Listen: Redefining a term through art

Abstract

Listening is often described as active hearing and the roles the other senses play are often overlooked. This definition of listening creates an exclusive action that excludes those who are deaf or hard-of-hearing and does not take advantage of all the experiential qualities of sound. This thesis presents the project *Listen* - an immersive installation where sound is heard, felt, and seen. I argue that the act of listening is not dependent on hearing alone, and instead, is multisensory. Additionally, such an approach to sound creates a more inclusive listening environment, while encouraging extended listening sessions, which oftentimes is hard to achieve in the gallery or museum setting.

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Introduction

Listen is an immersive listening space in which sound is experienced by the body, ears, and eyes. It purposely stimulates three of the five senses, urging participants to recognize visual and tactile experiences of sound as integral parts of the act of listening. In doing so, the installation creates an atmosphere within a gallery setting that allows for extended listening while also opening up the experience to those who are deaf or hard-of-hearing. Additionally, since most musicians and sound artists are accustomed to composing only for hearing, *Listen* opens up a world of new compositional possibilities and challenges, as touch and sight must be taken into account alongside hearing.

The purpose of this paper is to provide a theoretical framework for the installation, while also discussing the design of the soundscape - which includes the sounds themselves and the visualization - and the physical design of the installation. Chapter one consists of two parts: first, an exploration of varying ideas on the roles of the different senses in listening and second, an examination of the different modes of listening. Chapter two will discuss what inspired the piece and the reasoning behind the design of the hardware, software, and sounds. The conclusion will offer up some of the participants' experiences as described through commentary in the installation's guestbook and personal interviews in order to assess the success of the exhibit, which relates to its ability to achieve extended listening sessions while demonstrating that sound can be felt and seen as well as heard. The full text of the participants' experiences are online at http://danm.ucsc.edu/web/rupa/Listen/GuestBook.

1: Theoretical Framework for Multisensory Listening

The first section of this chapter discusses varying perspectives on the roles the different senses at play during the process of listening, ranging from those who privilege hearing alone to those who understand listening as a multisensory action. I also provide a brief overview of important contributions to our current notions of listening drawing largely from Jonathan Sterne's book, *The Audible Past: Cultural Origins of Sound Reproduction*. The second section explores different modes of listening and provides the basis for the type of listening I encourage through *Listen*. At the end of the chapter, I provide some reflection on what listening is and how an expanded understanding and redefinition of listening can contribute to art practice.

1.1: Of Sense and Sound

Jonathan Stern's *The Audible Past: Cultural Origins of Sound Reproduction* constructs a possible history of where our current notions of listening and hearing have come from as well as how sound reproduction technologies have shaped those ideas. According to Sterne, current listening techniques and our definition of hearing have been highly influenced by medicinal practices. In the chapter titled "Techniques of Listening," Sterne discusses how the invention of the stethoscope and mediate auscultation, or "the practice of listening to movements inside the body with the aid of an instrument..." and using the stethoscope to diagnose (99), by René-Théophile-Hyacinthe Laennec in the 1800s "encapsulated a whole set of meanings associated with hearing, listening, listening with technology, and the sounds heard via listening with technology" (113). The development of the stethoscope and mediate auscultation supported the separation of the senses, and particularly the sectioning off of hearing from all other senses: "...for the doctor to really listen, hearing must be separated from the other senses" (Sterne 110). Additionally, the treatment of the deaf during the late 1800s and early 1900s gave rise to the

notion of hearing as a mechanism, and set forth the idea that hearing is a physical and physiological activity that turns a certain range of vibrations into the sounds we perceive via the ears (Sterne 83, 96). "The ear, as a mechanism, became a way of organizing a whole set of sounds and sonic functions; it was an informal principle by which the mechanics of sound reproduction were arranged" (Sterne 83). This idea, according to Sterne, influenced the development of technologies such as telegraphy, phonography, the radio, and headphones (154), all of which have affected the way we experience sound today.

Sterne also offers his own ideas on how listening should be conceived. He begins by explaining why he uses the word "audile" throughout the book:

> The word has two primary definitions. As a noun, it refers to a person in whom "auditory images" are predominant over tactile and visual stimuli...As an adverb or adjective, it means 'of, pertaining to, or received through the auditory nerves' or 'of or pertaining to' the noun sense of *audile*. So the term is useful both because it refers to the physiological, process-based sense of hearing...and because it references conditions under which hearing is the privileged sense for knowing or experiencing (Sterne 96).

He later writes:

> Activity and practicality are also important for my conception of listening. Too often, hearing and listening are collapsed in discussions of the senses. Certainly, hearing is a necessary precondition for listening, but the two are not at all the same thing. The usual distinction is between hearing as passive and listening as active, but this is not quite right either...hearing is a physical and physiological

> activity, a form of receptivity. Hearing turns a certain range of vibrations into perceptible sound (Sterne 96).

What's important to note here is Sterne's obvious preference for the ear by utilizing the word "audile," which directly references the ear, and his failure to state that any other sense plays an active role during the process. Though this is a common view, he is identifying listening as an exclusive activity that does not allow those who are deaf or hard-of-hearing to easily participate, and does not take full advantage of the experiential properties of sound.

Similarly, composer and pioneer of musique concréte, Pierre Schaeffer, also privileges the ear's role in hearing and listening. In his critical essay on sound and listening titled "Acousmatics," Schaeffer uses the term "acousmatic" to describe a situation in which sounds are heard without seeing the objects that cause them. The acousmatic situation is designed to encourage reduced listening, or listening to sounds for their sonic qualities. For Schaeffer, the radio and other audio reproduction technologies allow the ear to perceive sounds without the aid of the other senses, making it possible for a sound source to be concealed and for any relation of a sound to what is visible, touchable, or measurable to be cut off. Additionally, sound-reproduction technologies allow for sounds to be manipulated in ways - such as time-shifting, reversing, and sampling to name a few - that reveal sonic characteristics that otherwise may not be heard (Schaeffer 76-78). This relates to Sterne's notion that the way we listen has been affected by technology.

Schaeffer also states that removing the visual reveals that much of what we hear is in "reality only seen and explicated through that context" (78). In other words, we may see an instrument, such as a cello or violin, being plucked or bowed, and then describe the sound in terms of the seen instrument instead of its sonic or heard qualities. According to Schaeffer:

> In listening to sonorous objects whose instrumental causes are hidden, we are led to forget the latter and to take an interest in these objects for themselves. The dissociation of seeing and hearing here encourages another way of listening: we listen to the sonorous forms, without any aim other than that of hearing them better, in order to be able to describe them through an analysis of the content of our perceptions (78).

