musical works.

In electroacoustic music, however, there is an aspect of space that is not commonly utilized in instrumental music. This aspect is directionality of sound, commonly referred to as spatialization. This idea has been exploited in some compositions for traditional acoustic media, by placing musicians in different locations in the performance space, but it is not common. Typically, musicians are on a stage or in a specified area and audiences perceive sound generally from one direction. But in electroacoustic music, it is relatively common to place loudspeakers in various positions throughout a performance venue and composers in the electroacoustic genre have utilized this potential for directionality as another fundamental musical construction along with time and pitch.

Furthermore, the actual physical space of the performance venue takes on a much more important role in electroacoustic music, because the physical space often has a direct impact upon the placement of loudspeakers and the adjustments made in the sounds sent to them, through modifications in overall amplitude as well as equalization. Speaker placement also creates a more complicated set of considerations of the listening spaces inhabited by performers and the audience.

Reynolds addressed the role of space in music in our interview, stating that he believes consideration of the various listening perspectives, and the ability of the composer to manipulate the sense of space in a piece of music, is necessarily limited by certain practical and logistical factors:

So then there is also the issue of balancing and mixing perspectives in the hall, which is to say that during rehearsals and performances you would like to have someone who shares the acoustic listening condition of the audience members in order to make the calls. And of course, frequently in the case with orchestras, or large concert halls, [this listening condition is] either an impossibility, or at best, a very awkward problem. So it often also seems the case that halls which are suited to the acoustic nourishment of a large ensemble are hostile to anything like spatial localization.

Beyond the direct consideration of the impact of physical space upon the presentation of the composition, there also exist several notions of space within the composition itself. If these ideas of space are manipulated in a way that they are complementary, rather than in opposition, the composer can be more successful with communicating the

ideas and expressive goals of the composition. Frank Henriksen offers the following observations on the relationship between space in an electroacoustic composition and physical space:

Thus, the spatio-structural intelligibility of the work is often dependent on a successful interaction between the spaces composed into the work and the space in which the work is heard. The electroacoustic genre depends on loudspeakers for its existence, and the type, placement and number of loudspeakers and their matching with the listening environment are a major influential factor on the performance practice and on the listening experience of electroacoustic music.

If a composer fails to take the notion of space into consideration when composing a work for the genre of orchestra with electroacoustics, the potential exists for interference between the different spaces involved. The risk for this conflict is greater when a composer who is unfamiliar with electroacoustic concepts of space seeks to insert electroacoustic materials into an orchestral composition.

Individual Work Habits

Since many composers engaging upon a work for orchestra and electroacoustics have never previously sought to integrate the two genres, complications can arise from the need to balance what had previously been two distinct work processes. From the standpoint of orchestration, the inclusion of an electroacoustic component adds a complicated layer of considerations. All of the issues previously discussed, such as space, coordination, control of the electroacoustic materials, the kinds of sounds or manipulations to be used, and so on, immediately become real and tactile problems for a composer. If the work is to be cohesive, the relationships between the orchestral and electroacoustic must be considered and implemented at the earliest stages of composition. From the standpoint of composing the electroacoustic materials, standard issues such as spatialization and masking are made more difficult, and the coordination problems must be solved. All of these additional considerations and how they affect the way a composer thinks and creates from either approach to the composition, will likely lead to necessary adjustments in the compositional work processes of the composer.

Collaboration

In some instances, engaging in a collaborative effort solves the problem of dual roles faced by composers in the creation of compositions for orchestra and electroacoustics, in which an instrumental composer teams up with an electroacoustic composer to create the work. Such a situation is described by Stephen Montague in an excerpt from an e-mail message (March 9, 2005):

I think the problem at least in this country [United Kingdom] is most "electronic" composers spend so much time and energy developing their computer chops they never learn or are not interested in writing for orchestras or large acoustic ensembles. I don't know any composer who writes well for both genres at a top level. Denis Smalley, for example, by his own admission could never in his life write an orchestra piece. Harrison Birtwistle, at the other extreme, hired Barry Anderson to do the hour or so worth of electronics (at IRCAM) for his opera, *Mask of Orpheus*, because he didn't have the skills.

