Bone conduction technology impact

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The world’s sounds can be perceived acoustically and as vibrations. Acoustic transmission, also known as air conduction, is sound that travels through the external ear. Through bone conduction, sound waves “ are transmitted to the inner ear by the cranial bones without traveling through the air in the ear canal” (Oticon Medical). Audiologists take advantage of these two principles when creating hearing aids for the deaf and hearing impaired. Traditional acoustic air conduction hearing aids treat and amplify noise appropriately to the user through the ear canals. Unlike air conduction, bone conduction involves bypassing the ear and resting on the bony prominence of the skin. Vibrations travel through the bones and into the cochlea where sound, including acoustic, is interpreted. Despite air conduction succeeding bone conduction in the hearing aid industry, bone conduction technology offers many potential uses and enhanced safety. Inventions such as bone conduction sunglasses and headphones allow users to immerse themselves in music without muting environmental sounds. Their ears would be open to hearing car horns and hollers, thus preventing many injuries and deaths that were initially caused by earphones blocking surrounding sound (Hsu, University of Maryland). Moreover, scientific studies have also supported the concept, that bone conduction technology causes less damage to the ears than ear buds (Monks, The Audiology Foundation of America). Bone conduction oriented hearing, as compared to air conduction oriented hearing, is a form of sound transmission that has greater potential for a wider variety of uses.

Air conduction oriented hearing is the standard sound transmission of the anatomy of ears. Sound travels through the ear canal, and next translated into vibrations by the eardrum. These vibrations then transmit through three tiny bones called the anvil, hammer, and stirrup in the middle ear which amplifies the sound. Lastly, the sound enters the cochlea lined with fluid and thousands of tiny hair cells that will transform the sound vibrations into electrical signals for the brain to interpret. Acoustic hearing aids have “ technologically advanced tremendously with each aid handling miniscule microphones, processors, and receivers” (Townsley). Sound is picked up through the microphone then processed into the specific hearing range of the user. For example, an air conduction hearing aid would pick up sound and strengthen high or low pitched noises to fit the hearing of the patient. Air conduction hearing aids benefit individuals suffering from cochlear damage, where the hair cells that stimulate hearing certain frequencies to the auditory nerve have deteriorated.

Bone conduction oriented hearing involves bypassing the external ear and transmitting sound via the bones of the human body, preferably the skull. There are two types of bone conducting hearing aids, bone conduction bands and bone anchored hearing aids. Unlike bone conduction bands, bone anchored hearing aids involve penetrating the skin by surgically implanting a titanium abutment to the mastoid (Oticon Medical). “ A microphone sound processor latches to this implant in order to directly transmit sound as vibrations to the skull” (Townsley). Bone conduction bands consist of a microphone, processor, and elastic band. These two mechanical components latch to the band that is worn around the patient’s head. The bone

conduction hearing aid provides a solution to those with profound hearing loss with sensorineural damage, single-sided deafness, or atresia, a birth defect where individuals are born without an ear canal. This option of hearing has gained most recognition from its ability to help the common condition, single-sided deafness. Individuals who suffer such, have an “ impaired ability to detect the direction of sounds and to separate background noise to make sense of speech” (Townsley). To avoid feelings of social isolation and exclusion from this, patients use specifically bone conduction hearing aids to regain consciousness of the position of sound and its source. Moreover, bone conduction hearing aids are used during hearing tests to uncover whether a patient suffers external or sensorineural ear damage (Townsley).

The use of air conduction is constant for those with normal hearing. Individuals with unobstructed external ear pathways and normal sensorineural function will automatically hear all sounds acoustically. Air conduction technology encompasses all appliances that allow individuals to hear sound. These include hearing aids, speakers, headphones, speaker implanted into cars and computers, etc. A magnitude of technology utilizes air conduction sound transmission, but the functional purpose of creating sound has not since presented any different potential uses.

Though bone conduction technology has been around for centuries, modern developments have shown the magnitude of its use. Ludwig Van Beethoven, born in the late 1700s, utilized sound bite principles to compose music after he threw a temper tantrum, fell over, and stood up to realize he had lost all hearing. By biting on “ a special rod attached to the soundboard on a piano

that he could bite”, Beethoven allowed musical vibrations to “ transfer to his jaw to increase his perception of the sound.”(Ealy 143) Bone conduction technology has since advanced as a safety precaution for secret military operations and daily activities. British Aeorspace Systems constructed bone conduction inspired helmets “ allowing soldiers to hear comms over the loudest battlefield noises” and “ bone phones”, ear pieces to use for silent communication (Wood). The documented navy SEAL raid that killed Osama Bin Laden stated the vitality of “ bone phones” for that mission (Owen). The fundamentals of the “ bone phones” have shifted to also accomodate citizens. In a study conducted by the University of Maryland, it concluded that 70% of all transportation accidents involving earphones led to death. The creation of bone conduction headphones henceforth came about. To promote situational awareness, users can listen to music through a headpiece that firmly sits transducers in front of the ear, on the cheekbones. Hollers and honks from surrounding cars will be heard by the user because their natural hearing sense is no longer depleted by an ear phone. Moreover, certain cell phone companies have begun to develop a bone conduction microphone. For busy men and women who must take calls on the go, but struggle to make their responses apparent and environment non-apparent to their recipient, this speaker will directly pick up the vibrations of their voice simply by resting on their head and transferring it to the phone to process and link to the recipient end. These products have been manufactured into articles of clothing that can be worn on the head such as baseball caps and glasses. These developments prove that bone conduction technology is advancing into uses beyond the hearing impaired.

