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Perception of Music in the Deaf and Hard of Hearing

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Abstract

This paper will focus on how deaf and hard of hearing people perceive music. I will be taking a look at the statics in hearing loss in the United States. There are different degrees (thresholds) of hearing impairment ranging from partial to full. Case studies have shown there is not a big difference in how deaf and hard of hearing people and normal hearing people listen to music. Some patients are able to acquire cochlear implants that often help with hearing, and others use vibration to feel the music. These vibrations give the deaf and hard of hearing people the opportunity to feel the tone, pitch, timbre and volume. Deaf concerts are now growing as a way to help the deaf community experience music.

Perception of Music in the Deaf and Hard of Hearing

Introduction

People take the sense of hearing for granted. Nobody takes into consideration of how much the sense of hearing plays a major role in our everyday lives. Listening to music gives us the chance to experience and express our emotions. What about people that are deaf or hard of hearing? How do deaf or hard of hearing people perceive music? Do they hear what we hear? Society can take a negative perspective toward deaf or hard of hearing people by casting them out and not acknowledging their existence, but many people who have lost or never had hearing, like Evelyn Glennie, have created music. Glennie was able to learn and make a career with music. A deaf composer, Beethoven, was scared of being shamed for his hearing loss, but he was still able to express himself through music. People with the ability to hear think music has to have a tone associated with it to be consider as music. In *Touch the Sound* Glennie being a percussionist she says, “you imagine for percussion players to just strike things” she tries to change how people her music and it is not as plain and simple as it may sound. She says “it’s trying to find the sound way, way, way, down under the surface.” In *Touch the Sound* Glennie describes this by putting out a finger and showing the audience that sound is not above the finger (the surface) but below the surface to find the “sound.” Banging on the head of a timpani may “sound” like music because it is above the surface, but not all music has to be heard through the ear.

For this research paper, I was able to explore how deaf or hard of hearing people perceive music whether it’s for entertainment, meditation, or expression. Deaf or hard of hearing individuals can learn to hear music without having to listen to a sound. Every

individual has a different hearing threshold that could cause pleasure or discomfort, and both musicians and non-musicians that are deaf or hard of hearing all perceive music differently but ”hear” the same.

Deaf Statistics

According to the National Institute on Deafness and Other Communication Disorders (NIDCD), hearing loss in the United States has dropped slightly from 16 percent (28.0 million people) between 1999-2004 down to 14 percent (27.7 million people) between 2011-12 in the age group of 20-69. The number difference may not seem to be a drastic difference, but that is about 300,000 people less that do not have hearing loss. This does not mean hearing loss is being cured, however; out of every 1000 children, two to three are born with a detectable level of hearing loss. About 18 percent of adults between 20-69 with hearing loss reported working in “loud-noise working” environments for five years or more, and five percent of adults with hearing loss worked in a “non-noise working” environment (NIDCD). Simple standard hearing examinations show that one in eight people have hearing loss in both ears (NIDCD). The statistics are not a sign hearing loss is becoming a larger issue in the United States. The number of deaf or hard of hearing people may be shrinking, but the number of people unaware or willing to help these people learn and play music is not growing either. These deaf and hard of hearing students may be looking up to other accomplished composers and performers for encouragement.

Deaf Composers and Performers

One famous deaf composer was Beethoven. Beethoven was not always deaf, but he eventually started to lose his hearing at the age of 26 (Biography). His lack of hearing did not stop him from creating music; in fact, some of his more well-known pieces were created while he was losing his hearing. Beethoven tried keeping his hearing loss a secret as he could not push himself to tell people, until he reached the age of 44. At this age he admitted he had complete loss of hearing and wrote to one of his closest friends, “For almost two year I have ceased to attend any social functions, just because I find it impossible to say to people ‘I am deaf.’” Beethoven was ashamed of himself and thought being deaf would take a toll on his career. Beethoven went on to say in his letter “If I had any other profession, I might be able to cope with my infirmity: but in my profession it is a terrible handicap.”(Biography)