This passage suggests an understanding, on Schaeffer's part, that hearing with the ears alone allows for the most meaningful analyses of sound and that information from other sensory modes detracts from performing such analyses.

Composer Michel Chion doubts the effectiveness of Schaeffer's method. In his book *Audio Vision: Sound on Screen*, Chion states that in concealing a sound's cause, the acousmatic situation does not encourage reduced listening, and instead, intensifies a listener's desire to deduce its cause. Chion also claims that knowing the cause of a sound allows a listener to pay closer attention to a sound's traits and writes:

> When we listen acousmatically to recorded sounds it takes repeated hearings of a single sound to allow us gradually to stop attending to its cause and to more accurately perceive its own inherent traits...Indeed, what leads us to deduce a sound's cause if not the characteristic form it takes?...Knowing that this is the "sound of x" allows us to proceed without further interference to explore what the sound is like in and of itself (33).

Steven Connor, in his essay "Edison's Teeth: Touching Hearing," expresses a similar view: "When we hear an instrument that we have never heard before, we cannot fully or properly hear

it until we have guessed or supposed in it the manner of its production, the mutual disposition of body and instrument that results in the sound and of which the sound bears the impress" (161).

In contrast to Sterne and Schaeffer, world-renowned percussionist Evelyn Glennie argues that hearing is actually a specialized form of touch and that we can actually hear and listen by feeling vibrations on our skin; this is especially noticeable with sounds of low frequencies since the ears are inefficient at interpreting them. According to Glennie, who is profoundly deaf, even higher frequency vibrations can be felt, but these sensations are usually drowned out since the ear is more efficient at perceiving them (Hearing Essay). In "Hearing Essay," she explains how she is able to distinguish the rough pitch of notes by associating where the vibrations are felt on her body: low sounds are mainly felt in the legs and feet while higher sounds are felt on particular places on the face, neck, and chest. Glennie also believes that listening involves vision. During a lecture on how to listen, she demonstrates this by pretending to hit a marimba with mallets and then explains that when we see something moving, we naturally imagine the sound that object is making (Glennie, TED Talk). In "Hearing Essay," Glennie offers her own definition of listening and writes:

> An electrical signal is generated in the ear and various bits of other information from our other senses all get sent to the brain which then processes the data to create a sound picture. The various processes involved in hearing a sound are very complex but we all do it subconsciously so we group all these processes together and call it simply listening (Glennie, Hearing Essay).

Similarly, Steven Connor also believes that sound is experienced by multiple senses. In his essay, "Edison's Teeth: Touching Hearing," he writes that we perceive events with all the

senses, and that even if one sense seems to predominate, the other senses have in fact "shadowed and interpreted" it (153):

> The sense we make of any one sense is always mixed with and mediated by that of others. The senses form an indefinite series of integrations and transformations: they form a complexion...This complexion of the senses knits itself together anew with each new configuration (156).

This echoes Glennie's explanation of why low frequency sounds and higher frequency sounds are perceived differently by the senses. Connor also describes differences among the relations between the senses, while also noting usual recurring relationships. For example, the relation between sight and sound is largely indexical: following a sensation of hearing, a listener often looks to find the source and location of a sound. This phenomenon may have provided Pierre Schaeffer's motivation in developing his acousmatic project, which attempts to deconstruct such relationships between sight and sound.

Connor then goes onto say that the relationship between sound and touch tends to be mimetic, in that touch *performs* sound rather than "translating or defining it" (Connor 154-155). However, Connor, like Glennie, does believe that sound can be heard via the sense of touch and writes that "sound literally moves, shakes and touches us..." (157) and later goes onto to describe how we can feel and hear with our teeth through a relationship between bone, skin, and hair:

> We feel our teeth and feel through them because we can hear with them. Hearing is the mode of tactility of our teeth, the way in which teeth feel... This sensation is not wholly localized in the mouth but also involves the prickling or raising of the skin. Perhaps it also involves the subtle cooperation of hair with teeth. For just as teeth convert sound into sensation by transmitting and amplifying it, so hair also

> transmits and amplifies sensation, especially delicate sensations such as the movement of air or breath (168).

Post-phenomenologist Don Ihde also supports a multisensory idea of listening. According to Ihde, the "auditory dimension" cannot be isolated from its "situation, its embedment, its background of global experience, so a 'pure' auditory experience is not possible, but it is possible to concentrate on listening" (44-45). This view of listening is in direct opposition to Pierre Schaeffer's idea of the sonic experience during the acousmatic situation, which attempts to reduce listening to the field of hearing alone, and echoes the claims of Steven Connor. Ihde also argues, like Connor, that sounds are normally considered clues for visual fulfillment and draws from phenomenologist Martin Heidegger in order to explain that objects have voices: "Much closer to us than all sensations are the things themselves. We hear the door shut in the house and never hear acoustical sensations or even mere sounds. In order to hear a bare sound we have to listen away from things, divert our ear from them, i.e., listen abstractly"[1] (Ihde 55, 117). This notion of abstract listening might have been what Schaeffer was attempting to achieve with the acousmatic situation.

Ihde, like Evelyn Glennie, believes that we hear with the entire body, though the ears are the best focal organs for hearing (45). When describing the experience of listening to Beethoven's Ninth Symphony in an auditorium, he writes:

> I suddenly find myself immersed in sound which surrounds me. The music is even so penetrating that my whole body reverberates, and I may find myself absorbed to such a degree that the usual distinction between the senses of inner

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[1] Quoted from: Heidegger, Martin. Poetry, Language, Thought. trans. Albert Hofstadter. New York: Harper and Row, 1971, 26.

> and outer is virtually obliterated. The auditory field surrounds the listener, and surroundability is an essential feature of the field-shape of sound (Ihde 75).

Ihde is describing a situation in which he is listening with his entire body, and as a result, is fully surrounded by and immersed in the music, creating an experience that hearing with the ears alone could not produce. The sense of touch here does not detract from our ability to pay attention to sound, as Schaeffer had proposed. For Ihde, sounds move past and through each other while making the objects in their paths reverberate (Ihde 82). According to Ihde, to listen "is to be dramatically engaged in a bodily listening which 'participates' in the movement of the music" (158).

