Presentation of Direct Sonification as an Art Form

Through sonification, trends and patterns in the pixel data of a digital image may

be heard in the audible spectrum. This literary review seeks to narrow the scope of

sonification into two categories: poiesis; the making of the work, and the esthesis; the

nature or aesthetic of the work. The problem with sonification as a compositional tool for

musicians and performance is not necessarily the gathering of data, but is both the

presentation and hearing of the data, how it is received, and how the listener interprets

meaning from the sonification.

This paper will be presented in such a way as to guide the reader through the

issues of aesthetics in electronic medium: how humans listen, the nature of the sound, the

nature of the art, musical perception, reduced listening, and sound visualization. The

second section will provide an overview and brief history of sonification, various

applications of sonification ranging from electromagnetic waves emanating from celestial

bodies, ozone levels, and human execution. The last section will share work being done

to expand on sonifications, manipulation of data, and computers as compositional and

performance partners.

The most important question for the twenty-first century sonic musician: is

sonification art? The second question, how will it be received? Arthur Danto's *After the*

End of Art: Contemporary Art and the Pale of History explores the philosophical defense

of the definition of art; the concept of artistic quality; the role of aesthetics, and the

relationship between philosophy and art. Danto uses the connecting thread of the end of history where all class conflict has been definitively resolved and all life goes on and inhabitants live as they see fit without criticism. Similarly art history is at an end. The declaration of the end of art history is enough to end art. The declaration of artistic freedom allows that there is no longer a struggle and there is no longer a single large narrative to follow. Whereas before, there were distinct artistic periods and trends, today there are untraceable trends and freedom to create without criticism. In defining art there can be no definition of art since no properties can fully describe it. Early art followed traceable trends, however, in the ß1960s the trends became harder to trace and it became difficult to sort out art from other objects. Danto cites Andy Warhol's *Brillo Box* and the use of imitation and the question: is imitation art? Danto describes three essentials of art: content, presentation, and quality. To that affect, Warhol's *Brillo Box* is art through imitation; this work is also symbolic art, cited as being one who's meaning lies outside itself. The craft, process, and quality define the art. Moving forward, Danto believes that aesthetics should be distanced from art; do not be an aesthetician, it is too restrictive. Let the value of the art be placed in the hands of the viewer.

Danto's argument is valid, as art and music move forward genres are being created daily and it is becoming harder to trace the craft. The idea of imitation is very interesting; creating something new using an existing medium is not a new idea, but is a fair measure of style and genre. Imitation presents a basis for evaluation and valuation of the quality of art can now be compared or contrasted to similar works in the field. The concept that art has ended is not a new idea. This paper is descriptive of the current state

of the craft and aims to find a common thread to connect the intricacies of a very complex medium. Should this paper be revisited in time from a historical perspective there would most certainly be common trends that describe the works of the time period. The difficulty in the modern age is the volume and breadth of what is being created. The content, presentation, and quality will dictate what is art and how the art is received; similarly, whether sonification is an art form or something else.

Eric Clarke sought to distinguish artistic compositional intentions and listener reception in his 2005 paper *Ways of Listening*. His study focuses on the ecological theory to explain musical meaning "Perception must be understood as a relationship between environmentally available information, and the capacities, sensitivities, and interests of the perceiver."(Clark 2005, pp. 17) Gibson's ecological model of perception assumes that structure is inherent in the environment, not the construction within the mind. Clarke describes that a musical sound is determined by the physical properties of the producing instrument such as the shape, mass, and density.

Listeners glean meaning from musical sounds and visual connection to the performance; the sound environment and physical environment. One example presented is Jimi Hendrix's *Star Spangled Banner*. The original context and meaning of the piece is being altered by environmental influences such as: the sound of the guitar, instrumentation, cultural practices, and motive behind the performance. Liberties taken in the rhythm, duration, and nuances of the piece further the underlying message. The reception of this performance is contrasted greatly against a traditional approach, performance and the ceremony surrounding the *Star Spangled Banner*.

