On the Suitability of Critical Listening and Reduced Listening Concepts for a Novel Musical Expression

By

Christopher Chraca

B.Sc., Columbia College Chicago, 2015

A Project Report Submitted in Partial Fulfillment of the Requirements for the Degree of

MASTER OF MUSIC

In the School of Music

University of Victoria

Supervisory Committee

On the Suitability of Critical Listening and Reduced Listening Concepts for Novel Musical Expression

By

Christopher Chraca

B.Sc., Columbia College Chicago, 2015

Supervisory Committee

Kirk McNally, Department of Music
Supervisor

W. Andrew Schloss, Department of Music
Department Member

Table of Contents

List of Figures

Abstract

In this report, I explore how to entice listeners into a state of active listening using an interactive sound installation, *Minimal Reduction*. First, I elaborate on background information regarding reduced listening and critical listening. Then, I compare critical listening and reduced listening. This comparison poses the "engineer's situation," which is when an individual is listening to recorded audio and changing the sound traits of the audio. By being in this situation an individual should enter the active listening axis which has reduced listening and heightened listening as the end points of the axis. To demonstrate the validity of the "engineer's situation" I created an interactive sound installation, known as *Minimal Reduction*. Two other installation are discussed to find that emergent interactivity and ownership of the sound are what allowed them to be successful. When constructing *Minimal Reduction*, emergent interactivity and ownership of the sound was taken into consideration to allow for similar success. *Minimal Reduction* uses a Max/MSP patch to send audio out an octophonic Ambisonics surround sound system. The patch is connected to an interactive device which has 14 potentiometers, 6 knobs and 8 faders, for individuals to control five sound traits of the recorded audio. The audio itself is an electroacoustic composition based in the *musique concrète* genre. Individuals who are on the active listening axis near reduced listening can understand the sounds or music by following the changes to the sound traits. With this research, I hope to facilitate an individual's ability to understand reduced listening, and how reduced listening can be utilized in my artistic practice.

Section 1: Background

1.1 Schaeffer

Pierre Schaeffer was a writer, composer, engineer, musicologist, and acoustician whose research helped shape experimental music into what it is today. He compiled his research into the “Treatise on Musical Objects" (Kane). The Treatise on Musical Objects (TMO) illustrates Schaeffer's work with musique concrète and all areas of experimental electroacoustic music, along with the theory and practice of the sound object. Within the TMO “Book Two: Hearing” focuses on Schaeffer’s theories related to acousmatics and reduced listening.

In the 1950s, Jérôme Peignot suggested to Schaeffer the term “acousmatic” as a way to describe the listening of musique concrète (Kane). According to the Larousse dictionary, acousmatic is a "name given to the disciples of Pythagoras who, for five years, listened to his lessons hidden behind a curtain, without seeing him, and observing the strictest silence" (Schaeffer 64; Larousse). This section of the definition is more historical, but it explains why Peignot suggested the term, while another section states "a noise that is heard without the causes from which it comes being seen" (Schaeffer 64). Here we have a specific definition that we can use to describe what Schaeffer and Peignot are trying to express with this term when they describe listening to music, specifically musique concrète, as an acousmatic situation.

People now listen to music and sounds through speakers or headphones more often than any other way of listening. This phenomenon is known as “headphone culture”. The issue here is that listening to sound in an acousmatic situation is extremely common so why does it matter? Schaeffer’s use of acousmatics is to put a veil over the source of the sound. The significance of acousmatics is not diminished even though most individuals listen to sounds in an acousmatic

situation, rather it allows for more individuals to experience the acousmatic situation regularly. Furthermore, acousmatics is the most optimal way to experience reduced listening which is the resulting concept from “Book Two: Hearing” (Schaeffer 116). Reduced listening will be explained later in this section.

Schaeffer says there are three musical situations for listening: the acousmatic, instrumentalist, and normal listening. In the acousmatic situation, the listener passively listens to sounds that they cannot see, such as recorded sounds amplified through a speaker. The instrumentalist's situation occurs where the individual creates the sound, while shaping and honing it to their liking. The normal listening situation, much like the acousmatic situation, is passive listening but it involves seeing what makes the sound. Schaeffer believes that the acousmatic situation increases the listener’s chances of reaching a state of reduced listening.

