A History of Musique Concrete and Ulysses

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A HISTORY OF MUSIQUE CONCRETE
AND
ULYSSES
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AND

ULYSES

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts in Music Composition

By

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ABSTRACT

This thesis paper examines the compositional techniques used in the construction of my capstone project for a Masters in Music Composition from the University of Arkansas. A history of musique concrete is included to place perspective on my work and to discuss techniques and philosophical approaches to concrete music. This history examines the work by the Futurists, Pierre Schaeffer, Karlheinz Stockhausen, and Edgard Varése among others. The technological history includes significant developments in audio recording but does not discuss the development of electronic instruments. A philosophical perspective of music and noise is included to validate the techniques and materials used in my piece Ulysses. Included are discussions of a definition of music, the German WDR vs. the French RTF schools, and the exclusion/acceptance of referential sound. Supplemental material includes an mp3 file of the composition Ulysses in 5.1 track audio.
This thesis is approved for recommendation to the Graduate Council.

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In the height of classical musique concrete, Edgard Varèse (1883-1965) premiered his *Poème Électronique* at the 1958 Brussels World's Fair. This work remains a monument to the style of musique concrete not only for its musical interest, but for the place it and Varèse stand in musique concrete history. Although this work was composed for 3 channel audio, the piece was performed on an estimated 350 different speakers with approximately 30 different sound projectionists manipulating the content and location of up to 12 speakers.¹ This makes *Poème Électronique* one the largest musique concrete performances to date.

The work was commissioned as a soundtrack to an abstract film by the director Le Corbusier.² Therefore, *Poème Électronique* represents one of the few pieces that combines musique concrete with a visual art. The performance took place in an architecturally impressive tent-like pavilion with a presentation nearby of Xenakis' (1922-2001) *Concret PH*.

Varèse creates his abstract work by avoiding the use of melody and harmony. If a melody is present, the melodic line is divided by the use of Klangfarbenmelodie. Furthermore, there is no external meter that controls the organization of sound. By omitting three features fundamental to the interpretation of classical and romantic music, *Poème Électronique* must be perceived with a different perspective than tonal works to find meaning. This new value can be understood as, “a matter of what has been left behind, and what we are left with after the drawing away: the abstracted man has left the world behind; the abstract truth has left behind all vagaries and contingencies.”³

Pierre Schaeffer (1910-1995), the “father of musique concrete” describes a similar perspective in his work:

Then, without the help of any melody, any harmony, you would only need to be able to discern and savor, in the most mechanistic monotony, the interplay of a few atoms of freedom, the imperceptible improvisations of chance.”

I understand Schaeffer to mean that without melody or harmony other features of sound become prominent. These features include timbre and rhythm. Therefore, the abstract work of musique concrete emphasizes rhythms or timbres by excluding melody and harmony.

Poème Électronique also abstracts external rhythms leaving only timbre and the internal rhythms of individual sounds. The musical interest being the relationship of these sounds.

To create cohesion, Poème Électronique is divided into different sections. These sections are not created by timbral continuity. They are separated by pauses. For example. The first section lasts 43 seconds. It includes bell tones, sirens, struck wood, electric glissando’s, tapping strings, and pure sine tones. This section is separated from the next by a brief (1 ½ second) pause. The next section includes similar sounds, like the electric glissandi and tapping strings. The second section also has new sounds like grinding sounds.

These noteworthy aspects of inception and performance are supplemented by a friendship between the composer Varèse and the Futurist poet Filippo Tommaso Emilio Marinetti (1876-1944). Their familiarity might have it seem that musique concrete and the Futurist movement are in agreement. However, as I will show, they are quite different a large part due to the philosophies and artistic concepts of the “father of musique concrete,” Pierre Schaeffer.

(published online May 18, 2003).
The Futurists

In his book, *Electronic and Computer Music*, Peter Manning describes the Futurist movement in music as “one of the earliest attempts to employ non-traditional sound-generation techniques as part of a communicative art form...”\(^5\) The movement took form in 1909 when Marinetti wrote his Futurist Manifesto. This article presents the artistic intentions of a passionate group to overthrow the past with violence, and these ideas are expressed in a statement of purpose with eleven discussion topics. Some of these topics include:

1. We want to sing the love of danger, the habit of energy and rashness.
2. Literature has up to now magnified pensive immobility, ecstasy and slumber. We want to exalt movements of aggression, feverish sleeplessness, the double march, the perilous leap, the slap and the blow with the fist.
3. We declare that the splendor of the world has been enriched by a new beauty: the beauty of speed. A racing automobile with its bonnet adorned with great tubes like serpents with explosive breath ... a roaring motor car which seems to run on machine-gun fire, is more beautiful than the Victory of Samothrace.
4. Beauty exists only in struggle. There is no masterpiece that has not an aggressive character. Poetry must be a violent assault on the forces of the unknown, to force them to bow before man.
5. We want to glorify war — the only cure for the world — militarism, patriotism, the destructive gesture of the anarchists, the beautiful ideas which kill, and contempt for woman.
6. We want to demolish museums and libraries, fight morality, feminism and all opportunism and utilitarian cowardice.
7. We will sing of the great crowds agitated by work, pleasure and revolt; the multi-colored and polyphonic surf of revolutions in modern capitals: the nocturnal vibration of the arsenals and the workshops beneath their violent electric moons: the gluttonous railway stations devouring smoking serpents; factories suspended from the clouds by the thread of their smoke; bridges with the leap of gymnasts flung across the diabolic cutlery of sunny rivers: adventurous steamers sniffing the horizon; great-breasted locomotives, puffing on the rails like enormous steel horses with long tubes for bridle, and the gliding flight of aeroplanes whose propeller sounds like the flapping of a flag and the applause of enthusiastic crowds.\(^6\)

These points are included because Marinetti's choice of words can be powerful. At times, the list is almost musical itself with metaphors like “a roaring motor car which seems to run on machine-gun fire,” or “great-breasted locomotives, puffing on the rails like enormous steel horses.” Taking hold of Marinetti’s “enormous steel horse” reigns, Balilla Pratella developed the musical implications of Futurism with his “Manifesto of Futurist Musicians.”

Pratella has modeled his argument on Marinetti’s standard and created 11 rules which Futurist Musicians should follow. Some of these include:

1. To convince young composers to desert schools, conservatories and musical academies, and to consider free study as the only means of regeneration.
2. To keep at a distance from commercial or academic circles, despising them, and preferring a modest life to bountiful earnings acquired by selling art.
3. The liberation of individual musical sensibility from all imitation or influence of the past, feeling and singing with the spirit open to the future, drawing inspiration and aesthetics from nature, through all the human and extra-human phenomena present in it. Exalting the man-symbol everlasting renewed by the varied aspects of modern life and its infinity of intimate relationships with nature.
4. To destroy the prejudice for “well-made” music—rhetoric and impotence—to proclaim the unique concept of Futurist music, as absolutely different from music to date, and so to shape in Italy a Futurist musical taste, destroying doctrinaire, academic and soporific values, declaring the phrase “let us return to the old masters” to be hateful, stupid and vile.
5. To proclaim that the reign of the singer must end, and that the importance of the singer in relation to a work of art is the equivalent of the importance of an instrument in the orchestra.

There are many similarities between these two manifesto's, which lay in stark contrast to future developments in musique concrete. I would like to emphasize the differences between them because I have been influenced by musical decisions made by Schaeffer and his coworkers at the RTF (Radiodiffusion-Télévision Française). In contrast to the Futurists, I do not see Scaheffer's music as an attempt to overthrow the past. In fact, Schaeffer worked alongside and
collaborated with Pierre Henry (b. 1927), a classically trained composer. Unlike the anti-commercialist Futurists, I see the origination of *musique concrete* as a proponent of commercialism. The RTF owned technology for which they were interested in finding a new market. After Schaeffer received success with the radio broadcast of his first work *Etude Aux Chemins de Fer*, other studios for musique concrete arose in Germany, and Italy. These workshops were in Cologne at the German radio station WDR (*Westdeutscher Rundfunk*) and in Rome at the Italian radio station RAI (*Radio Audizioni Italiane*). The symbiosis of *musique concrete* and commercial radio helped the advancement of *musique concrete* because the performance venue of the radio stations allowed the art to grow, giving the work an audience and attracting new composers. It is fortunate that Pierre Schaeffer and the early composers of musique concrete were not influenced by the Futurist perspective.

In 1913, Luigi Rossolo published a third text of Futurist music aesthetics titled *The Art of Noises*. Whereas the manifestos by Marinetti and Pratella hold violent overtones and, in my opinion, were documents which express the principles of Futurism as a charter for friends to establish legitimacy for the values of Futurism. Russolo's *The Art of Noises* serves more as a treatise of non-traditional instruments including a philosophy of the purpose of non-traditional instruments in music. Russolo agrees with the Futurists that the past should be overthrown:

> We futurists have all deeply loved and enjoyed the harmonies of the great masters. Beethoven and Wagner have stirred our nerves and hearts for many years. Now we have had enough of them, and we delight much more in combining in our thoughts the noises of trams, of automobile engines, of carriages and brawling crowds, than in hearing again the “Eroica” or the “Pastorale.” Rossolo, pg. 25.

Russolo not only provides this ethos for the creation and performance of Futurist works, but attempts to portray Futurism as a natural evolution of music; that because machines have
multiplied and integrated so fully into society, composers should reflect machine noises in their work.

**The Effects of Noise on Creativity, Performance, and Livelihood**

In retrospection, the composer, writer, and broadcaster Robert Worby, agrees in the 1990's with Futurism's nearly hundred-year old assessment of our modern machine-filled world, writing:

Noise may well prove to be the most appropriate metaphor for the twentieth century. This hundred-year period witnessed the gathering of human beings into the urban conurbations that have become our great cities, the invention of the aeroplane and the invasion of the motor car, the development of horrendous war machines and the evolution of radio, television and sound recording. Today there is more sound because there are more people and there are more ways of making, storing, retrieving and transmitting sound. Noise is with us all the time and it symbolizes a world that is forever expanding and accelerating. ⁷

There are aspects of this urbanization, like electricity, which create ambient sound. This constant sound has been shown, in most people, to limit creativity⁸ and performance.⁹ However, there have also been studies which show that it is possible for some (albeit fewer) people to use ambient sound to increase creativity.¹⁰ This conclusion is supported by a study that demonstrates moderate level sounds (70 dB) reduce the brains ability to process information, subsequently enhancing creativity.¹¹ A final study of ambient sound relates increased levels of sound to poor

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mental health in children. Therefore, noise pollution created in an industrialized society appears to have a mixed or somewhat negative effect on creativity and performance.

There are other louder noises, however, which have been shown to not only affect performance, but to create a lower standard of living, even correlating with terminal illness. Elise van Kempen writes about the number of people considered to be affected by these louder noises:

In Europe, about 450 million persons are exposed daily to equivalent noise levels of at least 55 dB; 113 million persons are exposed to equivalent noise levels of at least 65 dB; and 9.7 million persons are exposed to equivalent noise levels of 75 dB or more. This accounts for over half of Europe's population being affected by noise pollution of 55 dB (est. 800 million in 2002). The effects of these volumes on a population have been show to increase hypertension, myocardial infarction, and sleep deprivation. For noises less than 40 decibels there are no perceived physical consequences, including “annoyance” from the sound.

