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Informed hearing loss prevention for Theatre UNI

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INFORMED HEARING LOSS PREVENTION FOR THEATRE UNI

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Abstract

This study explores the opinions and behaviors related to hearing loss and hearing loss prevention in the demographic of theatre workers at Theatre UNI. Data was collected through a survey dispersed in a department-wide email and by measuring sound level in the scene shop and the costume studio. Survey responses from 11 participants indicated that theatre workers at Theatre UNI may be at risk for noise-induced hearing loss and that further education may aid in prevention of hearing damage.

Introduction

Theatre workers face many dangers which could impact their quality of life and ability to work. One such risk is hearing loss. The department of theatre at the University of Northern Iowa (Theatre UNI) is an educational environment. As such, Theatre UNI is tasked with providing information and opportunities to practice creating theatre to promote the future effectiveness of students graduating from the program. Recently, the department has begun an initiative to promote a "culture of safety" among students and workers. This initiative has consisted of a newly enforced policy to always wear safety glasses when in the scene shop (where scenic elements and props are constructed) as well as hosting presentations and discussions related to improving mental health. However, workers are rarely observed to be wearing hearing protection despite exposure to noise. The purpose of this study was to discover the current conditions and attitudes toward hearing loss at Theatre UNI then provide the information necessary to theatre workers about the signs and significance of hearing loss as well as methods for prevention.

Literature Review

The Risk

Theatre workers are at risk for a variety of occupational hazards. The only explicit information received by students of Theatre UNI concerning those risks is a video called *Play It Safe: An Introduction to Theatre Safety* (Kebow, 1994) shown in Stagecraft: Scenery and Lights, an introductory class to working in scenic and prop construction as well as lighting. Noise-induced hearing loss (NIHL) is recognized as a potential hazard, and safety instruction is given for about three and a half minutes in the segment about safety in the scene shop during the video series which is over sixty minutes in length. A great deal of information is covered throughout the series, all of which is important and valid. After all, there are much deadlier and more

insidious health risks present in the scene shop than loud noises. However, NIHL presents a significant risk to theatre workers who may never have been properly informed of the extensive impact a hearing loss can have on their personal and vocational lives.

The prevalence of NIHL is considerable. A study found that 24% of American adults between 20 and 69 years of age display a signifier of NIHL known as a noise notch (Center for Disease Control [CDC], 2017). A noise notch is a pattern of reduced sensitivity to sound displayed on an audiogram in a configuration similar to a downward-pointing arrow. This study also says that 21 million American adults who reported no exposure to loud noise at work still displayed a noise notch (CDC, 2017). Individuals were twice as likely to display a notch if they worked in a noisy profession (Carroll et al., 2017). At Theatre UNI costumers, actors, musicians, sound designers, and other workers are in close proximity to noisy equipment and may also use headphones or speakers while working. Sound that is too intense can damage hearing regardless of whether the sound is pleasant or not.

The Causes

On a website associated with the National Institute on Deafness and Other Communication Disorders (2008), information intended to promote hearing loss prevention in young people is available in text format as well as pictorially. Three factors of noise-induced hearing loss are discussed. One of these factors is sound level, another is distance from the sound, and the final factor is time.

Intensity.

NIHL is a risk in loud conditions. The National Center for Environmental Health (2017) indicates that “noise above 85 dB over a prolonged period of time may start to damage your hearing. Loud noise above 120 dB can cause immediate harm to your ears.” A paucity of

research was found on the sound levels in theatrical environments and on occurrences of hearing loss in the demographic of theatre workers, though many of the tools used by theatre workers are common household tools or construction equipment.

A theatre worker may underestimate the sound level they are exposed to because of a phenomenon where some sounds, at the same decibel level, are perceived to have different volume. This concept can be depicted as an equal loudness contour. Perception of loudness is affected by both intensity and frequency (Suzuki & Takeshima, 2004). While most depictions of the equal loudness contour are based on pure tones (a singular frequency), and noise involves many tones at differing intensities, the phenomenon still applies. This means that someone may be able to hear speech over the noise and believe that the speech must be at a higher intensity than the noise. In reality, humans are more sensitive to the frequencies of human speech than to other sounds. Noise can be erroneously discounted or assumed to be less harmful than it truly is due to the predisposition of the human hearing mechanism to the range of frequencies that constitute speech.

