Promoting Hearing Loss Protection and Conservation Techniques among MTSU Sound Engineers

by Micah Ediger

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Abstract

The goal of this thesis was to spread awareness about the risks of hearing loss in the live music industry to sound engineers at MTSU and encourage them to practice proper hearing protection and conservation techniques. To accomplish this, I did research about both hearing loss and hearing conservation techniques and used that information to create a series of flyers and social media posts designed to encourage students to protect their hearing. Additionally, I interviewed professionals in the industry as well as current MTSU audio production students to determine their views and practices regarding hearing protection.

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Introduction

The live music industry is a field that is commonly associated with both high levels of noise and long durations of exposure to noise. As a result, sound engineers in the industry are constantly exposed to hazardous volumes of noise that can cause damage to hearing functions or loss of hearing entirely. However, many sound engineers are either not aware of, or choose to ignore, information regarding hearing damage, hearing loss, and hearing protection. This is a significant problem, as impairment to the hearing of sound engineers can permanently impact their performance in their career and, in severe cases, end it entirely.

Despite the severe repercussions of hearing damage, it is not talked about or taken seriously enough among today's audio engineers. Even here at MTSU, hearing loss is mainly covered in our early classes but is barely mentioned past that. As a young audio engineer about to enter the music industry myself, I understand the seriousness with which hearing loss should be treated, but I fear that others in my situation do not. So, with my thesis, I hope that audio engineering students here at MTSU are more informed about hearing loss and are more motivated to pursue proper hearing protection for themselves as they too prepare to become engineers out in the real world.

Methodology

For this thesis, I did extensive research about the causes of hearing loss for sound engineers in the live music industry as well as effective hearing conservation techniques designed to prevent or lessen the effects of hearing loss for live sound engineers. The research was undertaken to create well-informed and effective flyers that were posted around the Bragg building on MTSU's campus and informational social media posts that were placed on Instagram that aimed to inform MTSU audio production students about the risks of hearing loss in the live music industry. These informational flyers and posts were intended to promote easy, applicable hearing conservation techniques as well. Additionally, I spoke to several people either in the live music industry or currently pursuing an audio production degree at MTSU about their knowledge on hearing damage and about their current practices of proper hearing protection.

Summary of Research

Hearing loss can be split into two main types: conductive, and sensorineural.¹ Conductive is a result of damage to the middle or outer ear, while sensorineural comes from damage to parts of the inner ears.² Noise-induced hearing loss is hearing loss caused by damage to the ear by excessive exposure to noise.³ Specifically, frequent exposure to loud sounds can cause the hair cells in the inner parts of the ear to become destroyed or rigid and lose some of their functionality.⁴ Typical human hearing ranges between the frequencies of 20 and 20,000 Hertz, though this range may be altered by listening to loud sounds.⁵ When the hair cells in the ear are repeatedly exposed to intense levels of noise, they become tired and respond less to stimuli resulting from sound, altering the frequency response and sound level heard in the ear.⁶ This is called a temporary threshold shift, and

¹ Tova Most, "The Effects of Degree and Type of Hearing Loss on Children's Performance in Class," *Deafness and Education International* 6, no. 3 (2004): 156.

² Thomas Zahnert, "The Differential Diagnosis of Hearing Loss," *Deutsches Arzteblatt International* 108, no. 25 (2011): 434.

³ William Clark, "Hearing: The Effects of Noise," *Otolaryngology – Head and Neck Surgery* 106, no. 6 (1992): 669.

⁴ World Health Organization, *Hearing Loss Due to Recreational Exposure to Loud Sounds: A Review* (Geneva: WHO Press, 2015), 2.

⁵ Kris Chesky, "Preventing Music-Induced Hearing Loss," *Music Educators Journal* 94, no. 3 (2008), 37.