These kinds of collaborations are not uncommon in this genre, and many of the collaborations have occurred at IRCAM. In our interview, Roger Reynolds spoke very highly of the situation at IRCAM, where experienced technicians and specialized facilities aid in the production of works for instrumental ensembles with electroacoustics:

I think that the key here is not that IRCAM has somehow attracted superior people, or that the brain trust and so on is more formidable there. I think that the fundamental issue is that the community, that IRCAM is an institution, and if you can refer to the people who have worked there over the years, assuming certainly all the people that I've mentioned, and certainly I've been fortunate to be in the same situation with regard to the fact that I've had a lot of work done at IRCAM. I think that the crucial thing is that they have addressed the logistical issues with appropriate seriousness. That's what matters.

In a situation where a composer can work well with an electroacoustic specialist, collaboration can be a means of compartmentalizing the compositional problems. However, not every composer can function effectively within such a relationship.

Notation

A thorough discussion of notation issues, as applied to electroacoustic music, would be a worthy subject for its own research. Such a comprehensive study is not included here. Nonetheless, it is useful within the investigation of the genre of orchestra with electroacoustics to introduce some of the notational considerations and look at some examples of how this issue has been handled.

Traditional music notation is essentially a two-dimensional grid with time represented on the horizontal axis, and frequency or pitch represented on the vertical axis. A system of specialized markings has developed over the centuries to allow musicians to read and interpret this matrix of information and manipulate musical instruments in real time. Notation becomes much more complicated, however, when electroacoustic elements are introduced. A question arises of whether the notation for the score should contain only control information, or if it is useful for a conductor to have some sort of visual representation of the sounds being produced by the electroacoustic components of the composition. This question has been answered in a variety of ways. Absent a standardized method of handling this problem, it is common that composers deal with this issue in a way unique to each composition.

The examples included here show a variety of solutions to these concerns. One aspect of the scoring appears to have emerged as a standard, however: where the electroacoustic notation is placed on the score. In every score I have examined, the electroacoustic instructions are placed on an orchestral score directly above the strings, with the percussion and keyboard instruments.

Figure 1 is an excerpt from a score for the Roger Reynolds composition *The Angel of Death*, a work that is not for orchestra but does utilize a combination of winds, strings, and electroacoustics. The instructions for the electroacoustics are placed directly above the string staves. There are also written instructions placed in that part of the score, illustrating the complexity of integrating the electroacoustic components of this work:

THE ANGEL OF DEATH
Roger Reynolds

S

FLUTE I
FLUTE II (PICCOLLO)
CLARINET
BASS CLARINET
HORN
1
2
TRUMPET
1
2
TROMBONE

COMPUTER

PERCUSSION 1
PERCUSSION 2
3
SOLO PIANO

VIOLINS I & II
VIOLA
CELLO
CONTRA BASS

Annotations:

- DB IS A CANONIC LAYERING OF 8 BUNDLES OF PARTIAL COMPONENTS EXTRACTED FROM THE ENSEMBLE VERSION OF THEME 5 (mm 343-361, 5); THE CANON IS IN THREE CONVERGING PHASES.
- DB START CUE. (130" DURATION)
- PHRASE 1
- N.B. THE SEQUENCE OF COMPUTER CUES INDICATED IN THE "S" SCORE (DB + 57) ARE IN PLAY ONLY WHEN "5" OCCURS AS THE SECOND PART OF A PERFORMANCE (D/S). IF "5" BEGINS THE PERFORMANCE (S/D), NO COMPUTER CUES ARE ACTIVATED UNTIL D10 (ON PAGE 403). IF "5" IS THE SECOND PART PERFORMED, THEN D10 BEGINS SIMULTANEOUSLY WITH IT. JUST AS D10 RNS (1) BEGINS AT THE END OF THE PRECEDING "5".
- * SHRIEK'S ARE PRODUCED BY PRESSING THE TIP OF A SWIRE BROOM STICK PERPENDICULAR TO THE SURFACE OF THE GONG OR TAM-TAM AND SCRAPING A WIDE, FIRM ARC AGAINST IT. [5]
- N.B. ENSEMBLE REINFORCEMENTS ARISE OUT OF, BUT NEVER DISTRACT FROM THE SOLOIST.