Proximity to sound source.

The space in which the equipment is used and the proximity of equipment to walls affects the sound level as well. Findings show that not only do many common power-tools have sound output over 85 dB, but equipment placed in the corner of a room produces a significantly more intense sound output than the same equipment in an open-air space or in the center of a room (Callahan, 2004). Because room acoustics play a role in the intensity of the sound level, seemingly insignificant changes to the location of the sound source can impact the safety of a room. Sound level output of a tool or loudspeaker in an enclosed space can be underestimated if previous experience or testing occurred in a different working environment.

Duration of exposure.

Theatre workers spend a great deal of time working on their projects. Courses at Theatre UNI in technical theatre as well as practicum assignments include a requirement to spend a specified number of hours per semester or per show working in an assigned field. Students are encouraged to spend a minimum of four hours per week working in the costume studio or scene shop to fulfill those requirements. In addition to this time, projects for class are completed outside of this hour requirement using the tools provided in the scene shop or costume studio. Technical assistants who do not receive course credit, but instead hourly monetary compensation also spend a minimum of four hours per week and a maximum of twenty hours per week on construction, technician, or supervisory crews. Noise exposure over time can cause permanent damage, even if the exposure is a single, long-lasting event (US Department of Health and Human Services, 2016). The more hours spent in environments where loud tools are used, the more likely constant, prolonged exposure to high intensity noise is to occur.

Process of NIHL

The following review from Hamill and Price (2014) of the process by which NIHL occurs details the changes to the anatomy of hair cells in the cochlea or nerve cells in the auditory pathway. Exposure to loud sound causes hair cells to pull potassium and calcium from the surrounding fluid. In the case of a loud sound, large amounts are absorbed, and the hair cells do not rid themselves of the potassium and calcium as quickly as they absorb it, causing the cells to swell. This causes a temporary threshold shift until balance can be restored between the cells and their surrounding fluid. However, permanent changes can also occur. Prolonged noise exposure releases an over-abundance of neurotransmitters which, over time, become toxic to the

neurons. The tip links of the hair cells can break, the cilia upon the hair cells can fuse together, or the cell membranes can rupture (p. 253).

Each of these changes in physiology affects the sensitivity of the hearing mechanism. Whether temporary or permanent, the ability to hear sounds at certain frequencies and especially at low intensities is impacted and affects the lives, either personally or vocationally, for those who incur a change in their hearing function.

Repeated exposure to noise without adequate protection can continue unchecked when symptoms of a hearing loss are overlooked, ignored, or assumed to be temporary. While a change in the sensitivity of the hearing mechanism can be temporary, repeated exposures to noise or single exposures to high intensity sounds cause permanent damage (Hamill & Price, 2014, p.253). In essence, a symptom may present intermittently causing the individual to wait for the symptom to abate instead of searching for a solution as the cure appears to be time.

NIHL is not always noticeable. In an issue of the *Morbidity and Mortality Weekly Report* (Carroll et al., 2017), it was reported that "one in four U.S. adults who reported excellent or good hearing displayed a noise notch." For someone who frequents noisy spaces, damage can progress while symptoms have no noticeable progression. The implication for theatre workers and their hearing is progressive damage that only gets worse, never better. Intermittent symptoms or the presence of non-bothersome symptoms does not mean that nothing is wrong. Recognizing symptoms and taking an active role in preventing further damage is crucial to hearing health.

The Consequences

Even after noticing a change in hearing, a person may take a considerable amount of time to seek a diagnosis. According to the Hearing Loss Association of America (n.d.), the average person takes seven years to do anything about a hearing loss. The implication for NIHL is that a

person may continue to damage their hearing for years after the initial incidence. A theatre worker who does not know the effects of NIHL may then continue to damage their hearing assuming any symptom is temporary and not noticing the advancement and prolongation of symptoms.