Wayne Bowman, like Ihde, also refers to phenomenology in order to explain sound and listening. In his book, *Philosophical Perspectives on Music*, Bowman draws largely from the works of phenomenologist Maurice Merleau-Ponty and conveys that the bodily experience is our essential way of being in the world and that the "world as perceived is the only world there is" (261). He paraphrases Merleau-Ponty and writes: "to perceive something is to live in it; to think about something, to hold it at a distance" and the body is always "saturated with its object"[2] (Bowman 261). For Bowman and Merleau-Ponty, perception is always bodily and it is what allows us to know what exists in this world without doubt, unlike intellectual consciousness. Bowman also states, while drawing from Merleau-Ponty, that the properties of an object and its profiles are perceived as an "indissoluble unity." In attempting to segregate such features like color, smell, shape, or texture, the object is reduced to something with a profoundly different nature and "such abstractions do not enhance perception" (262). This perspective should be brought to bear on Schaeffer's emphasis on manipulating sounds until their sources are

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[2] Merleau-Ponty, Maurice, Phenomenology of Perception. London: Routledge and Kegan Paul, 1962, 215.

unrecognizable, and utilizing the acousmatic situation to reduce listening to the field of hearing alone. When applying this concept to the acousmatic situation, it follows that Schaeffer was attempting to do something impossible: to separate an object from its own inherent properties. And in trying to do so, he did not enhance a person's perception of the sound object, but instead, created something abstract and detached from perceptual experience: an object designed for intellectual reflection. Bowman, like Evelyn Glennie, Steven Connor, and Don Ihde, emphasizes that the musical space is never strictly auditory (273).

According to Andrew J. King, a member of the Oxford Auditory Neuroscience Group, most, if not all, of our everyday experiences are multisensory. In the article "Development of Multisensory Spatial Integration," King states that:

> Many everyday objects and events generate cues that are available simultaneously or with some degree of overlap to different sensory systems. For example, it is often the case when listening to someone's voice that we also see their lips moving. The capacity of the brain to coordinate the different sensory signals that arise from a common source provides us with a unified percept of the world and is essential for directing attention and controlling movement within it. Moreover, it is well established that the neural synthesis of multisensory information can improve the likelihood of detecting and responding to an event and of identifying and localizing it accurately.[3] On the other hand, if conflicting information is present across different sensory modalities, then our perception of events may be

[3] Author cites: Welch, R.B. and Warren, D.H., "Intersensory Interactions" in Handbook of Perception and Human Performance. Vol. 1: Sensory Processes and Perception. Ed. K.R. Boff, L. Kaufman, and J.P. Thomas. Wiley: New York, 1-36.

> degraded or altered in ways that reflect a synthesis of the different sensory cues (1).

Though King does not directly address listening here, he does point out that many objects and events generate information that is perceived by multiple senses and that when this information is nonconflicting, we are better at detecting and responding to them. For example, if someone heard and felt a sound while also being alerted visually to its source in some manner, that person's attention would be more accurately focused on that sound than if the sound were only stimulating one sense.

King also refers to a person's perception of an event being "degraded or altered" when conflicting information is present. One example of such an occurrence is the "McGurk effect," which demonstrates that watching a person articulate one speech syllable while listening to them say a different syllable typically results in the perception of a third sound that represents a combination of what was seen and heard (King 1). This effect does not emerge from a lack of attention, but from an altered perception. The "McGurk effect" affirms what Schaeffer claimed: that much of what we hear is in "reality only seen and explicated through that context" (Schaeffer 78). However, it does not mean that the visual cannot be utilized in order to bring attention to sound, nor does it mean that the visual always degrades or alters perception. Instead, it demonstrates the multisensory nature of our everyday experiences.

1.2: Modes of Listening

Pierre Schaeffer, Roland Barthes, and Michel Chion have all proposed that there are different types of listening. Generally, the descriptions of the various modes do not differ between these writers except in name. Schaeffer, for example, proposes five modes of listening: ecouter, comprendre, l'écoute réduite (reduced listening), entendre, and ouir.

Ecouter involves listening for the cause of a sound in order to gather information about its source (Kane 4). It is the equivalent of Barthes' unnamed mode of listening and what Chion calls causal listening (Barthes 246, Chion 25). According to Chion, ecouter or causal listening allows the listener to track a sound's evolution, such as changes in its speed, pressure, or amplitude, in order to ascertain information about its source (27). Additionally, this mode of listening aims at visually locating the sound source and is discouraged during Schaeffer's acousmatic situation.

Comprendre means to listen for communicative sounds and meaning, as is the case with spoken, sign, and coded languages (Kane 4). This mode of listening, for my purposes, is the same as what Barthes calls "deciphering" and what Chion calls "semantic listening" (Barthes 245, Chion 28). In this form of listening, sound is a medium in which the message it carries is the ultimate goal. It often involves an accompanying visual, such as moving lips, hands, or other visual signs.

Reduced listening, in contrast to ecouter and comprendre, aims at attending to the sound itself without calling attention to a cause or a communicative sign (Chion 29, Kane 4). It involves two other modes of listening called ouir and entendre, which are exclusive to Schaeffer (Kane 4). "Ouir, is to perceive with the ear, to be struck by sounds, it is the lowest most elementary level of perception; one passively 'hears' many things that one neither seeks nor listens to (écouter) nor understands (comprendre)" (Chion, "Guide des objets sonores" 25, Kane 4). Ouir, by description, does not appear to be listening at all, but instead, hearing, which Jonathan Sterne refers to as "a form of receptivity" (Sterne 96). In contrast to ouir, entendre is a mode of listening in which a person "actively selects, appreciates and responds to particular attributes of sounds" and does not seek a cause for, or external meaning in, the sound (Chion,

"Guide des objets sonores" 25, Kane 4). Entendre, it seems, is the ultimate goal during reduced listening. Unfortunately, none of the modes of listening mentioned here refer to the sense of touch. Instead, they rely largely on listening with the ears, while écouter and comprendre, may sometimes involve sight.

1.3: Connecting to *Listen*

> **lis•ten** \li-sən\ verb
>
> **1:** to pay attention to sound <listen to music>
>
> **2:** to hear something with thoughtful attention: give consideration <listen to a plea>
>
> **3:** to be alert to catch as expected sound <listen for his step>[4]

The first listed definition of "listen" is how I choose to define the term, not only for my installation, but also in life. This description allows the verb to fully encapsulate the possible experiential qualities of sound by leaving the sensory modes of experience open in stating that to listen is "to pay attention to sound." I, like Evelyn Glennie, believe that since sound is vibration, it can be heard, felt, and seen. By addressing sound in such a way, listening is *not* defined as an exclusive action in which those who are deaf or hard-of-hearing cannot readily participate, as is the case with Jonathan Sterne's and Pierre Schaeffer's descriptions, which depend solely on the ears. Additionally, the second and third meanings listed above remind us that there is more than one type of listening, a notion that is supported by Roland Barthes, Pierre Schaeffer, and Michel Chion.