Music, however, can transcend these negative implications of noise to become something beautiful. This is where I feel my piece, *Ulysses*, is different from the work of the Futurists. With the violent and aggressive aspects of the Futurist manifestos, I believe some of their work was

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intended to create harm by reflecting the physical effects of noise. My work is different because it is created to be cathartic. I have been intrigued by noise, and this project explored the phenomenon of sound. At times the noise is explored as being dynamic, while in other instances, noise is presented as static. By contrasting both perceptions, I can explore a personal understanding of noise.

Take for instance minute 19:41 in my piece *Ulysses*. Here, the wind moves into a high register and is loud, shrill and aggressive. I am not presenting this sound to aggravate the audience; the harsh sound establishes contrast with the water sounds. When the water sound is reintroduced at minute 20:42, I want that sound to be wetter, even though the sound was present earlier in the piece. That specific water sound was chosen because it is the wettest sound I created. The frame and context the sound is presented in attempts to alter the sound's perception, becoming even wetter than it was before.

This attempt to alter the listener’s perception of the timbre may not be successfully conveyed. On this issue, I relate to the author Kurt Vonnegut when he said, “that every successful creative person creates with an audience of one in mind. That’s the secret of artistic unity. Anybody can achieve it, if he or she will make something with only one person in mind.”18 For my part, my “one person” is myself. Although I consider and value the opinion of others, I hold final judgment on all my work.

**Concrete Music**

Wherever we are, what we hear is mostly noise. When we ignore it, it disturbs us, When we listen to it, we find it fascinating.19

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~John Cage

Musique concrete does not have an exact definition. All definitions include that the sound being manipulated must be recorded. The strictest definition of musique concrete is the opinion that the sounds recorded must be by non-traditional instruments. A more lenient definition includes the recording of traditional instruments as long as they are manipulated in ways beyond a traditional performance. The most lenient definition includes the recording and manipulation of electronically produced sounds.

It is my belief that there is no definitive definition of musique concrete because the medium has not flourished as a classical art music form. Some modern uses of the medium include musique concrete being used as a recorded accompaniment. Davidovsky's (b. 1934) *Synchronisms* series is one example of this style, where the recorded sounds provide an extra element to a live solo work. A benefit to these compositions is that they do not relinquish either the visual element or the live performance aspect of music.

With the development of inexpensive personal computers programs like MAXmsp can help composer's create algorithms to process sound live. This allows for the development of electronic music performers. In the society of classical art music this format is the most exciting to take place recently.

However, the most prominent use of musique concrete is with popular music. The Beatles were one of the first groups to gain notoriety for their use of non-traditional instruments in their album *Rubber Soul*. Subsequent groups have included Pink Floyd, Queen, Radiohead and Modest Mouse.

The term musique concrete was originally chosen by Pierre Schaeffer because he did not
feel comfortable describing his work in terms of classical art music terms. As Schaeffer explained:

There are two possibilities: either one does or does not tell a story with noises; when one does not, one takes sounds for their intrinsic qualities and then the relationships between them give a kind of music. Actually, I did not then dare to call this 'music', for it was too unusual when compared to classical music. Therefore, I finally called it 'concrete' notation, composing—but that it consisted of recorded sounds not produced by especially designed musical instruments or by voice.\(^{20}\)

This does not mean that Schaeffer intended the work to be described in the English definition of Concrete, as in fixed or solid. In fact, the French translation can mean quite the opposite. In the introduction to Schaeffer’s diary/theory text *In Search of a Concrete Music*, Schaeffer explains the French definition of 'concrete', “The word in French, which has nothing of the familiar meaning of 'concrete' in English, is used throughout the text with all its usual French connotations of 'palpable,' 'nontheoretical,' and 'experimental'...”\(^{21}\)

This experimental music relies on a person being able to alter an object functional fixedness. Pierre Schaeffer explains,

It is strange how we value the craft of Stradivarius when he excels in building violins, or the work of a performer who tempers their body and mind to produce sounds from those violins, yet cast aside the skill of an engineer, who builds a train. We see a train's primary purpose to transport materials, or people, and the sounds it makes as a side-effect, or by-product of that transport. However, if the craft of both the engineer and musician can been seen as equals then the train can be seen with a primary purpose of an instrument with a byproduct of transportation. This proposition relies on the mind uncoupling the train from its economic relationship that created its functional fixedness. I feel that the sound of a train would be a more valid instrument if an engineer were hired by a professional orchestra...


This perspective represents the ability of any sound to become an instrument. However, there are opinions that only accept the sound made from a train as a side-effect.

The exclusion of sound from music has developed a stigma into the term *musique concrete*. This stigma involves musique concrete not being perceived as a valid art form. Therefore, I choose to use the term “concrete music” when referring to the art form abstractly or my interpretation of the art. I contrast my perspective of the medium with the original musique concrete to identify when a work or opinion outside of my own is being referenced to the medium. I make this distinction in an attempt to distance myself from a cliché of musique concrete.

**What is Music?**

These negative implications have a direct impact on *musique concrete*. This results in the medium not being accepted as music. Therefore, by defining a personal understanding of music the audience to my thesis can better understand the purpose of the work. This definition is given ethos with similar opinions by music professionals. I define music as the relationship between two sounds. Pierre Schaeffer has a similar, but more in depth interpretation, and explains:

> These occur when sounds bear musical value… If you hear a door creak and a cat mew, you can start to compare them—perhaps by duration, or by pitch, or by timbre. Thus, whilst we are used to hearing sounds by reference to their instrumental causes, the sound-producing bodies, we are used to hearing musical sounds for their musical value. We give the same value to sounds emanating from quite different sources. So the process of comparing a cat's mew to a door creak is different from the process of comparing a violin note to a trumpet note, where you might say they have the same pitch and duration but different timbre. This is the symmetry between the world of sound and the world of musical values.\(^\text{22}\)

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I believe if I can perceive relationships between pitches, timbres, or rhythms that sound is music. Some sounds can exist from a single source, yet have internal relationships that make them musical. Other sounds need a second sound, so that there can be a relationship between them. This defines my perception of music. However, there is no one agreeable definition of music. The starkest contrast to my opinion of music is the requirement of both form and pitch in a human created composition to classify a collection of sounds as music. There are three qualifications in that definition that can be explained.

To begin with form, there are probably individuals that need form to be an established musical construct, and others that can accept music that establishes its own form. For example, I see Beethoven's Ninth Symphony as an example of this difference in listener's perception. For those who need musical form to be established, they prefer the first three movements of the Ninth. Those who do not require form to be pre-established, can enjoy the form of the last movement as well. This idea was expressed by Edgard Varèse in an interview with Alfred L. Copley:

I have never tried to fit my conceptions into a known container. If you take a rigid box of definite shape – call it a sonata box – and you want to fill it, you must have something that is the same shape or that is elastic enough to be made to fit. But if you try to force into it something of different shape and harder substance, even if its volume and size are the same, it will break the box.23

The idea that music establishes its own form is not new. In his speech, the Frontiers of Nonsense, Charles Rosen describes the “paradox” of an artwork’s ability to stand alone, existent

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from the influences of the author, the listener, or the critic.²⁴ Rosen shows that this idea was first expressed in the manifesto of Central European Romanticism published in 1799, *The Athenaeum*:

Excellent works generally criticize {characterize, or review} themselves, and in this respect it is superfluous for another to perform yet again the very task that the author has doubtless already done. If such a criticism, nevertheless, is a work of art (as it always ought to be), then its existence is anything but superfluous; but it stands entirely for itself and is as independent of the written work criticized as this (manifesto) itself is independent of the material treated and described within it.²⁵

According to Rosen and *The Athenaeum*, the artwork, barring the inadequacy of the composer, forms a critique of itself. Then, the critics form their own artwork, scrutinizing the piece in question. Every listener, to every piece of music, on every hearing, forms their own unpublished artwork; analyzing, scrutinizing, and concluding a decision of validity on the synthesis of their experiences and the perceived effect of the art. This concept can be seen as the theory of relativity of art. This explains the dilemma of creating a universal definition of music, and allows each perspective to validate sound as music on a personal basis.

These theories from the 18th century describe the same concepts the French tradition used in composing with musique concrete. Pierre Schaeffer and other at the RTF studio searched for form inside natural sounds; Stockhausen and the Cologne school used electronics to manipulate sound with existing musical forms. In my opinion, the difference here is that Schaeffer's philosophy discovers music in sound, whereas the Cologne school makes music with sound. Therefore the French School can be described, much like Duchamp's *Fountain*, as appreciating sound because of the context. Schaeffer explains,

²⁵ Ibid.
Why shouldn't they broadcast three minutes of “pure coach” telling people that they only need to know how to listen, and that the whole art is in hearing? Because they are extraordinary to listen to, provided you have reached that special state of mind that I'm now in.  

This is why (in terms of the French School) a discussion on the philosophy of music is relevant.  

Robert Normandeau, a Concrete composer from Canada, discussed in an interview why he chose Concrete music (and my interpretation of the French tradition):  

I need to be in touch with sound, and the sound triggers my imagination, not the opposite. I’m not thinking in the absolute about some sounds. I can think about some sources, but thinking about the sources is not about sound. Sound is the real thing. When you go into the studio with a performer or with an object, or whatever, and then you start to create sounds. This is the sound. And you never know what will happen. And that triggers my imagination.  

This perspective has been very important to me developing a voice as a composer, and in determining the philosophical choices of taste regarding my compositions. I agree with Jean-Michel Jarre who, respecting Schaeffer, said “He was very important in my life because he was the first man to consider music in terms of sound and not notes, harmonies, and chords.”  

Ironically Schaeffer is not as convinced of his own perception, stating:  

I was involved in music; I was working with turntables (then with tape-recorders); I was horrified by modern 12-tone music. I said to myself, ‘Maybe I can find something different... maybe salvation, liberation, is possible.’ Seeing that no-one knew what to do anymore with DoRéMi, maybe we had to look outside that... Unfortunately it took me forty years to conclude that nothing is possible outside DoRéMi

29 Ibid, 56.
I may be wrong, but believe that information can be communicated through sound beyond melody and harmony; that music can be formed into sonata-allegro, a waltz or a fugue, but that music exists before form. Furthermore, like *The Athenæum*, I believe that music has a stronger emotional power when reflecting inner relationships of sound, rather than pre-established musical forms. Therefore, I enjoy Adorno's description on the purpose of form:

> Where serious music satisfies its own concept, every detail gets its concrete meaning from the total course, and this totality in turn receives it from the living interrelation of details that oppose and continue one another, pass into each other, and recur. Where the form is dictated from the outside, on the other hand, one will, as Wagner put it, 'hear the harness rattle.'

However, there is another school of electronic music from Cologne with a valid opinion to consider. The Cologne school was established by the physicist Werner Meyer-Eppler, the composer Robert Beyer, and the composer/critic Herbert Eimert. In the 1950's they petitioned the director of the NWDR radio station, Hanns Hartmann, to create an electronic music studio. It was the scientific exploration of Meyer-Eppler which led to the formation of the electronic studio at the German radio station WDR. In his book, *Other Planets, the Music of Karlheinz Stockhausen*, Robin Maconie explains:

> As part of his investigations, Meyer-Eppler dissected individual speech sounds from tape recordings, and reassembled them to form synthetic words and phrases. It was hearing the fruits of such experiments that persuaded Eimert that a sound theoretical basis existed for setting up an electronic music studio where a new art of music, grounded in pure research in tone synthesis and fundamental principles of musical organization and perception, might be created. It was out of this conviction that the Cologne Radio electronic music studio eventually came into being.  