Delayed action upon realization of a hearing loss is especially problematic due to neuroplasticity. Because of neuroplasticity, areas of the brain typically responsible for auditory processing may be adapted or repurposed. Adults with congenital losses as well as acquired losses show changes over time in the stimulation of different areas of the brain. Auditory areas have been shown to adapt and be used for processing visual information (Glick & Sharma, 2017). In practice, if someone is not receiving auditory input for extended periods of time, their brain may reassign the structures dedicated to auditory processing to another specialized task. After this repurposing has happened, aural rehabilitation and use of assistive hearing devices can be less effective than if the structures were still assigned to auditory processing.

Hearing loss can be difficult to manage. NIHL is a type of sensorineural hearing loss (hearing loss impacting the inner ear or nerves involved in processing auditory signal). In a review of sensorineural hearing loss, Tye-Murray (2015) states that sensorineural hearing loss is likely permanent and can reduce the ability to understand speech, even with amplification, because the site of lesion is within the mechanisms for processing sound information (p. 16). Communication deficits stemming from a sensorineural loss can be alleviated but not completely resolved by lip reading, auditory training, or learned communication strategies. Some equipment and technology used to manage hearing loss is expensive. For profound hearing loss, a major surgery may be needed to bypass the typical hearing mechanism.

The Occupational Safety and Health Administration (OSHA) provides information on the annual cost of occupational hearing loss on their website:

> Twenty-two million workers are exposed to potentially damaging noise at work each year. Last year, U.S. business paid more than $1.5 million in penalties for not protecting workers from noise. While putting a number on the human toll of hearing loss is impossible, an estimated $242 million is spent annually on workers' compensation for hearing loss disability (n.d.)

Awareness of the time and dedication involved in living with a hearing loss is vital to the safety education of those at risk for NIHL, as the risk to the livelihood of workers may not be obvious. Long-term costs can be lessened if there are fewer workers who acquire hearing loss, making the best interest for both employers and workers to work together in an effort to prevent hearing loss.

Prevention

Awareness of the symptoms of NIHL, not just the causes, can help to protect workers from repeated damage. In a podcast produced by the Center for Disease Control (2017), listeners are encouraged to be aware of symptoms early to prevent further damage from noise exposure. These symptoms include difficulty understanding speech or certain speech sounds as well as tinnitus—a “ringing, buzzing, or clicking” sound in the ear. If these symptoms occur in an individual who is unaware of the symptoms of hearing loss, they are not likely to draw the conclusion that their hearing has been damaged. An individual who is unaware that their hearing has been damaged is not likely to engage in hearing loss prevention practices or to seek professional solutions for the hearing loss.

Regulations for workplace noise levels are set by the OSHA. Their website states:

> With noise, OSHA's permissible exposure limit (PEL) is 90 dBA for all workers for an 8 hour day. The OSHA standard uses a 5 dBA exchange rate. This means that when the noise level is increased by 5 dBA, the amount of time a person can be exposed to a certain noise level to receive the same dose is cut in half (n.d.)

While having regulations in place is important, these regulations do not align with the 85 dB threshold set by the National Center for Environmental Health. In effect, there are regulations with which worksites must comply but, these current regulations may not be as effective as they need to be to protect workers.

With such permanent and pervasive effects, prevention of NIHL should be seriously considered, especially because according to the National Institute on Deafness and Other Communication Disorders (2008), NIHL is completely preventable. The National Institute on Deafness and Other Communication Disorders (2008) outlines exactly how to partake in prevention of NIHL: know what causes NIHL, and use protection against those causes. Hearing conservation benefits students, staff, and faculty who depend upon their ability to hear. There are practical prevention methods that can be implemented at Theatre UNI. Hearing loss prevention practices can improve with mindfulness of the risks present and with the motivation to practice safety. The purpose of this study is to apply this knowledge of NIHL prevention to effectively improve upon current education at Theatre UNI.