As I have already stated, one of the goals of *Listen* is to encourage people that sound can be felt and seen as well as heard. In order to do this I designed an installation meant for bodily

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[4] "listen." Merriam-Webster Online Dictionary. 2009. Merriam-Webster Online. 20 October 2009 <http://www.merriam-webster.com/dictionary/listen>

experience, rather than immediate intellectual reflection. *Listen* allows visitors to feel sound directly through their bodies by inviting them to lie on a bed containing subwoofers, hear sounds coming at them from beneath their bodies and from every corner of the room, as well as see sound via a visualization projected above their heads. Both Bowman and Merleau-Ponty have shown that perception is a bodily experience, and that this experience is what allows us to know what is real without doubt (Bowman 261-262). By saturating the body with sound, *Listen* gives no reason to doubt that the sonic experience is inherently multisensory.

Sterne states that technology has affected and still affects the way we listen to sound (113, 154). However, most advances in sound reproduction technologies have been and still are aimed at listening with the ears alone, though, technology can be used to encourage certain types of listening. For Schaeffer, technology was utilized in order to encourage listening through active hearing alone in an attempt to cause the audience to pay attention to the qualities of the sounds - such as pitch and timbre - rather than their causes. In *Listen*, subwoofers, studio monitors, a computer, and a projector are employed to demonstrate that listening involves the senses of touch and sight, as well as hearing, and that attention to sound is not reduced with a multisensory approach. Unlike Schaeffer, I am not attempting to remove the participants' curiosities about the sources of the sounds. Michel Chion and Steven Connor that concealing the cause may only intensify the search for it and that knowing a sound's source does not take away from a person's ability to describe a sound according to its specific qualities (Chion 33, Connor 161). A sound's qualities exist because of its source and a person can focus on those qualities with or without knowing its cause. As a musician and sound artist, for example, I find that I never cease to question where a sound is coming from or how it is made, and, in attempting to figure out the cause of a sound, I always focus on the sound's specific qualities as clues. I have received many

questions about how my sounds were made and do not view that as a failure, but as a success since it reflects an active interest in the piece. *Listen*, in contrast to Schaeffer's goal for the acousmatic situation, is encouraging people to focus on the experiential properties of sound and to realize that the sonic experience extends beyond the sense of hearing.

Steven Connor, Don Ihde, Wayne Bowman, and Andrew J. King all write that everyday objects and events are perceived by multiple senses, even when one seems to dominate. Glennie seems to support this view in her observation that most of us do not feel high frequency sounds because the ear is more efficient in hearing them (Hearing Essay). This viewpoint fully applies to everyday sonic experiences. For example, we experience visual, tactile, and aural sound everyday. When we speak, we can feel the vibrations in our bodies, as well as hear them with our ears, and when we listen to someone else speaking, we usually watch their lips in order to fully grasp what they are saying. Additionally, by stimulating multiple senses simultaneously with sound, it is more likely that a person will pay attention for a longer period of time. This is especially important in the art gallery setting where a sound piece - which is temporal by nature and evolves over time - must contend with the sounds of the people within the gallery, sounds from other exhibits, and the surrounding visuals. One of the goals of *Listen* is to gain and maintain attention so that participants actually experience the evolution of the piece. Stimulating more than one sense with sound simultaneously is the most effective method for doing so and aids in eliminating or reducing possible interferences from other sources of sensory information.

The type of listening that I am encouraging with *Listen* is extending listening, which simply means to listen for an extended period of time. For *Listen*, that means giving attention to the sounds for more than a few minutes, which is usually difficult to do in an art gallery setting because of the external sensory noise. Any of the modes of listening - ecouter/causal listening,

comprendre/deciphering/semantic listening, reduced listening, and entendre - as described by Schaeffer, Chion, and Barthes may exist during extended listening. However, ouir, which is inattentive and merely a form of sound receptivity is not encouraged since I do not believe it is actually listening. Comprendre, in *Listen's* case, does not mean the sound is carrying an external meaning, i.e., the sound is not a medium for something else. Instead, the bodily experience of the sound itself is the message and the meaning; it is communicating the nature of its own existence: that it is vibration and that it can be heard, felt, and seen.

2: *Listen*, the Installation

This chapter begins by discussing the experiences and artworks that influenced the creation of *Listen*. It then details how the piece works aurally, tactilely, and visually. I also explain my motivations behind the design of the soundscape - which encompasses the heard, felt, and seen sounds - as well as the physical design of the entire space.

2.1: Inspiration

The inspiration for *Listen* comes wholly from personal experiences with people, music, artworks, and a single trip through London streets that affirmed my desire to produce such a piece. I feel it is necessary to mention that I had not read any of the books or articles listed in the previous chapter before I decided to create this installation. My work always originates from sensory experiences and aims itself at creating immersive bodily environments, rather than spaces for immediate intellectual reflection.

In 2003 while living in London, I volunteered for an organization called the National Deaf Children's Society (NDCS) as a fundraiser. As a volunteer, I was given the opportunity to tour their facilities and meet with some of the children who benefited from the organization's

work. A few of the children were aspiring musicians and I was fortunate enough to be able to speak with them about their experiences with sound and how they listen. They informed me that most of their listening comprised of feeling the sounds, rather than hearing with their ears. I was already aware that sounds could be felt, but I had no idea that so much information could be relayed via touch. After speaking with them, I made a conscious effort to pay attention to the bodily sensations of sound and soon realized I could feel the vibrations from my headphones on my outer ear, and that these vibrations varied greatly depending upon the instruments being played. I also began to notice just how much of the sound pollution in London resonated within my body.

Listen was also heavily influenced by my experiences with live music, and especially by dubstep, which is a type of music characterized by its use of low bass frequencies. When attending a dubstep concert, the vibrations from the music are always felt in the body, especially in the chest, stomach, thighs, and sometimes by the scalp due to vibrating hair follicles. Also, the bass vibrates the floor and can be felt by the feet if you are either barefoot or wearing shoes with thin soles. However, since the music is so loud and the bass incredibly relentless, it sometimes becomes overwhelming, nauseating, and painful for the ears. My experiences with dubstep inspired me to figure out how to harness the power of low frequency sounds, but without the pain and nausea.