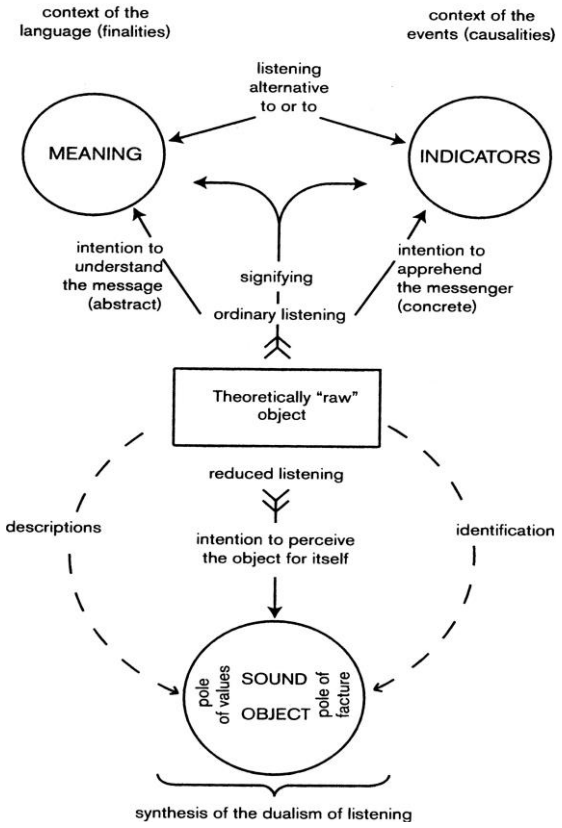

Figure 1. Final summary of listening intentions (Schaeffer 2017, 114)

Schaeffer concludes "Book Two" with the final listening intention, the three listening modes (see figure 1). Two of the three listening modes are *meaning* and *indicators* which are defined as: “what does this sound mean” and “what is causing this sound”, respectively (Schaeffer 115). Schaeffer refers to these two listening modes as "ordinary listening". By this, he means that these modes are natural and innate for human listening, unlike the third mode which is a part of specialized listening. Reduced listening occurs when a listener can ignore ordinary listening and focus only on the sound object or as Schaeffer puts it "having ignored the source and meaning, [they] perceive the sound object" (Schaeffer 115). The sound object has characteristics that a listener can perceive which are called *sound traits*. These sound traits are frequency, amplitude, spectrum, spatial, and duration and time. These sound traits are aspects that a listener can focus on analytically to listen in the mode of reduced listening. To conclude, a definition of reduced listening is needed. This is a definition from the New Media Dictionary “it stresses listening to sound for its own sake, in order to grasp its values and its character, without taking into account its source, what it reveals or its possible significance” (New Media Dictionary). This definition is prepared by Francis Dhomont, Robert Normandeau, and Claire Piché and edited by Louise Poissant. These individuals are all from the Groupe de Recherche en Arts Médiatiques and based the reduced listening definition from Schaeffer’s and Post-Schaefferian writing.

1.2 Post-Schaefferian critics

Many of Schaeffer’s critics have analyzed his concept of acousmatics and the three modes of listening. They have criticized his theories of reduced listening because there is no paradigm on how to achieve that state. Exploring Schaeffer’s critics can provide some needed pretext before diving into critical listening and how it compares to reduced listening.

1.2.1 Michel Chion

Michel Chion is a well-known Post-Schaefferian theorist and composer, who worked as Schaeffer's assistant at the Group de Recherches Musicales (GRM) in France. In his article "The Three Listening Modes", Chion discusses the semantic, causal, and reduced listening modes. These listening modes originated from the TMO (see figure 1). Chion changed the names of *meaning* and *indicators* to *semantic* and *causal*, respectively, and kept the same definitions. Chion states that in reduced listening, the individual must listen multiple times to hear the sound traits, which requires the sound to be fixed or recorded (Chion). This proposition, also shared by other Post-Schaefferian critics, Chion brings up is one important step in allowing individuals to enter reduced listening.

Chion states that "everybody practices at least rudimentary forms of reduced listening", and he explores its requirements (Chion). Rudimentary forms of reduced listening can happen if the listener is trying to pay attention to the sound traits, i.e., if a listener was identifying the pitch or frequency of a tone. If a sound does not have a fundamental pitch, but instead is classified as noise, then the listener can instead focus on the spectral information or timbre. Timbre is much harder to describe as there is not a descriptive system for it like there is for pitch or rhythm. Neither Schaeffer nor Chion explicitly discuss this, but it is not necessary to have such a system in place to think, notice and listen to timbre. Just noticing that there is timbral change is what makes it a part of the reduced listening mode. Chion brings up an example of "figuring out an interval between two notes" which is what instrumentalists do while analyzing music they will play (Chion); therefore, instrumentalists practice a "rudimentary" form of reduced listening.

Chion brings up the notion of listening in more than one mode at once, for instance, focusing on the timbral information of a sound to find out what the cause of a sound is. In this

example a listener will be in both reduced listening and causal listening modes. Even though humans do these kinds of listening tasks innately, reduced listening is about being in a state of listening where the listener ignores the causal and semantic modes.

1.2.2 Reuben De Lautour

Reuben De Lautour discusses reduced listening in his article “Inaudible Visitors: Theories of sound reproduction in the studio practice of Pierre Schaeffer". Lautour states "Schaeffer noticed that by listening to a looped recording of a train...the sound seemed to lose its referentiality", and it allowed Schaeffer to focus on the sound traits (De Lautour 166). Listening to a sound on a loop allowed Schaeffer to focus on the sound traits and aligns with Chion’s take that listening to recorded sounds multiple times can lead to reduced listening. Lautour introduces Sheila Black's research on semantic satiation, where repeated exposure to information allows for our attention to be placed in places of new information instead of semantic or causal (De Lautour 166; Black 63). Semantic satiation is one way to bring forth reduced listening especially for individuals who are not aware of or who are not trained in focusing on sound traits.