Methodology

Participants

Participants of this study include 11 individuals between ages 18 and 23 who completed the survey. Three individuals who consented to participate in the study were not included in the results. One completed only the demographic section, and another did not complete any section.

For clarity of results, one individual who completed the study who was not within the age range of 18-23 was not included in the analysis. Of the individuals included in the analysis, all had experience on a practicum assignment or in stagecraft coursework. Six respondents held technical assistant or technical director positions at the time of the survey. Two reported a hearing loss, four reported no hearing loss, and five reported being unsure of their hearing status. A graphic representation can be found in Figure 1. Four respondents reported a family history of hearing loss, six reported no family history of hearing loss, and one chose not to respond.

Materials

A sound level meter was used in the scene shop and costume studio to determine the noise level to which workers are exposed. A questionnaire containing questions about demographic information, behaviors, and opinions was distributed to participants. The questionnaire included questions to determine whether students are already displaying signs of hearing loss, if they are concerned about hearing loss, and if they engage in hearing loss prevention. See Appendix A for the full text of the survey.

Procedures

Measurements of sound level were taken in dBC three feet from the sound source. The questionnaire was distributed via a department-wide email to gather information on the current safety climate at TheatreUNI in regards to hearing loss prevention. Following the close of the survey, a fact sheet with information on NIHL symptoms, processes, and prevention was sent in the department-wide email (American Speech Language and Hearing Association, 2017). This fact sheet can be found in Appendix B.

Results

Sound Level Measurements

A sound level meter was used to evaluate noise level in the scene shop and in the costume studio. The measurement scale used was dB SPL. Each measurement was taken three feet from the target instrument in order to not disturb the operations of student workers. The data values are presented in Table 1.

The scene shop

The ventilator in the scene shop is used to clear sawdust from the air to decrease health risks caused by breathing particles of wood. The ventilator runs at any time that wood or metal is being cut or sanded and is a stationary piece of equipment that remains against a wall. The sound level of the ventilator was 74.6 dB SPL.

The table saw is used to make continuous cuts of wood. It is typically placed in the center of the scene shop, away from walls, but contiguous with the work tables in the scene shop. The table saw and work tables were in their typical locations at the time of the measurement. The sound level of the table saw was 90.0 dB SPL.

The panel saw is used to make continuous cuts on materials that are too wide, long, and thin to be cut by the table saw. Typically, the panel saw is near to a wall, but at the time of this measurement, it was in the middle of the room. The sound level of the panel saw was 101.3 dB SPL.

The chop saw is used for non-continuous cuts. The chop saw is typically positioned near a wall beside the panel saw. At the time of this measurement, the panel saw was in the middle of the room, and the chop saw was in its typical position. The sound level of the chop saw was 105.2 dB SPL.

The costume studio

The sewing machine that was measured was not touching any walls and had other sewing machines of the same type opposite and adjacent to its position. The sound level of one sewing machine was 63.0 dB SPL.

Reported Behaviors

All except one respondent reported working in a noisy environment outside of Theatre UNI. Six respondents reported some sign of hearing damage during or after work in a technical area of the theatre. The signs and number of students who reported each sign can be found in Figure 2. The amount of time spent working in technical theatre did not exceed 20 hours per week for any individual who responded. Four reported spending four or fewer hours per week, one reported spending five to nine hours, four reported spending 10 to 14 hours, and two reported spending 15-19 hours. This data is displayed graphically in Figure 3. When asked about other exposures to noise, six reported less than one hour of exposure to loud music each day, four reported two to three hours of exposure each day, and one reported eight to nine hours of exposure. One respondent reported never using hearing protection. Others reported using hearing protection in any of the following circumstances: any time working in the scene shop, when using specific equipment or in specific locations, when told to do so, when the noise level is painful. Quantities of respondents who wore hearing protection under each of these circumstances is displayed in Figure 4.