Clarke argues, what is there to be heard? There is an interaction between musical structure and musical perception. Such concepts as tonality and variables of pitch and formants change the way listeners hear and perceive music. Clarke goes on to argue that listeners become accustomed to changes in their environment and adapt to this change over time. In relation to developments in tonality in the twentieth century: listeners became accustomed to invariance or pivots and non-tonal methods of emphasizing certain notes. The compositional use of pivots and invariance formed out of more traditional trends of voice leading and cadence. Although the composer changed the foundation of the compositional environment the message is still being conveyed through the patterns in the music.

In substitution of placing 'value' on a sound Clarke describes value as affordance. He contextualizes this by asking, what does the sound of an instrument afford the listener? He describes the affect of a cello bowing on the C string and what message this affords the listener. This particular sound and any other sound communicates and interacts with the environment, the listener, and other sounds. This interaction affords the listener a concept of compositional intent.

This study does a fair job defending current music, perceptions, and receptions of a musical performance and the freedoms afforded by composers and listeners. However, Clarke does not include measures of his concepts. There is no measure for the effectiveness of a performance or the affording (value of) sound. While the environment does play a role in the perception of a piece of music, so too is the music affected by the intrinsic and internal experience of the listener. The definition of the environment is also

extremely broad and at times confusing. Clarke does little to differentiate between the physical space, the listening conditions, and the characteristics of sound production instead choosing the blanket term of 'environment'.

In Jean Luk Nancy's 2007 *Listening,* Nancy attempts to find the relationship between philosophy and listening. He establishes that there are two forms of listening: the first is hearing, the concept that one listens to something and the second is to understand a sense, the inherent truth that one understands. Nancy compares the idea that a view is different from a vision or a gaze. Similarly with vision and hearing there is a physical goal or there is mental contemplation. In Nancy's interpretation the goal and the contemplation are super imposed on each other and questions if there is a difference between the sense and the meaning. When a listener hears music they turn inward and withdraw from external influences; the eye is making the truth evident, the ear is making the truth resonant. Nancy states that the listening will always be the goal in an approach to oneself and the connection with the sound. "One can say of music that it silences sound and that it interprets sounds; makes them sound and make sense no longer as sounds of something, but in their own resonance."(Nancy 2007, pp.32) The overarching theme of the paper is that listeners open themselves up to sound and internally connect and interpret the sense that the music is conveying.

This paper is very effective in the way it defends the listening experience. The way the paper emphasizes how, through listening, listeners impose meaning on sound and how it resonates physically and internally is effective in its emotional appeal. This concept of self-resonance is helpful in the way it will defend electronic music,

specifically sonification. Electronic music is both a physical experience and an internal experience driven by sound, and is defended through the belief that the sound engages contemplation and deeper connections to the music.

The last aesthetic piece to bridge the philosophical and aesthetic with sonification is the scholarly book *Listening Through the Noise* by Joanna Demers. Her work combines the three previous and many more scholars in her defense for the listening aesthetics of electronic music. She presents a defense of synthesis, emulation, Demers found sound and the various genres that embrace those respective sounds. She cites Pierre Schaeffer, the inventor of the 1950s Musique Concrète movement and his concept of reduced listening and how one must extract themselves from prior experience to take in the sound and not its origin. This is a difficult task especially when compared to Jean Luk Nancy's work. This method fails in that it attempts to remove context from the sound. Schaeffer's end goal was complete compositional freedom that would allow an empirical connection of compositional intent to the listener. In some electronic genres this is achievable through synthesis, but the idea of removing context from found sounds like a bell tolling is impossible, a bell will always sound like a bell. Demers demonstrates that found sound does have a place in creating imagery for film and programmatic music, or programmatic sound. Demers goes on to discuss the presentation of sound in electroacoustics. In electroacoustics, traditional instruments are utilized that use recognizable timbres and use conventional music notation with traditional rhythms, pitches, signs, and gestures. This combination of synthesis and found sound is the difference between complete compositional freedom and that of nonelectric art music. In Schaeffer's case, his

compromise was to remove the attack from the found sound. By performing this action, the sound object resonated a sense of something familiar in exchange for the destruction of another object. A similar sound alteration would be to play a piano sound backwards instead of forwards.