1.2.3 Joanna Demers

Joanna Demers devotes an entire chapter to Schaeffer in her book "Listening Through the Noise”, where she outlines Schaeffer's concepts for listening, and current thoughts on what reduced listening offers to listeners of electroacoustic music. "Reduced listening as Schaeffer conceived of it may be impractical, if not impossible", but this does not invalidate Schaeffer’s work (Demers 31). Schaeffer’s work on reduced listening changed how scholars understand listening. Demers suggests that reduced listening can occur but "only under limited circumstances" (Demers 31). Demer brings up several other academics, including Jean Jacques

Nattiez. Nattiez explores the concepts in the TMO and states that "sound-object has an *esthesic* function" rather the "*poietical* interpretation" that Schaeffer foresaw (Nattiez 100). *Esthesic* means the perception of a work, and *poietic* means the act of making the work (Nattiez 11-2). This *esthesic* function captures an intent to use the sound object to create a situation where the listeners will perceive the sound traits and further enter a state of reduced listening.

Demer discusses the concept of nurturing rather than suppressing the feelings a listener would have regarding the sensory stimulation of sounds, which derives in part from Nattiez's *esthesic* description. This notion of surrendering to the other modes of listening is intriguing because a listener does not need to repress their modes of semantic and causal listening to have a reduced listening experience. Instead, Demers proposes that the listener can use all the listening modes as they come and go while they listen to a sound and still be in a rudimentary reduced listening mode. Schaeffer himself emphasizes the difficulty of reaching a state of reduced listening.

Demers discusses Leigh Landy's project, "Intention/Reception", which suggests that listeners' musical satisfaction requires "something to hold on to" (Landy 21-65; Demers 36). Demers notes that Landy's inspiration for her project derives from an earlier experiment by William Gaver. Gaver's experiment suggests that most listeners could not focus on anything other than external forces because they were not self-aware enough or could not unlearn old habits (Demers 37; Gaver). Listeners that cannot unlearn these habits, will find it near impossible, or at least unlikely, to reach a state of reduced listening when listening to music.

1.2.4 Leigh Landy

Landy's work examines the differences between reduced listening and heightened listening. Heightened listening allows the audience to "hold on to something", and that something is "the creation of aural storytelling" (Landy 106). Heightened listening appears as a concept within the world of soundscape composition, and R. Murray Schaffer and Barry Traux are the key figures of that world. Heightened listening stands as the polar opposite of reduced listening, and Landy states that these two points create an "axis" with a great deal of grey area between that artists may fluidly move within (Landy 173). This "axis" of active listening lies between listening for the sound traits (reduced listening) and listening for the meaning and cause (heightened listening) (see figure 2).

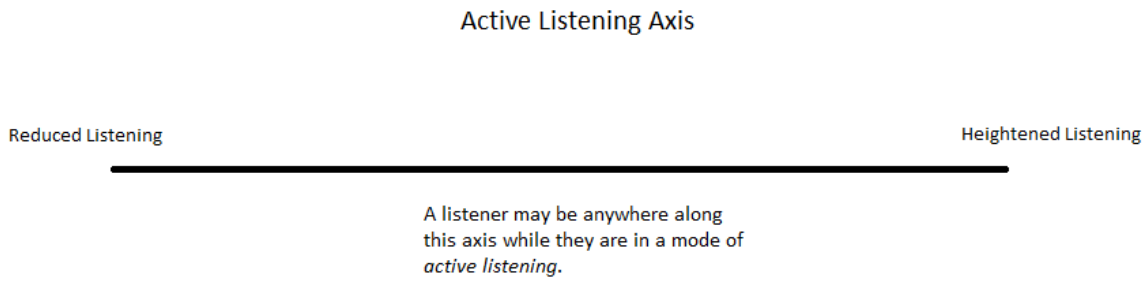

Figure 2. Active Listening Axis

1.3 Critical Listening

Michel White, a prolific audio engineer and instructor, defines critical listening in the following way: "critical listening primarily comes from the engineer's point of view. You're listening to the physical details of the music – frequency response, dynamic range, tone, imaging, and how instruments are blended together" (Garrison). Critical listening is an analytical skill that one develops and hones with practice to differentiate sound traits within a recording. Once these

sound traits are identified, an engineer can augment and alter them for the sound recording. This use of critical listening is vital for an audio engineer's craft because they can fine tune the sound that they record and mix. Scholars have extensively covered this subject. "Critical Listening Skills for Audio Professionals" by F. A. Everest is an instructional book and CD used in a classroom setting (Everest). These types of instructional books demonstrate what listeners should be listening for when they hear a certain kind of change in the sound. For example, the books help listeners notice the spectral change of white noise when a bandpass filter is applied at different center frequencies. "Golden Ears", another instructional tool, can teach listeners how to analytically listen for changes in the sound traits of recorded material (Moulton). A more academic piece of literature on critical listening, Jason Corey's "An Ear Training System for Identifying Parameters of Artificial Reverberation in Multichannel Audio" discusses a new form of training one's ear in relation to artificial reverberation (Corey).

