# Music with Context

## Audiovisual Scores for Improvising Musicians

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BA Music Technology
May 2005

MFA New Media
May 2013

In support of MFA Thesis Exhibition

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# Acknowledgements

It would have been impossible for me to produce this work without the generous assistance of the following people. These brilliant individuals have provided unending support, knowledge, inspiration, direction, and friendship.

David Andree
Christopher Baker
Jennifer Caruso
Misty Caston
Tom DeBiaso
Gretchen Gasterland-Gustafsson
Tom Haackenson
John Keston Sr.
Melissa Anne Keston
Vince Leo
David Means
Ali Momeni
Diane Mullin
Jenny Schmid
Piotr Szyhalski
Pramila Vasudevan

I would like to especially thank my mentor and collaborator Piotr Szyhalski from whom I learn something new every time we converse. I am also especially grateful to thesis committee members David Andree and David Means, both of whom with I have had the distinct pleasure of prior collaborations.

# Abstract

This paper explores the idea of mutable, audiovisual scores for improvised musical performances through the description of personal perspectives, practical examples, proposed projects, and research. The author postulates that an audiovisual score can be a useful tool to connect improvising musicians to each other and their audience through the insertion of a mediating audiovisual layer within the work. These systems are used as a primary influential agent for an ensemble of improvisers, providing them with a context for a musical conversation. In contrast to traditional notation and graphic scores, audiovisual scores embrace the chaotic ambiguities of environmental influences giving the music the context of unpredictable everyday events. Presenting an unpredictable audiovisual score parallels the indeterminate improvisation of the ensemble. It activates the last vestige of what remains immutable within traditional forms of notation driven performance inserting it into a mutable layer within the work.

# 1. Introduction

When I was eleven or twelve years old, my father brought home a couple of records by Japanese artist Isao Tomita. One of these records was Tomita's rendition of *Pictures at an Exhibition*[1] (1874) by Modest Mussorgsky. Just over one-hundred years after it was composed Tomita's 1975 recording of Mussorgsky's popular classical piece was performed and arranged entirely using the Moog Modular synthesizer[2], a behemoth of an electronic instrument on which Tomita spent tens of thousands of dollars and many months negotiating with customs officials to import from the US to his studio in Japan (Onoda). I listened to the record over and over again marveling at the uncanny and alien sounds that Tomita had painstakingly constructed and layered to produce his masterpiece.

Tomita's music and the work of others including French synthesizer pioneer Jean Michel Jarre, Brian Eno, David Byrne, and Laurie Anderson, led me to an early fascination with synthesizers. As a teenager, I bought my first electronic instrument; a used Moog Rogue monophonic synthesizer with a broken key. I used the Moog while recording extended experimental jam sessions to dozens of cassette tapes with high school friends on guitar and bass. Soon my collection of instruments expanded and I was hooked on the process of discovering sounds that had never before been heard.

My fascination with sound synthesis is a lifelong passion, but what is it about these techniques that keeps me captivated day after day? For one thing, there is a profound sense of discovery as one programs new sounds into electronic instruments. With the right equipment, all it takes is a handful of turns on a few knobs and the flipping of a few switches to evoke fantastic sounds unlike anything that occurs in the natural world. These sounds are physical manifestations of something that was once only audible in the imagination, or even unimaginable prior to its discovery. Jean-François Augoyard and Henry Torgue describe the process of imagining these sounds or music prior to composing or performing as *phonomnesis*. "Phonomnesis (phonomnesé) is a mental activity that involves internal listening: examples include recalling to memory sounds linked to a situation, or creating sound textures in the context of composition." Phonomnesis explains how listening can be an internal activity, letting our brains filter out external sounds. This might involve imagining the sound of voices as we read or write (Augoyard and Torgue 85).

Although the term sounds arcane, the process is commonplace. Our brains are wired to imagine sound. Barring rare neurological disorders we all experience the internal sounds of our own voices, voices of people we know, environmental sounds, and

[1] Listen to the opening rendition of *Promenade* on Tomita's *Pictures at an Exhibition* (1974): http://johnkeston.com/thesismedia/Promenade.mp3

[2] Synthesizers are electronic musical instruments that essentially create pure and accurate sonic waveforms from electricity manipulated through a variety of electronic circuits.

especially music. I would argue that if we could only transmit the sounds in our minds to a playback device we would find that almost every human being is a musician and a composer. Those of us who claim these titles have simply learned how to externalize the compositions, musical textures, melodies, and harmonies in our heads during rehearsals and performances.

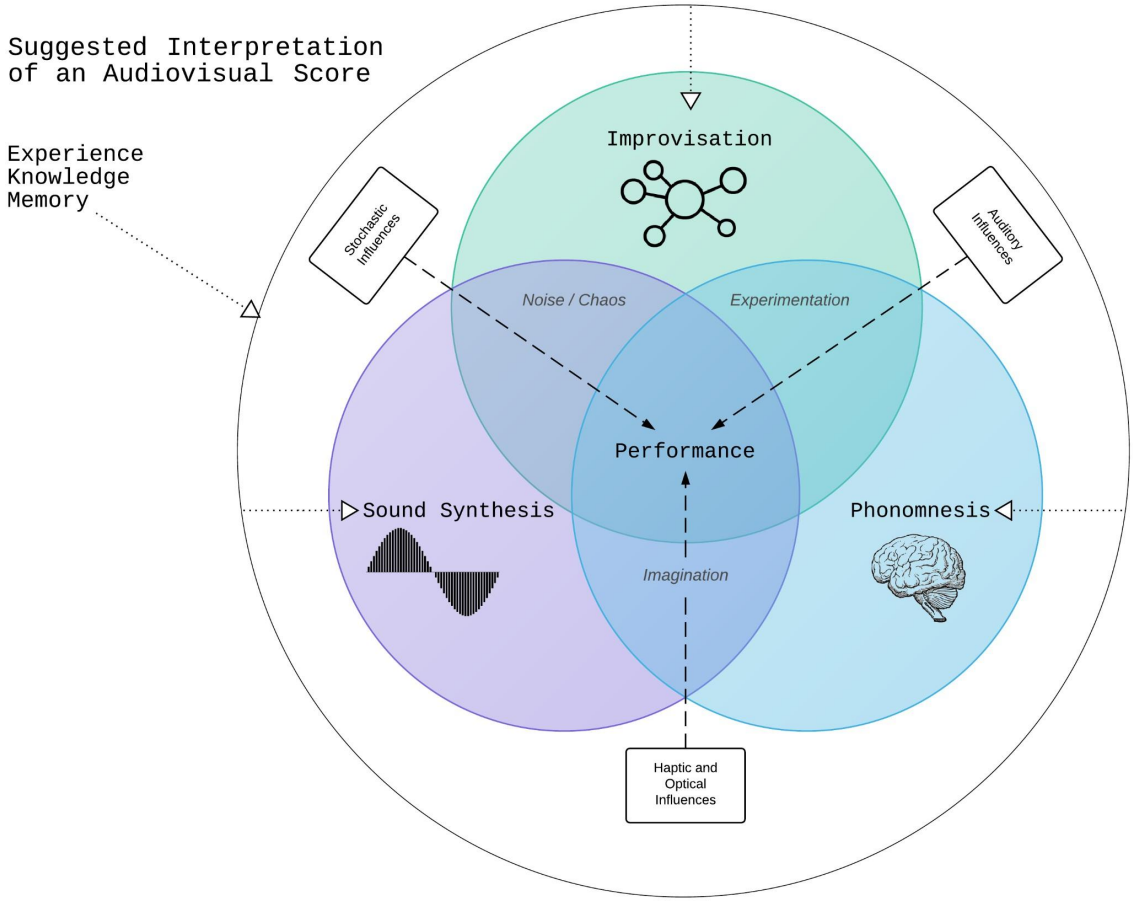


Fig. 1. *Venn Diagram* by John Keston.

Sound synthesized by electronic devices offers a methodology for externalizing sonic textures that have yet to be conceived. Performing and programming with synthesizers leads to a creative cycle that is, in part, triggered by the use of the instrument itself. Experimenting with the device produces sounds that in turn trigger the phonomnesis of more sonic textures and musical phrases. This creative cycle is an example of improvisation. Improvisation is a way for musicians to realize the music they are imagining as they imagine it. However, this is not a purely individual creative process. Like any other artform, thousands of influencing factors are involved. For a soloist, the influences include individual life experiences. For ensembles the most conspicuous influences are the other members of the group and how they interact with each other (see fig. 1).

One of the primary goals of my musical career has been learning how to improvise successfully as a soloist and with ensembles. Furthermore, my fascination with synthesizers and my interest in improvisation are deeply interconnected. Sound synthesis and improvisation are both methodologies for creating physical manifestations of phonomnesis as it occurs in the brain. Real-time, tactile adjustment of parameters on synthesizers offers immediate gratification. As the artist adjusts sliders or turns knobs on the instrument panel the sound responds instantly, just like imagined sound does in the mind of the artist[3]. Improvising with a group of musicians is an ideal setting for conjuring phonomnesis into a physical reality. Each artist makes musical statements that are combined with the other artists' interpretations thus building a comprehensive performative structure that is understandable by the ensemble and the audience alike.

Although this thesis will not attempt to explain what improvisation is and how it works, a definition is necessary because improvisational techniques are a significant component within the methodologies used in my practice. Contrary to popular belief, improvisation is not without structure or methodology. Improvisation can be described as a heteronomous technique. It entails a spectrum of rules that artists use to limit the musical language that is spoken during improvised performances. These rules range from being almost anarchic to being quite rigid. In free jazz, for example, tonal and temporal structures can be abandoned or used interchangeably without necessarily considering what other members of the ensemble are doing. Whereas, ensembles playing jazz standards usually restrict the key signature, time signature, tempo, and timbre to the confines of the composition and instrumentation.

It has taken decades of practicing my instrument, studying music theory, performing, and constructing sounds with electronic tools to achieve a satisfactory result when improvising either as a soloist or with ensembles. There is always more to learn and new challenges to take on. So, why do I have an unquenchable urge to bring music and sound out of the confines of my imagination and into reality? What makes it all worthwhile are brief moments of magic during a performance as the manifestations of phonomnesis from each member of the ensemble coalesce to form a fleeting yet stirring composition. These ephemeral etudes are rarely captured on studio quality recordings, but they often linger in my mind becoming new influences for the next performance.

Audible content is not the only kind of influence that impacts the work of musicians and composers, however. It has become increasingly evident that the interconnectedness of our sensorium, or sphere of human perception, plays a significant role in what we do as artists and what we are attracted to as art consumers.

[3] Listen to an experimental sound piece improvised on a Roland MKS-80 Super Jupiter analog synthesizer: http://audiocookbook.org/wp-content/uploads/2011/02/Noise-Jam-3-Through-Master-Effects-Chain.mp3

For example, projected visual imagery has become an expected component of many musical performances. These visualizations are usually produced as a response to the music and as a way to enhance the experience of the performance for the spectators. The musical performers are almost always situated with their backs to the projection screens, focused on the audience rather than reacting to the visual component. In part, this paradigm led me to conceive scenarios where the visual imagery was not just an afterthought, but an integral layer that influences the musical outcome of a performance piece. Shouldn't it be possible to stage a performance that engages an audiovisual score to guide soloists or ensembles of improvising musicians?

This thesis will investigate the idea of using an *audiovisual score* as a primary influential agent for performative works of sound. I will begin by presenting research into artists that have expanded the realm of influence over the composition, performance, and production of music, and artists that have explored non-traditional methods of designing musical scores. Next I detail some of my own efforts that have led me to the idea of an audiovisual score. Finally I will describe a new performance piece that aims to reveal the phonomnesis of improvising musicians that are responding to an audiovisual score. The score for this piece contains video and corresponding audio that are equally as important to the performance as the participating members of the ensemble.