Beethoven had several decades of practicing and listening to music notes and obtaining as much musical knowledge as he was able to before completely losing his hearing. The slow deterioration of his hearing gave him the opportunity to learn to feel the music notes instead of hearing the music notes. Beethoven was able to achieve this skill by sitting in front of a piano, placing a pencil in his mouth and touching the other end of it to the sound board of an instrument to feel the vibrations of the notes (*Biography*). The notes Beethoven used in his pieces changed during the start of his hearing loss from often using higher pitched notes to lower pitched notes that he was able to hear more clearly (*Biography*). The best example of this approach is *Moonlight Sonata* written in 1801 that mostly used lower notes throughout the entire piece. He did return to using higher pitched notes towards the end of his career/life. At that point he

was completely deaf and was using higher pitched notes through his remembrance. An example of this is the Ninth Symphony written in 1824.

Unlike Beethoven, a performer in *Touch the Sound,* Evelyn Glennie started to lose her hearing at the age of eight and lost it completely by the age of 12. This change of lifestyle did not affect Glennie's career, but it did cause for her to be an outcast by most band directors and teachers. Glennie mentions in the documentary about her, *Touch the Sound*, that she was denied music lessons. Glennie ended up meeting a music teacher that decided to help her but told her that she would be learning with him how to feel music. Instead of using pencils and pianos, as Beethoven did, to feel notes and patterns, Evelyn Glennie used drums to feel sound. Glennie decide to use this skill of hers to teach other deaf and hard of hearing kids. She has her students place their hands on the base of a drum as she strikes it each time with a different stroke so that the deaf person's brain will notice a pattern or difference and create a sense of sound with the vibration the student feels from every strike of the drum. Evelyn Glennie started her professional career in 1985, and her career continued to grow as she has become the first solo percussionist to make a full time career (Polar Music Prize). She has released more than 30 solo albums. Through her experiences she has made her own vision – "to Teach the World to Listen" (Polar Music Prize) Glennie has received many awards one being The Polar Music Prize in 2015, and she was part of the 2012 Opening Olympic Games in London. She has also been honored by Queen Elizabeth (Polar Music Prize). Glennie's efforts to change the acceptance of deaf and hard of hearing people in schools have given encouragement to current generations to pursue

music. In *Touch the Sound,* Glennie encourages all listeners to treat our [bodies as a resonance chamber and that we live in a universe of sound.]

Brain plasticity

Deaf people obviously are missing one of the five senses, so the brain automatically tries to adapt and uses different parts of the brain to work together to make up for the loss of hearing. Surprisingly enough, if a person loses one sense the rest of the senses are improved through brain plasticity (Tokuyama). A metaphor to think about brain plasticity is driving on the road and having one section of the road closed off (representing the loss of hearing). When that section is closed off, a detour is required to get to the other side and the destination. Hearing is similar in that people with hearing loss will be able to distinguish each sound even though the sound may need to take a different path in order to get to the same destination. To be specific, for deaf and hard of hearing people, the auditory cortex is closed off, and the other senses expand their paths so the sense of hearing can be heard through touch (Neary).