Once individuals learn critical listening, they must continue practicing this skill set to refine their skills to become better listeners. They can use tools, such as computers with digital signal processing software or knobs and sliders on different analog effect units, to practice. This is somewhat similar to how an instrumentalist would continuously refine the sound traits their instrument creates. Although an engineer works with a fixed recording and an instrumentalist creates the sound, they both augment the sound traits of their respective sonic medium.

Section 2: Critical Listening and Reduced Listening

2.1 The Comparison

Critical listening and reduced listening both require the listener to analyze sound, but critical listening serves to augment sound traits, while reduced listening involves passive listening that focuses on eliminating the causal and semantic meanings of the sound source. Both concepts require the listener to focus on the sound traits of a recorded sound. Critical listening takes advantage of the end purpose of audio engineering; by this, I mean using audio equipment to actively augment sound traits of live or recorded sound. An untrained listener can achieve active listening by actively augmenting the sound traits of a recording.

As discussed earlier, Landy introduces the notion of an active listening axis that has a grey area between reduced listening and heightened listening. This grey area does not disregard reduced listening, and instead uses it as a point on this axis. Since other critics have shown that it is almost impossible to achieve a pure form of reduced listening, this axis may be used to deviate from reduced listening toward heightened listening. Rather than creating a story for listeners to hear, it allows listeners to indulge in semantic and causal listening. In the end, if the focal point of the listener's active listening is on the sound traits, then their listening experience would be somewhat reduced as pertaining to the active listening axis Landy discusses.

The instrumentalist who continuously listens and refines the sounds they create will enter a rudimentary reduced listening mode to focus on the traits of the instrument's sound (Chion; Schaeffer). This mode may be a far cry from pure reduced listening that Chion discussed that requires passively interacting with a fixed sound, and instead it should be part of the active

listening axis. If this same concept can be applied to recording engineers and their work, then they will also enter the active listening axis.

2.2 A New Term

The previous sections compared different approaches to train individuals to enter the active listening axis while remaining close to the reduced listening point. I believe that the use of an interactive sound installation can achieve this goal and entice active listening. Before I describe this interactive sound installation, I believe a new term must be introduced to complete the comparison I am making between reduced listening and critical listening. This comparison does not propose a complete acousmatic or an instrumentalist situation because of the interactivity and the fact that listeners do not create the sound. The listeners or participants will instead mold the composition as it is played in the installation. I believe the term "engineer's situation" accurately describes this listening situation because the listener takes an active role in shaping and mixing the recorded sounds available without creating new sounds.

2.3 Sound installation, Interactivity, and Emergence

I chose a sound installation as the best artistic representation of this research because it is an intermedia work that lies between music and visual art (Iturbide). The visual component is important in the “engineer’s situation” because the individual needs to interact with something, such as faders and knobs on a mixer, in order to augment the traits of the sound they are listening too. Without this interactivity individuals will not be able achieve the “engineer’s situation” and in turn will not be able to achieve active listening. Interactivity “refers broadly to human-computer musical interaction, or human-human musical interaction that is mediated through a computer” (Weale). Interactivity contributes to the "engineer's situation" by allowing for human-

computer interaction. This interaction permits a participant to actively change all five sound traits when he or she interacts with the sound installation. A more specific term within interactivity is *emergence* and is defined by Waters as,

> Emergence signifies a conscious utilization of the changing boundaries between the subject (listener, interpreter) and the composer (artist, maker). This is particularly clear in situations where the former interacts with what the latter has made, and the work can be said to emerge in its completion by the user, rather than having been designed in its entirety by the artist and then ‘presented'. (Waters)

This installation must be emergent in terms of interactivity so that the participants can have control over the recorded audio’s sound traits. If participants do not interact with the installation, then the work is incomplete. Figure 3 is a visual representation of these concepts working together.