When Karlheinz Stockhausen (1928-2007) and Gottfried Michael Koenig (b. 1926) joined the program in 1953 the NWDR studio received an influx of students and teachers to compose on the electronic equipment. These composers included Konrad Boehmer, Luc Ferrari, Ernst Krenek, György Ligeti, Roger Smalley, and Iannis Xenakis, among others. Where the composers at the RTF tried to take sounds and make them into music, a la Schaeffer's *Etude Aux Chemins De Fer*, the NWDR composers relied more on pitch relationships and using synthetic sounds (rather than found sounds) in twelve tone or anti-twelve tone theories. This schism in electroacoustic music is summarized by Maconie:

Effectively, the choice facing the composer of tape music was either to follow Schaeffer in intuitive manipulation of preformed materials, following only instinct, totally lacking in scientific rigor, and offering no real hope of arriving at any systematic method--- or to aim toward a compositional system grounded on science, but for which neither a comprehensive and intelligible theory nor suitable technical means yet existed.\(^{32}\)

There are two examples from this era which branch this binary assessment. The first being a product of the Cologne school, Stockhausen's *Gesang der Jünglinge* (Song of the Youths, 1955-56), uses both electronically produced sine tones and recorded phonemes of vocal artifacts. *Gesang der Jünglinge*, provides an example of how Concrete sounds can be counterpoised against electronic sounds, with each creating a deeper understanding of the other due to the balance of their relationship.

The second example from this era, breaking the French-German schism, is the Italian Center for Concrete Music Development, established at the radio station, RAI, in 1955. The style of the RAI found a middle ground between the French and German schools by not worrying about philosophy of creation (electronic or recorded sounds) and focusing on the effect the

\(^{32}\) Ibid.
sounds created on the audience:

This center (RAI), although clearly influenced by the design of the Cologne studio, was created to serve the needs of the Italian schools of composition, reflecting far more catholic tastes than those associated with either of its forebears. The majority of composers thus paid little attention to the philosophical implications of using or avoiding the use of microphones in the production of material, for they were far more interested in the perceived characteristics of sound structures than the formalistic principals by which they were obtained.33

This facility, designed by the sound engineer Alfredo Lietti, sought to expand Electroacoustic music production beyond commercial electronic equipment with machines designed specifically for art music application.34 For a brief time, this facility became (technologically speaking) the leading center for Concrete Music production in the world.

Luciano Berio (1925-2003) acted as director of the electronic music department at the RAI which included compositions by Pousseur (Scambi, 1957) Berio (Thema---Omaggio a Joyce, 1958), John Cage (Fontana Mix, 1958-59) and Luigi Nono, (Omaggio a Emilio Vedova, 1960).

Henri Pousseur's Scambi is relevant to my composition because it addresses similar philosophical concerns and uses a white noise generator as its sole source material, which is similar to my use of a 'wind' sound for large sections of my work. In Scambi, the white noise is treated through equalization to focus specific band-waves into discernible pitches. Then, these sections are combined to create a ghastly (but beautiful) pitch tornado.

These three centers for concrete music show that making a binary assessment of the art does not give justice to the possibilities inherent in the medium. Furthermore, as time has passed, the medium has expanded to include possibilities beyond sound collages and 12 tone

34 Ibid 81.
construction. These new possibilities reflect both composer's expanding the possibilities of the medium, and technology developing to where composers can use less time and create more precise decisions with more accurate results.

**History of the Technology**

Concrete music became possible when Thomas Edison developed the phonograph in 1877. This was the first machine created that could record and play sound. However, it would be almost 70 years before a composer would use recorded sound to create music. The first uses of recorded sounds were commercial ones, with a focus on reproducing sound rather than creating it. The original phonograph cylinders would also have been of little use to a composer anyway, because within a few plays the tinfoil would deform and the quality of the recording would become disfigured. In 1879 Alexander Graham Bell and his Volta laboratories improved the durability of the wax cylinders, but the materials were still best suited for re-creating recorded sounds rather than creating new ones.

In 1889 Emile Berliner invented the laterally cut disc record to play back sound. He named his machine the Gramophone to distinguish it from Edison's wax cylinder Phonograph. The lateral medium of the Gramophone intrigued some early composers, as Manning explains:

> During the 1920s, for example, Paul Hindemith, Darius Milhaud, Ernst Toch and Percy Grainger each individually observed the subjective effects of playing gramophone records at different speeds. Their discoveries, however, were mainly of an exploratory nature, and no detailed records or artifacts have survived.”

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In 1888/1889, Vlademar Poulsen invented the magnetic wire recorder. His machine worked when an electric signal magnetized a pattern onto a passing metal wire. When the wire was sent through the “playback head” it would understand the magnetized signal and re-create the sound that was imprinted on it. Although most concrete music composers would work with tape or electronic mediums, the first piece of musique concrete ever composed was on a wire recorder by Halim El-Dabh in Egypt in 1944.\(^{38}\)

A different line of music technology developed around the mixed music media of a group of artists in the German art school, the Bauhaus. This organization specialized in mixing crafts with fine arts. Their musical experiments consisted of manipulating 78 LP's (long playing record) to create unique musical experiences. They did so by altering the LP record grooves using a fine paintbrush to imprint masking solutions, and mounting the playing stylus backwards to reverse sound. Manning explains:

Greater significance can be attached to the work of the Bauhaus artists László Moholy-Nagy, Oskar Fischinger and Paul Arma during the 1930's, seeking in the first instance to modify the physical contents of the record groove. However, their attempts to modify acoustical data by scratching new vibratory patterns produced only noisy distortions of the original material.\(^ {39}\)

The mixed media aspects of Bauhaus work included developing a synthesis between presenting visual images and creating a musical representation, or vice-versa. This style of composition was experimented with throughout the world. One of these experiments was by the Bauhaus influenced Russian composer, Yevgeny Sholpo, who in 1932, expanded on the idea of

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optical sound images with an “audio-only synthesis facility known as the Variophone.” The idea of creating optical sound continued into 1948, where in Canada, Norman McLaren experimented with a visual synthesis of sound. “In Loops (1948), for example, the movement of loops of red and white against a blue background form an intricate counterpoint with accompanying washes of synthetically drawn sound.”

These works in optical sound became overlooked, and then forgotten, due to advancements made in the high quality replication abilities of the tape-recorder.

Following the optical sound works of the Bauhaus, there were the Futurist inspired orchestral works by George Antheil. Poet Ezra Pound describes Antheil as “the first artist to use machines, I mean actual modern machines, without bathos.” His work Ballet Mechanique, a non-traditional film-score, uses 16 player pianos, airplane engines with propellers, and a siren, among more traditional instruments.

Antheil has made a beginning; that is in writing music that couldn't have been written before. His musical world is a world of steel bars, not of old stone and ivy. With the performance of the Ballet Mecanique one can conceive the possibility of organizing the sounds of a factory, let us say, of boiler plate or any other clangorous noisiness, the actual sounds of the labor, the various tines of the grindings...

In 1931, Merle Duston, a Detroit City (MI) native, provided a cheaper solution to recording sound by imprinting the audio information on chemically treated paper. These original tape recorders could only record sound, and needed a separate system to recreate the

40 Ibid., 6.
41 Ibid.
sound. Furthermore, these original machines were limited by not producing a realistic quality of sound recreation. However, the tape-recorder would prove substantial to the development of musique concrete because the paper could be manipulated in ways that wax cylinders, lateral LP records and wire recorders made impossible.

The German Magnetophon, developed by Fritz Pfeumer, improved on the practical commercial applications of audio recording by magnetically imprinting audio information. In 1935, the Magnetophon was premiered at the German Radio Exhibition in Berlin. Here, audiences “realized the many important applications of the machine,” and expressed desire to see variations of the Magnetophon, including “pre-recorded music and entertainment tapes; a special version to create artificial reverb for open-air concerts; feedback control for in-door performances with sound reinforcement; a device for 'speed telephoning', that is, recording a speech at normal speed, playing it back over the phone at a higher speed with the recorder on the other end of the line also working at the increased speed, and then playing back the tape at a normal speed.”

Even in 1935, 10 years before Halim El-Dabh creates the first piece of musique concrete, commercial audiences understood the techniques composers would use in the creation of a new art form. However, the idea that music could be defined outside of an instrumental world was, if not inconceivable, not yet actualized.

The Magnetophon remained a privilege to its German constructors until the Allied invasion of 1945. It was the dissemination of this machine among the allied forces, and the  

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commercial value that this machine provided radio stations, which led to the first centers for the production of musique concrete. The RTF, WDR, and RAI radio stations in Europe all used technology based on the magnetic tape and multi-track possibilities of the Magnetophon. Because of the American Electronic Corporation Ampex dissected the Magnetophon for marketing and research, Loius and Bebe Barron were able to create the first recording studio in America. However, it was the RCA Corporation in America that took the next leap in electronic music technology by developing a room-sized phenomenon of sound manipulation: the Mark II Sound Synthesizer.

In the early 1950's, the Columbia-Princeton Electronic Music Center became the premier studio for electroacoustic music in America. The center was founded by Columbia university professors Vladimir Ussachevsky and Otto Leuning as well as Princeton University Professors Milton Babbitt and Roger Sessions. A collaboration between Ussachevsky and Babbitt formed, and with the help of a Rockefeller Grant they received funding to purchase the Mark II. As Babbitt would write:

I talked with Harry Olsen and he agreed that if [Vladimir] Ussachevsky and I were willing to learn how to use it, he would be grateful, and we could evaluate it and decide which universities might be interested in purchasing it. Vladimir and I went there many times each week, early in the morning, under a cloak of industrial secrecy. They checked us for cameras. Vladimir would eat his Hershey bar and we would work in an un-air-conditioned room. But he decided early on that it wasn't the way for him, so I was left on my own.47

The RCA Mark II Sound Synthesizer allowed the composers to punch instructions into paper, much like how notes are punched into a player piano roll. The synthesizer would then

transfer pitches, sounds, and effects, from these instructions onto a LP record next to the
machine. In this way, the Mark II was able to create electronic sounds from a synthesizer as well
as mix electronic and concrete sounds in a binary sequencer. Charles Wuorinen described the
RCA Mark II as:

A 750-vaccum-tube affair in which information was encoded by a fiendish combination
of 4-bit binary switches, banks on the walls and console of this nearly room-sized
machine, and two particularly clever paper drives, each of which would encompass two
channels of information. Holes were punched in the paper that then passed over a metal
roller to which contact was made by a set of brushes. The brushes were arranged so that
they would lie over the holes that passed beneath, making continuous contact. Time was
represented on the machine as the number of holes at a certain rate of the paper drive.
Pitch and other information was represented in binary numbers by a combination of
preset switches and banks of holes in the paper. 48

For Babbitt, the advantage of the Mark II over tape-recorders was that he was able to
meticulously arrange and serialize his music in a way beyond the abilities of a tape-recorder. For
other composers, like Ussachevsky, this style of computer composition was not their style.
Although he would not begin to compose until the 1980's, the composer Robert Normandeu
describes here his opinion of how early computer music was not to his liking:

Computer music of that time was not for me at all because of the waiting time... I like to do
this music because I like the interaction with the sound. So putting numbers on the
punching card and waiting two days for the result that would sound like [makes “early
computer music” sound effect]. You know, how discouraging. 49

The final technological advancement in electroacoustic music construction would remove
the time hindrance facing Normandeu, but would take over 30 years to be realized. Although

48 Qtd. in Ibid.
49 Robert Normandeu, Interview with Robert Normandeu, Interviewed by Alexa Woloshyn.
     Université de Montréal. February 8, 2011.
     2013.)
popular music studios would find advancements in multiple track recordings, analogue equalization and reverberation machines, and most importantly noise reduction technology, it was not until the late 1980's that the next breakthrough in Concrete Music technology occurred. In the 80's, consumer grade computers developed to include enough processing power to manage audio editing software. It was in 1989 that Evan Brooks and Peter Gotcher's sound editing software *Sound Tools* debuted at the National Association of Musical Merchandisers.