This work is important because it strives to uncover an *organic* intersection between visual feedback, sound, and music. In this context I define "organic" as content that does not originate from computer algorithms[4]. For example, although digital video of a familiar scene uses computer algorithms to be stored, compressed, and displayed it is still recognized as a representation of a physical environment. In contrast, many projects that combine sound and visuals, involve the use of computers to artificially generate audiovisual content. These generative works are fascinating experiments that I intend to continue researching in my practice, however, I think it is also important to stage experiments that are not dependent on computer-generated content. In particular, I will explore the use of commonplace, audiovisual events, that we do not generally consider music, as layers in a musical composition. In other words, the question that this thesis will attempt to answer is: can the context of organic audiovisuals be presented, with an ensemble of musicians responding to the context and each other, as a cohesive performance? During my investigation into these concepts I have created audiovisual software tools, interactive installations, print work, and performance pieces that explore these ideas.

[4] An algorithm is a step-by-step process for solving mathematical equations that is usually performed by computers.

# 2. Graphic Scores

Technology has and continues to have an undeniable impact on music throughout the ages. The invention of sound recording and reproduction is among the most influential effects on the direction that music has taken since the late 19th century. Its impact was made clear by Chris Cutler in the introduction to his podcast "Probes #1" produced for *Radio Web Macba* in association with the Museu D'Art Contemporani De Barcelona:

> In the cacophonous world of mechanised modernity, and under the uncanny spell of the phonograph, not only had sound acquired a wide range of new qualities and meanings but it had metamorphosed into a material. From being elusive and insubstantial, sound had suddenly become as durable as paint: a kind of stuff that could be captured, pinned in place and endlessly repeated. (Cutler)

Cutler's prose depicts the environment that cultivated Musique Concrète, a form of music that exploits audio recording and reproduction technology to work with sound as objects that can be shaped and placed into compositions (LaBelle 5).

By the 1950s composers practicing Musique Concrète, electronic music, and other experimental disciplines needed a new technique for notating their work. They began to write scores that questioned the dominance of traditional forms of musical notation. John Cage, Karlheinz Stockhausen, and Iannis Xenakis were among many composers who began to create graphic scores. These scores differed from traditional notation through a wide spectrum. Some of them held onto the familiarity of staves, clefs, and notes, while others completely abandoned any remnants of the acceptable norms. Despite their differences, many of these new systems maintained heteronomous lists of instructions for the musicians to follow. Stockhausen's *Plus-Minus* (1963), for example, used a system of symbols to indicate different kinds of sounds, noises, or "sound-noises." These symbols "...are explained in seven pages of detailed instructions" (Cardew and Walters 25).

Although most of these systems still found a way to impose rules on the musicians, these rules almost exclusively contained ambiguities that allowed the musicians degrees of flexibility within their interpretations of the material. Ambiguities are also present in traditional notation, but traditional notation is usually more rigid than the graphic scores of the 50s and 60s. Cornelius Cardew and John Walters' paper, "Sound, Code, Image" (1997) explores an array of these systems and the questions that they elicit:

> Graphic scores raise some thorny issues: does the composer have a duty to specify every note, dynamic, articulation and then demand an equivalent degree of accuracy and fidelity in the resulting performance? Should the

> composer delegate certain roles to specialists (conductors, drummers, say) who bring new knowledge and traditions to bear upon the work? Should they merely set musical actions in progress and sit back to hear the result? These questions address issues of autocratic power versus democratic organisation and individual creative expression: the political stirrings of the 1960s were not lost on contemporary composers, who wrestled with such implications in the music they made. (Cardew and Walters 28)

Graphic scores freed composers and musicians from the autocratic constraints of traditional notation, but the scores themselves are usually immutable. Most of them are still and soundless images printed on paper until they are performed. Audiovisual scores on the other hand embed sound and motion. They are active and mutable as long as the composer allows for the score to contain the chaos of real time scenarios broadcast into the performance space rather than being pre-recorded and rehearsed.

With this comparison I am not suggesting that audiovisual systems override the significance of graphic scores. Graphic scores have been and continue to be an excellent tool for composers that loosen the constraints of autocratic, heteronymous notation by inserting ingenious suggestions rather than strict rules. Pointing out the differences between graphic scores and audiovisual scores allows me to illustrate what is new and relevant about this idea. It is my view that audiovisual scores that are implemented in the manner that I have described embrace the chaotic dynamics and ambiguities of environmental influences giving the music the context of unpredictable everyday events. The way that improvising musicians interpret audiovisual scores and graphic scores might be very similar, but inserting audiovisual media into the performance *as* the score invites the audience to experience the interpretations transparently from the perspective of the musicians.

# 3. Impetus

The impetus for the concept of an audiovisual score began with the work of John Cage (1912–1992). Two of his pieces in particular are luminous manifestations of his idiosyncratic phonomnesis. Ongoing, tied to its location, and dependent on its environment *As Slow As Possible* (1987) is being performed continually at a Medieval church in Halberstadt, Germany:

> The place will be St. Burchardi, one of the oldest churches of the city. Built around 1050 by Burchard of Nahburg, this church functioned as a Cistercian convent for more than 600 years. In The Thirty years War (1618-1648), St. Burchardi was partially destroyed, but rebuilt in 1711 and secularized by Je□ rome, the brother of Napoleon in 1810. For 190 years the church was used as a barn, hovel, distillery and a sty. St. Buchardi was rediscovered and is now the venue of this extraordinary project, that can arouse the fascination of many people around the world. (Mollerus)

*As Slow as Possible*[5] was originally written for a piano soloist with the simple instructions to play the piece as slowly as possible. Two years later Cage adapted the instrumentation for organ based on the suggestions of organist Gerd Zacher who performed the work for the first time in 1987 (Mollerus).

On September 5, 2001, coinciding with what would have been John Cage's eighty-fifth birthday, the monumental arrangement began its journey through time at St. Burchardi on an organ that is being specially designed to perform the work. However, in another example of Cage's clever whimsy, the piece begins with a musical rest, so based on the length of the piece the first audible note wasn't played until almost two years later on February 5, 2003. Notes on the instrument can be held indefinitely without the need for a musician present, and new registers are added to the organ as new notes are needed. Arranged to be played for six-hundred-thirty-nine years in duration, if all goes as planned, the performance will conclude in the year 2640 involving up to twelve generations of musicians to complete the work (Mollerus).

The performance of *As Slow as Possible* is tied to its location in a way that few if any other works of music are. A single note in the piece can take several years to resolve. The website offers a calendar with dates for when a new note will occur, drawing crowds from around the world including over a thousand visitors on July 5, 2008 to hear a new note arrive. No individual will ever be able to hear the piece in its entirety. In this sense the historic church that houses the instrument has become a part of the instrument itself (Mollerus).

[5] Listen to a 1:09 minute excerpt of music from the Halberstadt installation of *As Slow as Possible* captured on July 6, 2012: http://johnkeston.com/thesismedia/ASLSP-2012-07-06.mp3

Without this idyllic location the performance of *As Slow As Possible* could not happen. The building, that has been standing since the year 1050, might actually still be standing in the year 2640. In many ways the piece is no more distinct than other works of music written for organ, but in one very important way it is. That difference is scale. The scale has been expanded so far into the future that barring time travel, or the invention of immortality supplements, we can only imagine the finale. *As Slow As Possible* does not directly involve the use of an audiovisual score, but the fact that the performance in Halberstadt might go on uninterrupted for centuries means that the context of the environment cannot be separated from the music as it is played. The musicians and the audience must accept the context of the surroundings, whether it is sound from construction in the church, or the comments of nearby visitors, as layers within the work.

In contrast to producing notes that will continue for generations, the controversial piece *4'33"* written in 1952 by John Cage is a conceptual piece that has no notes. Rather than being tied to the location, the piece can be performed anywhere, but that location determines the content. Written for piano, it requires a pianist to sit at the instrument and play three movements of measures that contain only rests, adding up to a duration of four minutes, thirty three seconds. In the piece Cage challenges us to examine the everyday, environmental sounds that we usually take for granted and from which we cannot escape, whether it is a concert hall, city street, or public park. My initial reaction to *4'33"* was amusement and admiration for Cage's audacity, but soon afterward I found myself listening for music in everyday sonic environments. In his book, *Background Noise: Perspectives on Sound Art,* Brandon LaBelle summarizes Cage's approach to music:

> By overturning the musical object so as to insert the presence of the listener Cage resituates the terms by which the referent of music takes on social weight, beyond symbolic systems and toward immediacy and the profound presence of being there. (7–8)

John Cage famously said in an interview shortly before his death in 1992, "There is no noise, only sound" (Kozinn). Cage believed that any sound could be music. If you want to listen to the wind or traffic and think of it as music, then according to Cage, it is music. I tend to agree with his intuitive remark, and ever since discovering his work, I have continued to practice listening to the music within the arbitrary sounds of our environments.

*4'33"* presents a soundscape of an arbitrary environment as music, taking the traditional idea of music out and leaving us with a new appreciation for the incidental, sonic textures in our habitats. Whereas an audiovisual score inserts the soundscape as a layer in the composition along with the contributions of a soloist or ensemble. *4'33"* and *As Slow As Possible* offer us insight into the unique, phonomnetic imaginings of

John Cage, but they also provide an impetus for the idea of an audiovisual score that recontextualizes everyday events into experiential, musical performances.

These experiential events are not just a vehicle for the artist's phonomnesis to be transmitted to the audience. The atmosphere within a performative environment may psychologically change the way we perceive sound as well. Through a process called anamnesis, sounds trigger memories. "The anamnesis effect merges sound, perception, and memory. It plays with time, reconnecting past mental images to present consciousness with no will other than the free activity of association." This might be as common as a song that awakens a long past memory for the listener, a voice that reminds us of a particular person, or an ambient soundscape that evokes deep reminiscence (Augoyard and Torgue 21–22).

Rather than evoking phonomnesis, Janet Cardiff's and George Bures Miller's installation *Pandemonium* (2005) might stimulate anamnesis for the visitors. *Pandemonium* is an autonomous musical creation set in cell block seven of Philadelphia's Eastern State Penitentiary. This historic prison, designed as a panopticon[6], is known for its spoke-like architecture, innovative reform system, and solitary confinement, was shut down in 1971 and was still primarily closed to the public while the piece was installed from 2005 through 2007. One-hundred-twenty, computer-controlled mallets were attached to a broad variety of discarded objects around the cell block, such as cupboards, mop buckets, walls, tables, and toilet bowls. The mallets struck the objects rhythmically to create music that started with gentle tapping, hinting at communication techniques that the former prisoners may have used, and escalating up to a raucous apex of chaotic bashing[7] (Cardiff and Bures Miller).

What kind of anamnesis might these sounds have activated in visitors to the installation, given the ruined environment of an abandoned penitentiary? Fortunately, for most of us our mental images of prisons are generated through news media, television programs, and movies rather than the actual experience of being incarcerated. Not having seen the piece first-hand I can only rely on my imagination, but I suspect that the experience might verge on terror, and for someone who has experienced life in the prison system, horror. But this terror would not go without a substantial amount of fascination. Visitors might ask themselves, what would it be like to be trapped in solitary confinement for years on end? Or, who were the unfortunate inmates, and what were their crimes? How did they cope with the absence of human interaction?

[6] A panopticon is a prison designed in a circular fashion so that the inmates can always be observed by guards. The term is frequently used today as a metaphor for the surveillance that permeates public spaces.

[7] Listen to a 4:18 minute long recording of Cardiff's installation *Pandemonium* (2005): http://johnkeston.com/thesismedia/pandemonium.mp3

The physical and tactile nature of a space impacts the sounds produced in the area, and the soundscape of the environment may trigger visual memories for the listeners. This illustrates that, at a minimum, our senses of hearing, touch, and sight are all activated by the specific locations where sound works are performed. This idea is supported by the work of theorist W.J.T. Mitchell, professor of English and Art History at the University of Chicago. In parallel with sounds Mitchell points out in his article, "There Are No Visual Media," that neither is visual art ever strictly visual. Our senses of sight, touch, smell, and hearing are all involved in the process of experience, therefore "All media are, from the standpoint of sensory modality, 'mixed media'" (Mitchell 76). Mitchell cites Bishop Berkeley's theory that vision actually requires tactile stimulus to be effective. Oliver Sacks, among others, confirmed this theory by studying patients who needed to touch objects before properly "seeing" them after having their sight surgically restored following extended blindness. Furthermore, Mitchell proposes that the term "visual media" is too broad because it can include virtually anything that either reflects or projects light into our field of vision (78).