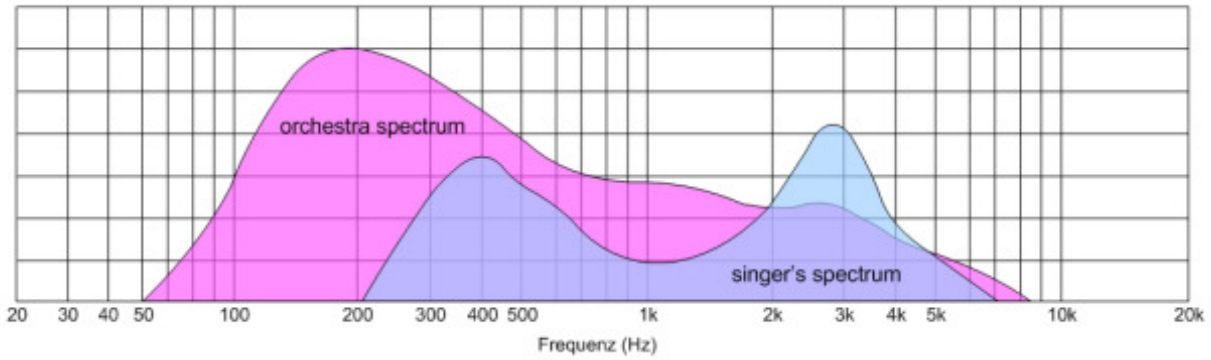
The sensory cortex focuses on touch; it controls tactile feedback, which provides feedback on the low frequency vibrations (Elaine). Ironically enough listening to music/sounds at a high volume can be damaging to a person of hearing, but for people that are deaf it is easier for them to “hear” louder sounds. The auditory cortex is mainly responsible for the ability to hear (Elaine). The nucleus accumbens and amygdala are a three-in-one part of the brain and are responsible for connecting music with emotions (Elaine). Deaf and hard of hearing people do not have their auditory cortex functional, and to compensate the sensory cortex has to widen its functionality on tactile feedback

through touch. The sensory cortex has to create another path between hearing and touch to bridge the two senses together. Base of the vibration received from the sensory cortex the nucleus accumbens and the amygdala can connect the vibrations felt with emotions from a musical piece whether it is harsh drumming to intensify a piece or a softer more melodic line to soothe. The “listener” will be able to get a sense of what the music is going for and sounds like. Overall, losing one sense enhances and improves the other senses.

Music Wellness

Music has been shown to have a direct link with a person’s well-being. For example, social development and language are influenced by music (Hiraga and Hansen 2). The advancement of technology within a five-year span helped Rumi Hiraga and her team create an audio-based game for smart phones and tablets that was created with the intended purpose of helping hearing impaired people listen to music more attentively. The technology in 2010 was only able to measure hearing loss in people, but not capable of measuring a deaf and hard of hearing persons perception of music. Improvement in technology helped Hiraga how to determine a deaf or hearing impaired person’s perception of music through applications. Hiraga took notice that the deaf and hard of hearing people were not ones to actively seek out music for entertainment. To combat this issue this audio game was developed at the Tsukuba University of Technology in Japan for Android devices and was called *Music Puzzle*. The game enforced focused listening to encourage listening to music. An experiment using this game compared hearing impaired and deaf people to people without any

hearing impairment using three categories: simple speech recording, instrumental music, and a combination of the two. The experiment showed both groups perceiving music the same but through different styles of listening. The hearing impaired group perceived every sound the same in Music Puzzle. The game was not able to give a distinct difference of sound to the deaf and hard of hearing while playing the game because of this it took the deaf and hard of hearing longer to complete the game (Hiraga and Hansen 4). They started listening to every sound evenly allows the hearing impaired to take their time in consuming the sound before moving forward; they have to focus on what is being played to be able to distinguish the difference. People with hearing can obtain the sound differently so they are able to differentiate each distinct sound immediately to be able to move forward as fast as possible. *Music Puzzle* had a "play solution" button and a "cheat button" that were frequently used by the hearing impaired (Hiraga and Hansen 5), which goes hand in hand with consuming before moving forward, by listening to the sound more attentively and thinking about how each sound fits in. Hiraga believes "the task of getting the order right seems to get priority over the finer details" in reference to the hearing impaired "cheating" to get the correct original sound. After concluding the experiments, it was found that hearing impaired listeners prefer music rather than the other sounds tested, which were speech and mixed. With these findings, the researchers believed that nonverbal sound sends out less information and makes it easier for the hearing impaired listener to grasp (Hiraga and Hansen 6). Musical sound has different spectral qualities than speech sound; it has a broader frequency range (see fig. 1).