Additionally bone conduction has been utilized as a marketing gimmick. In the summer of 2015, a Kentucky Fried Chicken (KFC) in South Africa hoped to increase its relevance through creating a modern indoor entertainment system. With the growing number of unsigned musical artists and the fact that KFC was not a record label, the fast food chain decided to create “ record tables” (Chase and Brandt). They took advantage of bone conduction principles by engineering tables where customers would place their elbows on the table and cup their hands on their ears to get a musical treat (Chase and Brandt). This high-tech addition yielded outstanding results in business “ increased the average dwell time of the customer in store and widespread social media hype about the innovation” as well as “ overwhelmingly positive feedback about the experience” (Chase and Brandt). Bone conduction has created a new form of advertisement in an exciting and interactive way that it has been introduced into the public transportation systems in Munich and North Rhine-Westphalia. In 2013 Sky Go, a mobile streaming service, enhanced the glass windows of trains to transmit messages through bone conduction to passengers who lay their head on the window. This glass emits “ high frequencies that the brain processes into words heard by no one else on the train” except for those who also have laid their head on the window. Information on weather, music, and advertisements transmitted into the commuters’ heads. Despite a Sky Go representative, Susanne Keyzers, claiming passengers “ were surprised but enjoyed this new form of advertising”, on camera reactions prove that bone conduction may not be the best fit for transit advertisements. Several passengers looked shocked then angry for not being able to shut their eyes for nap while leaning against a window (Dicker). Though bone conduction has introduced an entirely new

dimension to the world of advertisement, manufacturers must recognize the line between voluntary interaction and invasion of privacy. For its invasive characteristics, the talking window has opened an aspect of marketing known as guerilla advertising.

Outside of practical and marketing use, bone conduction technology has also made strides in the recreational and comfort fields. Aquatic sportswear companies such as FINIS Incorporated have developed underwater headphones, dubbed the Neptune headphones, through the use of bone conduction principles. This recent innovation “ mimics the way whales and dolphins communicate underwater” (Smith) by transferring sound as vibrations from an mp3 player to small pieces latched over the cheekbones. The music plays as if inside the user’s head, giving this new headphone a “ surreal” (Smith) reputation. Another company that hoped to take advantage of bone conduction’s potentials uses was Google. In 2013, Google created its first Google Glass prototype, a glasses gadget that could provide information to its user instantly by being closer to the human senses (Warr). Essentially computer glasses, these gadgets included a bone conduction speaker to transfer information to the user regarding camera use, internet information, map directions, or music. Due to its still continuing development, the Google Glass has never been sold to the public. The head Glass coordinator, Tony Fadell, spoken out that several versions of Google Glass are being made for different situations. Currently, an Enterprise Edition exists which aimed at businesses in healthcare, manufacturing, and energy industries. And beyond that, bone conduction has become a player in the comfort industry. Integrated Listening Systems built a Dreampad bone conduction pillow in

2014 (Kooser). The Dreampad consisted of several bone conduction speakers fitted into all sort of pillows to help sing users into a pleasant slumber. Their target audiences encompassed those diagnosed with insomnia and those who wish to listen to music or audiobooks to sleep while their bed buddy may prefer complete silence. By using a very subtle sound bone conduction based approach, the Dreampad soothed people to sleep. The expanse of bone conduction technology from underwater workouts to inducing sleep, highlight its many uses as compared to air conduction technology.

Not only does bone conduction offer a new take on leisure items, it also has become a vital part of entertainment experiences for the deaf community. Recently, the world famous DJ Martin Garrix and the soda brand 7Up teamed up to create a “ Concert for the Deaf”. “ In cooperation with Fake Love, Martin Garrix and 7UP created a concert for the deaf that utilized a variety of tactile experiments and features to give participants the experience of feeling their music” (Meadow). The project involved the construction of numerous vibrating speaker cones and padded flooring, revolving around bone conduction principles, so that the deaf attendees would be able to interact and physically feel the music around them. “ Visuals were paired to water experiments that the music itself brought to life, creating a completely seamless and encompassing audio and visual experience”(Meadow). The designers of this concert created plexi-glass boxes with a thin base level of water. Attached to the bottom, were lights and vibrating speaker cones that vibrated the water at different frequencies. These vibrations accompanied the visual projections and ultimately the beats played by Martin Garrix. “ Some attendees were also fitted with Subpac-like backpack systems that

conveyed bass throughout the body” (Meadow). The project thoroughly utilized bone conduction principles in order to gear a musical concert to an all-deaf audience. Though the vibrations could not be perceived as sound because of the audience’s complete auditory deafness, the vibrations could be picked up by the bones of the human body in rhythms recognizable to the brain. And the results succeeded expectations. People of all ages who had never heard a sound in their entire lives or for many years enjoyed a night of electronic music and dancing to beats that literally flowed through their bodies. Bone conduction technology can create new inventions, but it can also be a fundamental principle in creating life experiences that yield lasting amounts of joy and happiness.