The same is true of sound. Sound activates our sense of touch through vibrations in in our bodies and in the matter that surrounds us. Our eardrums, sensitive to subtle changes in the air pressure, are essentially touched by sound as it enters our nervous system through membranes, tiny bones, and electrical impulses. Once sound stimuli have entered our brains, cognition takes place allowing us to understand language, experience the emotive qualities of music, and undergo psychological effects like anamnesis, perhaps "seeing" visual memories in our mind's eye. This is one way that our sense of sight is activated by sound. In addition, the moment something changes in our sonic space, our reflexes respond and we cannot help but turn in an attempt to view the source of the incident. Furthermore, sounds are often produced through a process that we can see, including physical events like footsteps, a glass breaking, or a door closing. We see sound because almost everything in motion is accompanied by an audible signature. Mitchell points out that a new language of signifiers is necessary to "produce a much more nuanced, highly differentiated survey of types of media" (77).

# 4. Semiotics, Music, and Audiovisual Scores

Micthell's desire for a new language of signifiers brings us to the idea of using semiotics to explain the significance of audiovisual scores as a vehicle for improvising musicians. Semiotics has been shown to be an effective means of analysis for visual works of art, including two- and three-dimensional pieces, and moving images. But can semiotics be used to analyze music that has been composed using audiovisual scores? If it is possible to define music as a language, then surely semiotics can apply to music in its written form at a minimum, and potentially offer a way to examine audiovisual scores, improvisation, and other characteristics of music.

Semiotics differs from other techniques of analysis in multiple ways. As well as identifying meaning, it is concerned with how meaning can be transmitted by art and language. As a scientific study of the rules of language semiology is an empirical method bypassing unverifiable, metaphysical claims of theories like Hegel's spiritual "Absolute Idea" postulating a higher consciousness by focusing on the communications used to arrive at meaning (Hatt and Klonk 202).

Swiss linguist Ferdinand de Saussure (1857–1913) begins his *Course in General Linguistics* by defining terminology and presenting diagrams to help support his theories. He starts by explaining the relationship between the sign, signifier, and signified. The sign contains both a concept and a sound-image that in turn creates a "two-sided psychological entity." The sound-image represents the signifier while the concept is what is signified (Saussure 65–67). This relationship is easily applied to written music. Dots that appear on the staff signify sound-images or notes of a particular frequency, duration, and dynamic. Where this relationship fails, however, is that the individual notes themselves do not signify a tangible concept in the way that the word dog signifies a furry, four-legged, domesticated canine. Traditionally, music requires the context of the notes before and after each other for melodic structures to emerge.

Saussure explains that "the linguistic sign is arbitrary" (67). Although language, certain traditional practices, and rituals may have been originally created with a meaning or purpose in mind, often that meaning has long since been forgotten. Generations of people using these signs introduced linguistic mutations over the ages into the present forms. Saussure uses several examples to illustrate his point:

> Words like French fouet "whip" or glas "knell" may strike certain ears with suggestive sonority, but to see that they have not always had this property we need only examine their Latin forms (fouet is derived fāgus "beech-tree," glas from claseicum "sound of a trumpet"). The quality of their present sounds, or rather the quality that is attributed to them, is a fortuitous result of phonetic evolution. (69)

In this passage Saussure shows that onomatopoeic relationships do not necessarily support claims that specific terms are not arbitrary. In other words, the sound of a word that sounds like its concept such as woof, or ticktock, may have origins that did not sound like the concept. Here, again, the linguistic usage of semiotics as applied to music breaks down. Most systems for written music are not arbitrary and only mutate when deliberate actions are taken to modify the system, or invent a new system altogether. A pianist that has learned to play music written using modern staff notation will be able to interpret music that is more than three centuries old as easily as a piece that was written today.

In the second chapter of *Course in General Linguistics* Saussure makes the seemingly contradictory case that signs are both immutable and mutable. Language is accepted by the culture that uses it without question because it is passed down from generation to generation resisting sudden changes to its content and syntax. This is what makes the signifier immutable. However, the sign is also mutable because over time phonetic changes, or changes in meaning are introduced. Once again, Saussure cites several examples to support his claims including the evolution of the Anglo-Saxon word for feet (fōti) to its modern English counterpart. The mutability of the sign is a result of a language being used over time by a "community of speakers" upon which the language is dependent (Saussure 74–77).

In a similar fashion to language, music can be examined as a mutable and immutable form of communication. What is more subject to change over time in relation to musical language are the styles and timbres used by composers and musicians rather than the systems that represent the musical forms, phrases, and compositional structures. This can be heard from one decade to the next in popular music as well as jazz, classical, and other styles. Therefore, the styles and timbres used in music are often mutable, while the systems that are used to represent musical compositions are usually immutable.

In contrast, I hypothesize and have found that an audiovisual score is much more prone to mutability than rigid, traditional, notation systems. For example, if the score *is* the context of an urban environment, the content within it is evolving by the minute. Even when the same environment is used again the piece will never be repeated identically. An audiovisual score can also be immutable if the composer chooses to capture and repeat a moment of time on video to be used as the score for improvisors. However, even when the audiovisual score is identical from one performance to the next, the improvising musicians will have changed – even if the musicians are the same people they will have changed through new experiences, knowledge gained, and memories retained – and the performance will still be unique and distinct from previous iterations.

Charles Sanders Peirce (1839–1914) works within a logical framework to show that a variety of perceptual judgments can be interpreted from a set of events (303–305). In this way he takes a different approach to semiotics by breaking up signs into a multitude of types. The core three types of signs are icon, index, and symbol (Hatt and Klonk 209). The iconic sign references an object recognizable by the viewer, like a painting of a dog titled Rufus. The indexical sign shows evidence of an object or event, such as footprints in sand indicating a person previously walking through the landscape. Finally the symbolic sign closely resembles the generalized sign of Saussure except that Pierce does not require that the sign has to be arbitrary because the symbol itself may have a secondary meaning that applies to the example. Artworks analyzed through Pierce's technique may illustrate more than one or even all of each sign type (Hatt and Klonk 209, 210).

Semiotics can be used to describe music, especially in its written form, symbolically, but music is not obviously indexical. No visible, physical trace is left behind. Perhaps music itself is iconic. We usually know we are listening to music when we hear it. Thomas Lloyd Short (b. 1940) suggested in his book, *Peirce's Theory of Signs*, that "...music is an icon: it represents the qualities that it embodies." Short explains that although we attempt to describe music in emotional terms we can never do this adequately with language. Also, the composer is not directly expressing his or her own feelings, but expressing contemplated emotions. The audience receives this emotional content, but in the same contemplative way that the composer created it rather than directly experiencing an emotional state (Short 204).

Neither Saussure's nor Peirce's linguistic theories of semiotics provide a complete solution for analyzing the musical phenomenon. In order to use semiotics more effectively for analyzing music, a significant expansion to the linguistic model is necessary. One complex example of this sort of modification has been proposed by Swiss mathematician, jazz musician, musicologist, and University of Minnesota professor, Guerino Mazzola (b. 1947) in his paper, "Semiotic Aspects of Musicology: Semiotics of Music." In 2009 I had the serendipitous pleasure of attending a concert with Mazzola on piano, David Wessel on electronics, and Douglas Ewart on saxophone and hand made instruments, at the Spark Festival of Electronic Music and Arts. This improvised concert provided me with a window into the creator's level, or "poietic niveau," prior to any knowledge of Mazzola's writings on the topics of semiotics and music[8].

Mazzola states that "This preliminary investigation makes evident that the study of music is not reducible to the 'dimension' of semiotics..." as it stands, and proposes a three dimensional cube as a diagram (see fig. 2) to illustrate the semiotic aspects of musicology (2). He calls this diagram the ontological topography of music. The cube

[8] Listen to a 7:29 minute excerpt from the Wessel/Ewart/Mazzola performance from February, 2009: http://johnkeston.com/thesismedia/Wessel_Ewart_Mazzola.mp3

is broken up into three dimensions: signs, realities, and communication. On the top of the cube are the signs which closely resemble the Saussurean system and are labelled as the significate (sign), signification (signified), and signifier. Down the side of the cube are the levels of reality. These include the mental, psychic, and physical realities of music. The bottom edge of the cube is reserved for communication which is made up of creator, work, and recipient (Mazzola 1).

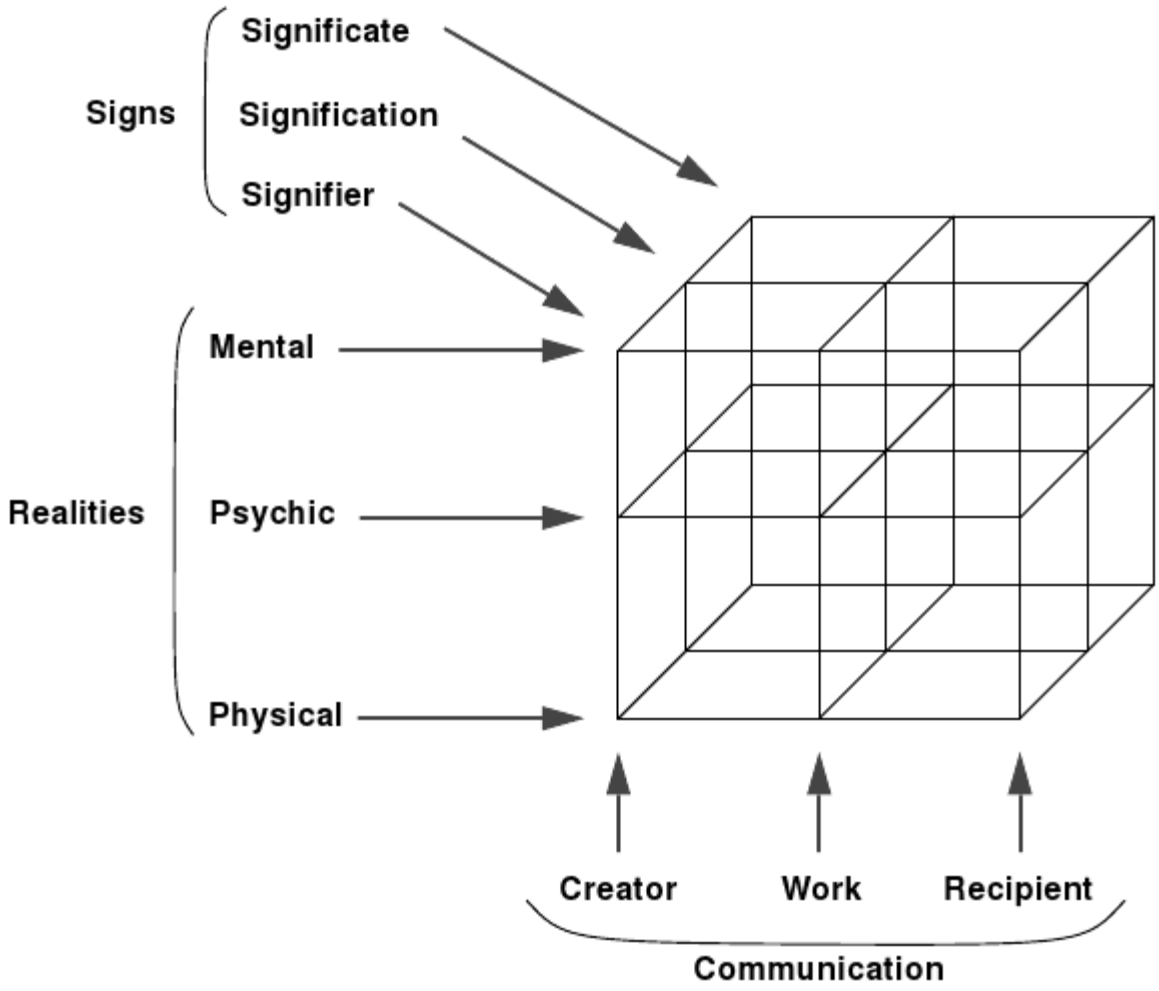


Fig. 2. The cube of musical topography (Mazzola 1).