*Sound Tools* (later named Pro-Tools) was the first DAW (Digital Audio Workstation). This advancement in the history of recording technology has had a monumental impact on my own work. *Ulysses* is entirely manipulated inside of Pro-Tools, allowing for exact adjustments of audio files. This program allows for instant actualization of the manipulated music, including an undo feature that allows me to experiment in ways composers of the past could not. Pro-Tools has also allowed me to build sounds into giant amalgamations of material, sometimes sounding approximately 100 different sound files within a second's time.

**Spatialization of the Sound-field**

Along with the technological advances in compositional technology, there has also been progress by composers and audio engineers developing the sound-space relationships. Spatial Music is music that is written with compositional interest in the location of sound. This can be achieved in classical art music by placing a choir offstage, by creating a unique arrangement for members of the orchestra or by putting orchestra members in the audience.

Orchestral spatialization is different from an electronic sound space because of the aleatoric nature of live music compared to the exact repetition of electronic sound. If two clarinets are standing on stage, one on stage left, the other on stage right, and they are playing an
identical passage, it is almost infinitely improbable that the vibrations will be identical. Because
the vibrations are not identical, and vary in amplitude, vibrato, pitch, timbre (emphasis of
overtones), and duration, the mind will process the sound information as two distinct clarinets.
Because electronic music can be identically replicated in multiple speakers, electronic music
creates a phantom signal, where the sound exists between the speakers.

Norman Lee and his colleagues explain that when “2 spatially separated coherent signals of
equal intensity that arrive at the ears simultaneously, vertebrate auditory systems experience a
psychophysical phenomenon known as summing localization and perceive these inputs as a
single 'phantom' source located between the actual sources.”50 If the levels in each speaker are
equal, the sound will be perceived in a middle space equidistant from both speakers. Therefore,
although the spatialization of orchestral music may seem a similar subject, in practice they
different.

For my work Ulysses, each sound is recorded separately and the sound spatialization
occurs by manipulating the placement and timbre in the DAW. Also, because my sounds are field
recordings, I was not able to maximize the sound quality through microphone choice or
placement. My portable Zoom H2 provided the most practical means to record the sound, and I
was only able to modify the means by which I created the sound, not how I captured it.

These spatial aspects can be controlled by altering the quantity of speakers replicating
sound, by modifying the arrangement of the speakers to consider a desired acoustical effect, or

50 Norman Lee, Damián O. Elias, and Andrew C. Masona. “A precedence effect resolves
phantom sound source illusions in the parasitoid fly Ormia ochracea”. Proceedings of the
6357.
by sending sounds individually through the speakers.

The compositional interest in spatial music emphasizes the brain's ability for auditory spatial attention (ASA). ASA acts with sound much like the eyes with light and objects, informing the brain if an object is to the left, right, near, or far. In more recent human history, the strength and necessity of ASA to function in daily life has been suggested to have decreased as humans have relied more on visual cues. Spence and Driver wrote that human ability to accurately perceive information with ASA may have atrophied by the brain relying more on other senses, resulting in “decreased spatial acuity”.51 This is important to consider as a composer because of the ease spatialization becomes either cliché or unnoticeable to an audience. Furthermore the value of ASA increases for a composer because by removing the visual element of a live performer, the brain must find other ways to perceive the incoming sound, and will fall back on the atrophied sense of spatial attention. The importance of ASA creates a wide variety of options for creating a spatial environment for sound performance.

To begin with, a speaker is required in electronic music to replicate and present the sound. If only one speaker is present a listener is confronted with a one dimensional spatialization of sound.

The sound field can be increased to two dimensions by information being presented from two speakers. This information can either be present with equal information coming from both speakers, or different sound and volumes of sounds appearing in each speaker. With two speakers, the directional origin of sound becomes a front-facing wall, or, can create a linear

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environment if placed on each side of a listener. There is an interesting piece by the composer Alvin Lucier called *Music on a Long Thin Wire* where the sound space between two speakers manipulates a wire, which creates its own tones based on the frequencies sent vibrating through the speakers. Unlike music which creates a phantom signal, Lucier's work creates a new sound in the space between the speakers. The wire can create a fundamental pitch if the speakers play the same frequency, chord tones through combination frequencies if the speakers play different pitches, and passing tones as the wire changes vibrations to align with new pitches from the speakers. This piece provides a unique approach to manipulating the sound space between two speakers by using the “phantom center” to create new sounds. As a final note, I have not found a piece which aligns one speaker raised above the other to manipulate sound on the vertical plane.

This is surprising due to a human deficiency in detecting sound vertically. In 1968, S. K. Roffler and R. A. Butler studied the brain's ability to perceive sound localization and found that although humans can accurately detect the location of a sound horizontally, we are inept at accurately locating sound vertically.52 This phenomenon results in pitch affecting the vertical perception of sound. A high pitch is perceived as originating higher in space, and low pitches from lower spaces, even if the pitches sound from the same location.

Although most electronically produced sound is stereophonic with two speakers, a third speaker increases the sound space to include a possible 360° sound circle around a listener. If more speakers are added, the sound field could become even more immersive. The more common set-ups include 4 channel, 5.1 channel, and 7.1 channel audio, where the .1 represents a

low-end channel dedicated to a subwoofer.

More recently there have been presentations to expand Hollywood recording technology, and thereby home theater systems, to be as expansive as 11.1 audio. The Blu-Ray edition of *The Expendables 2* claims to be the first movie released with an 11.1 channel audio option.\(^{53}\) This is an exciting development which occurred during the production of my thesis.

If the speakers are arranged symmetrically to each other and equidistant from a central point, a “sweet spot” or “ideal center” is formed in the center of the speakers, where sound from all the speakers arrives simultaneously. My work in surround sound relies on producing enough stimuli in each speaker and exploiting sound localization to reduce the ability of the sweet spot producing an ideal listening location. This does not mean that I have attempted to spatially reduce the ideal listening location; rather, each audience member listens to a different piece of music depending on their location in the sound space. In this way, an aleatoric (chance) effect is created by different locations influencing different perceptions of the musical information. This concept expands on the work of Earle Browne, Pierre Henry, and Karlheinz Stockhausen, by manipulating the ideal sound location, not through speaker placement, but through sound manipulation.

One of the first, if not the first, electronic pieces composed for eight channel audio was Earle Brown's *Octet I* (1953). This piece was followed by a subsequent sequel, *Octet II* (1954). Both of these pieces were composed for eight loudspeakers and were some of the first works for complex stereophonic sound (eight channel audio). *Octet II* differs from *Octet I* in that it allows

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an indeterminate factor to be decided by a live performer. The eight tape sections can be looped

to create layers of sound to provide the piece with a more aleatoric element than Octet I.

The first large scale manipulation of sound space was created by Edgard Varèse with his
Poème Électronique. This work utilized an “open” sound space, rather than a “bounded one.” This
means that although the piece was three channel, the sound engineers operating the speakers are
able to control where the sound comes from. In this instance, they could manipulate up to 12
speakers each. In contrast to my work, this “open” sound space creates an aleatory effect
different from my “bounded” work; my project will always have the same sounds sent to the
same speakers. I achieve my aleatoric effect not through performance, but through perception.

A more ambitious sound-space environment was created for a group project designed by
Pierre Henry and the GRM. In the early 1960's nine composers54 collaborated on a project in
which each composer added musical segments to create a collage. This project developed into an
expansive sound theater complete with stadium seating and speakers facing both toward and
away from the audience at different distances. This set-up helped remove the “ideal sound
center.” The construction of this theater was important because, as Simon Emmerson writes:

For the first time a controlled sound environment was conceived for concerts at the GRM,
including loudspeakers surrounding the audience and a console for 'spatialization' at the
centre of the room. Such a system was launched at the first of an annual series of
Expositions de Musique Experimentale in 1966.55

In the 1970's, Henry continued to develop work in the expansion of sound space with his
Second Symphony. Henry, along with Varèse and Xenakis, continued to develop compositions

54 Francois Bayle, Edgardo Canton, Philippe Carson, Luc Ferrari, Francois Bernard Mache, Ivo
Malee, Jean-Etienne Marie, Bernard Parmegiani, and N'Guyen Van Tuong.
directly related to an imagined sound space speaker arrangement. In this instance, The Second Symphony was composed for the circular theater named the Cirque d'Hiver. Henry explains:

It was a work for a 16-track recording, which was very ambitious for the time; we used eight stereo tape recorders, wired together and about 100 loudspeakers that would diffuse the sound circularly. People would feel immersed and surrounded by the music.\textsuperscript{56}

Stockhausen also explored different sound-space set-ups with the intention of, in his words, “equalizing the experience of spatial sound throughout the auditorium” by using “several rectangular geometric 'solutions'.\textsuperscript{57} During 1958-1960 Stockhausen manipulated the spatial aspects of his piece Kontakte to promote spatial interest. He explains:

In Kontakte, I discovered a way of making 'flood sounds'. You have sound continually starting in speakers behind the listener, and after a short delay the same sounds appear in speakers at the left and right, and, again a short time later, in the speakers in front... The sound really passes from the back to the front like water going over your head\textsuperscript{58}.

I found Kontakte, particularly interesting because of Stockhausen's similar interest in flood sounds. Where Stockhausen and I differ in actualizing these concepts is that I do not try to maximize an equal sound environment but provide different levels of information depending on where each listener is positioned. In this way, I have found that I create an aleatoric effect in the music because the listener does not receive the same amount of information each time they listen to the piece and I cannot control the location of each listener. My music reflects that by not allowing the sound to be in the same place either.

Another solution would be to create a second (or third or fourth) ideal center by considering the phonic rebound of the source sound. With careful consideration of room

\textsuperscript{58} Jonathan Cott, Karlheinz Stockhausen, Stockhausen: conversations with the composer (Pan Books: 1974), 150.
acoustics and speakers placement new “ideal centers” could be created. Norman Lee, et al., explain, “Localizing individual sound sources under reverberant environmental conditions can be a challenge when the original source and its acoustic reflections arrive at the ears simultaneously from different paths that convey ambiguous directional information.”