⁶ Mukesh Edward et al., "Prevalence, Awareness, and Preventive Practices of Noise-Induced Hearing Loss in a Plywood Industry," *Indian Journal of Otology* 22, no. 1 (2016): 16.

the ear usually reverts back to normal after around 16-24 hours.⁷ However, if this temporary threshold shift occurs too often, then the threshold shift can become permanent.⁸

Live music engineers are at risk of this permanent hearing threshold shift due to the level of volume their workplaces generally reach. In fact, live music features some of the louder workplaces out there, being in the same area of loudness as jobs like farming and construction.⁹ In general, the rate of occupational-caused hearing loss is typically much higher during the first 10-15 years of exposure,¹⁰ though this hearing loss can be accentuated later on due to age with the hearing loss rate as much as doubling every ten years as someone grows older.¹¹ This reduction in the ear's frequency response is

⁷ Bruce Kirchner et al., "Occupational Noise-Induced Hearing Loss," *Journal of Occupational and Environmental Medicine* 54, no. 1 (2012): 106.

⁸ Allen Ryan et al., "Temporary and Permanent Noise-Induced Threshold Shifts: A Review of Basic and Clinical Observations," *Otology and Neurotology* 37, no. 8 (2016): 272.

⁹ Mariola Sliwinska-Kowalska and Adrian Davis, "Noise-Induced Hearing Loss," *Noise and Health* 14, no. 61 (2012): 274.

¹⁰ American College of Occupational and Environmental Medicine, "Noise-Induced Hearing Loss," *Journal of Occupational and Environmental Medicine* 45, no. 6 (2003): 579.

¹¹ Lisa Cunningham and Debara Tucci, "Hearing Loss in Adults," *The New England Journal of Medicine* 377, no. 25 (2017): 2465.

important as there is currently no treatment for noise-induced hearing loss.¹² Hair cells in the ear cannot regenerate, although the rate at which they are affected can be reduced.¹³

Hearing loss also affects the volume at which things are heard. Decibels (dB) are the way the intensity of sound is measured. The threshold of human hearing is defined as 0 dB with the threshold of pain as a result of hearing is around 120-135 dB.¹⁴ For reference, typical casual conversation sits around 50-60 dB, while something like a whisper is around 30 dB.¹⁵ Hearing damage can occur due to the intensity of a sound, the length of time spent listening to it, or both.¹⁶ The Center for Disease Control (CDC) recommends that workers should only be exposed to an average 85 decibels (dB) over the course of 8 hours before it is unsafe to do any further listening in that day.¹⁷ Additionally, the length of time that is permissible is halved every time the average dB increases by 3 dB.¹⁸

¹⁵ World Health Organization, *Hearing Loss: A Review*, 8.

¹² Stephen Fausti et al., "Hearing Health and Care: The Need for Improved Hearing Loss Prevention and Hearing Conservation Practices," *Journal of Rehabilitation Research and Development* 42, no. 4 (2005): 47.

¹³ Clark, "Effects of Noise," 672.

¹⁴ World Health Organization, *Hearing Loss: A Review*, 7.

¹⁶ Peter Rabinowitz, "Noise-Induced Hearing Loss," *American Family Physician* 61, no. 9 (2000): 2749.

¹⁷ National Institute for Occupational Safety and Health, *Occupational Noise Exposure* (Cincinnati: NIOSH Publications, Dissemination, and Information Division, 1998), 1.

¹⁸ Wesley Bulla, "Daily Noise-Exposure of Audio Engineers: Assessment of Daily Noise-Exposures of Professional Music-Recording Audio Engineers Employing OSHA PEL

The World Health Organization (WHO) states that the intensity of sound in live music venues averages around 92 dB over the course of around 3 hours.¹⁹ Per CDC guidelines, a safe listening period for a volume of 92 dB is only around 1.5 hours which is half the typical time for a live concert.²⁰ This means that sound engineers are on average exposed to twice the length of time recommended for safe listening for that level of sound on a regular basis, and that is not even including the time they spend on sound checks and room tuning during the day. Because of these dangerous volumes and periods of listening, sound engineers are at a higher risk of developing hearing loss early due to their repeated exposure to unsafe levels of sound. For example, a study done by the Academy of Sound Engineering determined that half of the sound engineer participants experienced a significantly reduced perceptiveness to frequencies in the 3,000 and 6,000 Hertz range, which implies early signs of hearing loss.²¹ The sound engineers' loss of hearing is worrisome; a significantly modified frequency response like this can seriously impact the audio skills of a sound engineer.