Experiencing Kaffe Matthew's artwork titled "Sonic Bed," which is part of a larger project called *Music For Bodies*, in 2007 helped me finally realize how to utilize bass frequencies tactilely without causing any pain or nausea. The "Sonic Bed" (Figure 1) was in a large empty space with bright lights, a wall made of windows, and a concrete floor with white walls. It was a large wooden tank containing four subwoofers and eight mids and tweeters that

guests would step into after climbing up a couple of stairs. The artist was always present and decided which pre-recorded musical composition a guest would experience. Sadly, when I lay down, Matthews chose to play a looping track somewhat reminiscent of circus music and there were people hovering around staring down at me as I attempted to relax and listen to the music. I found this very distracting and left earlier than I would have liked to. The experience, however,

Figure 1: Kaffe Matthews' Sonic Bed at Rich Mix, London. Music for Bodies 1 Oct. 2006. <http://www.musicforbodies.net/wiki/Image:Bed_set1.jpg> , 11 Nov. 2008.

was mostly positive and the bodily sensations felt very pleasant. I talked to Matthews about her inspiration for the piece, how the bed was built, how the music was panned in a multi-channel system, and why she chose not to have any kind of sonic visualization. The magic behind pain-free tactile sound, I found out, was in vibrating some medium with carefully placed subwoofers. Matthews also told me she felt that a sonic visualization would take away from listening and instead create an experience similar to watching a film. Experiencing the piece inspired me to make a bed of my own, but I also knew that I needed to make some changes in order to avoid some of the problems I encountered, such as being stared at and the predictability of looped music, while trying to listen.

The final experience which affirmed my desire to create a bed of my own occurred during an acid trip in London a few months after visiting the "Sonic Bed." I had been walking the London streets in the cold rain listening to Radiohead, Autechre, and Skream on my MP3 player. However, instead of feeling cold and wet, my body was completely immersed in the music and I could not help but feel as though the sounds were reverberating within my entire body and keeping me warm. When I returned home, I turned on the stereo and jumped into bed. My body was still immersed in the music and upon closing my eyes the most amazing colors and figures danced along with the sounds. At this point I knew what I had to do: to create a sound bed of my own complete with a colorful sonic visualization.

2.2: Soundscape

The motivation behind the soundscape was to create sounds that were pleasing to the ears, body, and eyes while maintaining a strong connection between the sensory experience and the sounds themselves in order to ensure that listening was being promoted at all times. It was also important to create an ever-changing piece that lacked predictability, so that the soundscape would never become boring or come to an end; such an approach to sound production is more likely to encourage visitors to listen longer and possibly lose track of time. In order to do this, the sounds were always the central focus during *Listen's* production and Max/MSP was utilized for real-time sequencing, panning, and visualization.

The Sounds

All of the sounds in *Listen* are self-composed and, for the most part, designed to soothe and relax in order to encourage extended listening. There are two major sets of sounds in in the installation: low frequency sounds, which are designed to be felt, heard and seen, and higher frequency sounds, which are designed to be heard and seen only. In the Max patch, these sounds

are divided into six sound banks: three for bass and three for high-frequency sounds. There are 87 sound files in total and they are divided amongst the sound banks according to specific qualities, such as timbre, volume, length, and rhythm. For example, bass sound banks 1 and 3 consist of extended synthesizer sounds only, while bass sound bank 2 consists of rhythmic sounds, which come from synthesizers, drum samples, and bass guitar samples. Higher frequency sound banks 1 and 3 consist of single instrument tracks, which include samples of guitars and glockenspiels and the sounds of bank 1 are of higher pitches than those in bank 3. Sound bank 2 contains synthesizer samples and one glockenspiel sample. Each sound file in bank 2 is no longer than 30 seconds in length, while sounds in banks 1 and 3 range from two to 4.5 minutes.

The sounds were divided into their respective banks according to an intuitive process. I initially divided them into six different folders and then created a Max patch that would randomly select sound files from the six sound banks, while also sending all bass sound files through low-pass filters set to cutoff frequencies between 85 and 105 Hz. If a sound from one of the banks did not blend well with the other sounds, it was either moved to another bank, dropped altogether, or edited in order to make it usable. At the same time, notes were taken on what cutoff frequencies were to be used with which bass sounds according to how they felt and sounded through the bed. The range of cutoff frequencies was also chosen in order to ensure the subwoofers would have long and healthy lives. This basic testing patch formed the basis for the final patch used in the installation.

The Sequencer

The main purpose of the sequencer is to create an unpredictable ever-changing composition where the sounds go together, but do not necessary move together in any noticeably

structured musical pattern. The sounds are all sequenced in real-time and the sequencer does not operate according to a master clock. Instead, each sound is allowed to play until it reaches its end and the sequencer tracks how many times each file has been played. If the file has been played a certain number of times, as chosen at random by the program, a new sound is chosen along with a new panning pattern. The panning patterns for each sound bank are described in Table 1 on the following page and were designed so guests are able to feel the sounds moving under their bodies. There are two bass sound banks, however, which are controlled by two of the higher frequency banks in addition to the main algorithm. Each file in those higher frequency sound banks contains two channels: one audio channel (left) that participants hear and one data channel (right) consisting of high amplitude drum sounds placed according to where I would manually change a low frequency sound in a pre-sequenced composition (Figure 2).

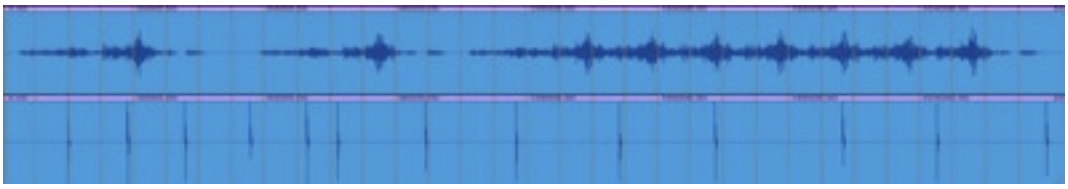

Figure 2: High frequency sound file with right channel as data channel

When one of these drum sounds occurs, the patch generates a new random number and changes the corresponding bass sound file. The purpose of this system is to link major sonic changes in a higher frequency sound file, such as a sudden rise in loudness or change in pitch, to a perceivable change in the bass sounds, while maintaining an unpredictable soundscape. However, since up to six different sounds can be playing at any given moment, these pre-sequenced changes are hard to notice.