There have been other sound-immersion centers, most notably the Pepsi Pavilion at Expo '70 in Osaka, Japan. This structure was an immense geodesic dome which existed as an integration of architecture, art, and music. As well as being built for musical considerations, the outside layer of the dome was covered in a six foot thick water vapor cloud structure, mixing sculpture, architecture and music. Inside the dome were seven, six-foot tall sculptures equipped with speakers and moving at less than two feet per minute. The performance area consisted of a sound-field structure created by David Tudor. This space and included 32 inputs connecting to 37 speakers capable of moving sound throughout the dome.

One of the few modern sound spatialization centers is the Audium in San Francisco. This building was designed by the composer Stan Shaff and sound designer Doug McEachern. With help from the National Endowment for the Arts this facility has held weekly performances since 1972. The facility started with 16 speakers and has increased to currently total 176 speakers.

Referential Sound

The use of referential sounds in Concrete Music is one of the controversial issues surrounding the medium. The debate is whether to use recorded sounds where the origin can be identified. For example, in *Etude Aux Chemins de Fer*, the audience can perceive (with help from the title) that the source for the material used is a train. Schaeffer's crusade to distance his work from referential interpretations came from a desire, unlike the Futurists, to “remove meanings and definitions of his sounds and create a deeper psychological-emotional response.”\(^6^2\) Joel Chadabe explains Schaeffer's reasoning:

[Schaeffer's] method of returning meaning and emotion to music was to go into the world and the sound effects library of his radio studio... In the process, he became more interested in his sound effects for radio plays rather than the dramas themselves. "From the moment you accumulate sounds and noises, deprived of their dramatic connotations, you cannot help but make music," he insists.\(^6^3\)

To add pathos to his argument, Schaeffer explains, “A friend, Jerome Peignat, told me that the Greeks knew of this experience and called it acousmatics the study of the meaning of sound and noise when their origin is ignored or unknown.”\(^6^4\)

Konrad Boehmer, a German composer who studied at the Cologne school at NWR, agrees that referential sound should be excluded from musique concrete. His perspective is based on the idea that composers who use referential sound, do so in a way which excludes the audience. This is accomplished by needing a single understanding of the sounds, which only the composer can have, to understand the musical implications. He explains:

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This is one of the main problems of most compositions that make use of sounds “captured” by composers themselves. They may have very specific associations or remembrances concerning the respective sound that they confuse with musical relevance, believing that they are “specific.” The listener hears only the sound, which, in general, is exposed solely within the framework of a composition and is not integrated on these (subjective) factors.  

In contrast to Schaeffer and Boehm's arguments, Robert Normandeau feels that there are times when referential sounds are accepted, even preferred to non-referential sounds:

*Cinéma pour l’oreille* is really when I work (sic) on a piece in which I will use daily life sounds, for example: sound recognition. And I will use them especially for that, because they have a meaning for me, and I don’t suppose it has a meaning for everyone. If I use the sound of a train whatever it means for you, it will have a meaning. It will put a reference of something in the piece... If I use a sound of a train, it will be every listener’s train according to their own experience. It will remind them of different things. And then they will be put in a situation where they have to deal with themselves. But if I put a train on a screen it will be my train for everyone, the same train for everyone. It triggers the imagination a lot less compared to *cinéma pour l’oreille*.  

I enjoy Normandeau's perspective, and can relate to it. When I picture a train, I see the Hoosier State rolling across E. Hanna Ave. outside of the house I rented in Indianapolis. This effect transports me to a unique listening environment created by my experiences.

Another example of a successful musique concrete composition which uses referential sounds is Luc Ferarri's *Presque Rien*. This work takes the recordings over multiple mornings of a French fishing village “waking up.” These recordings are not presented naked, but rather in “almost nothing” like the title indicates. There are sections in this piece which sound like uninterrupted versions of daily life, contrasted against sections which manipulate the artifacts into rhythmic motives.

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C.J. Darwin enriches this argument with work on the brains' ability to reference a sound when information is being directed from multiple sources. Darwin writes, “The intelligibility of speech masked by a single continuous noise is higher when the speech and noise come from different directions.” I use this technique in my work at minute 28:00 during the tornado section. The tornado sound can be thought of as the “single continuous noise” distorting the brains' ability to reference other sounds. In minute 31:03, when the bird sounds begin, they are done so in a way which masks their identity. These sounds are peeled away to reveal the identity, in a way I feel enhances the emotion of the work.

The idea of referential sounds creating or diffusing emotion becomes more interesting when looked at scientifically. Cornelia Fales writes about how humans are programmed to perceive sound referentially, “With whatever degree of auditory unconsciousness, the fact remains that listeners are amazingly and confidently good at deriving information about the acoustic world from the perceived world it inspires.” Keeping this information in mind, each composer must decide whether emotion is created by fulfilling the human desire, or by subverting it.

In Schaeffer's philosophy, by subverting the human desire to categorize sound in a lexicon of its origin, he is heightening the emotional response of the audience. From Normandeau's perspective, fulfilling the human desire of categorizing the acoustic world is, at times, better suited to create an emotional response because it transports each listener to a

personal experience “from the perceived world” the referential sound inspires.

In this regard, there will be composers who are able to effectively emphasize an emotional aspect of their music by either allowing or avoiding referential sound. Therefore, in my piece *Ulysses*, I have chosen to agree with Normandeau and not exclude referential sounds from my work. This can enhance an aleatoric perception of the work, allowing the audience to perceive an unintended experiences.

**A Theory of Musique Concrete, Classifications of Sounds.**

An attempt to create a catalogue for the classification of concrete sounds, in essence, is a device for the perception of concrete music. For the composer, this may be to understand compositional choices made, in terms of similarity and contrast. For the music theorist, this may be to provide a solid definition of terms so that analogies between concrete music pieces, and musical works in other genera can be established. I will address the attempts\(^{69}\) of Luigi Rossolo, Pierre Schaeffer, and Robert Erickson to create references with which to discuss concrete music.

There may be, or have been, a classification of concrete sounds prior to Luigi Rossolo. However, Rossolo's *The Art of Noises* provides one of the first classifications of extracurricular sound techniques. His manifesto classifies non-traditional sounds into 6 “Families of Noises.”

1: Roars, Thunderings, Explosions, Hissing Roars, Bangs, and Booms
2: Whistling, Hissing, Puffing
3: Whispers, Murmurs, Mumbling, Muttering, Gurgling
4: Screeching, Creaking, Rustling, Humming, Crackling, Rubbing
5: Noises obtained by beating on – Metals, Woods, Skins, Stones, Pottery, etc.
6: Voices of animals and people – Shouts, Screams, Shrieks, Wails, Hoots, Howls, Death Rattles, Sobs

\(^{69}\) I call them attempts because they have not become the industry standard for concrete music.
While this list is not all-inclusive, I am surprised by the sound of talking being excluded, as the voice becomes fundamental to the works of Stockhausen, Schaeffer, and others. However, as Pratella wrote, the “reign of the singer must end”. Russolo seems to have taken this to exclude all words above hushed tones.

Unlike talking, there are some sounds excluded from Russolo's list that can easily be included into an existing category. For instance, clicking can be included into category 4 with creaking and crackling. There are also sounds less easy to classify. For instance, where should crunching be classified? I can see crunching food being added into category 4 because of rustling and crackling, but crunching glass does not fit into category 4. Furthermore, if the volume of crunching glass were increased, it might be included into category 1 with hissing roars.

By considering volume in the classification system a whole new set of problems arise. For instance, “when does a hum become a roar?” I found this same problem in my own work when I created a list of intensities of different sounds, only later to realize that I have used the decibel level as a factor of my classification. Also, it is not so easy to balance the levels of sounds with different timbres, attacks, and sound structure. Whereas one may have a strong attack and a weak duration, another may be more uniform throughout, and the sounds cannot be balanced because of the differences in their content.

Russolo's classification system breaks down further when considering it in terms of a concrete performance because the catalyst for sound cannot be seen. If two listeners of concrete music are hearing the same piece, they may disagree as to whether someone was “beating on metal” in category 5 or thundering in category 1. To help in this discussion, Russolo includes an explanation of how these sounds should be considered by a listener and how these sounds should
be used by a composer:

Every manifestation of life is accompanied by noise. Noise is thus familiar to our ear and has the power of immediately recalling life itself. Sound, estranged from life, always musical, something in itself, an occasional not a necessary element, has become for our ear what for the eye is a too familiar sight. Noise instead, arriving confused and irregular from the irregular confusion of life, is never revealed to us entirely and always holds innumerable surprises. We are certain, then, that by selecting, coordinating, and controlling all the noises, we will enrich mankind with a new and unsuspected pleasure of the senses. Although the characteristic of noise is that of reminding us brutally of life, the art of noises should not limit itself to an imitative reproduction. It will achieve its greatest emotional power in acoustical enjoyment itself, which the inspiration of the artist will know how to draw from the combining of noises.⁷⁰

My final concern with this list is a lack of explanation for why the list must exist in the first place. A classical orchestration book, by Rimsky-Korsakov, or Olivier Messiaen for example, includes examples on how they used timbres in their work; but, by leaving the combination of these noises to the “inspiration of the artist”.

This final concern is resolved by the more scientific approach taken by Pierre Schaeffer in developing his “Theory of Musique Concrete.” This new approach shows both the advance in technology between 1913 and 1960, and understanding of sound based on Schaeffer's training as a radio engineer. This new approach has three axis consisting of Decibel level on the y-axis, duration on the x-axis, and pitch on the z-axis.

The strength of this Schaeffer's method is the meticulous construction, specifically of the duration element. This element is broken into three categories: attack, sustain, and decay. This classification is an important way to understand musique concrete because the then-new advances in technology allowed manipulation of sounds that alter their core perception. Schaeffer discovered in his experiments that removing the attack of a sound has a profound

effect on the listener being able to discern the origin of the sound:

By having one of the bells hit I got the sound after the attack. Without its percussion the bell becomes an oboe sound... If I cut off the sounds from their attacks, I get a different sound; on the other hand, if I compensate for the drop in intensity with the potentiometer [A joystick used to control pitch], I get a drawn out sound and can move the continuation at will.71

Therefore, by removing the attack, the ability to reference the sound is limited.

A third classification for “contemporary music” is Robert Erickson's Sound Structure in Music. Although this text is not created as a theory for concrete music, Erikson classifyes sounds by timbre, much in the same way as Rossolo and Schaeffer.

Erickson expands of the work of Schaeffer by providing conclusions from the scientific field on timbre and sound perception. Erickson provides a comprehensive list of experiments that provide relevant information to a composer. What I mean, is that modern research appears to be related to how the core of the audio cortex, and specifically the caudolateral (CL) and caudomedial (CM) regions are interrelated in interpreting information sent from the cochlea.72

Miller, Recanzone, Merzenich. explain:

despite considerable effort to determine how the cerebral cortex process acoustic space, our understanding remains rudimentary. From these studies and others, we know that acoustic space is not topographically organized in the mammalian cerebral cortex and single neuron spatial receptive fields and very broad and, in themselves, unlikely to account for localization ability. Thus, some form of population code is likely used to represent acoustic space in the auditory cortex.73

Therefore, while Erickson's book is 35 years old, modern studies have provided little

71 Ibid 7.
73 Ibid.
information relevant to perception, as scientists have been studying (albeit inconclusively) how and where in the brain sound information is processed.

Erickson's book also includes examples of Klangfarbermelodie, with examples from Bach, and Webern. Although the subject is discussed, Erickson provides no information past Helmholtz (1877) on timbral synthesis. Further analysis of recent studies on fusing timbres with modern technology would be interesting to develop in musique concrete.