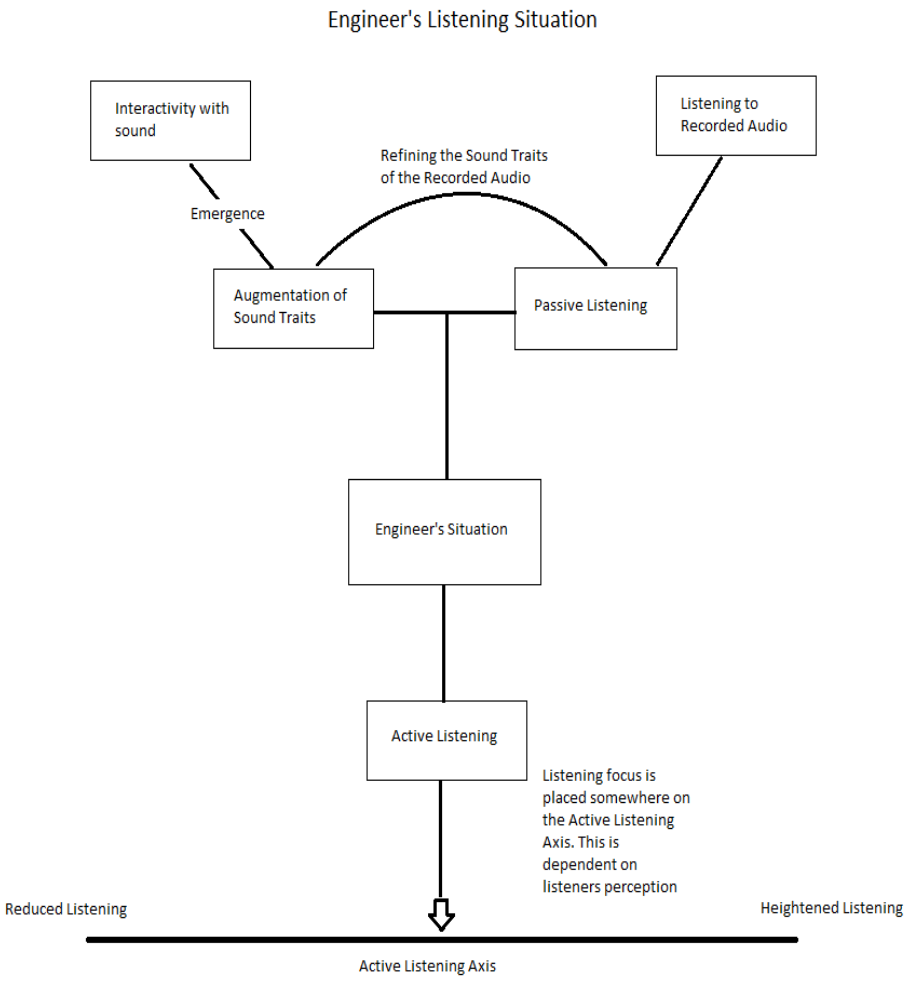

Figure 3. Flowchart of the Engineer's Situation

Section 3: Other Installations and Works

This research has led to a point where a participant does not only have to listen, but also interact with something to entice active listening. The name of my interactive sound installation is *Minimal Reduction*. The name refers to the research done to understand reduced listening and the minimal visual element within the installation. In this section, two other works will be addressed in order to see where they have succeeded. These works provide a base for my interactive sound installation and its possible success.

Sound Jewelry, created by Takuya Yamauchi and Toru Iwatake, is a live performative installation where individuals wear or hold musical instruments like a pendant and the environment changes according to how many instruments are present and their spatial arrangement within the area. The parameters are constantly changing every time the installation goes up, but some variables can be: the location and distance between participants wearing *Sound Jewelry*, and the participants' physical condition such as body temperature (Yamauchi 33). More variables can be analyzed and more can be added. This is an example of emergence interactivity within an installation. The participants control the sound that they hear within the installation, and they can alter it over the duration of the installation. *Minimal Reduction* will only allow participants to change the sound traits of the prerecorded sounds unlike Sound *Jewelry*, which allows participants to create new sounds. Yamauchi and Iwatake observed that "participants seem to enjoy the music and become playful in the environment" within their installation (Yamauchi 37). Emergence gives participants a feeling of ownership over the sound that they hear, and it will elicit more interactivity.

Cave of Sound, another interactive sound installation created by a collaboration of eight artists from Music Hackspace, has eight different instruments for participants to interact with. Each instrument was created by one of the collaborators. The installation has the instruments arranged in a circle with speakers pointing out. The inspiration behind this layout derives from theoretical prehistoric musical practices where individuals would collaborate with different instruments. (Murray-Browne). *Cave of Sound* also exemplifies emergence interactivity within a sound installation. It uses a similar concept, akin to *Sound Jewelry*, that allows multiple people to interface with the installation at once. In contrast, *Minimal Reduction*'s environment does not foster an intimate sound installation experience because participants only listen to their direct influence on the sound. *Cave of Sound*'s positive reception and success traces back to the participants' feelings of ownership over the sound within the installation.

A stark difference between these two works and my own is the end goal of the installations. *Minimal Reduction* 's foundation derives from the literature of Post-Schaefferian theory and critical listening, and it is supposed to entice active listening. However, *Sound Jewelry* and *Cave of Sound* do not have a similar purpose. Both works allow individuals to create and alter the sounds through the installation, and each person maintains ownership of the unique sounds they create. I plan on using this aspect of ownership and emergent interactivity in *Minimal Reduction* to achieve similar success.

Section 4: Description of The Interactive Sound Installation

4.1 The Sound Installation

The original purpose of *Minimal Reduction* was to entice reduced listening, but now it serves to invoke a state of active listening that lies between reduced and heightened listening within the axis Landy discussed (Landy 173). The point I will be looking for is one as close as possible to reduced listening, but I will not disregard the listeners urge to listen in the semantic or causal listening modes. The listener can nurture the other two listening modes until they are completely satiated with the information. This will allow for natural motion along the axis towards reduced listening and away from heightened listening. This satiation will also be explored in the composition of the sound objects, which is pertaining to Sheila Black's research in semantic satiation (De Lautour 166; Black 63). The sound objects will be looped so that the semantic information of the sounds will satiate the listener and their focus will lead them elsewhere, preferably towards the sound traits.