The sequencer also decides when to mute a sound bank. Each time a new random number is generated according to how many times a sound file has been played, there is a 33%

chance that the corresponding higher frequency sound bank will be muted and a 20% chance that the corresponding low frequency sound bank will be until a new random number is generated. High frequency sound bank 1 is an exception to the rule, however, since the sonic visualization most noticeably changes when sounds in that bank are active. There is only a 16.7% chance that

Pattern	Description	Low Sounds	High Sounds
Random	A sound may exist in more than one speaker at a time. The speaker and the amount of time it remains in that speaker is chosen at random.	X	X
Delay	A sound will exist in no more than two speakers at any given moment. The sound is sent to each speaker in order, delayed in between, and then sent to the next.	X	X
Forward	A sound will exist in one speaker at a time, moving through them in order.	X	X
Backward	A sound will exist in one speaker at a time, moving through them in reverse order.	X	X
Forward/ Backward	A sound will exist in one speaker at a time, moving through them in order and then in reverse order.	X	X
Double...	A sound will move through two speakers at a time in consecutive order and will follow one of the patterns named Forward, Backward, or Forward/Backward.	X	
Silence	The sound is not played through the speakers.	X	X

Table 1: Panning Patterns, an "X" denotes pattern use

high frequency sound bank 1 will be silenced. The silences are significant to the piece since they allow participants to notice the different sounds in the composition. Additionally, this allows the soundscape to go between periods of being quiet and being quite loud, adding to the unpredictability of the heard, felt, and seen sounds, giving each guest a unique experience any time they visit the installation.

It is important to note that none of the high frequency sounds are filtered and panned to the subwoofers. This is because these sounds either have no tactile frequencies - i.e., frequencies that can be felt - or they do not contain pleasant tactile frequencies. I did initially create low

frequency sounds that were attached to each higher frequency sound file in order to mimic the existence of tactile frequencies, but this approach required the sounds in the subwoofers to move in the exact same pattern as the higher frequency sounds being emitted by the regular speakers located around the bed. If the movements of the sounds were not synchronized perfectly, the correlation between the higher frequency sounds and the bass was imperceptible. Also, since there are six subwoofers under the bed and only four speakers surrounding the bed with no similarities in their physical locations, synchronization was exceedingly difficult, and in the end, did not yield satisfactory results. Synchronization also greatly decreased the unpredictable nature of the soundscape since it required each sound file from each bank to be played with a specific corresponding file. This lack of correlation between the bass and higher frequency sounds, however, does not prevent the installation from achieving its goal of demonstrating that sounds can be heard, felt, and seen. Instead, it provides another layer of information by showing that certain sounds of a specific nature are tactile, while others are not.

Visualization

The sonic visualizer was designed to correlate directly with the sounds being heard and felt. It was important to make the connections somewhat obvious in order to keep the sounds as the central focus of the installation. I use the phrase "somewhat obvious" here because the visualizer demands a certain level of attention to be given to the sounds in order to understand how they affect the visuals.

The visualization for the higher frequency sound banks results in a series of layered waves that appear to be moving towards the listener as the sounds become louder. These waves rotate and grow in size based on the amplitude of each sound, and each sound bank is mapped to its own waveforms. The waves also change color randomly every 900 to 1200 milliseconds.

The change in color was implemented in such a way purely for aesthetic reasons and to ensure that the visual would never be static, even when no high frequency sounds were being played. Stasis was avoided since it is sometimes confused with malfunction and because it is not visually pleasing. The most noticeable change in the visualization occurs when the sounds from sound bank 1 become louder (Figure 3). These sounds are at the forefront of the visual because they are the easiest to isolate by the ears when listening to the soundscape, making it easier to map what is being heard to what is being seen. As mentioned in the previous section, high frequency

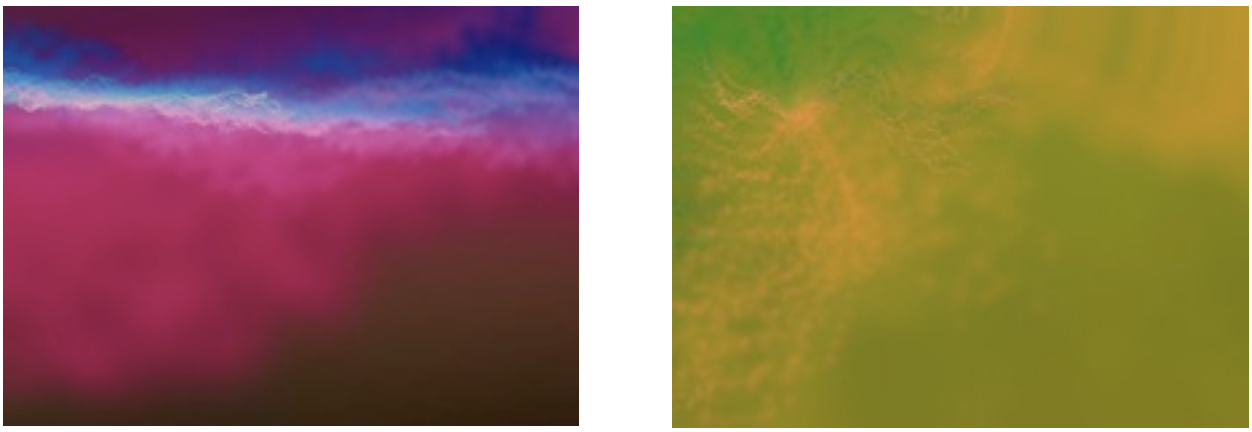

Figure 3: High bank 1 played at medium volume (left) and high volume (right)

sound bank 1 is less likely to be muted than the other sound banks since it forms the main meat of the visual. The visual changes that occur due to variations in loudness of the sounds from banks 2 and 3 are more easily noticed when sounds from bank 1 are not being played (Figure 4).