Conservation techniques for hearing generally revolve around regulating one of three factors: the intensity of the sound, the duration of the sound exposure, and the

Criteria," *Music and Entertainment Industry Educators Association Journal* 3, no. 1 (2003): 56.

¹⁹ World Health Organization, *Hearing Loss: A Review*, 9.

²⁰ National Institute for Occupational Safety and Health, *Occupational Noise Exposure*,2.

²¹ Liepollo Ntlhakana and Angie A Heliopoulos, "The Hearing Function of Sound Engineers: A Hearing Conservation Perspective," *South African Journal of Communication Disorders* 67, no. 1 (2020): 25.

distance from the sound source.²² Earplugs can reduce the volume of a sound to the ear, and they are one of the most popular forms of hearing protection among many sound engineers due to their ease of acquisition. Earplugs can easily be purchased as cheap premade foam plugs, and engineers also have the option of getting more expensive, custommolded varieties.²³ Some sound engineers are wary of using earplugs, however, because of the way the earplugs affect hearing; studies have shown that wearing earplugs can limit the frequency and pitch response of the ear, which could affect the way a sound engineer mixes.²⁴ Other ways for live sound engineers to reduce exposure to dangerous levels of sound include lowering the volume or reducing the time spent listening to loud sounds, although these means are not typically utilized due to their lack of practicality in the business.²⁵ Additionally, some studies have suggested that listening to something at a moderate volume prior to exposure to a loud volume of sound can help "prepare" the ear for the loud sound it is about to hear.²⁶

However, many sound engineers are not aware of, nor do they possess, accurate information regarding the specifics of what constitutes dangerous levels of listening. A

²⁵ World Health Organization, *Hearing Loss: A Review*, 11.

²² World Health Organization, *Hearing Loss: A Review*, 10.

²³ Alessandra Samelli et al., "The Study of Attenuation Levels and the Comfort of Earplugs," *Noise and Health* 20, no. 94 (2018): 114.

²⁴ Rebecca MacLeod, John Geringer, and David Miller, "The Effect of Wearing Foam and Etymotic Earplugs on Classical Musicians' Pitch Perception," *Journal of Research in Music Education* 69, no. 4 (2021): 444.

²⁶ Deepak Prasher, "New Strategies for Prevention and Treatment of Noise-Induced Hearing Loss," *The Lancet* 352, no. 9136 (1998): 1240.

study done among sound engineers in 2003 found that 71% of participants believed hearing damage does not occur until levels above 100 dB, and 29% believed that hearing damage could be repaired.²⁷ This level of misinformation can be costly to sound engineers; if they are not aware of safe operating procedures when it comes to hearing damage and prevention, they risk substantial negative effects to their own hearing, which could have serious consequences in their lives and careers.

This is why I believe that MTSU sound engineers need to be more aware about hearing loss, safe listening procedures, and hearing protection. More and more young people are developing signs of hearing loss, with about 14.9% of children aged 6-19 showing symptoms associated with hearing loss in 1998²⁸ and about 19.5% of the same age group showing those same symptoms in 2006.²⁹ Additionally, a study from 2019 found that only 9.8% of adolescents and young adults respondents who had attended a live music concert had worn proper hearing protection,³⁰ and another study from 2005 reported only 9% of young adult respondents had experienced hearing health education in

²⁷ Bulla, "Assessment of Daily Noise-Exposures," 58.

²⁸ Amanda Niskar et al., "Prevalence of Hearing Loss Among Children 6 to 19 Years of Age: The Third National Health and Nutrition Examination Survey," *Journal of the American Medical Association* 279, no. 14 (1998): 1071.

²⁹Josef Shargordosky et al., "Change in Prevalence of Hearing Loss in US Adolescents," *Journal of the American Medical Association* 304, no. 7 (2010): 775.