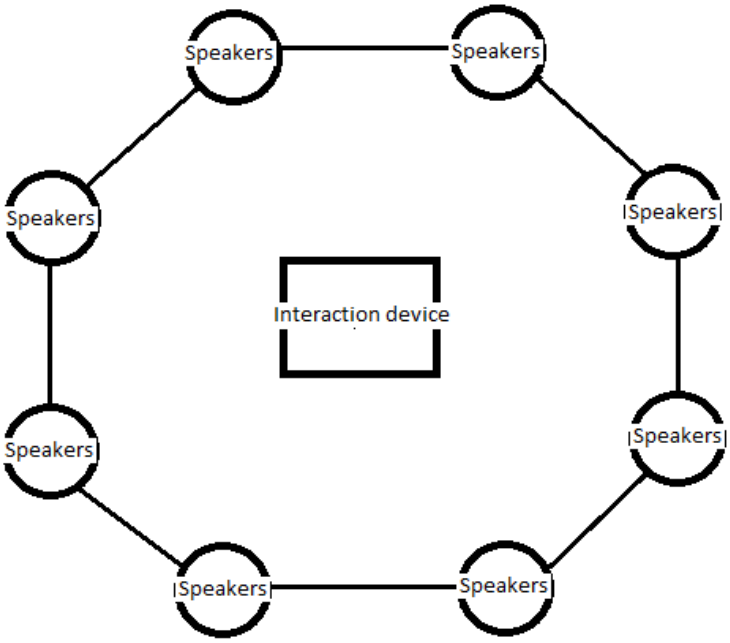

Figure 4. Installation Diagram

Minimal Reduction consists of an eight speaker surround sound system around a table with an interactive device on top of it (see figure 4). The room housing the installation should be dimly lit. This minimalist design and lack of light should minimize visual stimulation from sources other than the interactive device. I used a 3D printer to create a housing structure for the device. (see figure 5). This device has an Arduino Mega, microcontroller, with 15 potentiometers connected to it, and the Arduino sends serial data to a computer with a Max/MSP patch (see figures 6, 7, and 8). The interactive device resembles a mixer. The patch has a musique concrète composition that plays in the installation. Participants will be able to augment the sound traits of the composition by changing the positions of the potentiometers.

Figure 5. Interactive device

```
analogReadVal1 = analogRead(analog1);
 poten1 = map(analogReadVal1, 0, 1023, 0, 1023);
 if (abs(poten1 - old_poten1) > 5) // only send out values when there is a change
  {
  old_poten1 = poten1;  // save the changed value
  Serial.print(1);  // which pot value
  Serial.println("/t");  // send tab
  Serial.println(poten1);  // send out pot value
  delay(10);
  }
```

Figure 6. Arduino code that is copy and pasted for all 15 potentiometers. All the variables are instantiated beforehand.

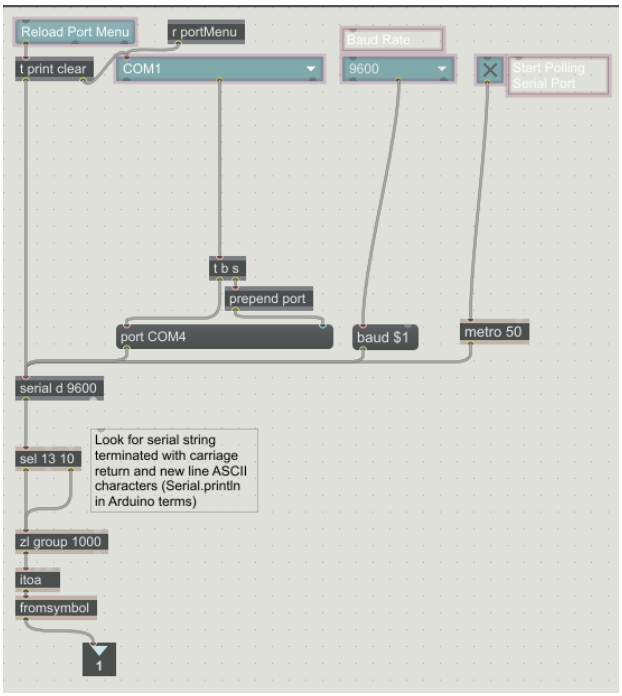

Figure 7. Max/MSP patch for serial data conversion

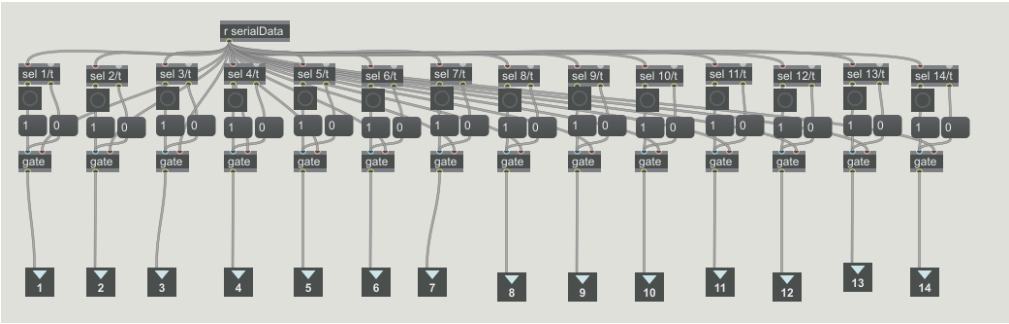

Figure 8. Max/MSP patch for serial data parsing

4.2 The Device and Max Patch

The device does not have any of the potentiometers labeled, so that participants can discover what each of them do. Participants should be able to focus on the effects their actions