Mazzola details communication in a series of niveaus or levels. The creator is the composer of the work and on the "poietic niveau." This can be the person who wrote the music in a premeditated fashion, or a musician improvising as a soloist or in an ensemble like the concert I attended in 2009. The "neutral niveau" is the work conceptualized in its media; classically the score, but since not all music is written it can be through phonomnesis or a mental image of the work held in the mind of the creator that is communicated through an oral tradition. Thirdly, the "esthesic niveau" is the receiver of the musical message, classically the listener or audience. Mazzola uses the term esthesis rather than aesthetics to distinguish the experience from the

classical idea of beauty, placing the emphasis on the recipient who is perceiving the stimulation and reacting to it based on his own personal value system (Mazzola 4-5).

The physical reality of music refers to the fact that music and sound in general are an "acoustical phenomenon" that physically exist in our environments and are detected and interpreted by the largely mysterious process of human hearing. Mazzola explains that although much is known about the complex physiology of human hearing, cognitive levels are not as well understood. For example, the ability that most humans have to discern the variations in pitch from one sound to another cannot be explained by what we know about the cochlear subsystem or by what is happening in the higher cortex (Mazzola 3).

Mazzola's idea of mental reality relates directly to the phenomenon of phonomnesis. Music is consciously created in the mind and then communicated through oral or written scores. The scores are "mental guidelines" that are used to inform "musical objects" (Mazzola 3). Usually these objects are an ensemble of musicians, or a soloist. Technology has enabled the objects to become autonomous, like a music box, player piano, a record player, or modern sequencing software.

The psychic reality of music refers to the emotional content inserted by the composer and interpreted by the listeners (Mazzola 3). To me, the psychic reality of music is the most difficult aspect to articulate. Short points out a relevant quote from Mendelssohn: "It is not music that is too vague for words; it is too precise for words" (204). Music seems to transcend language, communicating at a deeper, perhaps unconscious, level what verbal communication does not. How else is it possible that human beings from completely distinct and isolated cultures are able to enjoy and understand each other's music, while their languages might have little in common? No matter how much we analyse music, regardless of the methodology, the psychic reality remains mysterious. Perhaps music is an innate, primal, human response that we have learned to tame into traditional forms. Yet even the most formal of these traditions cannot shed the collective, intrinsic, esthesis to which almost all humans can't help but react.

Using an audiovisual score that is constructed from the sound and visible context of everyday events as an influential agent for improvisation may provide insight into the psychic reality of music. How does one improvise in the midst of these influences? Our psychology plays an important role in the process of improvising music. As I have shown in the Venn diagram (see fig. 1) our experience, knowledge, and memory are shaped by influences that include: 1) stochastic or random events, noise, and chaos experienced in the world at large, 2) auditory influences like the tones, textures, and phrases performed by adjacent members in an ensemble, 3) optical stimulus like the expressions on the faces of those around us, 4) and haptic information that we receive through our sense of touch; from handling a musical instrument, to vibrations from sound, to the movement of the air around us. These influences transform how

we improvise music, and produce sonic textures. However, improvisation cannot take place before the psychological experience of phonomnesis triggers our musical thoughts. I am particularly interested in these psychological triggers. How we, as artists, leverage the space between the neverending bombardment of chaotic influences, our intuitive impulses, and the technical skills that we are preoccupied with acquiring throughout our development is a phenomenon that will never be fully understood. It is, however, a phenomenon that we can learn to apply to our practices.

As a trained musician I have learned how to allow phonomnetic triggers to manifest themselves as musical phrases. This usually happens at the tips of my fingers on keyboard instruments including piano, synthesizers, samplers, and other electronic devices. This process is intuitive and until discovering and researching the concept of an audiovisual score I had thought little about it. I believe the process of phonomnesis and improvisation happens for virtually all human beings, but it requires practice to be able to execute internal musical thoughts into a physical reality. As a person who has practiced these techniques extensively I am keenly aware that improvisation is much more fluent when one or more of the influences described are also present. Even hearing a single note on a piano can be enough impetus to begin improvising. Hearing and seeing other musicians, and the touch of a familiar instrument are also well trodden pathways into the realms of collaborative and spontaneous music making.

One group that has an exceptional ability to spontaneously produce improvised music that sounds composed is the Norwegian collective known as Supersilent[9]. The group has released a sequence of eleven albums starting with *1-3* in 1998 through *11* in 2010. Each album is simply named with a number, and each individual piece is also numbered with a point system so that the third track on *6,* for example, is titled *6.3*. The artwork for each set of recordings is just as stark as the naming system including one background color and the minimum amount of text necessary to know that it is a Supersilent record on the Rune Grammofone label. However, the spartan naming, labeling, and album art belies the rich landscape of instrumental textures that are performed by the group on each record. Christian Lysvåg reveals a brief glimpse into their process in his review of *8* (2007):

> The album has been mastered by US mastering guru Bob Katz in close collaboration with producer Deathprod, and it has been handled almost like classical music to keep the extremely dynamic range of the original recording. Again, the names of the players do not appear on the cover. This is Supersilent music, collective work, group improvising, and not a matter of individual grandstanding. They never rehearse as a group and don't discuss the music with each other, meeting only to play concerts or to record. Supersilent music lives in a no-man's-land between the genres, somewhere between rock,

[9] Listen to *8.8* from Supersilent *8* (2007): http://johnkeston.com/thesismedia/Supersilent8.8.mp3

> electronica, jazz and modern composition. It can sometimes appear to be written or at least arranged, again making it clear that these musicians communicate on a high, almost telepathic level. Needless to say, there are no overdubs (Lysvåg).

Once hearing Supersilent it is difficult to argue that the quartet, including trumpeter Arve Henriksen, Helge Sten (AKA Deathprod) on electronics, keyboardist Ståle Storløkken, and drummer Jarle Vespestad are not astounding improvisors. One thing that makes their work stand out is the musical experience, knowledge, and memories that each member brings to the collective. As they perform, and are influenced by each other, their experiences help create new memories that inform their work as it evolves.

Although the group does not incorporate audiovisual scores into their performances, their methods and style of improvisation provide a useful model for this thesis. We are told that the group does not rehearse or discuss their process with each other, which is in itself a methodology (Lysvåg). Instead a collection of unspoken rules are necessary for the group to achieve the musical structures found in their recorded material. First of all they are carefully listening to each other. This is apparent because within the music rhythmic, tonal, and textural similarities are at times mimicked and repeated by each other. Secondly, this mimesis also indicates that as well as listening they are responding to each other. Thirdly the ensemble demonstrates an extraordinarily broad range of dynamics. Their dynamic palette spans barely audible segments of slow ambience to searing, chaotic passages of loud and distorted instrumentation. Throughout this expansive dynamic range the group responds to each other by providing room for leading voices as they emerge.

# 5. DKO

My insight into the methodological approach of Supersilent is in part informed by the work of my trio, DKO. This group includes Jon Davis (AKA Ghostband) on electric bass and bass clarinet, myself on Rhodes electric piano and synthesizers, and Graham O'Brien on drums. We formed the ensemble specifically to explore and challenge our notions of musical language. Our vehicle for this exploration is loosely based on free improvisation. Although jazz trained we tend to avoid the consistent use of typical idioms and timbres within the genre in favor of interjecting electronic sounds, distortion, atonal phrases, and atemporal passages. We also frequently perform with guest artists including Douglas Ewart, Steve Goldstein, J. Del Monico, Mankwe Ndosi, and many others.

One of our formative performances included DJ Luke Anderson on electronics at the Minneapolis Institute of Art during the Northern Spark Festival in June 2011[10]. The ensemble provided a three hour long improvised musical accompaniment for an interactive exhibition titled *Battle of Everyouth* by Ali Momeni and Jenny Schmid:

> The Battle of Everyouth is a projection-based performance staged at multiple sites on and around the museum, which is blend of live cinema, participatory theater and live performance, and creates a context for exploration and conversation on the theme of global youth and violence (Momeni and Schmid).

Momeni and Schmid asked me to produce the music for the piece, and suggested trading sets with Anderson. After a few meetings with the collaborators we decided to perform as a quartet with Anderson rather than break up the performances into separate slots[11]. We rehearsed several times prior to the event and even recorded several thematic segments to review. However, none of the rehearsed themes was repeated during the performance.

What purpose do rehearsals serve if the music practised is not repeated? Firstly, improvisation is a skill that must be learned and practiced if it is to be successful in an ensemble. Although well rehearsed as a trio, the addition of the fourth member, Luke Anderson, made it necessary to explore the new possibilities available as a quartet. Secondly, the rehearsals allowed us to develop a language of musical ideas – a language structured around concepts, style, texture, and interplay rather than specific phrases, harmony, time, or other formal characteristics – for the performance.

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[10] Listen to a 2:06 minute segment from DKO with DJ Luke Anderson at *Northern Spark*, June 2011: http://audiocookbook.org/wp-content/uploads/2011/06/Battle-of-Everyouth-Segment-103_28-to-105_44.mp3

[11] Watch video documentation of *Battle of Everyouth* (2011): http://vimeo.com/26515526

Finally, the experience of playing as a quartet helped us understand our limitations as a group and respond accordingly.

Most DKO performances take place without rehearsals or pre-conceived arrangements. This works because we have already uncovered enough of our particular musical language to converse fluently. This does not mean that we are not still discovering techniques within the context of the project. With each performance new territories become available as we evolve individually and as a group.

The collaborative, open, and experimental nature of DKO led me to invite the ensemble to interpret an audiovisual score on December 7, 2012 during the Minneapolis College of Art and Design (MCAD) MFA open studio night titled *FRANK*[12]. Oliver Grudem produced the audiovisual score in real-time. Grudem's video and sound was broadcast into the performance space as he walked around the Minneapolis Uptown area. The visuals and sound from his walk provided an influential agent for our improvisation. On the evening of the performance a snowstorm occurred which added a mysterious quality to the nighttime imagery. The environment, time-of-day, weather, and Grudem's perspective were all factors in the score that were more-or-less chance happenings. This corresponds with one of the primary goals of using audiovisual scores: applying stochastic events in our environments and surroundings as influential factors for improvisation (see fig. 1). The system was setup so that Grudem was able to hear our musical reactions to the audiovisual score as he was broadcasting. This allowed Grudem to participate in depth by experiencing the auditory influence (see fig. 1) of the music as it was performed.

The piece was documented with a custom built binaural head microphone to capture the sound localization of the performance space. Binaural recording techniques work by simulating the mechanics of human hearing to playback three dimensional sound spatialization that accurately represent the localization of the original sounds. To reproduce this phenomenon it is necessary to wear circumaural headphones[13]. A stationary camera and a second handheld camera were also used to capture the video.

Documenting the piece in this way provides a good quality representation of the performance that can be reviewed in context with the audiovisual score. When reviewing this material I was encouraged to discover that the ensemble treated the introduction of an audiovisual score into the performance space as another participant in the musical ensemble. Throughout the performance we adjusted our dynamics to allow the sound from the score to interchangeably become the leading

[12] Watch a video excerpt of the DKO with Oliver Grudem performance at *FRANK* from December, 2012: http://vimeo.com/56028072

[13] Circumaural or over-the-ear headphones preserve the effects of the pinnae, or outer ear, on our hearing therefore allowing the binaural localization phenomena to occur.

voice or background textures. Each of us was clearly responding to the audiovisual score in the ways that I had predicted. This performance served as a successful proof-of-concept for audiovisual scores, and will be performed on a much larger scale at Northern Spark in June 2013. The Northern Spark project will be discussed in detail later on in this thesis. For now, it is important to note several other projects that led to my discovery of audiovisual scores of this nature.