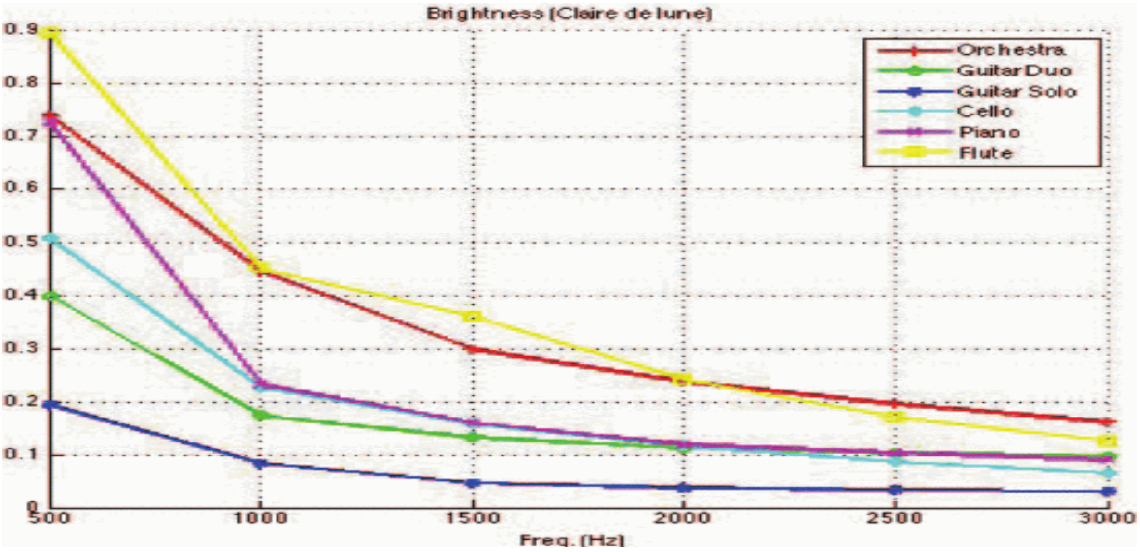


The figure above shows the hearing spectrum in humans with 20 kHz being the max and 20 being the minimum. Hearing impaired people have a lesser ranger of frequencies they can hear, which is why musical sound was easier to consume as a musical ensemble is on the lower end of the spectrum until it comes to timbre.

Timbre feeling

This brings up two questions: can hearing impaired people hear a difference in timbre, and how can music sound appealing to the hearing impaired? Being able to only listen to lower frequencies or feel vibrations makes it harder to consume the whole picture. Timbre is defined by the American National Standard Acoustical Terminology as "that attribute of auditory sensation in terms of which a listener can judge two sounds similarly presented and having the same loudness and pitch as dissimilar" (Hiraga and Otsuka 2103) In other words, timbre is specific to instruments; for example a flute and cello could play the same note (middle C), but both have a different distinct sound because of the frequencies each different instrument puts out. Just as hearing impaired people perceive music differently, they also perceive timbre differently. Hiraga and her team gave a group of deaf and hard of hearing different musical phrases that consisted of different timbres. Some of these phrase were easily distinguishable to the deaf and