have on the sounds they hear. This interaction should entice active listening somewhere on the active listening axis because the participant focuses on augmenting the sound traits of the sound objects. Individual sound objects will be referred as SO-X where X is 1-5. The Max patch has five recorded sound objects that are sent into an Ambisonics mixing object. Before the audio reaches the Ambisonics object, each of the five recordings can be augmented. Sound objects will each only have one of the following characteristics: SO-1 will change its amplitude and duration, SO-2 will change its amplitude and spectrum, via band pass filter, SO-3 will change its duration and amplitude, SO-4 will change its speed of playback and amplitude, and SO-5 will change its speed of playback and spectrum, via band pass filter. All the sound objects are then put in an Ambisonics mixing object connected to an octophonic speaker system.

Using Ambisonics allowed the sound objects in this installation to move fluidly in the octophonic system. Ambisonics was used over VBAP, which has a very similar outcome, because Ambisonics sends signal to about four to five speakers, which allows for better spatial positioning. Ambisonics does have an issue when the listener is not in an ideal position within the speaker array it may appear that the sound is coming from more than one location (Pond 6). Since *Minimal Reduction* had the primary listener in the center of the speaker array it would be more beneficial to use the Ambisonics system over the VBAP system.

Additionally, all the sound objects, except SO-2, will stop sending out a signal after 30 seconds if a participant does not interact with the installation. These augmentations encapsulate all 5 sound traits to be observed within the installation.

4.3 The Sound Source

The five sound objects within the installation come from three distinct sources. Sound source one and two were augmented within Ableton Live 10. The sound source material was augmented to obscure the original recordings when creating the distinct sound objects for this installation. The first source is a recording of a construction truck. This first sound source is edited, equalized, and pitch shifted to create SO-1, SO-4, and SO-5. SO-1 is supposed to sound like a vehicle of some kind but due to the pitch shifting it is hard to pinpoint the kind of vehicle it is. The length of the sound object is 30 seconds long and it is quite repetitive. This repetition will be seen throughout all of these sound objects to allow for semantic satiation (Landy 21-65; Demers 36). SO-4 is a rhythmic edited version of the recorded sound lasting 2 seconds, which is pitch shifted down in frequency and stretched. The type of pitch shifting algorithm, entitled beats, is built into Ableton and created a slight stuttering effect. SO-5 is similar to SO-4 but is not stretched and is pitch shifted up in frequency. The duration of each sound within SO-5 is shorter in duration and the overall duration of the object lasts 5 seconds. SO-4 only has 3 distinct beats while SO-5 has 9 distinct beats. The second source is a recording of a person stomping around in a puddle of water on mud. This recording was edited and pitch shifted to create SO-3. SO-3 lasts 8 seconds and sounds like an underwater recording of someone dropping an object in water. The third source and SO-2 is a white noise generator from Audacity. The primary purpose of this sound object was to create a noise floor that would be constantly heard while the installation was running. A recorded white noise audio file was used over a noise~ object in max to keep all five sound objects recorded audio files. Since all the other sound objects will turn off after 30 seconds, the installation needed a passive sound that could be played the whole time without irritating people. The use of recorded sounds was inspired from Schaeffer's own

musique concrète genre, and one piece that I listened to for inspiration was *Étude aux Chemins de fer*. The most notable similarity is the use of a recorded industrial machine, but this is only a nod towards Schaeffer's work and nothing more.

4.4 Survey

I conducted a survey after each participant was finished with their first experience using the installation to understand the participant's understanding and response to the installation. I refer to a paper from NIME that used questions to evaluate a perceptual experiment to construct these questions (Huberth). Since this installation is not a perceptual experiment it does not follow the same rigor as the experiment referenced. The questions I used for the survey were:

1. What did you focus on to during your time listening in the installation?
2. Was your focus different while you were interacting with the installation?
3. While interacting with the installation was it easier to notice what you were focusing on?

I collected ten different responses to these questions. I hypothesized that participants would focus on the cause and effect of what the device did to the sound, and the responses confirmed my initial hypothesis. Although some individuals seem more fixated on the device itself than the sound objects, eventually their focus moved strictly to the sound once they understood what the device did. This survey shows that most individuals are in fact listening within the active listening axis.