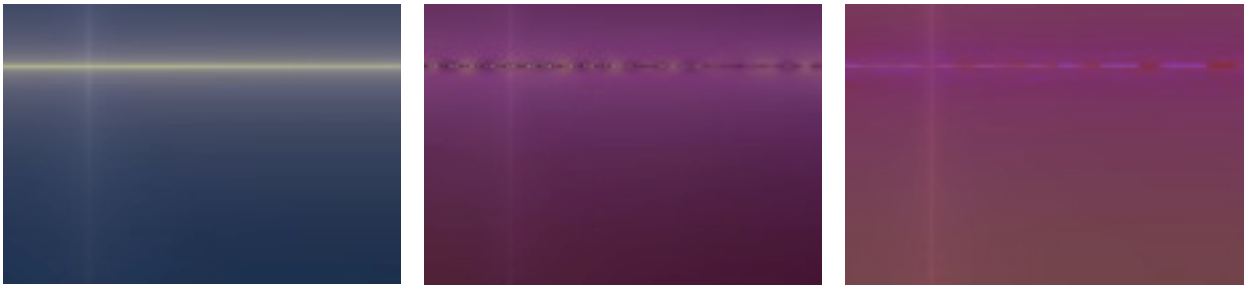

Figure 4: No sound (left), high bank 2 only (center), and high bank 3 only (right) being played

This is because they are also easier to hear and isolate from one another when sounds from bank 1 are not being played. When sounds from bank 1 are being played at the same time, the visuals attached to banks 2 and 3 add extra layers of color (Figure 5). I chose to utilize the sounds in this

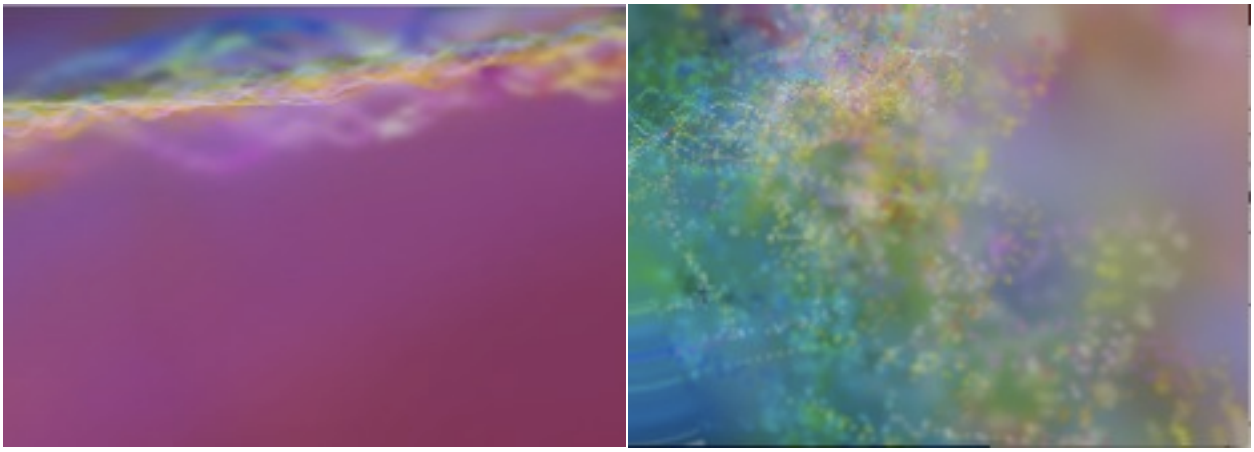

Figure 5: All high frequency banks active at low volume (left) and high volume (right)

manner to avoid creating a confusing or messy visualization that would make it difficult to connect the sounds to the visuals.

The low frequency sounds form a sort of ripple effect on the screen. The ripple effect consists of a number of black circles that move outward and respond to the amplitude of the bass frequencies (Figure 6). The effect was chosen because it resembles the movement of sound in space: it begins from a central point and then spreads outwards. Instead of analyzing each low

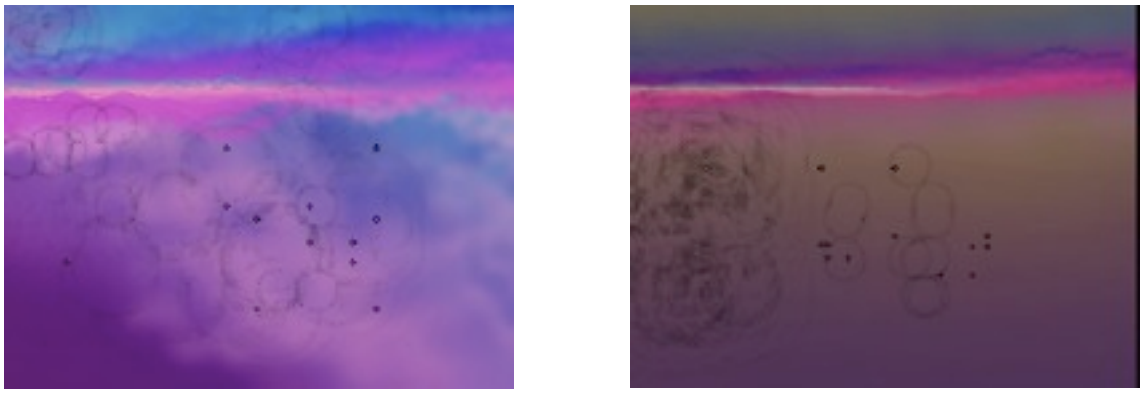

Figure 6: Area of highest amplitude frequently changing (left), concentrated in one area (right)

frequency sound bank's amplitude, an average amplitude is calculated every 50 milliseconds for each subwoofer. That value is then used to change the sizes of the circles, while also affecting the amount of time each circle lingers on the screen; louder bass creates a larger ripple effect that remains onscreen for a longer period of time than quieter bass. Also, the exact location of each circle is randomized, but constrained to the area of the screen that corresponds with the subwoofer emitting the loudest sounds. This was done in order to create a perceivable connection between the visualization and the low frequency sounds being felt and heard.

2.3: Physical Design

For *Listen*, I decided to create a sectioned off space within the art gallery in order to block out as many outside distractions, including noise and visual pollution, as possible. Oftentimes, such distractions make it difficult to listen to sound works and also result in visitors not experiencing the evolution of a piece for more than a few minutes. Additionally, it was necessary to make a comfortable space in order to encourage extended listening sessions.

Speakers

The installation utilizes a total of ten speakers, each receiving its own channel of audio. There are six custom-made subwoofers for low-frequency output and four monitors for mid- and high-frequency output. The six subwoofers allow listeners to feel the sounds moving along their bodies and the four monitors ensure that sounds approach people from every possible location in the space - there is one monitor at each corner of the bed. Also, it was necessary to create a space where more than one person at a time could experience the sounds fully, i.e., aurally, tactilely, and visually. Using a larger number speakers allowed for this to happen. The configuration of the speakers was chosen in order to stimulate as many parts of as many listeners as possible and is discussed in the next section.