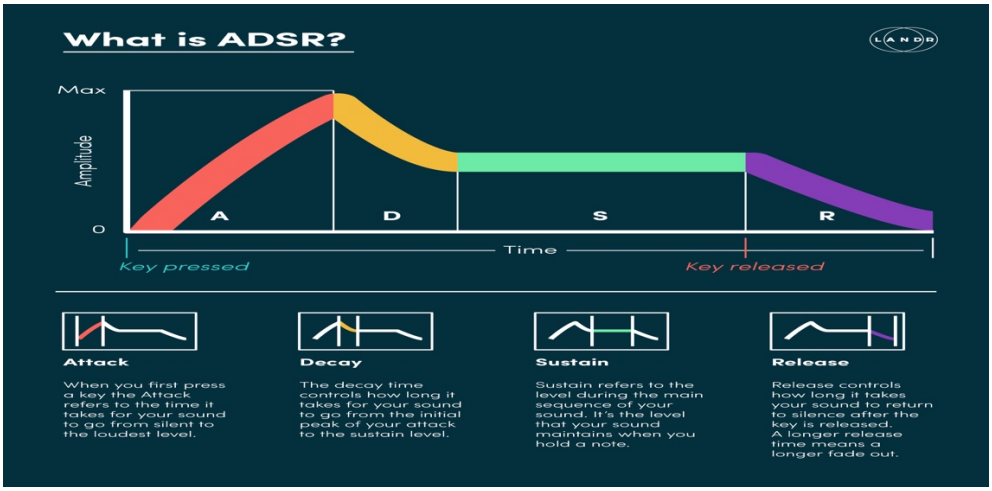
hard of hearing, but some timbres were more difficult to distinguish for the deaf and hard of hearing. An experiment Hiraga conducted found that similar timbres are “better perceivable when the number of similar timbres is larger” (Hiraga and Otsuka 2106).



This curve above from this study is called “The Brightness Curve.” Hiraga explains the curve:

> When a frequency value is assigned, the ratio of energy above the frequency is returned…The envelope often referred to as “ADSR envelope” in sound engineering, affects the timbre. “Attack time,” the first term of the envelope, starts from the time where there is no sound and ends at the point where the sound reaches full volume“ (Hiraga and Otsuka 2107).

ADSR envelope is a graph that shows the amplitude instrumental sound with A-attack, D-decay, S-sustain, and R-release. (Seydel) (fig. 3).



The brightness curve (fig. 2) shows the highest average attack slope, spectral centroids, and the roll off frequencies of sound. The attack is on the y-axis with amplitude height and decreases according to the frequency values, which are on the x-axis. The orchestra and flute line have a similar energy force helping deaf and hearing impaired people to distinguish the two. The opposite to this is the “guitar duo” and “piano” line both have a different attack peak but they practically have the same energy force at the highest frequency level, 3000 Hz.

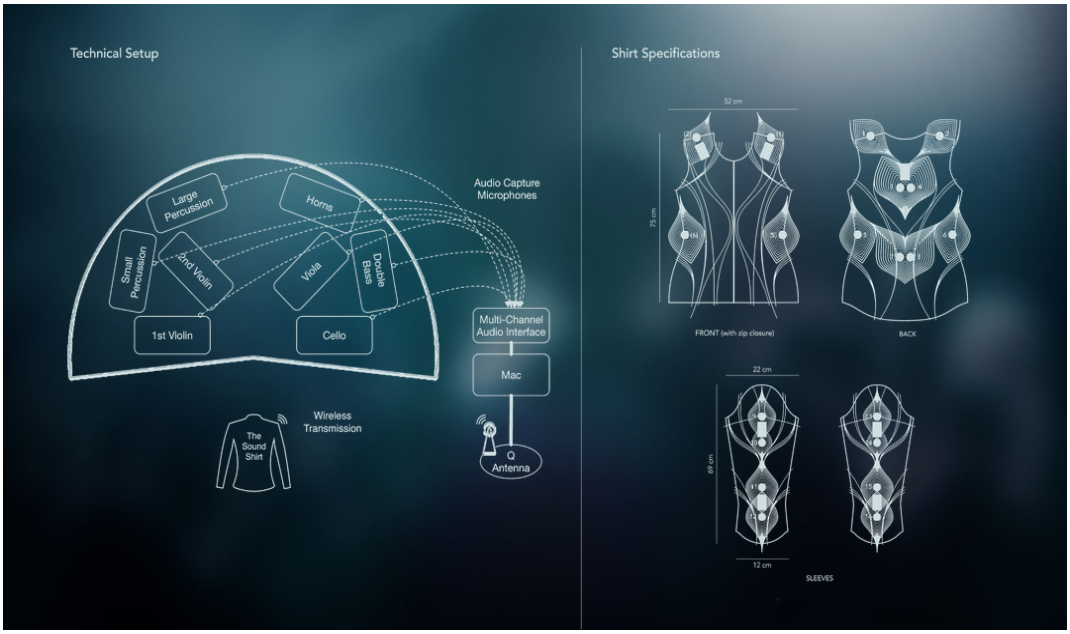
What Is Being Done to Help the Deaf/Hard of Hearing Community