Tempo: ♩ = 120
Title: EQUILIBRIUM IN EXTREMIS (THEME 1)

Rehearsal Mark: 15

Figure 1. Excerpt 1 from *Angel of Death*, by Roger Reynolds

Figure 2 is a close-up of that page, showing more detail in the instructions and commentary provided by the composer:

Annotations:

- DB IS A CANONIC LAYERING OF 8 BUNDLES OF PARTIAL COMPONENTS EXTRACTED FROM THE ENSEMBLE VERSION OF THEME 5 (mm 343-361, 5); THE CANON IS IN THREE CONVERGING PHASES.
- DB START CUE. (130" DURATION)
- PHRASE 1
- N.B. THE SEQUENCE OF COMPUTER CUES INDICATED IN THE "S" SCORE (DB + 57) ARE IN PLAY ONLY WHEN "5" OCCURS AS THE SECOND PART OF A PERFORMANCE (D/S). IF "5" BEGINS THE PERFORMANCE (S/D), NO COMPUTER CUES ARE ACTIVATED UNTIL D10 (ON PAGE 403). IF "5" IS THE SECOND PART PERFORMED, THEN D10 BEGINS SIMULTANEOUSLY WITH IT. JUST AS D10 RNS (1) BEGINS AT THE END OF THE PRECEDING "5".
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Tempo: ♩ = 120
Title: EQUILIBRIUM IN EXTREMIS (THEME 1)

Rehearsal Mark: 15

Figure 2. Excerpt 2 from *Angel of Death*, by Roger Reynolds.

Budd Udell, in his composition *Judgement* (1972), provides a page of detailed instructions at the beginning of the score, specifying speaker placement and explaining the notation he uses in the score. This page of instructions is shown in Figure 3.

P E R F O R M A N C E I N S T R U C T I O N S

ALL INSTRUMENTAL PARTS ARE TO BE PERFORMED BY SINGLE PLAYERS.

BOTH PIANOS SHOULD BE PREPARED IN ADVANCE WITH A FOUR INCH WIDTH OF MASKING TAPE PLACED ON THE TOP SECTION OF STRINGS.

THE ELECTRONIC TAPE PART IS TWO TRACK STEREO, FOR WHICH THERE SHALL BE FOUR SPEAKERS, ONE PLACED ON STAGE RIGHT, ONE ON STAGE LEFT, AND ONE EACH ON THE RIGHT AND LEFT IN THE BACK OF THE HOUSE. THESE SPEAKERS SHALL BE IDENTIFIED BY NUMBER ACCORDING TO THE DIAGRAM BELOW. THE TAPE HOOK-UP MUST BE SO ARRANGED THAT EITHER CHANNEL, A OR B, CAN BE DIRECTED TO ANY ONE OR TWO OF THE SPEAKERS. THE TAPE OPERATOR MUST BE PREPARED TO DO THIS DURING THE PERFORMANCE OF THE PIECE.

THE FOLLOWING DIAGRAM WILL BE USED TO INDICATE THE PROPER CONNECTIONS. IF ONLY ONE SPEAKER IS TO BE FED FROM ONE CHANNEL, A SHORT DASH WILL BE USED TO INDICATE THE UNUSED FEED.

THE NECESSARY PATCHING CHANGES MUST BE DONE AS QUIETLY AS POSSIBLE.

DYNAMIC RANGE: 0db INDICATES SILENT BEGINNINGS OR ENDINGS.
pppp INDICATES THE SMALLEST AUDIBLE SOUND.
ffff INDICATES MAXIMUM VOLUME.
mf IS THE MIDDLE DYNAMIC.