The Bed

A queen-size bed was chosen to house the subwoofers in order to create a comfortable listening environment. A bed was chosen over other types of furniture, such as a chair or sofa, because lying down for an extended period of time is much more comfortable than sitting up or standing. Also, I did not want listeners to be sitting upright watching the sonic visualization since such an experience would too closely resemble watching a film or television. For this same reason, the bed's headboard was removed. Removing the headboard also meant that people would not feel obliged to lie on the bed in a certain direction and could choose to feel the bass in whatever part or parts of their bodies they so chose.

The size of the bed used was based on two key factors: it needed to house six subwoofers and allow more than one person to lie down at a time. Allowing more than one person to lie down at a time means that people could share their listening experiences with friends and family, increasing the likelihood of achieving extended listening sessions. Additionally, the subwoofers are spaced out almost evenly underneath the bed so that if more than one person is lying down, each person will still be able to feel the sounds.

The bed's mattress consists of 4" thick custom-made firm foam and rests upon wooden bed slats. Several different thicknesses and densities of foam were tested out before settling on the 4" thick firm foam. It was decided between myself and several other people that this foam transmitted the vibrations from the subwoofers the most efficiently while also being extremely comfortable to lie on. The bed slats were chosen for the same reasons.

Since the mattress was custom-made and not of a standard thickness, a mattress cover was sewn-to-fit. A solid color was chosen so that the cover would not compete for attention with the sonic visualization. The bed skirt was also sewn-to-fit since the bed had been raised up by 9"

in order to accommodate the subwoofers. A black fabric was chosen in order to conceal everything under the bed and so that it would go well with any color chosen for the mattress cover.

Figure 7: Close-up of the bed

Curtains

The curtains are made of a white silk voile fabric and were hand-sewn on site to fit perfectly around the bed. Their main purpose is to enclose the bed in a space of its own in order to block out as many visual distractions as possible and create an intimate and immersive listening space.

The color white was chosen because it is neutral and does not distract from the sonic visualization. Also, it reflects the light emitted by the projector, serving to light up the otherwise dark space with colors from the visualization (Figure 8). The silk voile was chosen for its porous texture, allowing visitors to see into the space before entering. Eye-catching pink ribbon was sewn onto the opening in the curtains in order show guests where to enter.

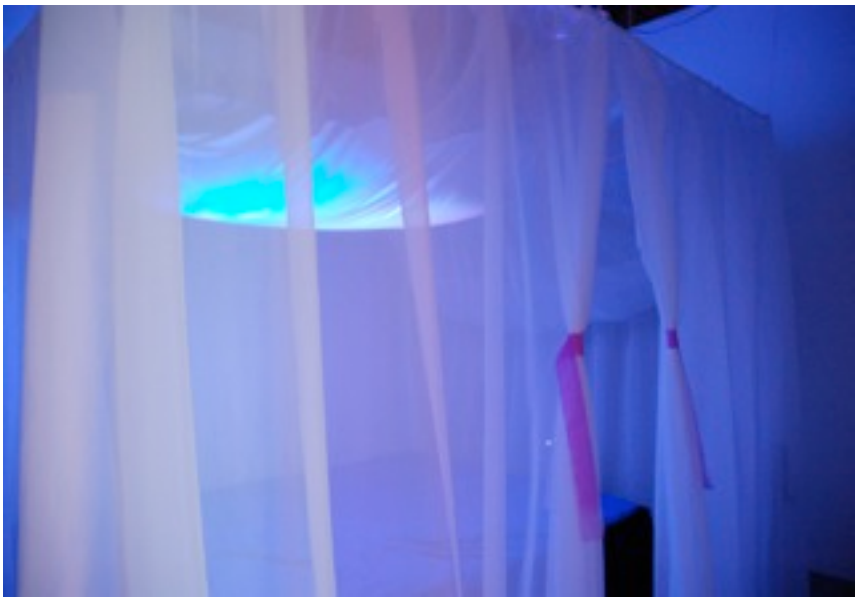

Figure 8: Curtains reflecting the blue light from the visualization

Projection Screen

The projection screen is made from spandex and designed specifically for rear projection. Spandex was chosen since it can be draped or stretched in any direction, unlike standard projection screen material. I chose to drape the spandex because I did not want a uniformly distributed visual. Due to the location of the projector, the visualization could not fill the screen and was trapezoidal in its overall shape; draping the fabric counteracted these aesthetic problems.

Figure 9: Views of the projection spandex

3: Conclusion

> **lis•ten** \li-sən\ verb
>
> **1:** to pay attention to sound with the ears, body, and/or eyes; a sonic experience that actively includes those who are deaf or hard-of-hearing

The idea for *Listen* came about over two years ago as a direct result of my experiences with music, people, art, and LSD. I initially did not know what I wanted to get out of the project, nor did I know what I wanted others to take from it, aside from an enjoyable and memorable bodily experience. Conducting research over the past year and a half aided me in realizing what the project truly is about, why it is important, and how to execute it successfully. The works of Evelyn Glennie, in addition to my work at the NDCS, inspired me to make the project about redefining listening and creating an experience that actively includes those who are deaf or hard-of-hearing. Schaeffer and Connor provided me with an understanding of the usual relationship between sight and sound, while King and Bowman influenced the overall design of the project by describing how our sensory interactions with the world affect our perceptions of events and objects.

I believe the installation achieved its goal in demonstrating the multisensory nature of sound while also encouraging extended listening by literally *saturating* the listeners' bodies with sound. Many of the visitors expressed they wished to have stayed longer and several even said they spent at least twenty minutes in the space. Additionally, one visitor's response to *Listen* expressed that this multisensory approach to sound production does create a more inclusive listening space when he wrote:

> I lost my hearing in my right ear eleven years ago, and since then, my experience of sound has been somewhat limited and frustrating. Yesterday, I got a chance to

experience your sound environment at the MAH, and it was a delightful revelation as well as the fullest hearing experience I've had since my hearing loss. What I learned from the process was how hearing can be enriched by other senses, particularly feeling and sight. In my classes, I do some occasional talking about synesthesia, but your environment was a vibrant demonstration of it. Interestingly enough, lying on your sound bed, I slipped into a hypnogogic state for a few minutes (or more - I lost track of time). I was somewhere between sleep and waking awareness, and I felt quite alert when I left your tent. Thanks for the experience.

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