³⁰ Nasim Alnuman and Talha Ghnimat, "Awareness of Noise-Induced Hearing Loss and Use of Hearing Protection Among Young Adults in Jordan," *International Journal of Environmental Research and Public Health* 16, no. 16 (2019): 2962.

school.³¹ Being young, many engineers going into the live music industry may not understand or care about proper hearing conservation techniques and may end up adversely affecting their hearing and, as a result, shortening how long they can pursue this career as a result. Luckily, MTSU already emphasizes hearing protection and educates about safe listening levels as a part of its curriculum, so most students in the audio engineering program are well informed about the topic. However, much of this information is taught at the beginning of the program and is more thinly covered in later classes. Another problem that arises is that students ignore the information entirely due to laziness or general disregard. My hope is that with this research, I can inform audio engineering students at MTSU about the risks of hearing loss and proper listening procedures as well as motivate them to practice hearing conservation techniques.

³¹ Jeanne Chung, et al., "Evaluation of Noise-Induced Hearing Loss in Young People Using a Web-Based Survey Technique," *Pediatrics* 115, no. 4 (2005): 862.

Dissemination Campaign

The first part of my plan to educate and motivate MTSU students to use proper hearing protection was a dissemination campaign. Using the research that I gathered about the causes of hearing loss for sound engineers in the live music industry as well as effective hearing conservation techniques, I created several posters that I posted around the Bragg building on MTSU's campus and on social media on Instagram throughout September and October of 2021. I used both flyers and Instagram as my means of information dissemination because audio engineering students were able to see the flyers when going to class as well as view them on Instagram where many students spend their time online. I was given approval for each of the posters from the Dean of the College of Media and Entertainment before posting, and I ended up making four sets of posters that I put in and around the Bragg building. The social media posts featured the same images I had made as printed posters, just put online instead. The four posters that I created, for print and digital dissemination, are featured at in the Appendix.

Summary of Interviews

The second part of my plan involved interviewing several audio engineering students on their thoughts surrounding hearing loss and their use of hearing protection. I conducted a series of five interviews, with four of these interviews being with MTSU students and the last being with an audio engineer currently working in the live music industry. Through these interviews, I hoped to better educate each person about hearing loss and also understand their personal views and experiences. Additionally, I wanted to gain a better understanding of how much hearing loss was talked about in the classes at MTSU and how much students personally apply that teaching themselves.

In these interviews, I asked each person a few basic questions about (1) their current thoughts on hearing loss, (2) whether they were aware of my hearing loss dissemination campaign, (3) how often hearing loss was talked about in each of their classes at MTSU, (4) whether they had any experiences with hearing damage themselves, and (5) whether they used hearing protection in live music environments. These questions covered the core of what I was trying to learn: what the audio production students at MTSU think about hearing loss and how seriously they take it. Additionally, to the one person currently working in live music as an audio engineer, I also asked about how much hearing loss is talked about at his place of work and whether he had any advice for young engineers regarding the subject. His responses helped me better understand how prevalent ear protection is in the live music industry and what students should know before entering the industry themselves.

Nicholas Tichota

Nicholas is a freshman at MTSU majoring in Audio Production, although he has been working with audio in some fashion for many years. He believes hearing loss is a real problem, but that it is not taken seriously enough in the industry. In his classes, hearing loss was talked about, though it was mainly at the start of the year and was only mentioned in passing later in the semester. He was unaware of my dissemination campaign until I told him about it, although he commented that it was a step in the right direction. Nicholas himself has a small amount of tinnitus, which resulted from a family incident, not anything regarding music or audio production. He also carries around a case of earplugs on his keychain so that he has hearing protection available for when he needs it. Overall, Nicholas is a staunch believer in using hearing protection, and he thinks that hearing loss should be taken more seriously both in the industry and in his classes here at MTSU.

Olivia Gaston

Olivia is a senior in the audio production department here at MTSU, and she will be graduating Fall 2021, entering the live music industry after graduation. She said the thought of hearing loss is scary since you would be losing one of your five senses. She went as far as saying that she would rather be blind than deaf, since she needs her hearing to be an audio engineer. Olivia had not only seen my posters in the Bragg building on campus, but they had motivated her to get her own custom earplugs, a thing she had been thinking about doing for a while. As for her classes, she said that earlier classes like Audio Fundamentals covered hearing loss as a topic, but in her classes now, hearing loss is only mentioned if the professor feels strongly enough about it. She even mentioned Mr. Hanson, a professor in the Recording Industry Department here at MTSU and my advisor for this thesis, as someone who personally discusses hearing loss in their classes.