In Georges Forget, work L'appel, he mixes the sound of waves and traditional instruments, like clarinets, violins and an organ. This synthesis has sounds crashing in and out of the wave sounds. The combination of multiple instruments creates a “thick” sonority in Schaeffer’s “criterion for thickness” which matches the waves “thick-white” timbre very well. In this way, Forget creates his own study of timbral synthesis

**Ulysses Timeline**

The following list displays the time for sounds and events in my work *Ulysses*. The work is constructed from only recorded sounds (no electronically synthesized sounds). These include water, wind, fire, and birds. The piece lasts 45 minutes.

Ulysses Timeline:

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00-6:23</td>
<td>Introduction and exposition of timbres</td>
</tr>
<tr>
<td>0:00-0:18</td>
<td>Rattle – amplified water static</td>
</tr>
<tr>
<td>1:25-1:49</td>
<td>Light Rain Storm – collection of soft rain drops</td>
</tr>
<tr>
<td>1:54-2:04</td>
<td>Loon Call – lowered in pitch and lengthened to disguise sound source</td>
</tr>
</tbody>
</table>
3:25-3:52  Shimmer Rain – high frequency boost to help it shimmer
3:31-3:41  High Wind Sound (C-Speakers)

6:25-10:21  Water Development

6:25  First Low Water Boom – pitch dropped from “A1” rain drop
6:32  Short Overtone Water Gurgles – “A1” sound source
6:53  Loon 1 with Tuning Forks
7:03  Loon 2 (up a perfect 5th) with Tuning Forks
8:33-8:50  Overtone Water Gurgles
9:15-10:20  Same Rain Drop Storm - “A1” sound source

10:19-18:06  Same Sound Wind Development
             The wind sound is a whale ejecting water from its blowhole

16:40  Low Crash in Silence

18:10-19:39  Low to High Wind Transition

19:41-21:46  High Wind Development

19:41-19:53  Sparse Development
19:53-20:41  Fast Rhythmic Development – Bach section
20:42  Water Drop
20:45-21:12  Water Pouring
21:14-21:45  Ascending Wind Transition

21:45-26:18  Rumble Transition

22:10-32:33  Tornado

22:10  Tornado inner circle (T1)
22:32  Tornado second circle (T1+T2)
23:21  Tornado third circle (T1+T2+T3)
24:04  Tornado fourth circle (T1+T2+T3+T4)
24:48  Tornado fifth circle (T1+T2+T3+T4+T5)
25:39  Tornado sixth circle (T1+T2+T3+T4+T5+T6)
30:17  Add Fire Balls – the fire balls are compressed recordings of matches being lit

31:03-35:54  Bird Calls
35:54-40:41  Matrix-Rain

38:33  Add New Drops
39:06  Add First Heavy Drop

40:42-43:30  Total Tornado
            -including matrix rain

40:42-40:02  Tuning Tornado
40:51  Fire Balls
40:02  Pitched Tornado

43:09-45:00  Fade Out Static

_Ulysses_

Sounds exist in acoustical contexts. In live performances we perceive sources at different locations, and at different distances, in rooms that can give us strong impressions of envelopment. A complete reproduction should convey the essence of these impressions. A moment's thought reveals that because our binaural perceptual mechanism is sensitive to sounds arriving from all angels, reproducing a persuasive illusion of realistic direction and space must entail multiple channels delivering sounds to the listener from many directions.74

~Floyd Toole

A purpose for my thesis was to explore sounds in 7.1 channel audio. As an undergraduate student, I wrote pieces for two and four channel audio, and a 7.1 channel piece was a challenge I felt fitting to the master’s thesis ideal. The challenge 7.1 channel audio poses to an artist is how to use the channels in an effective way, so that there is a purpose to the music for requiring more speakers. I avidly avoided working with the speakers in a way that 5.1 or less audio would have allowed for a similar experience. I also avoided using the speakers in the way I believe that movies use them. In my opinion, movies use speakers to place sounds around the audience that immerses them in the “story”. Therefore, for my purposes, I believe that the greatest asset of 7.1

channel audio over two channel audio is that the extra speakers allow for increased information
to be transmitted. In this way 7.1 channel audio immerses the audience in the sound by
physically having the vibrations manipulate the body from different directions, not by localizing
the origin of sound for interest.

In choosing 7.1 audio, I then had to create an idea of how I would arrange the speakers to
create an interesting sound-field to explore. If all 7 speakers are equidistant from a location, a
specific point becomes a “sweet spot” for an ideal listener to perceive the sound. This idea is
especially important for film foley, like moving cars. If a listener is situated too close to a
speaker, that person may not hear the movement of the vehicle. If a listener is too far away, that
person may not hear the vehicle at all. This central location provides a balance for the artist to
mix the sound in an “ideal setting.”

In establishing the speaker placement for *Ulysses*, I had to conclude if an ideal “sweet
spot” reflected the purpose of the music. I considered aiming the speakers in different directions
to allow the performance space harmonics to manipulate the performance. I rejected this idea
because I believe muddy quality of random room acoustics did not fit the meticulous structure of
the piece. I also considered placing the speakers at different heights so that the sound-field could
include a vertical element. I partially rejected this concept because I chose this subject to expand
on my undergraduate work with four channel audio. With this being my first exploration of 7.1
channel audio, I decided to keep the possibilities for sound-field development on the horizontal
plane. By using only seven speakers, staggering them vertically would not effectively create a
sound field either vertically or horizontally. If in the future I am able to create a sound space that
implies 28 separate speakers with individual channels, I may explore the possibilities of vertical
sound construction. However, by placing the subwoofer underneath the audience, a vertical element can be achieved with an electronic device called a crossover. The crossover divides a signal into frequency ranges and then sends different frequencies to different channels. By layering multiple crossovers, I have achieved a false vertical element that adds more information to the sound spectrum than would have been accomplished by sending new sounds to the subwoofer and eliminated the extra costs of more speakers.

**Diagram 1 Speaker Placement**

![Diagram 1 Speaker Placement](image)

Diagram 1 demonstrates the arrangement of speakers in ideal conditions. The diagram is labeled by the names of the sends which I used to arrange the sounds. The “B” channel speakers, 3 (left) and 4 (right), are used prominently as a central location for sound because the “ideal” listener will be sitting between them. Again, this does not mean that I intend all listeners to sit in the “sweet spot” nor that listeners sitting outside the sweet spot receive a less than ideal performance. When levels and panning were being considered the “sweet spot” acted as a central location to balance, or unbalance the sounds. Channel 7, the “front” speaker, is used to begin the piece because I believe that the forward location will promote a casual listener perceiving the
content of sound before they become conscious of a manipulation to the location of that sound. I tried in this piece to never use aural architecture as a gimmick, but to immerse the audience in a sound field. Finally, in ideal conditions the audience would be sitting above the subwoofer to maximize the vertical element created by the crossover patches; however, due to performance constraints, the premier of this piece will not have the audience elevated above the subwoofer.

Once the arrangement of the speaker had been decided, my attention turned into how I could use them to maximize their purpose (i.e. needing 7.1 instead of 5.1 or 4) while limiting the perception of sound localization as a gimmick. I decided that my purpose for 7.1 channel audio would relate to a deficiency I have noticed in recording sound: specifically the sounds of rain, wind, crowds, or any similar cacophony. Because the sound of rainstorm is created by thousands of individual vibrations coexisting, and amplifying due to their relation, a single microphone cannot accurately capture the effect a rainstorm creates. Although a group of microphones placed throughout a rainstorm would achieve better results, it would not allow me to manipulate the sounds in a “musical” way. Therefore, I decided to attempt to re-create rainstorm from the source; individual drops. The 7.1 channel audio is suited for this because it can immerse the listener in a sound-space similar to someone standing in the center of a rainstorm.

Therefore, for my thesis, I felt that the timbre of the sounds I used to create my cacophonies was important and hypothesized that rain made from small water smacks would be a small rainstorm, and that rain made from a garbage bag full of water being dropped 10 stories would be a heavy rainstorm. I recorded the sounds of different size water balloons being dropped. These sessions included recording the sound of two garbage bags full of water. I also felt that the velocity that these “raindrops” achieved would change the information carried by
their sound. Therefore I recorded dozens of different sized balloons at different heights (ranging from 1 to 10 stories), being thrown with fast acceleration on impact for “aggressive” sound information, or being dropped and gently accelerating for “fluffy” sound information.

I completed the palate for my water sounds by creating drip sounds. I found that recording a drip does not work well; when the drip is amplified, extra sound (electronic buzzing) is also amplified, creating unwanted static and polluting the pure water sound. Therefore, I recorded sounds made from manipulating water with water balloons, pans, cups, and mallets. With the water balloons, I explored ways of creating water sounds with jiggling, flicking, and striking, and popping the balloons. I experimented with balloons of different sizes and balloons with different consistencies of water and air inside the balloon. I found that it is possible to flick a water balloon and minimize the timbre of the rubber balloon sound to create only the sound of water. Popping the balloon did not create the sound desired; resulting in a sound determined not by the balloon size or water density, but by the sound of the vessel which captured the water. I also experimented recording water drips on different surfaces including towels, paper, and vessels of glass, metal, and ceramic. These vessels were used to change the timbre of pouring water. Like the dropped balloons, I tried different heights to adjust the aggressiveness of the sound.

From these recordings I have found that my hypothesis of velocity affecting timbre for non-traditional sound creating was true. Therefore, I partly agree with Konrad Boehmer, a student of Stockhausen and the Cologne School (PhD 1966), when he wrote:

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...the number of causes [in my case water balloons] is not infinite, although the derivations may manifest numerous subtle variations so that their quantity can be considered unrestricted— at least in relation to the capacities of the human brain. This “infinity” is of a very restricted aesthetic relevance: no sea wave surging toward the shore will ever sound exactly like any other sea wave before or after it, and thus, its countless variants have only an extremely restricted aesthetic and thus compositional significance.... may, at best, be useful for psycho-acoustic listening tests.76

Where I disagree is with his understanding of the “aesthetic and compositional significance” of the waves. In my thesis, I will show that the attack and timbre of the water balloons directly affects the aural effect of the music, and is art, not a psycho-acoustic science project. The array of recordings I established allowed me to select timbres which best reflected the purpose of the moment. In my opinion, sounds are neither good or bad. All of the sounds can serve a purpose if used to their timbral, rhythmic, and melodic advantages. To use an orchestral analogy, because I recorded so many different wet sounds, I could choose not only between a wet (violin) and a dry (trumpet) sound, but I can call upon different techniques to the wet sound, like a violin using mutes, bowings, and extended techniques.

I have focused on discussing the timbral effects of the recorded sounds because with modern technology I have found that all other aspects can be modified. There are limits to this modification. If a sound is to be pitch-shifted, different programs have limits on the range the pitch can be shifted where the sound maintains its natural integrity. This means that if a sound is shifted further than the program allows then “electronic” artifacts are introduced to the sound. Again, these artifacts are not necessarily bad. For pitched sounds, I have found the program Melodyne to be most effective in pitch-shifting. I have found that most tuning software can

adjust a pitch a semi-tone up or down before I can notice a discernible alteration to the timbre of the sound; whereas, Melodyne can adjust a sound at least a minor third (3 semitones) sometimes even up to a perfect fourth (5 semitones) before I can detect a timbral shift.