Opinions and Beliefs

The final section of the survey requested opinions on hearing loss and on education regarding hearing loss by the department. The first question asked respondents to select how they felt about hearing loss. Participants were able to select more than one answer. Six reported fearing hearing loss, three had not thought about it, two felt it was inevitable, two reported

apathy toward safety and the future in general, and one reported that hearing protection was more trouble than it was worth. The next question asked how new or worsening hearing loss might affect the life of the individual. Four reported accommodations would be needed to continue living as they did at the time, five reported that little would change, and two reported that their lives would change drastically.

Discussion

Sound Level Measurements

Based on the OSHA guidelines, workers at Theatre UNI may be at risk for NIHL. Some of the common tools had noise outputs over the threshold for causing a hearing loss. Some tools were significantly over this threshold. Given that the time that can be spent in noise is reduced by half for every five decibels over 90 (i.e. a 90 dB output is tolerable for up to eight hours, and a 95 dB output is tolerable up to four hours), some tools should be operated while wearing hearing protection (OSHA, n.d.). Moreover, individuals who are near this sound source but not necessarily operating the tool should also be wearing hearing protection when the noise levels exceed the threshold. Workers should also be made aware of these guidelines and their application outside of Theatre UNI because almost all respondents indicated working in noisy environments outside of the department.

Demographic Information

Approximately half of all respondents were unsure of their hearing status. Statistics show that many individuals who have noticed a change in their hearing also do not seek a diagnosis until seven years after first noticing the onset of symptoms (Hearing Loss Association of America, n.d.). During that time, the individual's brain may be changing in physiology due to neuroplasticity (Glick & Sharma, 2017). This can cause difficulty when later taking steps to

manage the loss as the structures necessary for auditory processing may have been repurposed. Because these respondents noted that they were unsure of their hearing, the possibility exists that they are displaying some signs of hearing loss but have yet to seek diagnosis.

A common sign of hearing damage reported by participants was the need to speak louder or the inability to hear someone three feet away during or after working in some area of technical theatre. This response is important as it relates to the equal loudness contour. For someone to feel the need to raise their voice over the sound of equipment, that equipment may be louder than it seems as the human ear is more sensitive to frequencies of human speech than sounds of higher or lower frequencies (Suzuki, 2004). If speaking over noise that is higher or lower pitched, the voice does not need to be at a higher volume than the noise in order to be heard. Needing to speak even a small amount louder than normal indicates that noise in the background may be louder than expected.

There were some respondents who indicated they wear hearing protection when told to do so. This practice shows that there are individuals open to using hearing protection but they either do not have enough knowledge or experience to know when hearing protection is necessary. Because Theatre UNI is an educational environment, and because most respondents also indicated working in noisy environments outside of the department, developing intrinsic motivation for students to use hearing protection should be a priority.

Four respondents abstained from answering if the education provided by Theatre UNI regarding hearing loss and hearing loss protection had been adequate, due to lack of experience. This is remarkable for the fact that all respondents had some experience working in technical theatre as either a practicum assignment or stagecraft course. Because every respondent had experience in technical theatre, every respondent should have been assessed of the risks involved

in working in technical theatre. This suggests a lapse in education that could be potentially harmful for the workers at Theatre UNI.

Opinions and Beliefs

Respondents' feelings about hearing loss revealed belief in misconceptions, a lack of awareness, and apathy about safety. Respondents who marked that hearing loss is inevitable or that hearing protection is more trouble than it is worth demonstrated misconceptions about hearing loss. NIHL is entirely preventable (National Institute on Deafness and Other Communication Disorders, 2008). Moreover, given the costs of managing hearing loss and the investment of time and energy that accompanies the need to change aspects of an individual's personal and professional life (OSHA, n.d.), hearing protection is assuredly worth the inconvenience.

Some respondents marked that they had not thought about the possibility of acquiring a hearing loss. Hopefully, this study and the efforts of Theatre UNI to usher in a new "culture of safety" will not only raise awareness but also increase workers feeling of efficacy in preventing NIHL. This "culture of safety" initiative also includes efforts to promote better mental health. A few respondents indicated a feeling of apathy toward safety and their future in general. Theatre UNI has already taken steps to address concerns about the mental and emotional well-being of workers. Based on the data collected, practices to promote the health, safety, and wellness of workers should continue.