# 6. The Gestural Music Sequencer

One of my early ventures into work that was not exclusively based on sound was an Open Source application that I developed in 2009 called the GMS or *Gestural Music Sequencer*[14]. My idea for this originated while I was working with Ali Momeni PhD and Jenny Schmid MFA in *Minneapolis Art on Wheels,* otherwise known as MAW. MAW is an ongoing collective of artists who stage large-scale, impromptu, projection outings in public spaces. MAW projections are often hand drawn, generally improvised, and usually collaborative in nature. While projecting work with MAW I envisioned ways to generate corresponding, improvised music that would be based on the projected imagery. This led me to develop the GMS, a software device that generates musical phrases in real-time from a live video signal or pre-recorded video file (see fig. 3).


Fig. 3. Screenshot of GMS illustrating the interface controls (2010).

In addition to generating notes, the GMS displays video normally, mirrored, or through a number of dynamically selectable filters. This offers choices for the artist that alter the notes and visuals produced during the performance. For example, the

[14] Watch an early experimental video created using the GMS and a "light controller" from April 2009: http://vimeo.com/4204980

mirrored mode makes it easier for a performer to view and apply her movements captured by the camera to the musical results because it mimics how we see ourselves in mirrors.

Each frame of video is analyzed for brightness, then the *x* and *y* coordinates of the brightest pixel are converted into a MIDI[15] note. The *x* axis is used to select a pitch, while the *y* axis determines the dynamics of the notes by translating the position to MIDI velocity data[16] that is usually applied to the amplitude of the note. As users move, dance, gesture, or draw in front of the capture device, notes are generated based on a scale. The available scales are typical examples of western tonality and include pentatonic minor, whole tone, major, minor, and chromatic, all of which can be dynamically selected during a performance.

Rather than using a preset scale, users can dynamically assign probability distributions to weight the likelihood of specific notes within the chromatic scale, thereby effectively allowing the user to invent his own scales within the confines of the equal tempered twelve tone system. However, instead of generating audio signals the GMS simply generates MIDI notes. This makes it possible for microtonal[17] scales to be performed when they are programmed on the external MIDI devices or within virtual instrument software that has been interfaced with the GMS.

Since its development I have used this software to perform on dozens of occasions. I most frequently use the GMS with my electroacoustic[18] duet, Ostracon, featuring Graham O'Brien on percussion and myself on electronics. The focus of this project is to explore new ways of improvising with live drums and electronic instruments. During Ostracon performances my setup involves interfacing electronic instruments with generative software that I have been developing, including the GMS and other custom built applications and plugins (see fig. 4). In this capacity the GMS facilitates using projected visuals as a *source* for musical content in contrast to the more typical example of projecting visuals in response to a musical performance[19].

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[15] MIDI stands for Musical Instrument Digital Interface and is a communications protocol used since the early 1980s by electronic instruments and computer music software for sequencing, editing, performing, and composing music.

[16] MIDI velocity data is a value transmitted by MIDI instruments, controllers, or software to adjust the volume of the notes thereby allowing for musical dynamics to occur.

[17] Microtonal refers to scales with pitches that are less than a semitone apart, or scales that do not divide pitches into twelve divisions or equal temperament (Western system).

[18] Electroacoustic is a term used to describe music that is dependent on electronic instrumentation or the manipulation of electronic recordings in order to be composed and performed.

[19] Listen to an excerpt from a 2011 Ostracon performance: http://audiocookbook.org/wp-content/uploads/2011/08/Ostracon-Live-Segment-13a-with-Drums.mp3

Fig. 4. Ostracon performing in 2011.

To do this I make use what I refer to as light controllers. I typically use some sort of handheld object that emits light as a light controller. These are often flashlights or bicycle lights, but I have also used a modified spinning top with LEDs, a mobile phone, and an iPod Touch display. The technique involves maneuvering the light controller in front of the video camera lens to generate notes. The light controller movements are projected as the notes are being generated so that the projected visuals are a direct representation of how the music is being composed during the performance. Even though the relationship between the music and visuals is essential, it is not always clear to the audience that the visual content is responsible for the music. Furthermore, the projected visuals are not typically an influence for the musical direction of the ensemble. For these reasons I do not consider audiovisual content of GMS a direct example of an audiovisual score, although, it could be used in this fashion by informing an ensemble to interpret the audiovisual content during a performance. Instead, the way we use GMS in Ostracon is an attempt to interact with the audience by activating their visual senses in a way that corresponds directly with the musical content.

GMS does, however, provide a stochastic influence. The act of moving a light controller, one's body, or other objects in front of a video camera to generate notes is admittedly not a very accurate way to play music. Most musical instruments are precision devices that allow the musician to play the exact note that they want when they want it played. This is not only very difficult to do with GMS, but also not the intended use of the instrument. Tactile musical instruments are much better suited for accurate performances. GMS was designed as an instrument that allows the artists to improvise difficult-to-repeat, angular musical phrases that she might not otherwise play. As was mentioned in the initial description of the GMS, probability distributions mapped to sliders in the interface can be used to influence the likelihood of specific notes within a scale (see fig. 3). I designed the GMS because I wanted to generate

music directly from visual content, but I did not want to limit the results exclusively to the brightness tracking in the video signal. Therefore, I added several controls in the interface to randomize the results. To my ears, pure randomness is not interesting for very long, so I designed the randomization controls in the GMS to be adjustable. This is not only possible for the pitches, but also available for the rhythmic output. There are a set of sliders that make specific note durations more or less likely than others, as well as a slider for the likelihood of dotted notes, and another for the likelihood of rests. Combining the chaotic generation of notes from video signals with techniques for reining-in the randomness around western traditional tonal and temporal structures produces ephemeral phrases that are oddly familiar yet impossible to duplicate from one performance to the next[20].

[20] Watch a video for the piece *Photon Coercion* (2011) by Ostracon: http://vimeo.com/25319109

# 7. *Duets for Synthesizer and _____*

The performance methodologies I have employed using the GMS as a soloist and in ensembles can be described as an indirect example of an audiovisual score because the visuals produced are not directly interpreted by the improvising artists. The musical phrases are also dependent on computer generated techniques and therefore lack some of the organic qualities of my ongoing series of video installations, *Duets for Synthesizer and* _____ (2012). For this direct interpretation of audiovisual scenes I played several musical duets while immersed in everyday environments. For example, in one of the pieces from the series I played a synthesizer along with the sounds of washing machines in a public laundromat. The piece was documented by shooting video of me performing along with a washing machine as it executed its various cycles[21]. The audio was recorded in three separate audio channels; one for the performed monophonic synthesis, and a stereo pair reserved for a set of binaural microphones.

Music has always imitated nature, and in more recent history, music began to mimic industry. Rather than imitating or alluding to the ambience of urban spaces in compositions, I am attempting to join in with the sounds as if they were conscious participants in an improvisational ensemble. Using a simple analog synthesizer I am either providing accompaniment for the location or the ambience of the space involuntarily accompanies me.

Machines, traffic, architecture, and people in urban environments produce oscillations that cause sound waves forming drones or rhythmic patterns. I respond to these oscillations with fundamental, electronic waveforms like pulse, saw, or triangle waves. The synthesized tones are filtered using envelopes and low frequency oscillators to create more complex textures that alternately blend and contrast with the ambient sound.

To emphasize this process the environmental recordings were made using binaural microphones, designed to simulate how human hearing operates. One example of this kind of microphone, the KU100 by Neumann, resembles a stylized human head with anatomically correct pinnae or outer ears. Instead of using the KU100, I used a technique that requires a person to insert microphone capsules into his own ears, effectively turning the living human head into a microphone. This allows the camera operator to move around as she records and shoots the environment simultaneously. When listening using stereo headphones the playback of a binaural recording accurately localizes each sound for the listener, immersing them in the spatial soundscape. For example, in the laundromat the listener can see and hear the washing machine that I am utilizing as the primary influence for the improvisation, but he can

[21] Watch video documentation *for Duet for Synthesizer and the Washing* (2012): http://vimeo.com/41795344

also hear washing machines running behind them, coins dropping into other machines to the left or from above, and other localized, ambient sounds as if they were occupying the space of the camera operator.

Each piece was shot on location while I improvised with the environment. However, passersby are unable to hear the synthesis that I am producing because it is only reproduced in my headphones while the piece is being documented. This is necessary because I do not want my playing to impact the environment or to bleed into the binaural recording. What is the point of performing this way if it impossible for an audience to experience the performance as it happens? This irony did not escape me while working on this series.

In order for others besides the artist to experience this performance it is necessary for them to take in the recorded documentation of the piece in a specific way. When presenting this documentation at the *Good-Bye Moments* exhibition, September 2012, I played the video on a 24" display with two distinct sound sources. Only the environmental sounds were played on speakers in the room, but when the viewer donned headphones she heard the binaural recording of the environment combined with the synthesized response. This presentation made it possible for the visitors to hear the environment in its natural state, then while wearing the headphones, listen to the sounds that I synthesized combined with the binaural recording of the environment.

To contrast the binaural ambience the synthesis was recorded in monophonic sound, with no additional processing making it sound as though it was coming from inside the listeners head. This placement in the center of the listener's sound-space simulates the performer's phonomnetic experience of imagining sounds to accompany the environment.

Although the listener doesn't need to be, nor can they be, at the place and time of the performance to experience it, the location is a critical component of the piece because it provides both content and context for the work. Furthermore, at a minimum, the listener must see the video representation of the environment as he hears the binaural recording and synthesized accompaniment in order for the phonomnesis effect to be represented.

Fig. 5. Video Still from *Duets with Synthesizer and* _____ (2012).

Fig. 6. Video Still from *Duets with Synthesizer and* _____ (2012).

Fig. 7. *Duets with Synthesizer and* _____ at the *Good-Bye Moments*, September 2012.

These etudes represent my personal interpretation of everyday environments as audiovisual scores. I chose to use an electronic instrument because it is chronologically aligned with our period and its timbre is ideal for the mimesis of the incidental sounds of the machinery that pervade our contemporary surroundings. In performances and compositions musicians and composers have interpreted their environments for millennia. Through these studies I am alluding to this tradition, but reinterpreting traditional methodologies by literally using the sounds of the environments as an unpredictable voice that is embedded the work.

# 8. *Voice Lessons* (2011)

*Voice Lessons*[22] is an interactive installation and electronic, audio device that interrogates the popular myth that every musical instrument imitates the human voice. Via a touchscreen interface the participant is able to manipulate moving images and vocalizations of the "voice teacher" as he recites vocal warm up exercises. The installation, developed in MaxMSP, uses a 32" touchscreen to apply a digital processing technique called granular synthesis to the sound. Granular synthesis is a way to produce unique sounds by looping small fragments of digital waveforms. Using this technique often produces harsh, glitchy, and characteristically digital timbres. The video is granulated in a similar fashion, synchronized with the sound, providing uncanny, visual feedback for the user. The piece resides in the space between a musical instrument and voice lesson. Moving the touch point left, right, up, and down allows the visitor to explore the visual and auditory possibilities. Rapid high pitched granules occur while touching near the top of the screen while lower pitched longer loops are heard near the bottom (see fig. 8).

Fig. 8. Video still from *Voice Lessons* documentation (2012).

The actor in the video representations, also named John Keston, is my retired father who became a voice teacher after a long career on stage in plays, operas, and musicals with the Royal Shakespeare Company in our native country, England, and abroad. Growing up I remember a recurring discussion that I had with my father who insisted that every musical instrument can be traced back to the mimesis of human

[22] Watch video documentation of *Voice Lessons* (2012): http://vimeo.com/31977188

phonations. World renowned interactive artist and MCAD professor, Piotr Szyhalski, described the project to me in a personal email:

> [*Voice Lessons* is] a poetic extension of the dialogue between you and your father about the nature of music and the human voice. In a sense, by allowing the audience to manipulate your father's voice, you are inserting them in the middle of your dialogue about the origins of musical instruments. (Szyhalski)

This dialogue has been translated into an audiovisual experiment that instead of answering the question about whether all instruments mimic the human voice, becomes an instrument that is *made* from digital representations of the human voice. The paradox is that the device is definitively not the human voice. The high frequency loops and harsh textures have a digital characteristic that is impossible for the human voice to reproduce, yet can only be produced using voice samples as the foundation for the granular synthesis.