ALL OTHER DYNAMICS ARE CALCULATED BETWEEN THE MIDPOINT OF mf AND THE TWO EXTREMES, pppp AND ffff. ALL SIGNALS ON THE TAPE ARE RECORDED AT FULL VOLUME, SO THAT CONTROL OF DYNAMICS IN PERFORMANCE IS THE RESPONSIBILITY OF THE TAPE OPERATOR. EACH CHANNEL MUST HAVE INDIVIDUAL CONTROL.

LEADERS OF DIFFERENT COLORS ARE USED IN THE TAPE, AND ARE INDICATED ACCORDING TO THE FOLLOWING EXAMPLES.

WL - WHITE LEADER, GL - GREEN LEADER, RL - RED LEADER.

AN ARROW ↓ WILL BE USED TO INDICATE WHERE THE TAPE SHOULD BEGIN TO RUN. IT IS RECOMMENDED THAT A MACHINE WITH A PAUSE BUTTON BE USED.

Figure 3. Excerpt 1 from *Judgement* by Budd Udell.

In Figure 4, an excerpt from the same Udell score, the staff for the tape part is shown in greater detail, at a moment in which the tape part enters:

The image shows a musical score excerpt with five staves. From top to bottom, they are labeled: BASS, CHANNEL A, TAPE, CHANNEL B, and VIOLIN. The BASS staff has a handwritten box containing 'WL'. The TAPE staff has a handwritten 'Odb' and a large horizontal line with a downward-pointing arrow. Below this line are two small triangles labeled 'A' and 'B', followed by '1 2 - -'. The CHANNEL B staff has a handwritten 'PPPP' and a large horizontal line with a downward-pointing arrow. The VIOLIN staff has a handwritten 'Very Slow ♩ = c.54'. The score is written in a standard musical notation style with a treble clef and a key signature of one flat.

Figure 4. Excerpt 2 from *Judgement* by Budd Udell.

Figure 5, which is a third excerpt from the Udell score, shows a sample of the graphic notation used to illustrate the sounds produced by the electroacoustic component of the composition. Although the basic time/frequency paradigm used in traditional notation remains in effect, some liberty is taken with specificity as a trade-off for overall clarity:

The image shows a musical score excerpt with six staves. From top to bottom, they are labeled: TENOR, BASS, CHANNEL A, CHANNEL B, VIOLIN, and VIOLA. The TENOR and BASS staves have lyrics: 'Praise, glory, wis-dom, hon-or, pow'r, and might be un-to the Lord for-ev-er' and 'Hail, pitch and rhythm ad lib.'. The CHANNEL A and CHANNEL B staves have graphic notation, including a large black shape, a wavy line, and a large black shape. The VIOLIN staff has the instruction 'Senza misura' and a '25\"/>

Figure 5. Excerpt 3 from *Judgement*, by Budd Udell.

DISSEMINATION

Rehearsal Preparation and Process

There are many factors to consider in preparing for and holding rehearsals for an orchestral composition with electroacoustics: cost, performance venue, materials, personnel, and coordination.

An important consideration in the process is in the overall setup used for the rehearsal and performance of the composition. In our interview, Roger Reynolds discussed some concerns with technical setups:

The adapting of the dissemination strategy to the performance space requires a lot of experience and a lot of concern and a considerable amount of setup time and even some trials in the space. That's one issue that takes up a lot of time, and is a rehearsal constraint. The other is, of course, the lack of time with musicians.

Reynolds makes it clear that there is a fundamental trade-off to consider: time spent working with the technical aspects of the rehearsal often cuts into potential rehearsal time with the musicians. This point should be on the forefront of planning operations by the composer, conductor, and technicians, and will shape many other aspects of the entire rehearsal process.