Prevention in Practice

In looking at the three factors that lead to NIHL, targeted approaches to hearing conservation can be developed for the specific needs of each workspace and each individual worker. For example, distance from the source of the noise is one factor. While the person

operating the power tool cannot change their distance from the sound source, others who are working on more mobile tasks can choose a quieter area to work.

Another factor is sound level. Perhaps the most common solution to loud sounds is to wear ear-plugs and/or over-ear headphones. However, in an educational setting such as Theatre UNI, it can be difficult to perform the tasks of teaching, seeking instruction, collaborating, and maintaining awareness of potential dangers in a case where sounds are muted or muffled. Filtered headphones are commonly used in music venues to allow performers to hear a range of sounds at a more reasonable volume while blocking the high intensity sounds that are less relevant to the needs of the performer. These tools can be used interdisciplinarily to aid theatre workers as well, especially when music and theatre often share spaces. Increased awareness of sound level can help in knowing if noise levels are at dangerous levels. Apps to measure sound level are available on many smart devices for free. Personal monitoring of sound level when listening to voice recordings and music is also important.

On a less personal, more systematic level, workshops or staging areas can be outfitted with sound level meters as a preemptive way of protecting workers. Employers and institutions can arrange their spaces in a way that prevents reverberation that would increase the sound level of a tool by making use of outdoor or open-air space when available or by positioning the equipment away from walls.

The final factor is time. Often time is the thing that theatre workers do not have, so suggesting a reduction in overall time spent on a project is not only unrealistic, but also suggests leaving a project incomplete or at a lower quality, which is a non-solution. What can be done about time is to allow a recuperation period for the structures of the inner ear. Taking breaks from noise, be it environmental noise from equipment or recreational noise from voice or music

recordings, allows the hair cells to return to normal function even if only temporarily which reduces the demand on these structures.

Limitations

This study surveyed the theatre department at UNI. Application to other theatre environments and scholarly departments, all with different climates, is limited. Expanding this study to other universities, academic settings, or professional theatres could potentially increase awareness of the risks and effects of NIHL as well as methods of prevention. Each working or learning environment will present unique challenges which affect the experience of workers. For example, Theatre UNI is an educational environment which gives the program different goals than a professional company. Each place that employs or educates theatre workers has a responsibility to know if workers are facing the danger of NIHL.

Conclusions

Results indicated that more education on hearing loss and hearing loss prevention may be a useful addition to the curriculum. Over time, the goal is for education and awareness to spread and for fewer cases of NIHL to occur among theatre workers. Hopefully, this study brings to light some of the risks for hearing loss among theatre workers and highlights some possible solutions that can be applied to make Theatre UNI safer for all workers during their tenure at the University of Northern Iowa and as they enter the workforce.

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Appendix A

Informed Hearing Loss Prevention at Theatre UNI survey

Welcome to the Hearing Loss and Hearing Loss Prevention Study!

This survey is being conducted by Mallory Park and Jaimie Gilbert at the University of Northern Iowa. We are interested in understanding perceptions of hearing loss and hearing loss prevention at Theatre UNI. You will be asked questions about demographics, behaviors, and perceptions which pertain to hearing loss or to your involvement in the department. Some of these questions are based on information from the American Speech-Language-Hearing Association Audiology Information Series. This survey is confidential. While we will not request your name, we will ask for some demographic information. Because the survey is on the internet, we cannot guarantee that the data will not be intercepted by others, although this seems unlikely. Individual results will never be shared with anyone. Grouped results will be shared in articles and presentations.

The study should take you less than 10 minutes to complete, and you will receive no direct compensation for your participation. To address potential stress, distress, or discomfort from increased awareness of hearing loss risks, information about hearing loss prevention will be provided after the survey closes. The only risks to privacy come from IP addresses. This risk is minimized by using Qualtrics software. Potential benefits include promotion of hearing health and education of hearing conservation for current and future workers at Theatre UNI as well as other theatre environments. Your participation in this research is voluntary. You have the right to withdraw or skip questions at any point during the study, for any reason, and without any prejudice. If you would like to contact the Principal Investigator in the study

to discuss this research, please e-mail Mallory Park at parkmac@uni.edu or her faculty advisor, Jaimie Gilbert, at jaimie.gilbert@uni.edu. If you have questions about the rights of research participants, contact the UNI IRB Administrator at anita.gordon@uni.edu.