The process of developing the piece was a way for me to satisfy an urge to invent meaningful connections between electronic sounds and visuals. Because the voice and the video of the actor making the vocalizations are synchronized during the granular synthesis, a connection between them is unmistakable. Although the piece could very well be used to improvise an audiovisual score, this was not my original intent for the work. Instead the piece was exhibited as a standalone installation. My observations of people interacting with the installation in this setting revealed that most of the interactions were brief and incited an amused reaction. Longer interactions, although rare, illustrated the process of discovery as users learned what was possible with the interface and then used it to create a performance.

During a performance at the MCAD MFA open studio night, *Show + Tell*, December 2011, I used *Voice Lessons* as an instrument within a live, electronic music setup instead of a standalone installation. This completely changed the dynamic of the piece. In addition to using *Voice Lessons* as an instrument, I had a laptop setup and a MIDI controller to improvise live arrangements of original electronic music. The *Voice Lessons* instrument was there as a focal layer above the loop based accompaniment I was producing from the laptop. I placed the touchscreen in my setup so that it could be accessed by me, but also available to the audience. The visuals were also projected in front of the setup so that the audience could see what was happening on the touchscreen. I made the instrument available to the audience because based on my observations of longer interactions from the exhibited installation, I assumed that perhaps one or two people would be interested in interacting with the piece during the performance.

What actually happened was that after I had demonstrated using *Voice Lessons* as an instrument the audience members lined up to participate in the performance non-stop. This was a pleasant surprise that allowed me to focus on collaborating with the

audience by providing accompaniment for their interactions. Essentially the audience member's participation with *Voice Lessons* had transformed the piece into an audiovisual score that I could read sonically and visually and respond to improvisationally.

# 9. *Post-prepared Piano (2013)* by John Keston and Piotr Szyhalski

Another project embeds the environment into the work in a completely different way. *Post-prepared Piano* is a piece in collaboration with Piotr Szyhalski that was installed at the Burnet Gallery at Le Méridien Chambers, Minneapolis from January 12 through March 10, 2013 (see fig. 9)[23]. The installation was part of a show called *Interactions* that featured the work of select MCAD MFA students in collaboration with their mentors.

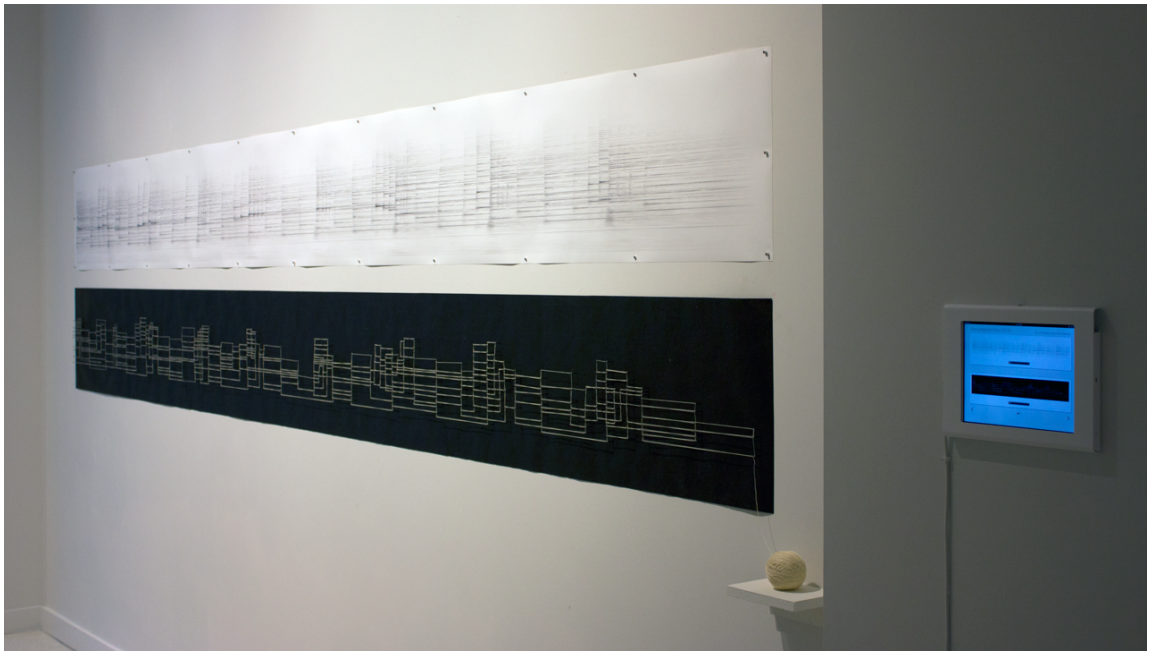

Fig. 9. *Post-prepared Piano* (2013).

The idea for *Post-prepared Piano* originated during my project *One Sound Every Day* (2008–2009). This project involved posting a sound that I created every day for a year on the sound design resource site, Audio Cookbook (audiocookbook.org), which I founded in January, 2008.

Sound designers, musicians, producers and engineers are all familiar with manipulating sound through the use of audio processing. Most examples of processing, like filters, reverbs, and delays[24] produce a relatively predictable result.

[23] Explore documentation for *Post-prepared Piano* (2013) including sound, images, and video: http://audiocookbook.org/sound_design/post-prepared-piano-by-john-keston-and-piotr-szyhalski

[24] Filters are used to cut or boost frequency ranges within sound like the treble and bass settings on a stereo system, while delays and reverberation (reverb) effects simulate changes to the spatial

The same sense of discovery that led me to find sound synthesis intriguing also applies to processing sound with an unpredictable result. Using an application called Photosounder I came up with the idea to try processing sounds using Adobe Photoshop filters. The author of Photosounder, Michel Rouzic, was aware of my ongoing project to create and share a daily sounds on Audio Cookbook. He provided me with a copy of his software so that I might post examples produced using Photosounder on the site.

Photosounder is designed to convert digital images into digital audio. Any image can be loaded into the software and then converted into sound. This usually produces chaotic, dissonant static, but if the images have high contrast and horizontal or diagonal lines, pitches can be discerned. My initial experiments with the application involved loading in photographs and listening to the sounds they produced. Photosounder also has the capability to generate images from sound files. This led me to try and capture the images it creates from the imported audio in order to use an image editing application, such as Photoshop, as an audio processor. Although producing the unpredictable results that I desired, the process didn't work very well because much of the resolution was lost when capturing the image from the computer screen. As a result of these experiments, Rouzic added a feature to Photosounder for exporting full resolution spectral analysis[25] images from sound files. This made it possible to for me to experiment more effectively using Photoshop filters as audio processors.

In one example I produced a simple musical phrase with an electric piano plugin. After rendering the digital file into the proper format I opened it in Photosounder. Without changing any settings I immediately saved the sound as a bitmap image. Next I opened the image in Photoshop and started experimenting with the image filters[26]. Once I had some filtered images I loaded them back into Photosounder to see how they sounded. The filters Gaussian blur and Liquefy created some unique effects, but my favorite was Glowing Edges[27]. This filter seemed to transform the electric piano phrase into a haunting choral passage.

After posting the results of my experiments Rouzic added another a new Photosounder feature called, lossless mode. Previously there was some loss of

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properties of sound. A reverb might process sound to seem as though it is inside a church, while a delay usually produces an audible echo.

[25] Spectral analysis when used at sound frequencies produces imagery that displays the timbre, transients, frequency, and amplitude of an audio signal or recording.

[26] Image filters provide preset and adjustable effects that are used by designers to process digital images. The Gaussian blur will take an image out of focus by a variable amount based on Gaussian curves, Liquify bends images as if they were deforming into a liquid, and Glowing Edges is used to create neon light effects around the edges of images.

[27] Listen to the Glowing Edges filter applied to a phrase of music through the use of Photosounder: http://audiocookbook.org/processing/processing-sound-using-photoshop/

resolution importing the audio into the software, but with the lossless mode enabled after importing the image the sound quality is identical to the original audio signal. Rouzic explained how this new mode might apply to my experiments in an email to me from February, 2009:

> Basically the lossless mode in question is a sort of 2D time-frequency filtering mode, kind of like some other programs like Audition 3 do by letting you airbrush on a spectrogram, that's the idea basically. The difference here is that besides the brushes that Photosounder has, you can export the image to Photoshop and do some very precise filtering, for example making a sound feature disappear by hand, enhancing parts of a sound, subtracting to sound as I once did by making the difference between a song's spectrogram and its instrumental version's spectrogram to isolate the vocals, experiment with contrast, curves, levels, sharpening, various effects (I'm pretty sure you could for example try the glowing edges again and get a different sounding result). (Rouzic)

This new feature meant that the manipulations that I was doing to the image files would be applied to the sound without any other loss or manipulation that was previously happening as a result of the sound to image conversion process.

Although these experiments were fascinating I did not pursue them much further. Creating the Photoshop filtered sounds is a step-by-step process that cannot be produced in real time. This does not translate well for performance and at the time the majority of my work was performance based.

Later in 2011 I found that I had an interest in and opportunities for installation based work, so I decided to revisit the idea of manipulating printed versions of spectral analysis as installations. Furthermore, a series of installations might lend themselves to collaboration through offering printed materials to another artist for interpretation. Collaborators could distress the paper to introduce sonic anomalies, or entirely recreate the spectral analysis using visual-art techniques. I made a series of proof-of-concept experiments with the intent of determining what might be possible by physically manipulating printed versions of spectral analysis versus relying on the Photoshop filters that I was exploring in 2009.

I started by producing spectral analysis prints of short works of recorded music. After making the prints I used a variety of techniques to distress the paper and ink introducing flaws into the printed materials. These flaws might include tears or wrinkles in the paper, liquids dripped onto the prints, or incidental marks made by bike tires. After the prints were distressed I scanned them back into digital form and then converted them back into music.

I used the Rhodes electric piano for the proof-of-concept series musical phrases. I selected the Rhodes because as a popular, electro-mechanical instrument it is easily recognized and has a clear, organic, bell-like tone. This tone quality means that the physical manipulations that are applied to the printed material produce an easily discerned, audible contrast to the original recording. For example, in one of the prints mineral spirits were dripped onto the paper. This created lighter foggy areas in the spectral analysis that when played back introduced hissing sounds that faded in and out along side the passage of electric piano (see fig. 11)[28].

With each manipulated print I included a QR code[29] that when scanned directs the viewer to a web page that shows the scanned version of the image and then automatically starts playing the sound that was rendered from the print displayed.

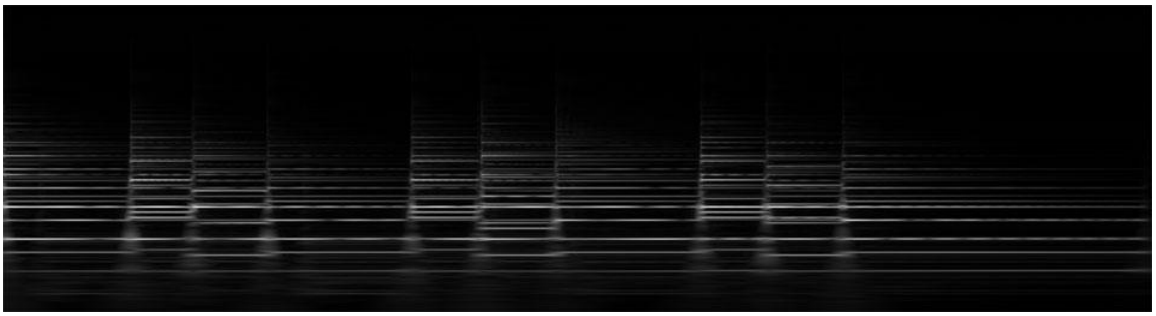

Fig. 10. Original spectral analysis of piece, *Untitled Fragment* (2012).
Visit http://mcad.johnkeston.com/ps/rhodes1.html to listen.