Cost: Money Changes Everything

There is a good deal of disagreement regarding the financial limitations of the genre. For instance, Larry Austin believes that the technical requirements for these works are out of reach of many orchestras, stating in my interview with him that, "I'm afraid that such requirements are too expensive for most orchestras to afford." Roger Reynolds, however, has a different point of view:

Because when you think of how much it costs to hire a major soloist, or a major conductor, you realize that it's a spurious constraint to say that you have to pay \$10,000 for a sound system, which is probably more than you would have to spend, but let's say that you have to do that. It's trivial compared to how much it would cost to hire a major soloist. So I don't really buy the idea that orchestras frequently say, or a large ensembles, say that it is prohibitive from a cost standpoint. I think it's a choice that they make. And so the question would be partly how will you begin to erode that resistance assuming that the economic argument is not tenable.

The issue of the expense of music technology appears frequently in discussions and writings upon orchestral music with electroacoustics and is often presented as an inhibiting factor. I am inclined to agree with Roger Reynolds, however, that the issue of expense is more of a psychological factor than a true logistical obstacle.

Performance Venue

The actual performance venue for a composition can be a widely varying factor in the production of a composition for orchestra with electroacoustics. In situations where a commission is involved, or a composer is working with a specific ensemble or educational institution, there may not be any opportunity to select a performance

venue. In situation where a composer seeks to initiate a performance of a composition, there may be some flexibility in selecting a preferred venue. This latter case is the exception, however, and the former case is much more common.

Because composers typically do not have the opportunity to choose the venues for performance, there are often situations where the circumstances are less than ideal. This discrepancy is magnified when considering the differing needs for orchestral performance versus those for electroacoustic performance. This discrepancy is manifested not only in the physical and sonic attributes of the venue, but also in its availability for rehearsal and testing.

In a common example of such a scenario, Anna Rubin wrote, via e-mail message (March 23, 2005): “The amplification system at Carnegie was less than desirable and of course, too little rehearsal time. [My composition] has not been performed since.”

Again, Roger Reynolds cited IRCAM as a location where effective planning and experienced support have mitigated this issue, noting that “they are capable of saying that for a complex work there will be a week of rehearsals in the space.” Such opportunity for rehearsal is invaluable in preparing a performance of a work with technical demands that are commonly found in works for this genre.

Necessary Materials for Electroacoustic Performance

Presenting a performance for an orchestral composition with electroacoustics requires equipment and materials beyond those needed in most orchestral performances. It is much more involved than contacting a publisher and renting parts, or finding a performer who can handle an unusual doubling or instrumental demand. Electroacoustic compositions require physical media for the musical elements, such as tapes, CDs, or computers. In addition, there is often a set of diagrams or charts to consider: speaker placement, wiring instructions, or other setup information. Furthermore, the components of the amplification system must be considered, including elements such as playback devices, control mechanisms for these devices, a mixing board, amplifiers, speakers, and cabling to connect it all together. These are not prohibitive concerns, as they can usually be handled with little trouble by one or two experts; however, if not acknowledged early in the rehearsal preparations as vital and legitimate needs, difficulties may arise in a situation when they are more difficult to address.

Elliott Schwartz made direct reference to the necessary personnel in our interview, as well as the roles these people must play:

The old orchestra-plus-tape format was fraught with many challenges. For starters: WHO "performs" the tape part, and WHERE is the tape deck located? How can the two parts be synchronized (assuming that one wants synchronization)? How does the composer create silences in the tape part ~ by starting & stopping the tape, or having silent durations included on the tape?

Tod Machover, in a 2001 interview (Oteri, 2001b), addressed the complications involved in integrating electroacoustics into the orchestra, saying, “If you’re a symphony orchestra, you have almost every practical consideration going against you to try anything really different.”

Steven Sloane offered some general comments regarding the basics of the technology, which “has changed so much, and continues to, of course, and that makes things so much easier.” He stated that, “CD is easier to synchronize than tape, for instance, and sound systems are getting smaller and more versatile, making setup simpler for the tech guys.”