By clicking the button below, you acknowledge that your participation in the study is voluntary, you are at least 18 years of age, and that you are aware that you may choose to terminate your participation in the study at any time and for any reason.

Please note that this survey will be best displayed on a laptop or desktop computer. Some features may be less compatible for use on a mobile device.

- I consent, begin the study (1)

Which best describes your current role at Theatre UNI?

- Technical Assistant/ Technical Director (1)
- Stagecraft Student (2)
- Practicum Student (3)
- Faculty (4)
- Staff (5)
- None of these (6)

Please select all roles that you are currently in or that you have held in the past at Theatre UNI.

- [ ] Technical Assistant/ Technical Director (1)
- [ ] Stagecraft Student (2)
- [ ] Practicum Student (3)
- [ ] Faculty (4)
- [ ] Staff (5)
- [ ] None of these (6)

Other than your roles at Theatre UNI, have you previously worked in a noisy environment?

- Yes (5)
- No (6)

Do you have a hearing loss?

- Yes (1)
- No (3)
- Unsure (4)

Do you have a family history of hearing loss?

- Yes (1)
- No (2)
- Prefer not to answer (3)

Please provide your age

- 18-23 (1)
- 24-29 (2)
- 30-35 (3)
- 36-50 (4)
- 50-64 (5)

○ 65+ (7)

Do you ever experience any the following during or after working in the scene shop, costume studio, or other technical theatre location at Theatre UNI? (Select all that apply)

☐ Ear pain (1)

☐ Ringing, buzzing or roaring sound in your ears (2)

☐ Sounds (especially voices) around you are muffled or dull after leaving the area (4)

☐ You must raise your voice to be heard (6)

☐ You cannot hear someone 3 feet away from you (7)

☐ None of these (5)

On average, how many hours per week do you spend in the scene shop, costume studio, or other technical theatre location at Theatre UNI?

- 4 or fewer (1)
- 5-9 (2)
- 10-14 (3)
- 15-19 (4)
- 20-24 (5)
- 25-29 (6)
- 30-34 (7)
- 35-40 (8)
- More than 40 (9)

On average, how many hours per day do you spend listening to loud music?

- Less than 1 (1)
- 2-3 (2)
- 4-5 (7)
- 6-7 (8)
- 8-9 (9)
- 10-11 (10)

○ 12 or more (6)

When do you wear hearing protection? (Select all that apply)

☐ Whenever I work in the scene shop. (1)

☐ When the noise level is painful. (2)

☐ When I am told to do so. (3)

☐ When using specific equipment or working in specific environments. (4)

☐ Never (5)

How do you feel about hearing loss? (Select all that apply.)

☐ It is inevitable. (1)

☐ It scares me. (2)

☐ Hearing protection is more trouble than it is worth. (3)

☐ That is what hearing aids were made for. (4)

☐ I have not thought about it. (5)

☐ I am apathetic toward my safety and the future in general. (6)

How do you feel new or increased hearing loss would affect your life?

- ○ It would not affect anything. (1)
- ○ It would affect me a little, but I could cope. (2)
- ○ I would need accommodations to continue the life I lead. (3)
- ○ It would impact my life drastically. (4)

Do you feel you have been given adequate information on hearing loss and hearing loss prevention by Theatre UNI?

- ○ Yes (1)
- ○ No (2)
- ○ Abstain due to lack of experience (3)

Appendix B

https://www.asha.org/uploadedFiles/AIS-Noise.pdf

American Speech-Language-Hearing Association

AUDIOLOGY Information Series

Noise

Noise is difficult to define!

One person's music is another person's noise. Sounds that are soothing for some are irritating to others.