[28] Listen to the mineral spirit experiment:
http://mcad.johnkeston.com/ps/audio/rhodesScan07.mp3

[29] QR codes (quick response codes) are visual representations of data, similar to barcodes, that contain textual information such as a website address, or contact information. Most mobile devices are capable of reading the codes with the built in camera.

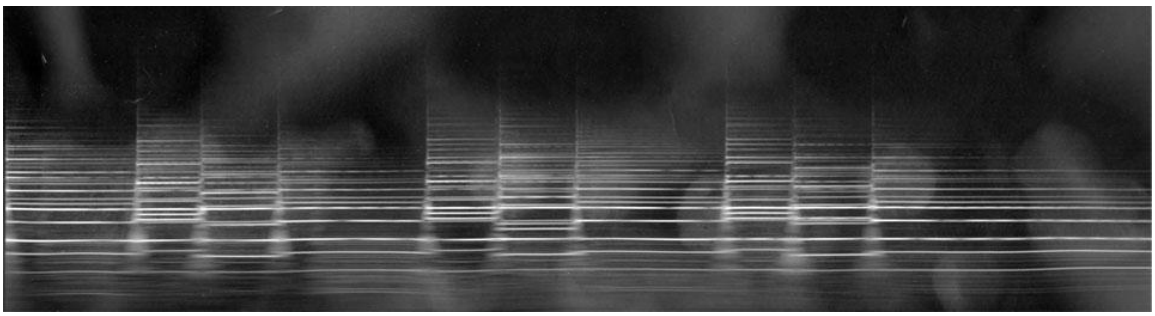

Fig. 11. *Untitled Fragment #7* (2012) manipulated with mineral spirits.
Visit http://mcad.johnkeston.com/ps/rhodes7.html to listen.

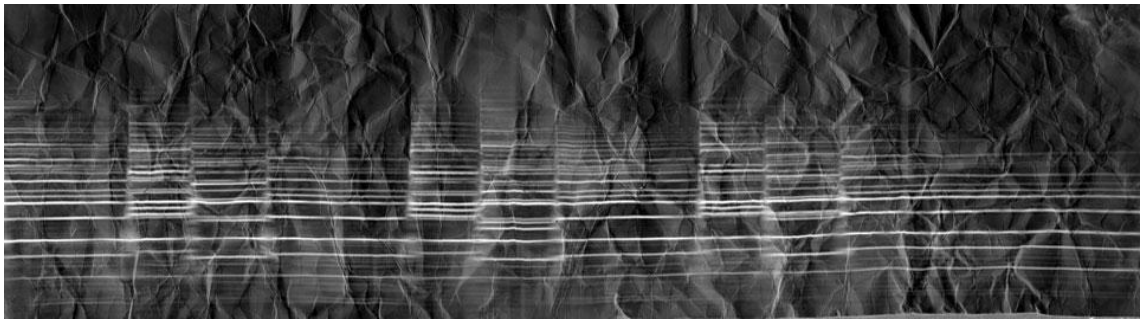

Fig. 12. *Untitled Fragment #4* (2012) crumpled and re-flattened.
Visit http://mcad.johnkeston.com/ps/rhodes4.html to listen.

*Post-prepared Piano* consists of several components. The first part is a 14′ wide and 17″ tall inkjet print of spectral analysis from a short piano composition that I performed and recorded using my custom built, binaural head microphone. Below the print is an installation that Szyhalski constructed from tarpaper, nails, and one continuous piece of twine (see fig. 13). This handmade mapping of the spectral analysis was then photographed and converted back into sound. Thirdly, we installed an iPad with headphones that allows the visitors to hear the original recording, the nails and string version, and a combination of the two layered on top of one another[30].

[30] Visit the tablet optimized web application: http://ppp.johnkeston.com

Fig. 13. *Post-prepared Piano* (2013) detail.

The nails and twine rendered audio serve as a physical, handmade method of sound synthesis, or perhaps a way of producing "analog sampling." The official didactic for the piece goes a long way in a short amount of text to explain what the project aims to convey:

> Post-prepared Piano is an exploration of non-musical processes as methods in constructing new sounds. By juxtaposing virtuosic piano performance with the crudeness of hammering nearly 800 nails, a vast territory of what may be considered artistic practice is outlined. Discovery of new pathways in that territory lies at the heart of this project. In its final form the work functions as a residue of an intricate process during which sound travels through multiple realms: the physical and non-physical, the high and low technologies, the sophisticated and proletarian materials. A short piece composed and performed by Keston is converted into a spectral analysis digital image that visualizes the timbre, transients, frequency, and amplitude of the recording. The digital print of that process constitutes the upper half of the installation. This visual record of musical performance is then manually mapped by Szyhalski and re-rendered on the gallery wall through a labor intensive process of materializing multiple, individual frequency bands. The new object is then photographed and converted back into sound. The resulting audio sounds like a haunting echo of the original piece, but is warped and contorted in unusual ways. (Keston and Szyhalski)

The interpretation of the score in this case was confined to the spectral analysis of the original piece. Szyhalski based his hand mappings entirely on the way the music looked rather than how it sounded. Subsequently converting the visual interpretation into sound led to discovering a new sonic interpretation of the piece. The original textures became unglued and variable in comparison to the precision of the piano frequencies.

This project introduced the unpredictable results I am interested in much more effectively than the original concept using Photoshop filters. The process of physically printing, manipulating, or re-constructing music visually followed by converting the modified representations back into a listenable, musical form leads to an intense anticipation for discovering new sound. This non-musical process makes it impossible to internally hear exactly what the piece will sound like before the process is complete. Phonomnesis cannot predict the outcome, however, not for lack of trying.

Designing, building, and viewing the re-mapping inspires phonomnetic imaginings, but they are wildly different from what is finally uncovered sonically. When improvising music during a performance skilled musicians can internally hear what they will play before they play it. When re-interpreting music through a non-musical process of re-constructing the spectral analysis, phonomnesis only provides a vague prediction of the final outcome. Throughout the installation of the piece Szyhalski and I asked each other, what will it sound like? What attributes will be similar and in what ways will it differ from the original piano composition? We knew it would not sound like piano anymore, but we also suspected that the frequencies and transients would maintain enough of the original characteristics to illustrate the connections between the original piece and the re-mapping. What we discovered had a surprisingly organ-like timbre with harmonic structures that emphasized the subtle overtones and undertones in the piano textures.

This discovery led me to experiment further by combining the original piano recording and the rendered nails and twine version into a single mixed piece. Layering the two tracks illustrates the differences in color and texture along side the similarities of cadence and pitches between them. During the timespan of the combined piece frequencies match for brief moments and then wander off again as tiny flaws and variable slackness in the twine shape the "hand synthesized" sonic textures. I had to adjust the position of a few transients in the sound rendered from the nails and twine to make up for a slight offset that was caused by the photographic compositing process. A composite of two photographs was necessary to get enough resolution in the image of the nails and twine to produce the new sound as accurately as possible. Otherwise, this combination provided a new perspective to the collaboration by

composing a duet from the original piano composition and the re-mapped interpretation[31].

[31] To listen to the combined version of *Post-prepared Piano*: http://ppp.johnkeston.com/#2

# 10. *Instant Cinema: Teleportation Platform X*

*Instant Cinema: Teleportation Platform X* is an improvisational concert and projection piece that provides musical accompaniment for an audiovisual presentation. An ensemble of musicians are situated in front of a projection screen and sound system. A remote video camera operator shoots video and captures sound of nearby events as they unfold. This content is broadcast in real time to the projection screen and sound system for the ensemble to follow along as an audiovisual score. This process also creates a musical score for the audiovisual content thereby generating instant cinema. This piece will be performed at Northern Spark on June 8th through 9th, 2013 continuously from sunset to sunrise or for about nine hours. Northern Spark is an annual all night arts festival or Nuit Blanche that has been happening in the Minneapolis and St. Paul metropolitan area since 2011. Hundreds of artists present work including installations, projection, dance, music, and new media. As well as being an interactive performance piece, *Instant Cinema: Teleportation Platform X* is a scheme to collaborate subversively with almost all of the Northern Spark festival participants in real time.

In my practice audiovisual scores have provided an effective means for stimulating the creative process. Utilizing this technique gives the artist a vehicle to submit a transparent dialogue regarding the concepts surrounding the work. Although this dialogue is present the work might still harbor enigmatic qualities. For example, what is the meaning of synthesizing sonic textures while immersed in an environment already brimming with ambient and incidental sound? Why improvise with an ensemble while watching and listening to a video broadcast of someone walking along city streets? What purpose does it serve to re-map the spectral analysis of a piano composition with nails and twine and then convert the imagery back into music?

Here I could continue on about the contrast between sonic reality and imagined sound, or the significance of phonomnesis, but to me what is most appealing about this kind of work is the discovery process. Surprises occur with every step along the journey of interpreting these systems. The trick to making discoveries and encountering surprises is to code the potential for chaos into the audiovisual system. Chaos can never be eliminated. This was phrased elegantly by Rosa Menkman in her "Glitch Studies Manifesto":

> The dominant, continuing search for a noiseless channel has been, and will always be no more than a regrettable, ill-fated dogma. Even though the constant search for complete transparency brings new, 'better' media, every one of these new and improved techniques will always have their own fingerprints of imperfection. (Menkman)

Rather than filtering noise and imperfections audiovisual scores introduce unpredictable behaviors similar to what is found in everyday events like the weather or the stock market. These chaotic dynamics[32] are introduced without disregarding the expertise of the artists who are producing the interpretations.

Szyhalski's tarpaper, nails, and twine rendering of the precise frequencies and transients in my piano playing is a rough approximation, simply because of the materials involved. However, it required a perceptive understanding of the concept, a steady hand, and a large dose of patience to construct the re-mapping effectively. The new timbres and frequency shifts heard in the conversion of Szyhalski's rough, visual approximation into sound are not simply chance, but chaotic dynamics that were coded into the re-mapping. For example, using tar paper as a background for the horizontal twine produced noise that was not present in the original piano piece. The twine had its own texture that shaped the new sound, but it was also not perfectly horizontal. This variable slackness caused the frequencies to stray away from the piano notes. The piece illustrates an artificial transition from the almost pristine piano textures into a partial state of manufactured entropy.

When an improvisational ensemble interprets an audiovisual score made from a real time broadcast of an external event the chaotic dynamics are coded into not just the score, but the performance space, the performers, their relationships with each other, their experiences, their knowledge, and their memories. In addition to these seemingly stochastic elements the performers all contend with an assortment of influences. These include sensory stimuli like auditory, haptic, and optical input. Haptic influences occur as musicians physically interact with their instruments. The sound produced by the other performers, sound that is present in the performance space, and the sound that emanates from the audiovisual score all influence the phonomnesis experienced by each player the instant before they produce their reactions to it (see fig. 1).

Optical influences are everywhere we look, but centered around the score when one is in use. Without scores, improvisers often close their eyes while playing, perhaps to block out optical influences. I do this frequently myself, involuntarily, during moments of intense concentration. However, it can be helpful at times to be looking at the other members of the ensemble in order for the music to coalesce intelligibly.

When an audiovisual score is in place cohesion may center around the audiovisual content of the score, but maintaining visual contact with the ensemble is still important. Visual cues and signals like nods, looks, gestures, facial expressions, even foot tapping are all part of an intuitive language understood by improvising musicians. The intent of the audiovisual score is not to distract from using this

[32] Chaotic dynamics refers to mathematical equations within chaos theory defined by Edward Lorenz and others that model unpredictable behavior in natural systems like weather patterns.

language, but to provide subject material for the conversation. The audiovisual score could be pre-recorded and rehearsed, but this would dilute the spontaneity of not knowing what is about to occur. Presenting an unpredictable audiovisual score parallels the indeterminate improvisation of the ensemble. It activates the last vestige of what remains immutable within traditional forms of notation driven performance inserting it as a mutable layer in the work.