Section 5: Conclusion/Discussion

In this project, I created an interactive sound installation, *Minimal Reduction*, which originally was to entice reduced listening and changed to entice active listening in untrained participants. The culmination of the research ended with the creation of a new term “engineer’s situation” to describe this listening situation. A device using the Arduino microcontroller was designed and constructed to allow for interactivity with the participants, which was connected to a computer running a Max/MSP patch that had five different sound objects being played in an Ambisonics octophonic system. The device allowed for control of the five sound traits which allowed the sound objects to be altered/manipulated. This emergence interactivity creates a unique and intimate relationship with the participant and music.

I would like to find more sources on conducting perceptual experiments and evaluating the results. With these sources, I would design a perceptual experiment that could evaluate whether my hypothesis is correct or not. After conducting this experiment, I could create a new survey that would best highlight the information I am looking. Another interest I have in continuing this work would be to refine the actual sonic and interactive elements of *Minimal Reduction*. I had several notes from participants that suggested that the device should be more instant in its augmentation of the sound traits. This will eliminate confusion some of the participants had when interacting with the installation. I understand their confusion as some of the parameters only work if other parameters are used.

Bibliography

Black, Sheila R. “Review of Semantic Satiation.” *Advances in Psychology Research*, vol. 26, edited by Serge P. Shohov. 2003, pp. 63–74.

Chion, M. “The Three Listening Modes.” *The Sound Studies Reader*. 2012, pp. 48-53.

Corey, Jason. “An Ear Training system for Identifying Parameters of Artificial Reverberation in Multichannel Audio.” *Presented at the Audio Engineering Society 117th Convention*, San Francisco. October 2004, pp. 28-31.

De Lautour, Reuben. “Inaudible Visitors: Theories of Sound Reproduction in the Studio Practice of Pierre Schaeffer.” *Organised Sound*, vol. 22, no. 2, 2017, pp. 161–171. doi:10.1017/S1355771817000073.

Demers, J. “Listening to Signs in Post-Schaefferian Electroacoustic Music.” *Listening Through the Noise: The aesthetics of experimental electronic music*. Oxford University Press. 2010.

Everest, F. A. *Critical Listening Skills for Audio Professionals*. Boston, MA: Thomson Course Technology. 2007.

Garrison, M., & White, M. *Critical Listening: How to Train Your Ears*. January 04, 2018. http://blog.shure.com/critical-listening-how-to-train-your-ears/

Gaver, William W. “What in the World Do We Hear? An Exological Approach to Auditory Event Perception.” *Ecological Psychology*, vol. 5, no. 1, 1993, pp. 1-29. https://doi.org/10.1207/s15326969eco0501_1

Iturbide, Manuel R. "The Expansion of Sound Sculpture and Sound Installation in Art." *Academia*. 2014. https://www.academia.edu/8101034/The_expansion_of_sound_sculpture_and_sound_installation_in_art.

Kane, Brian. “Schaeffer, Pierre Henri Marie.” *Encyclopedia of Aesthetics*. 2nd ed. Oxford University Press. 2014. www.oxfordreference.com.ezproxy.library.uvic.ca/view/10.1093/acref/9780199747108.001.0001/acref-9780199747108-e-644.

Landy, Leigh. *Understanding the Art of Sound Organization*. MIT Press. 2007.

Larousse, Pierre. *Grand dictionnaire universel du* XIX*e siècle: Français, historique géographique, biographique, mythologique, bibliographique, etc.*, 15 volumes. Paris: administration du Grand dictionnaire universel. 1900.

Moulton, D. *Golden Ears*. KIQ Productions, Sherman Oaks, CA. 1995.

Murray-Browne, Tim. "Cave of Sounds." *Cave of Sounds*. 2017. http://caveofsounds.com/.

Nattiez, Jean Jacques. “The Status of the Sound-Object.” *Music and Discourse: Toward a Semiology of Music*. Princeton University Press. 1990.

"New Media Dictionary." *Leonardo* 34, no. 3. 2001, pp 261-64. http://www.jstor.org.ezproxy.library.uvic.ca/stable/1576946.

Pond, Robert. *Spatial Composition using Musical Programming Languages*. University of Victoria. 2018.

Schaeffer, P. *Treatise on musical objects an essay across disciplines*. Translated by Christine North. and John Dack. University of California Press. 2017.

Waters, S. *Beyond the acousmatic: hybrid tendencies in electroacoustic music*. Music, Electronic Media and Culture. 2000.

Weale, Rob. "Interactivity." *ElectroAcoustic Resources Site*. January 2, 2005. http://ears.pierrecouprie.fr/spip.php?article50.

Huberth, Madeline, J. Cecilia Wu, Yoo Hsiu Yeh, and Matthew Wright. “Evaluating the audience’s perception of real-time gestural control and mapping mechanisms in

electroacoustic vocal performance.” *Proceedings of the international conference on new interfaces for musical expression*. Brisbane, Australia. 2016, pp. 206-211.

Yamauchi, Takuya, and Toru Iwatake. "Sound Jewelry." *Leonardo Music Journal* 18. 2008, pp. 33-37. http://www.jstor.org.ezproxy.library.uvic.ca/stable/25578113.