A musician by the name of Wendy Cheng started the Association of Adult Musicians with Hearing Loss (AAMHL). AAMHL is a nonprofit, community-based agency that provides advocacy, education and support to adults with hearing loss. Cheng mentions she will never become a professional on viola as she would like to be; due to her hearing impairment, she can’t achieve the precision of intonation needed to move forward. Cheng’s primary instrument is the viola and is sadden as she stated “I doubt I’ll ever becoming a professional on the viola due to the high intonation requirements need to get to that level” (Cheng). Cheng has bilateral cochlear implants,

which are implants placed behind the ear under the skin that causes electrical stimulation to the auditory nerve whenever there is sound present and signals the brain. These signals stimulate the brain's auditory nerve which make the ears "hear" exactly at the same time. People with the ability to hear don't have these implants, so instead of hear any type of audio at the same time one ear will receive audio faster than the other. Cheng mentions her success in completing a required aural ear training sequence for undergraduate music majors, and hearing impaired people are able to learn music and use it to play in orchestras or bands successfully (Cheng). Cheng was nine years old when she began to lose her hearing, and as she grew up she was not given attention to pursue music as a career (Cheng). Cheng's loss of hearing did affect the way she played music, but she was able to develop skills to fix the intonation she was unable to hear. Deaf and hard of hearing music students do not learn or understand music differently from people with normal hearing, but they do have to listen differently to follow and stay in tune with a band. Cheng mentions that she did not have to focus on hearing to get better at playing the viola; instead, she had to develop a new skill: kinesthetic awareness. Hearing impaired students can develop this skill by listening/feeling for resonant notes. For Cheng, because she played a string instrument, she was able to feel the notes on the fingerboard, but she also had to pay attention to the amount of weight that was being put on the bow arm to obtain the correct tonality of a note. Cheng was diagnosed with flat loss which means she was only able to hear frequencies on the lower end of the spectrum. Flat loss is the "best" kind of hearing loss for musicians to have (Cheng). Flat loss lowers the volume of all frequencies instead of limiting the frequencies that are able to be heard. Cheng was aware and stated "I grew

up not receiving a lot of encouragement to purse music…this was unfortunate because I gravitated more towards aural music than any other activity" (Cheng) this was a continuously issue she went through in her younger life because of her deafness, but so has Evelyn Glennie. Each of these women has pushed forward and encouraged musical teaching and listening in both children and adults.

Technology has also helped deaf and hard of hearing people hear. A company called Cutecircuit developed a shirt called "The Sound Shirt" that will help deaf people feel a live symphonic concert on their skin. This company believes that every live concert should be an experience shared equally by everyone (Cutecircuit), and with this shirt they believe they have accomplished that vision. The shirt contains 16 micro-actuators embedded in the fabric that receives music in real time with each actuator linked to a different part of the orchestra.



The image above shows what parts of the shirt are connected to the parts of the stage. This shirt provides a “series of haptic (touch-like) sensations across the torso of the person wearing the shirt” (Cutecircuit).

In conclusion, there have been deaf composers and performers in both the past and present that have made it possible for future generations to learn the skill to hear music through touch. The brain helps deaf and hard of hearing people to connect the missing dots need to experience music like the rest of the world. Studies have proven that these people perceive music differently from those with the ability to hear, but they “hear” the same sounds. Building on the relevant research, many people are creating more effective opportunities to allow deaf and hard of hearing people to experience music and not be excluded from the social value it can provide.

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