Olivia said she has some experience with hearing damage herself. When she is in a loud environment, such as a concert, her hearing in her left ear gets the sensation that it is underwater. She has talked to a doctor about this, but her doctor was unsure on how to treat it without making the problem worse. Olivia uses hearing protection at concerts, both when she is attending as a fan and when she is working as the audio engineer. She said that my dissemination campaign has motivated her to use proper hearing protection and to encourage others to do the same.

Shelby MacIntire

Shelby is also a senior audio production student at MTSU who is graduating Fall 2021. She is well aware of the negative consequences of hearing damage, and she said that she personally wears earplugs to any live music event she attends. She saw my posters in the Bragg building, although she did not see the posts I had made on Instagram. When it comes to her classes, she remembers hearing loss being a bigger deal in the classes she took as a freshman, but the topic was only mentioned in her later classes sporadically. Shelby used to attend many concerts without hearing protection when she was younger, and as a result she would have ringing in her ears after loud concerts. However, since coming to school, she always brings earplugs with her wherever she goes, including to live events. All in all, Shelby believes in the use of proper hearing protection, and she is convinced to take it even more seriously thanks to her classes here at MTSU. She also thinks that it should be a topic that should be discussed more in the higher-level classes that students who are close to graduating from the College of Media and Entertainment will be taking.

Jake Martino

Jake Martino is a senior at MTSU in the audio production program who is graduating Spring 2022. He said that he is understandably not a big fan of hearing loss, and that he is more conscientious about it as time goes on. He was aware of my dissemination campaign because of my posters in the Bragg building, but he had only seen them in passing. Jake brought up how, in his classes, hearing loss was a topic that was only brought up intermittently and that learning about the subject matter really depends on the professor. However, as he has spent more time in the audio production program, he has become more aware and concerned about hearing. He uses earplugs at concerts he attends, and he has not had any issues with hearing damage yet, a fact he is thankful for since he works so much with loud music. Finally, Jake mentioned how he wishes that more professors would talk about hearing loss since it is such a scary outcome for people in the music industry.

Jacob Judkins

Jacob is the front-of-house engineer for New Vision Baptist Church in Murfreesboro, Tennessee, and he also works live concerts in the Nashville area. Jacob thinks hearing loss is a big issue and that a lot more people have it than they realize. At his place of work, people talk about hearing damage quite often, and there are standards for safe volume levels across the New Vision Baptist Church. He graduated from MTSU many years ago, and he recalls that hearing loss being talked about a bit, but he did remember having much emphasis placed on it during his time there. The topic was also more prevalent in his earlier classes, but it was not reiterated as much as he wished. Personally, Jacob himself has a little bit of tinnitus from his years working in the live music industry, but his hearing range is normal for a person of his age according to the testing he has done. While at live music events, he always wears earplugs, but in the rare cases he failed to bring some, he stands outside the venue for small periods at a time to minimize the amount of time his ears are exposed to that level of noise.

Jacob also had some advice for young audio engineers regarding hearing loss. He said that engineers should always bring some way to meter the volume level if they are running audio for an event, even if it is something as simple as a cell phone app. Also, he stated that earplugs should always be worn at concerts, but if one is mixing the show, then the audio engineer should instead take off his or her earplugs as needed throughout the show, but wearing them more often than not. Additionally, Jacob recommends that audio engineers get their hearing tested at least every two years to find out if they are developing early signs of hearing loss.

Reflection and Conclusion

If there is one common theme I learned throughout this process, it is that many of the audio engineering students here at MTSU are aware of the harmful effects of hearing damage and believe in the use of proper hearing protection. However, they also believe that MTSU does not emphasize the subject enough in classes, and they wish that hearing loss was a part of the curriculum more, especially in classes that students take as they prepare to graduate and enter the music industry. It also appears that my posters were quite helpful, and the posters even motivated one person to purchase a custom set of earplugs for herself. The social media posts, however, were not as well received. I heard no indication that the social media posts had been noticed or were useful to the students here at MTSU.