Some may argue that although bone conduction technology offers a spectrum of uses, its quality does not permit it to reach full potential. Many online reviews of bone conduction inspired works such as Google Glass or the Dreampad are negative. Users usually feel dissatisfied with the vibrational sound being muffled and unclear, and for certain developments, users find them physically unappealing. A recent popular review on the Dreampad gave credit for its impressive technology but derailed it for its limited application (Lovejoy). It also detailed the false sense of the Dreampad’s efficacy by discussing its limited research. The Dreampad advertising site claimed to have had performed a study with Columbia University. However, the study in its entirety included twenty-nine people with only ten actually using the Dreampad pillow. Additionally, Lovejoy noted that the bone conduction music “ was almost painful to listen to” and that the given podcasts “ were both muffled and quiet even at maximum

volume”. But, this demonstrates only one heavily studied and documented opinion. For the Google Glass, a plethora of complaints and criticisms arose. Initially this invention held highly regard, being named one of TIME magazines “ Best Inventions of the Year” as well as receiving an astounding number of pages in several popular magazines, being referenced in popular television shows, and even premiering on the runway for New York Fashion Week. But within a year it began its descent into infamy. Its initial exclusivity made it far more desirable and idealized in society. Once technology reviewers got a hold of a pair and both tested and deconstructed it, Google Glass met its downfall. Major criticisms revolved around the weak bone conduction sound system, abysmal battery life, its plague of cyber-bugs, and limited use (Bilton). Google Glass recording abilities made it banned from bars, movie theaters, and casinos. Despite bone conduction technologies good intentions to thrust humanity into the possibilities of the future, its overall quality has kept it from truly progressing.

Clearly, bone conduction offers a great variety of uses. However, it is not necessarily the better option compared to air conduction both in quality and health. As stated earlier, bone conduction inventions have faced excessive criticism concerning the sound quality and whether or not it is effectively portraying sound to those with hearing disabilities. A common misconception, is that bone conduction is a less risky form of headphone and therefore healthier. Headphones that are bone conduction oriented will pass sound through the skull and straight to the bones of the middle ear to the cochlea. Likewise, sound that is transferred through air conduction will pass through the ear canal, ear drum, middle ear bones, and the cochlea. Either

way, both still put the hair cells of the cochlea at risk when playing loud music. Listening repeatedly to loud volumes will lead to damage of the cochlea no matter what kind of hearing technology.

Air conduction and bone conduction principles have led to a vast amount of advancements in many aspects of life; innovations in hearing, traffic safety, the work place, and even personal comfort. The limits of acoustic sound application stem from the primary purpose of giving off sound for those of normal hearing. As compared to bone conduction, air conduction does not offer as many potential uses or variety of applications. Through the developments of bone conduction headphones, military helmets, glasses, tables, and even pillows one can truly see the possibilities of bone conduction. And beyond tangible objects, bone conduction has played a role in ensuring the safety of pedestrians and bikers and creating impactful memories of hearing and feeling music. Although there are currently many shortcomings, I believe that bone conduction technology has the promise of making countless technological advances in the future. Bone conduction oriented hearing, as compared to air conduction oriented hearing, is a form of sound transmission that has greater potential for a wider variety of uses.

Bone conduction technology has massively expanded in its uses. Now reaching far beyond the hearing aid market it was originally intended for; headphones that help ensure safety, and pillows that play silent music to help the user fall asleep. It has greatly transcended the cell phone company market by offering new ways to add clarity and efficiency to calls. Bone conduction has even reached the battle field, by being implemented into military helmets. Soldiers can now clearly receive and understand orders

from their commander over the blasting sounds of cannons, guns, tanks, or aircrafts. It has also become greatly useful in secret operations. By having a slim bone conduction piece attached to the arm, agents are able to communicate silently in the most physically unobvious way: without any headpiece or audible sound. And after defense, bone conduction has been monumental in helping the deaf hear. In a recent concert and commercial put on by 7 Up Soda, the public was able to see how bone conduction speakers and platforms were able to transmit sound to deaf individuals so that they may enjoy a full on visual and physical musical experience. But despite its success and high regard by society, it does have its own shortcomings. Users of bone conduction products have found much fault in its quality as well as its overall efficiency. Reviews on the Google Glass and Dreampad yielded not the most gentle remarks. Critics also point out the use of bone conduction as guerilla advertisement, specifically in the talking window campaign in western Europe. Its invasion of privacy and improper application by Skygo have somewhat downscaled the popularity of bone conduction. However, seeing the amount of things it can do and accomplish, the multiple inventions made, I have believe that the future of bone conduction technology is promising. The potential uses bone conduction technology has are boundless, and I believe will be vital in the development of future inventions and discoveries.

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