Click and Coordination

Some pieces have extreme technical demands. Larry Austin provided one such example in his interview with me:

My completion and realization of Charles Ives's *Universe Symphony*, which does not include electronic music but does have prodigious technical requirements: a 16-track click-track with 25 headphones for the 20-member percussion ensemble and the five conductors to follow same.

Roger Reynolds offers a more direct assessment of the trouble with the use of click tracks in solving the coordination problem:

And even the issue of what would make a good click track, if there were such a thing, is up for grabs. Because on one hand, the click track wants to be clearly audible, but on the other hand it doesn't want to be audible to the audience. You don't want it to have pitch. It's actually a fairly complicated problem in and of itself. And if you don't have a click track so that the musicians are controlling the coordination, then you have the issue either of score-following or of some attitude toward the issue of coordination that is tolerant.

Also notable in Reynolds' point of view is that he seeks to mitigate the interference of technology upon the traditional activities of the musicians, saying that, “in my case, I have very much opted for the idea that coordination should be a relatively subordinate issue, because I like the musicians to be free to be musicians.”

Performance from the Perspective of the Stage

It is important to make the distinction between the performance perspectives of the musicians and of the audience. As Roger Reynolds observed, “the musicians themselves and the listeners inhabit different spaces.” He comments that “normally speaking, the electroacoustic dissemination surrounds the audience and frequently, if not always, one almost could say always, the performing musicians are relatively unaware of what the audience is hearing,” and that this situation affects the ability of the ensemble and the audience to have a shared experience.

If the members of an orchestra cannot have a sense of what is taking place in the electroacoustic component of a composition, an uncomfortable discontinuity exists for the musicians. But if the musicians are provided adequate monitoring, then the risk arises that the overall sonic effect desired by the composer is compromised. Thus, a careful balance is required, which should be determined by the composer or a technician.

Another important consideration is the physical placement of the person who handles balance and control. If the technician is onstage, or just offstage in a location to provide clear communication with the conductor, then the issue of not being able to hear what the audience hears re-emerges, potentially leading to an unsatisfactory situation of balance between the orchestra and electroacoustics. If the technician is seated in the audience, however,

communication with the conductor is much more difficult. Furthermore, locating a technician with a mixing board and sound equipment in the audience can be a distraction from the actual performance.

It is my belief that careful planning of these issues can allow them to be handled in a way that allows maximal communication between all parties involved in the performance, optimal mixing and balancing, and minimal distraction. But if these issues are not addressed until the beginning of the first rehearsal, problems are likely.

Performance from the Perspective of the Audience

Audience can be defined specifically as the people in a concert hall who have chosen to attend a performance, or more generally as a society at large that engages in some degree of consumption of musical works. Frank Henriksen describes the specific situation (Henriksen, 2002):

The life of the musical work is not fulfilled unless it is made available for others to hear. Concert performance, radio broadcast and record distribution represent the mediating link between composer and audience. When the finished work has left the composition studio, it is likely to be played in a variety of listening environments on a range of different types of playback systems. The spatial experience of music is quite different in a concert hall with a large multi-channel loudspeaker system surrounding the audience compared to solitary listening on headphones or on a two-channel stereo system at home. The potential of the sound system and the room in terms of flexibility to be adjusted to spatial elements composed into the work are of concern to the composer and performer of electroacoustic music with regard to how these elements may come across to the listener.

A more general view of the audience and the way in that composers should consider communicating with it in composing new works, is offered by Tod Machover in this excerpt from a 2001 interview (Oteri, 2001b):

I think that to imagine that the core parts of our culture are not going to involve more and more sophisticated technology is naïve. I think it will. And I think we're probably going to want to find ways to incorporate those ideas into our forms of expression because that reflects our experience most. So I think orchestras probably really should be thinking of ways of embracing the technological world and leading in the technology world and helping to create new art forms in their midst rather than outside of it. And obviously you can always make great art and great thoughts; all you need is a mind and a heart. It's not the tools that do it, but I think the tools are here to stay.