This discussion of pitch shifting and electronic artifacts has only included recordings where the desire was to shift the pitch without shifting the duration. The easiest way to avoid electronic artifacts is to shift pitch and tempo at the same time.

In Pro-Tools, the function called “Pitch Shift” has a time correction box which can be un-selected and allows for adjustment of a sound proportionally to its shift in pitch. Although drastic changes in sound do effect timbre, the change happens in a way more analogous to the different timbral registers of a piano.

This ability to electronically manipulate sound files with perfectly proportional relationships between the origin and the manipulated sound is a new development. In tape music, a sound can be adjusted by stretching the tape, but if two tape sounds are stretched in the same manner, they may warp in different places not producing a result equally proportional to the original.

Another early manipulation of tempo was Conlon Nancarrow's *Study no. 21: Canon X*. In *Canon X*, the Nancarrow manipulated tempi for two series of 54 notes. 77 Because of the extra-human performance abilities of the player piano, Nancarrow was able to have one row accelerate tempo while the other row retards in tempo. Pro-Tools (and probably other DAWs) is able to expand on this idea, not only by having 54 different tracks with different tempi, but by expanding the duration of the sound proportional to the tempo of the music.

This effect is used in minute 35:54 with the re-capitulation of the rain timbre. The rain drops are introduced as 12, 12-tone rows. Each row enters with a different tempo. These tempo's range from 60 to 120 bpm with a rain drop on each quarter note. Each row repeats 12 times. These rows were manipulated so that the final drop of each series sounds simultaneously. This technique allows for both the melodic exposition of the tone row used in the piece, as well as a new organization for creating a cacophony.

The pitch-duration relationship between sounds becomes essential to my piece, Ulysses, because the pitch aspect is obscured by the “white noise” characteristics of either the wind sound or the ambiguous nature of pitch conglomerations. The complication I faced as a composer, which made this relationship a prominent compositional factor, is the choice I was given by the technology and the knowledge that just and equal temperament are not identical.

In 12 tone music, enharmonic equivalents are considered equal. The benefit/complication of Pro-Tools pitch shifting is that if a pitch is to be changed, the semi-tone and cents can be adjusted independently. This means that to shift a pitch I must decide how many semi-tones and cents each sound is shifted.

Because I must make this decision, I decided to create a system to determine the arrangement of sounds. Due to many of the sounds being described contain multiple frequencies (qualifying as “white” in Shaeffer's criteria for thickness), the relevance of such a system is debatable. Part of this thesis acts to qualify the relevance of unserialized and relevant un-pitched sound construction aurally. However, if a listener does not agree aurally with my assessment of sound than it can still be agreed upon that the durational relationships (which remained proportional to the shifted pitch relationships) are audible, sometimes transforming a sound from
10 seconds to less than a 1/10 of a second.

**Living and Dead Sounds**

The development section of my piece opens at minute 6:25. There is a bass ostinato created from the recording of a high-velocity water balloon explosion. The sound is repeated on five different tracks, with each successive sound being five cents higher than the previous sound. The interval of five cents was chosen because that is the smallest interval a human ear can distinguish when two sounds are not played simultaneously. The attack of the explosion is removed from most of the files, with the full file being reserved for every 20th file to distinguish when the pitch has increased on octave. This also helps the music to mark a passage of time, much like a cadence would in tonal music. The ostinato also uses a technique I developed to animate the sounds, and keep them “alive”. I have found that a sound or combination of sounds being repeated identically kills the novelty of the sound. To clarify my meaning; a repeated sound becomes robotic, electronic, and loses the joy of its timbre and quality. In electronic music it is possible to identically repeat a sound in a way that no live performer can. This mechanically repeated sound becomes “dead.” The “deadest” sound I can describe is an artifact being repeated identically with no space in between over and over again. I have found that, after about three repetitions, the sound dies and my perception of the sound is drastically altered. However, if space is placed between the sounds than the sound begins to be animated; if that space is evenly repeated than the silence becomes part of the sound and together the sound and silence “die”. But, if the silence between identical sounds is altered, the sound gains life, and even the identical nature of the sound constricts it's life to being boring, like an accountant, the changing space still allows it to live. To change both the silence between the sound and the sound itself allows the
sound to enrich its “life”.

Pierre Schaeffer discovered the same technique while working on his first Concrete piece _Etude Aux Chemins de Fer_: Schaeffer describes isolating the mechanical rhythm of the train yet contrasting the color to create an “identity” for the sound:

I've managed to isolate a rhythm and contrast it with itself in a different sound color. Dark, light, dark light. This rhythm could very well remain unchanged for a long time. It creates a sort of identity for itself, and repeating it makes you forget it's a train.\(^{78}\)

I believe Schaeffer's identity is similar to my “living sound”. However, I do not want to promote the concept of living sounds over dead sounds as being superior. There is a time for both. The dead sound technique was used brilliantly by Brian May, the guitarist for the rock band Queen, in _We Will Rock You_. At the end of the song, the guitarist plays a riff, and the riff repeats. Rather than record him playing this riff multiple times, the band chose to loop the riff mechanically. In an interview with NPR's Terry Gross, May said:

We are in a different universe once the guitar starts, and that was the intention... you may notice that the last piece, the very last little riffs, are repeated, and they are not just repeated by me playing them again, they are repeated by cutting the tape and splicing it on again and again. And that is deliberate too, it’s a way of getting a sort of a thing that makes you sit up towards the end, and then it stops, there is nothing after it, which I really enjoy, there is no big ending it just stops and leaves you in mid-air, thinking, what happened there.\(^{79}\)

I believe this technique to be effective because radio stations rarely play the song by itself, but follow the song with another by Queen, _We are the Champions_. To me, the radio stations have subconsciously agreed that ending with this repeating riff is uncomfortable, and following _We Will Rock You_ with the next song does not leave the listener with that uncomfortable ending.

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79 Brian May, Interview by Terry Gross, _Queen's Brian May Rocks Out To Physics, Photography_. NPR, August 10, 2010.
Whether my interpretation is correct, or radio station's use these two songs for a bathroom break, or any other reason, does not change that these two songs are almost always played together, and there are few other songs coupled like this. Therefore, the coincidence of Brian May's decision to create an uncomfortable “new universe” through mechanical repetition and the coupling of these songs shows how concrete music can be used outside of art music to create an effect in the audience impossible in a live setting.

My piece explores the ability to maintain living sounds with minimal living elements. The opening rainstorm in minute 9:15 keeps the sounds living while moving a collection of single pitch drops from a chromatic scale to a whole tone scale. Although my ear cannot distinguish the exact pitches in the rain collection, I believe I hear an effect of dissonance moving to consonance, however, I am willing to admit that I may be creating this feeling mentally because I understand what is happening musically. I look forward to seeing different perceptions of these segments by both musicians and non-musicians and finding out their interpretations.

The music collections begin to get more complicated with the development of the wind sound at minute 10:19. This first development of sound uses only one “pitch” and duration of wind sound. This sound is played both forward and backward (reversed). The sound begins in the “phantom center” of the C speakers, and moves outward with three files in each direction creating seven files in the C speakers level depth. A tempo of 82.5 beats per minute is created for this file where one measure is equal to the length of the file, about three seconds.
Diagram 2, Wind Sound 1

In Diagram 2, the numbers 1, 2, 3, and 4 show the tempo markings in relation to the first wind sound. This artifact acts as exposition in forward form to the subsequent wind section. It is followed by two beats of silence, as shown by the letter “a”. The first sound is then repeated in “m. 2 beat 3”. The sound develops by becoming layered with itself, and in “m. 3 beat 1” an identical repetition of the sound is added in the new sound space, panned 33 left. This is followed in beat 2 of measure 3 with an identical sound being played in the sound space panned 33 right. When the first file that sounded ends, it is followed by 3 beats of silence as shown by letter “b”. Each subsequent development of the sound includes extra versions added on the sides of these sounds and eventually moves forward toward the B and A speaker levels. Every time the waves begin again, one more beat of rest is added between the opening sound and the next opening section, as shown with 4 beats of silence at letter c, 5 beats at d, 6 at e, etc.
This effect is used to maintain a baseline of “living” in the sound; however, the life is minimal. The sound can be heard bouncing back and forth between speakers, and the relationships between the sounds remain very similar throughout the six minute section. However, the trail end of the last ripple and the new ripple mix in different ways, and the identical relationship between sounds is only slightly altered. I believe that this technique allows the sound to be viewed on more of a microcosm than a macrocosm. Schaeffer also noticed this same effect while working on Etude aux Chemins de Fer and relates the result to an architect working on a building:

Architecture is not bothered about chemically pure materials but about their form. If I put stones together, I will be interested not so much in their striations and veins as in their volumes and alignments. So the internal rhythm of a “train” element that, from the music theory point of view, is very important becomes negligible when this element forms the elementary material of composition.\footnote{Pierre Schaeffer. Dack, John and Christine North Translator. In Search of a Concrete Music (California Studies in 20th-Century Music) (University of California Press: Berkely, 2012) 14.}

Continuing with Schaeffer's metaphor, for my architecture, I am not so much interested in the external form (sonata, rondo, etc.) as I am on emphasizing the interest in the “striations and veins.” I feel that by limiting the life of the sound, I am emphasizing these characteristics in the work.

This section ends by the development unraveling from its beginning. This unraveling, to me, is like experiencing sound die. This death is different from the dead electronic effect, and I relate it to a mushroom I once held. I plucked a mushroom from the ground, and held it in my hand. After some time the mushroom began to sweat, and shrivel. Watching this mushroom die impacted me in a way I tried to create here musically. After the whole network of 49 sounds is
exposed, the sounds cease starting from the beginning, unwinding in a musical replication of this
death. The sounds follow the same pattern as they have before, with each succession continuing
to lengthen the intermittent silence by one beat; however, there are now fewer sounds for each
section. This eventually creates a silence in the material. I was reluctant to fill the silence with
sound, because the uncomfortable silence created affected me the same way that the mushroom
did. However, the purpose of this section, the next section, and the transition in between was to
prepare for one moment. And if I fulfilled the effect of having this sound die, I was taking away
from that moment. Therefore, I reluctantly added sound in underneath the silence so that this
section continues to build toward a further moment.

Following this section, there is a transition section where the wind sound changes timbres
from low to high. This section was created by layering different pitch and duration-shifted wind
sounds in strict tempos. The original tempo for this section was not related to the duration of the
wind sound; however, subsequent tempos were layered proportionally to the original tempo.
Therefore, if the original tempo was 60 bpm and the pitch were raised a fifth, the following
tempo would be 90 bpm. Using pitch ratios for all raised intervals, these tempi remain strict
throughout the transition section.