These perspectives are very important to consider when sonifying data. The first problem is to create a meaningful experience out of potentially patternless data. The second problem is the method in which the sonification is performed. The question is: should the data be represented by a found sound, a representative sound event, synthesis, emulation, traditional western instruments, or a combination of both into an electroacoustic setting? A sonification performed in any combination of these factors will be influenced. The desired intent will be defined by the method of interpretation as well as the performance environment, prior perceptions of the listener, and the truth and understanding of the sound.

There are several current methods for sonification. Sonification can be split into two important parts: a technique and the intent. "The technique is the process of mapping numerical data, presumable embodying some relationships in the physical world, or a model world, to sound" (NASA, pp.1). The intent is to communicate something about that world. The NASA paper provides the example of this relationship through a Geiger detector whose sound conveys a message about the level of present radiation or how a bell can convey the current time. The paper defines three major types of sonification. Iconic sonification is the mapping of data to found sound that is associated with certain phenomena. A simple example of iconic sonification is using the sound of rain to indicate

the high probability of rain in the forecast. The second type of sonification is direct conversion. Direct conversion sonification maps empirical data to sounds with the goal of listening for patterns represented in the data. The most common example of this is measuring electromagnetic waves directly transposed into human hearing range. Examples include sonifications of electromagnetic waves emanating from Saturn's rings, the Sun, Earth, and other celestial bodies. The final type of sonification is musical. Musical sonification is when empirical data is mapped to sound in a musical way generally to create a musical work. The paper does not describe direct conversion or iconic sonification as being musical in nature.

The second section of this paper describes the history of sonification beginning with Pythagoras who analyzed the structure of harmonies and applied them to musical scales. "Manipulating sound for musical ends based upon data or mathematically derived structures arises from a distinguished tradition" (NASA, 2005, pp.3) In 1914 the first audio interface reading machine was invented by Fornier D'Albe. The first contemporary sonification began with Ficks and Pollack in 1954. The pair researched the use of audio variables to convey quantitative information. Their project included a display that showed eight binary variables encoded as variables such as pitch, volume, tone, and alteration. In 1961 Speeth conducted experiments that utilized audification of seismic data to determine if test subjects could differentiate the sound of an earthquake from the sound of underground bomb blasts. The seismographs were sped up into the audible range. 90% of test subjects were able to differentiate between the two sounds. Through this breakthrough scientists were then able to listen to twenty-four hours of seismic data in

under five minutes of listening. More recently, Rabenhorst, working at IBM, uses auditory representations of visuals to interpret scalar fields of electron density, hole density, and potential energy throughout the volume of a semi-conductor. Benefits of sonification include "uncovering patterns masked in visual displays, identifying new phenomena, improving exploration of multi-dimensional data sets, and analyzing complex, rapidly temporally changing data." (NASA 2005, pp.4)

The way this paper presents the history and overview of sonification is concise. The problem with the three types of sonification is that music is its own category. One could argue that the pure data in itself is music. To tie in what Clarke said, listeners will adapt to the environment and inherently look for patterns in the sound. Conclusively, the dividing line between iconic, direct conversion, and musical sonification is the type of sounds used to convey the information. The choice of how the data is interpreted and the sound medium used: synthesis, emulation, or found sound define the sonification type. The poiesis of the sonification is empirical data dictated by the science; the esthesis of the sonification relies on several factors. These factors include the aforementioned sound choice, but also the listening environment, the physical environment where the sonification is being received and also how the listener receives, perceives, and interprets the sounds. The esthesis is also affected by the content, presentation, and quality. In the focus of the research will be the sonification of digital images and the quality will be judged by the choice of images used and sound choices. Presentation will be affected by the sounds used, context of the work, and accompanying visualizations. The definition of

this type of sonification either scientific or musical is left to the listening environment,

the listener's interpretation, connection, and resonance with the experience.

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