These two descriptions of audience interaction indicate that a composer must keep both extremes in mind when composing a piece of music for the orchestra with electroacoustics. Without clear and effective presentation of the work, the potential cultural relevance of the composition is lost.

REACTION

Post-performance

After the performance has taken place, the opportunity for reflection upon the experience exists for the composer, performers, audience, and critics. These thoughts can be about the immediate performance, or upon the genre in general. An assortment of these ideas is collected in this section.

Canadian composer Laurie Spiegel, interviewed in the October 2001 issue of *NewMusicBox*, offered the following thoughts on her experiences in the genre:

The few times I've tried to combine the two media [of the orchestra and electroacoustic music], I have not personally found any aesthetic benefits not more easily attained within either medium alone, but that is strictly a subjective experience. For other composers there may well be good reasons to put these media together.

After the performance, everyone involved in the performance is left with some opinion, reflection, or assessment of the event. Spiegel wisely acknowledges the subjectivity of her statement; it is possible that everyone else involved with the performance had a contrasting point of view. Considering the wide variety of roles involved, consisting of composer, conductor, performers, technicians, and audience, the nature of these opinions is bound to be diverse. For the genre of orchestral music with electroacoustics to be successful, I believe it is crucial that opinions from those filling all of these roles be actively gathered following a performance. I believe much could be learned from a single thorough case study of the preparation and performance of a composition for this genre, an examination done by a party whose sole purpose is to observe and record the entire event.

Are These Compositions Musically Viable?

A fundamental issue permeating this study is whether these works for orchestra and technology genuinely offer a viable outlet for artistic expression. I was surprised at the large amounts of doubt I encountered from many people while conducting my research. Is there an artistic reward for these efforts? Is there a future for these sorts of interactions in the future? I believe there are.

Guy Garnett, in an interview from *NewMusicBox*, offers an optimistic viewpoint of the potential for musical interaction between humans and technology, a viewpoint that I share:

Rather than set up a dichotomy of human versus machine between a live performer attempting to keep up with the machine knowing full well the machine can move more quickly, more loudly, and less bounded by physical or cognitive restraints than any human possible can - rather than all there, it is now possible to use the machine, the computer, or any and all electronic and physical devices, without the dichotomy, to join the mechanical power of the machine to the nuanced and subjectivizing control of the human performer. As the computer can amplify human-produced gestures, so too will it be able to amplify human expression.

Final Thoughts and Observations

Deborah Borda, who is the President and Chief Executive Officer of the Los Angeles Philharmonic Association, made the following comments in the October 2001 issue of *NewMusicBox*: “There is no question that the Internet, electronic manipulation of orchestral sound, and multimedia presentation are issues that symphony orchestras must explore.”

It is encouraging that such a highly ranked member of the administration of a large and important orchestra made this statement. The statement shows that there is indeed high-level support for experimental music with the orchestra and technology, and that composers are better served by looking for potential avenues of success than by fixating upon frustrations and perceived failures.

Ray Kurzweil, in a 2001 interview (Oteri, 2001b), stressed the importance of having people who are fluent in both the musical and technological worlds to act as intermediaries and advocates:

I think what we really need more of are people who really understand something about technology and understand music and have the artistic insight to use these tools. Because to some extent there are two different worlds and we need more of a bridge between the whole idea of artistic expression, which is communicating emotion from a performer to the audience and understanding what the technology can do, which I think is a lot. We need people who can form that bridge.

I think Kurzweil is correct in this assessment. Success of the genre of orchestral music with electroacoustics is dependent not only upon knowledgeable and talented individuals, but also on those who are open-minded and make wise decisions as to how the genre should be nurtured. The potential for success does indeed exist, and should not be squandered on shortsighted or self-indulgent works. As stated so succinctly by Roger Reynolds in our interview, composers should seek to do “modest things eloquently,” and proceed with focus and careful planning in the creation of works for the orchestra with electroacoustics.

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