The next section develops the wind sound with new techniques in a high register. The
section begins by adding silence and space to the wind sound, which has been almost constant
for 10 minutes. After this space, the wind sound develops with a strict tempo to the tune of Bach
BWV 997. Because the wind sound contains numerous pitches, the tune to BWV 997 is not
audible, but I feel that the sounds are perceived as being constructed for a reason rather than
presented as random.
Example 2: Bach BWV 997

The Bach theme is not a direct replication as I have inserted sections where the sounds follow an ascending or descending chromatic scale. I found that the scale creates a sense of tension because the sequential sounds are easier to perceive than the Bach melody. This section, and the previous section, are all building to a moment at minute 20:42 where the wind sound is contrasted with the sound of water. I found while working with the high wind sound in noise canceling headphones that the dry nature of the high wind sound compounded and was like a desert to my ears. After listening to this sound for 30 minutes I heard the water sound again, and it created a pleasing effect. By framing the water sound with the dry wind sound, it changed my perspective on the timbre and accentuated Schaeffer's “striations” of the material. Robert Erickson describes “my” timbre technique in his book Sound Structure in Music:

A composer who wishes to carve out certain sounds from this infinity of possibilities must decide: which ones? He may attempt to create “an instrument,” meaning some sort of unified selection of sounds from the infinity of possibilities. This is an avenue that has been explored by some of those composing computer music, and the results have been somewhat disappointing. Or he may go at things more abstractly, thinking in terms of contrast, similarity, sound classes. He will discover the paradox that the more he tries for an infinity of timbres the more he will tend toward no significance contrasts. He may accept this situation or even make it the basis of his music, eliminating the possibility of any significant organization of timbre. For those composers who try to organize a large
variety of contrasting sounds the puzzle is still there.\textsuperscript{81}

Therefore, rather than trying to create a diverse field of techniques, I create contrast by limiting possible techniques, and existing inside of them for time periods longer than normal practice, until that universe of sound is forced on the listener. This perspective on timbral maintenance reflects my before-mentioned philosophical perspective on the purpose of sound. In practice, this effect borders on used as a cliche. However, I hope through future practice to refine this “orchestral” technique.

**The Tornado**

The spatialization aspects of my piece are most meticulously constructed around the formation of my 'wind tornado'. The idea was to create different layers of sound spatially which combine into a cacophony of swirling wind. The sound begins with the creation of an “all interval tone row.”

**Diagram 3 – 12 Tone-Row**

\[ \begin{array}{cccccccc}
\downarrow P4 & \uparrow M6 & \downarrow m6 & \downarrow M2 & \uparrow TT & \downarrow m7 & \uparrow M7 & \downarrow M3 & \uparrow P5 & \uparrow m2
\end{array} \]

This tone row does not exist on the list of 1,928 different “all interval tone rows” possible, because I established a different criteria for using all of the intervals. As can be seen from the table below Diagram 3, the intervals go either up or down at every possible interval,

with a “reach-around” interval of a major second. This row was then used in constructing a Matrix where the root C of P₀ is placed in the Left C speaker.

### Diagram 4 – 12 Tone Row Matrix

<table>
<thead>
<tr>
<th></th>
<th>I₁</th>
<th>I₂</th>
<th>I₃</th>
<th>I₄</th>
<th>I₅</th>
<th>I₆</th>
<th>I₇</th>
<th>I₈</th>
<th>I₉</th>
<th>I₁₀</th>
<th>I₁₁</th>
<th>I₁₂</th>
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</thead>
<tbody>
<tr>
<td>P₂</td>
<td>D</td>
<td>A</td>
<td>F#</td>
<td>Bb</td>
<td>G</td>
<td>F</td>
<td>B</td>
<td>Db</td>
<td>C</td>
<td>Ab</td>
<td>Eb</td>
<td>E</td>
</tr>
<tr>
<td>P₇</td>
<td>G</td>
<td>D</td>
<td>B</td>
<td>Eb</td>
<td>C</td>
<td>Bb</td>
<td>E</td>
<td>F#</td>
<td>F</td>
<td>Db</td>
<td>Ab</td>
<td>A</td>
</tr>
<tr>
<td>P₁₀</td>
<td>Bb</td>
<td>F</td>
<td>D</td>
<td>F#</td>
<td>Eb</td>
<td>Db</td>
<td>G</td>
<td>A</td>
<td>Ab</td>
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<td>B</td>
<td>C</td>
</tr>
<tr>
<td>P₆</td>
<td>F#</td>
<td>Db</td>
<td>Bb</td>
<td>D</td>
<td>B</td>
<td>A</td>
<td>Eb</td>
<td>F</td>
<td>E</td>
<td>C</td>
<td>G</td>
<td>Ab</td>
</tr>
<tr>
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The pitch shift feature of Pro-Tools allows for the specific pitch intervals to be adjusted in either equal temperament or just temperament. Because of this, I decided to adjust my matrix where the left column of sounds are in just temperament, and each row has its pitches determined based on the just interval between sounds. For example, in P₄, a B-natural would normally have a relative temperament to C-natural of 1 semitones and 12 cents lower (represented as -1-12). However because row P₄ begins on E natural at +4-14, and the B natural is altered as a perfect fourth lower (inverted as -5+29) than +4-14, the resulting pitch for B natural is -1+15, 27 cents
higher from the just temperament of B-natural in the key of C. Diagram 5 shows my altered pitch matrix:

Diagram 5 – The Just Altered Pitch Matrix

To create a sound field with this material I decided on panning and level manipulations for each sound. I was lucky to spin the tornado in a counterclockwise direction, which I was later informed by Dr. Robert Mueller, a professor at the University of Arkansas, is more common for
tornados in the northern hemisphere. The panning choices can be seen on the bottom of the Diagram 5.

The 12 sounds are most evenly divided among the 199 possible settings (99 Left, 99 Right, and 0 in the middle) by dividing the units into groups of 17. These divisions are expanded in practice to include 8 point manipulation in the lower sounds (octaves 1-4) a 6 point manipulation in octave 5 and a 4 point manipulation in octave 6. Therefore, the -9-08 on the bottom row, near the center, 6 sounds in from the left side, will move from 34 left to 17 right throughout the duration of the sound. The -7-4 sound on the top row will move 17 right to 34 left.

The sounds are also manipulated between the stereo groups of speakers by adjusting the levels manually (the way panning does automatically). The levels I used to balance the sounds in each sound's space and are shown on the right side of the graph. Therefore, the +5-29 on the left side of the chart near the letter B will move in the A speaker from -35 to -∞, the B speaker from -8 through 0 -8 and the C speaker from -∞ to -28 decibels.

There is an imbalance created in the level displacement due to the algorithmic nature of the levels chosen and the logarithmic of the decibel system. Originally, this discrepancy was due to my inability to understand the logarithmic construction of the decibel system. However, perfectly balanced levels would create a balanced depth of sound. Therefore, the imbalance created by the mathematical differences is an enjoyable layer of depth added to the sound structure.

The next layer was created by shifting the wind sound into different octaves based on where the wind would be spinning in the “Just Altered Pitch Matrix.” In Diagram 5, boxes were
created over the sounds to choose which sounds would be in which octave. 6 octaves were chosen, with the lowest octave and highest octaves length being picked based on personal preference of the duration, and sound quality. The central box of 4 sounds (+2-20, -4-37, +1+14, +7+31) creates the lowest octave. The next octave includes the 12 sounds (8+4) that surround the central four sounds. The lowest sound in the second group (-10-28) exists lower than the highest sound in group 1.

There are two ways that depth are created to distinguish these sounds. First, the sound in the second group will be moving a larger distance than the sound in the first group. Second, as the tornado develops, depth is added to the sound with increasing layers of reverberation.

A two dimensional representation of the sound circle can be seen in Figure 6, while Figure 7 shows a 3-dimensional representation of the sound-field.

**Figure 6– A 2-dimensional representation of the tornado sound-field**
Figure 7 – A 3-Dimensional representation of the tornado sound-field
Using these rules and charts as a basis for construction I manipulated the files to create my sound tornado; each file existing in a precise location, direction, duration, and depth. Although the pitch content is considered “white noise”, I believe that the meticulous nature of the construction creates a feeling to the music not possible with aleatoric or serial techniques.

The Tornado exposes the sounds from the center outward. Then the panning and leveling of the wind aligns. This makes the wind appear to be circling the audience. This sound grows until the bird sounds are added underneath. These sounds are added to the tornado to increase the tension of the phrase.

To remove referential aspects from the bird sounds, they are broken into shorter fragments and pitch-time shifted to lower and lengthen their content. These non-referential bird sounds are replaced by segments which are more natural and easier to identify. The bird section ends by lowering the tension created by the tornado. The final bird calls heard are three that I find relaxing. These are ducks, barn swallows and red winged blackbirds.

The silence after the red winged blackbird call is the “far-out point” of the development of these sounds. The next section brings the sounds already developed back together into the thickest texture. This begins with a statement of the twelve tone row in a rain drop sound. All 12 rows of the matrix are used. Each row is aligned to a grid tempo of different lengths (from 60-120 bpm) with each drop sounding on a quarter note for that tempo. All 12 tempo’s sound their final drop within .1 of a second from each other.

To create tension in this section, other rain drops are added in. These drops have their own tempi and pitches, some of them tonally melodic. The rain drop intensity increases with the addition of new drops, with the most intense drop being a garbage bag full of water falling 10
stories. To release tension, all 12 drips of the matrix-rain sound by themselves.

Following this moment ensues a final crescendo of material. The tornado sound is
brought back, but this time an equalizer has been automated to create pitch in the white-noise.
The first time the equalizer moves during the wave sound. This creates an effect similar to tuning
a radio. This is done with 34 different tracks of the tornado to create a thick texture.

The second section individually equalizes each file, and the equalizer stays constant
throughout the sound. This creates a different, more stable effect then the first technique. The
sounds of the matrix rain drops and fire balls are added underneath to create a full sound of the
elements heard throughout the piece.

The final element releases the tension and returns the material back to the background
noise that started the piece. This is so the piece can be repeated on a loop, much like the novel
Finnegan’s Wake.

Conclusion

_Ulysses_ combines the sounds of water, wind, fire, and birds to create a 45 minute cyclical
experience. The different sections of the work develop the sounds, first through simple, and then
by increasingly complex methods. The most musical experiences are created when the sounds
are synthesized together. However to understand these complex sections, the sounds are first
developed simply.

_Ulysses_ explores the possibilities of 7.1 channel audio in an attempt to maximize the
sound space created. This includes the piece beginning and ending in the front “7” speaker; the
rain sound immersions; the wind moving from back to front; the tornado moving in a circle, and
the birds both immersing the audience in sound and retreating to the sides.

_Ulysses_ is constructed from both internal and external structures. Along with the 45
minute length of the work, this might make the piece un-enjoyable. Dennis Smalley explains:

Today we continually need to reassert the primacy of aural experience in music. The
heritage of twentieth-century formalism and the continuing propensity of composers to
seek support in non-musical models have produced the undesirable side-effect of
stressing concept at the expense of percept. Borrowing concepts from non-musical
disciplines is common and can be helpful, but unless concept is cross-checked or
mitigated by the ear it is always possible that the listener will be ostracized. 82

It is possible that some audience will be ostracized from _Ulysses_ because I have stressed
concept over perception. However, this was not done in ignorance. The structure of the work is
created from the structure of motivic cells. These cells are presented at first as small units, then
combined for more substantial combinations. The important moments are emphasized and
become emotional because of their structural treatment. I believe that by building each
complicated texture individually the “entertainment” value of the work is diminished. However,
I believe this is actually an asset to the work, by creating structure, balance, patience, and
cohesion.

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82 Dennis Smalley, “Spectro-morphology and Structuring processes” in _The Language of
Works Cited


Onosko, Tim. Wasn't the Future Wonderful?: A view of Trends and Technology from the 1930's (1979).