This unpredictability of the audiovisual system is not purely random. Instead, like Szyhalski's tar paper, nails, and twine, it involves the introduction of chaotic dynamics. However, we are not simply rolling dice, or pulling notes out of a hat like Dadaist composers have done since early in the twentieth century. Deliberate decisions are being made by the camera operator as she creates the score. However, these decisions are sensitive to changes in the environment. A loud noise, or bright light is all that is necessary to attract our attention. We recognize that we are being influenced by a myriad of unpredictable factors. It is the discovery of what these influences conjure that I find fascinating. We still draw from our vocabulary of musical phrases, techniques, textures, and interplay, but we can never predict what will occur during the performance. The audiovisual score lets us embrace the influential factors around us, rather than shutting them out, and leads us to the unexpected.

# 11. Conclusion

Today most of the prepared audiovisual events we experience are mediated by screens. Examples are everywhere. The screen has become such a ubiquitous interface within our society that it can rarely be escaped. Most of us carry them around in our pockets, keep them on our desks, and relax by looking at bigger screens after a long day of looking at smaller screens. Screens are present in all of the work that I have produced in tandem with this thesis. *Duets for Synthesizer and _____* requires a video screen to be presented to an audience. *Voice Lessons* requires an interactive touch screen to be installed. To perform to the audiovisual score proposed for *Instant Cinema: Teleportation Platform X* the ensemble must suffice with a facsimile provided through the interface of a screen and projected image rather than interacting directly with the environment. However, inserting the media through this interface provides the artists with new perspectives on the tensions between the unpredictable score and the deliberate acts of the camera operator.

In *Instant Cinema: Teleportation Platform X* mediating the environments that the camera operator is broadcasting through the interface of a projection screen gives the ensemble an opportunity to contribute to producing a kind of instant cinema. The audiovisual score is read by the improvisors and the response is in turn a score for the audiovisual content. The presence of the screen is necessary because otherwise the environment would merge with the performance space and the score would be polluted by the performance. If the work is meant to emerge as a response to the environment then influencing the environment by the visual presence and sounds of the artists distracts from that intent. The screen mediates the two locations so that the audiovisual score is untampered by the ensemble responding to it.

As the title of this paper suggests music performed in response to an audiovisual environment mediated by a screen presents an unfamiliar context for the music. However, is the mediating presence of a screen necessary to provide this context? It goes without saying that the familiar context of music with dance does not need screens or projected images to be successful. I would argue that there are unfamiliar contexts for music that do not rely on the insertion of a mediating screen. For example, imagine two philosophers in conversation on a stage. Perhaps they are in armchairs rather than at podiums. An ensemble of musicians is responding to their discussion as it happens. Perhaps one member of the ensemble is using an electroacoustic technique to manipulate or re-process the voices of the philosophers as they converse. Other members might inject improvisational phrases of music to accompany the speakers. In this scenario the audiovisual score is replaced by two people in conversation. The ensemble is unable to predict what the philosophers will say or even how they will respond until the performance unfolds, yet the words are delivered deliberately by the speakers providing a similar tension to an audiovisual score presented through a mediating screen.

With or without a mediating screen, when improvisational music is performed with the unfamiliar context of an audiovisual score, a philosophical discussion, or other unexplored scenarios, the artists are undertaking an exciting challenge; to make music out of something that is not music and, perhaps, cinema out of something that never intended to be cinema. If the artists convince an audience that the arbitrary sound is absorbed into the piece as a contextual layer in the music, and that the visual content is aligned closely enough with the music to merge into a cinematic experience, then the performance has succeeded in meeting that challenge.

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# Appendix 1

The links to audio and video media found in the footnotes throughout this paper are an essential component of this document. For convenience, I have compiled a list of the links to online media in the order that they appear in the text and numbered as they are in the footnotes. The media presented here is for academic use only. Please do not distribute without the author's consent. In some cases additional information and links not found in the footnotes are provided.

1) The opening rendition of Promenade on Tomita's Pictures at an Exhibition (1974): http://johnkeston.com/thesismedia/Promenade.mp3
3) An experimental sound piece improvised on a Roland MKS-80 Super Jupiter analog synthesizer: http://audiocookbook.org/wp-content/uploads/2011/02/Noise-Jam-3-Through-Master-Effects-Chain.mp3
5) 1:09 minute excerpt of music from the Halberstadt installation of *As Slow as Possible* captured on July 6, 2012: http://johnkeston.com/thesismedia/ASLSP-2012-07-06.mp3
More information and the original media: http://www.aslsp.org/
7) 4:18 minute long recording of Cardiff's installation *Pandemonium* (2005): http://johnkeston.com/thesismedia/pandemonium.mp3
More information and the original media: http://www.cardiffmiller.com/artworks/inst/pandemonium.html
8) 7:29 minute excerpt from the Wessel/Ewart/Mazzola performance from February 2009: http://johnkeston.com/thesismedia/Wessel_Ewart_Mazzola.mp3
More information and the original media: http://blog.lib.umn.edu/ali/spark2009doc/2009/02/spark-festival-2009-concert-10-wesselewartmazzola.html
9) *8.8* from Supersilent *8* (2007): http://johnkeston.com/thesismedia/Supersilent8.8.mp3
10) 2:06 minute segment from DKO with DJ Luke Anderson at the Northern Spark June 2011: http://audiocookbook.org/wp-content/uploads/2011/06/Battle-of-Everyouth-Segment-103_28-to-105_44.mp3
11) Video documentation of Battle of Everyouth (2011): http://vimeo.com/26515526
12) Video excerpt of the DKO with Oliver Grudem performance at FRANK from December 2012: http://vimeo.com/56028072
14) An early experimental video created using the GMS and a "light controller" from April 2009: http://vimeo.com/4204980
19) An excerpt from a 2011 Ostracon performance: http://audiocookbook.org/wp-content/uploads/2011/08/Ostracon-Live-Segment-13a-with-Drums.mp3
20) Video for the piece *Photon Coercion* (2011) by Ostracon: http://vimeo.com/25319109

21) Video documentation for *Duet for Synthesizer and the Washing* (2012): http://vimeo.com/41795344
22) Video documentation of *Voice Lessons* (2012): http://vimeo.com/31977188
23) Documentation for *Post-prepared Piano* (2013) including sound, images, and video: http://audiocookbook.org/sound_design/post-prepared-piano-by-john-keston-and-piotr-szyhalski
27) Glowing Edges filter applied to a phrase of music through the use of Photosounder: http://audiocookbook.org/processing/processing-sound-using-photoshop/
28) Mineral spirit Photosounder experiment: http://mcad.johnkeston.com/ps/audio/rhodesScan07.mp3
30) Tablet optimized web application for *Post-prepared Piano* (2013): http://ppp.johnkeston.com
31) Combined audio from *Post-prepared Piano* (2013): http://ppp.johnkeston.com/#2

# Appendix 2

The following list of additional images, sound, and video are work samples that may be included on an enclosed DVD-R. This content relates to this paper, but is not required to illustrate the concepts contained.

**Images:**

1) John Keston, Spectral Tablature (series 2013), Inkjet Prints, Screen Print, Digital Audio, iPad, Headphones (01_Spectral_Tablature_2013.jpg)
2) John Keston, Vocal Exercises (2013), 41" x 17" Inkjet Print, Digital Audio (02_Vocal_Exercises_2013.jpg)
3) John Keston, Vocal Exercises Reprise (2013), 41" x 17" Inkjet Print, Digital Audio (03_Vocal_Exercises_Reprise_2013.jpg)
4) John Keston, Synthetic Arches (2013), 68" x 17" Inkjet Print, Digital Audio (04_Synthetic_Arches_2013.jpg)
5) Jasio Stefanski (collaborator) Synthetic Arches Reprise (2013), 68" x 17" Screen Print, Digital Audio (05_Synthetic_Arches_Reprise_2013.jpg)
6) John Keston, Rubato Etude #9 (2013), 48" x 17" Inkjet Print, Digital Audio (06_Rubato_Etude_no9_2013.jpg)
7) Jon Davis, Rubato Etude #9 Reprise (2013), 48" x 17" Inkjet Print, Digital Audio (07_Rubato_Etude_no9_2013.jpg)
8) John Keston, Machine Machine (2013), 32" Interactive Touchscreen, Speakers, Sound, Video (08_Machine_Machine_2013.jpg)
9) John Keston, Machine Machine (2013), 32" Interactive Touchscreen, Speakers, Sound, Video (09_Machine_Machine2_2013.jpg)
10) John Keston, Duets (2013), 24" iMac, Speakers, Headphones, Video, Binaural Recording, Synthesizer (10_Duets_Installation.jpg)
11) John Keston and Piotr Szyhalski, Post-prepared Piano (2013), 168" x 17" Inkjet Print, 168" x 17" Tar paper, Nails, Twine, Digital Audio, iPad, Headphones (11_Post-prepared_Piano_2013.png)
12) John Keston and Piotr Szyhalski, Post-prepared Piano (2013), Detail (12_Post-prepared_Piano_Detail_2013.png)
13) John Keston and Piotr Szyhalski, Post-prepared Piano (2013), Detail #2 (13_Post-prepared_Piano_Detail2_2013.png)
14) John Keston, Suggested Interpretation of an Audiovisual Score (2013), Digital Image (14_Thesis_Venn_Diagram.png)

15) John Keston, Voice Lessons (2011), 32" Interactive Touchscreen, Speakers, Sound, Video (15_Voice_Lessons_2011.png)
16) John Keston, Voice Lessons (2011), Video Still #2 (16_Voice_Lessons_Still2_2011.png)
17) John Keston, Voice Lessons (2011), MaxMSP Patching Window Screen Shot (17_Voice_Lessons_Patch_2011.png)
18) John Keston, Voice Lessons (2011), Video Stills Grid (18_Voice_Lessons_Stills_2011.png)

**Sound:**

1) John Keston, Vocal Exercises (2013), 41" x 17" Inkjet Print, Digital Audio (01_Vocal_Exercises_2013.mp3)
2) John Keston, Vocal Exercises Reprise (2013), 41" x 17" Inkjet Print, Digital Audio (02_Vocal_Exercises_Reprise_2013.mp3)
3) John Keston, Synthetic Arches (2013), 68" x 17" Inkjet Print, Digital Audio (03_Synthetic_Arches_2013.mp3)
4) Jasio Stefanski (collaborator) Synthetic Arches Reprise (2013), 68" x 17" Screen Print, Digital Audio (04_Synthetic_Arches_Reprise_2013.mp3)
5) John Keston, Untitled (2012), Injet Print, Mineral Spirits, Digital Audio (05_Rhodes_Print_Mineral_Spirits_2012.mp3)
6) John Keston and Graham O'Brien (Ostracon Performance), Untitled (2011), Digital Audio (06_Ostracon-Live-Segment.mp3)
7) John Keston, Jon Davis, Graham O'Brien, Luke Anderson (DKO Performance), Battle of Everyouth Segment (2011), Digital Audio (07_DKO_Battle-of-Everyouth-Segment_2011.mp3)
8) John Keston, Untitled (2011), Digital Audio (08_Noise_Jam_3_2011.mp3)

**Video:**

1) John Keston, Duet for Synthesizer and Railcars (2013), Digital Video (2:51) (01_Duet_for_Synthesizer_and_Railcars_2013.mp4)
2) John Keston, Duet Under Bridge (2013), Digital Video (2:04) (02_Duet_Under_Bridge_2013.mp4)
3) John Keston, Duet for Synthesizer and Spin Cycle (2013), Digital Video (5:35) (03_Duet_with_Spin_Cycle_2013.mp4)

4) John Keston, Post-prepared Piano - Animated Sequence (2013), Digital Video (2:12) (04_Post_Prepared_Piano_Animation_2013.mp4)
5) John Keston, Voice Lessons - Demonstration (2011), Digital Video (2:22) (05_Voice_Lessons_Video_2011.mp4)