Another principle I learned through this thesis process is to be flexible. Because of COVID-19, many plans I had made originally fell through, and I had to find other solutions to complete my project. For example, my advisor, Professor Michael Hanson, went to the National Association for Music Merchants (NAMM) in Nashville and collected contact information from earplug manufacturers in the hopes that they could come to campus as a part of my information campaign. However, due to rising COVID concerns, none of the people I contacted was able commit to a visit. Additionally, I was working with the Audio Engineering Society here at MTSU to bring someone to campus to speak about hearing loss, but those also plans fell through because of COVID-19. Additionally, some of my original plans for my thesis would have required IRB approval, but after spending a good amount of time in the IRB application process, I decided to

scrap receiving IRB approval since I felt that I was straying too far from the original idea for my thesis creative project.

Through all these circumstances, however, I was able to shift the direction of my project in a way that was still helpful in achieving the main focus of my thesis. I doubled down on the dissemination campaign, making more posters and social media posts than I had originally planned. Additionally, I shifted my idea for a survey into one-on-one interviews focused on their perception of the quality of my information campaign as well as the interviewees' experiences with hearing loss themselves. The interviews ended up being incredibly helpful in understanding the current attitude of MTSU audio engineers, and I am glad that my plans for a survey did not end up working out in the end. So, even though my original plans fell through, I feel as though I was still able to effectively achieve the goals that I had set for myself when I pursued this topic in the first place.

In the end, I hope that the idea of promoting hearing protection at MTSU does not end with this thesis. Hearing damage is so important in the audio engineering world because it can seriously affect one's career if it becomes severe. Because hearing health is such an important topic, I believe the school should make hearing loss a more prominent part of MTSU classes. Plus, as shown through my interviews, there is a strong desire among audio engineering students for hearing loss to be better covered in their classes. So, I hope that MTSU makes hearing loss a priority in the College of Media and Entertainment teaching so that all the young audio engineers here at the university are aware of its risks and can protect themselves and have a safe, healthy career doing the thing that they love.

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Appendix: Posters

Four original posters were created for this thesis project. Each of them was placed around the Bragg building on MTSU's campus. Each is listed below in the order created.

Poster #1









Poster #4 (Outside)

THE AVERAGE INTENSITY OF SOUND IN LIVE MUSIC VENUES IS 92 DB OVER THE COURSE OF 3 HOURS.¹ ACCORDING TO CDC GUIDELINES, WHAT IS THE SAFE LISTENING PERIOD FOR AN INTENSITY OF 92 DB?.²

> 4 HOURS 3 HOURS 2 HOURS 1.5 HOURS 1 HOURS

YOUR EARS ARE YOUR CAREER. **PROTECT THEM.**

 "Hearing Loss Due to Recreational Exposure to Loud Sounds: a Review." World Health Organization. World Health Organization, January 1, 1970. https://apps.who.int/iris/handle/10665/154589, 3.
"Noise-Induced Hearing Loss: Journal of Occupational and Environmental Medicine." LWW, June 2003. https://journals.lww.com/joem/fulltext/2003/06000/noise_induced_hearing_loss.1.aspx.



O @YOUREARSAREYOURCAREER

Poster #4 (Inside)

THE AVERAGE INTENSITY OF SOUND IN LIVE MUSIC VENUES IS 92 DB OVER THE COURSE OF 3 HOURS.¹ ACCORDING TO CDC GUIDELINES, WHAT IS THE SAFE LISTENING PERIOD FOR AN INTENSITY OF 92 DB?.² INCORRECT INCORRECT INCORRECT! INCORRECT! INCORRECT!

YOUR EARS ARE YOUR CAREER. **PROTECT THEM.**

 "Hearing Loss Due to Recreational Exposure to Loud Sounds: a Review." World Health Organization. World Health Organization, January 1, 1970. https://apps.who.int/iris/handle/10665/154589, 3.
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