People who study sound define noise as complex sound waves with irregular vibrations and no definite pitch. In engineering, noise is defined as a sound signal that interferes with the detection or quality of another sound signal. And still others define noise simply as unwanted sound.

))) One person's music is another person's noise. Sounds that are soothing for some are irritating to others. (((

Noise is one of the most common pollutants. It is often ignored because it is colorless, odorless, and tasteless. And yet it can have negative effects on human well-being.

Is music noise? Is highway traffic noise? Maybe early morning construction falls within your definition of noise. Or do you find lawn mowers and leaf blowers to be noise?

Whatever you define as noise, it can affect your hearing. Listening to loud noise for long periods of time can cause a permanent hearing loss by disrupting the delicate hearing system.

This is called noise-induced hearing loss (NIHL). NIHL happens in the following way:

- The loud sound is collected by the ear as sound waves. The sound travels down the ear canal to the eardrum.
- The loud sound passes through the middle ear into the inner ear, also known as the cochlea. The tiny hair cells lining the fluid-filled cochlea can be damaged by loud sound.
- Only healthy hair cells can send complete electric signals to the brain for interpretation and understanding. If the hair cells are damaged by loud noise, the signals cannot be correctly interpreted by the brain.
- Once hair cells are damaged, there is no current treatment to repair them. The resulting hearing loss is permanent.

How can I tell if I am listening to dangerous noise levels?

- You must raise your voice to be heard.
- You can't hear someone 3 feet away from you.
- Speech around you sounds muffled or dull after you leave the noisy area.
- You have pain or ringing in your ears (tinnitus) after listening to loud noise.

Noise has other negative effects on the human body.

Noise can affect our quality of life. It can hamper our ability to do daily tasks, increase fatigue, and cause irritability. Noisy classrooms can make it harder for all children to learn. Just trying to hold a conversation in a noisy restaurant requires more concentration and energy.

Noise can cause nonhearing changes in the body. It can:

- Increase blood pressure
- Change the way the heart beats
- Disturb digestion
- Contribute to premature birth
- Disrupt sleep

What can I do to protect myself?

Wearing earplugs or earmuffs to protect your hearing when you know you will be around loud noise can help. But for unexpected loud noise, it is best to limit your listening time in the noisy area. The same applies when listening to loud music (live or through earphones). Keep MP3 players set to no more than half volume. Become a model for good listening behavior to educate your children. Have your hearing tested by an audiologist certified by the American Speech-Language-Hearing Association (ASHA) if you think you may have lost some hearing.

Cell phone apps allow you to measue many different types of noise. You can find out how loud some everyday sounds are—like the noise made by your car, dog, television, or stereo.

All noise levels below are measured in decibels. The decibel is a commonly used measurement of sound pressure level. Sounds that measure 70 dBA or higher are considered dangerous to hearing after 8 hours of listening time.

Painful

150 dBA = fireworks at 3 feet

140 dBA = firearms, jet engine

130 dBA = jackhammer

120 dBA = jet plane takeoff, sirens

Extremely loud

110 dBA = maximum loudness of some MP3 players

106 dBA = gas lawn mower, snowblower

100 dBA = hand drill, pneumatic drill

90 dBA = subway, passing motorcycle

Very loud

80–90 dBA = blow-dryer, kitchen blender, food processor

70 dBA = busy traffic, vacuum cleaner, alarm clock

Moderate

60 dBA = typical conversation, dishwasher, clothes dryer

50 dBA = moderate rainfall

40 dBA = quiet room

Faint

30 dBA = whisper, quiet library

(Retrieved from www.noisyplanet.nidcd.nih.gov/parents/athome.htm and www.lhh.org/noise/facts/environment.html on September 24, 2009)

NOTES:

For more information and to view the entire Audiology Information Series library, visit **www.asha.org/aud/pei/**.

For more information about hearing loss, hearing aids, or referral to an ASHA-certified audiologist, contact:

American Speech-Language-Hearing Association

2200 Research Boulevard
Rockville, MD 20850
800-638-8255

E-mail: actioncenter@asha.org
Website: www.asha.org

Compliments of
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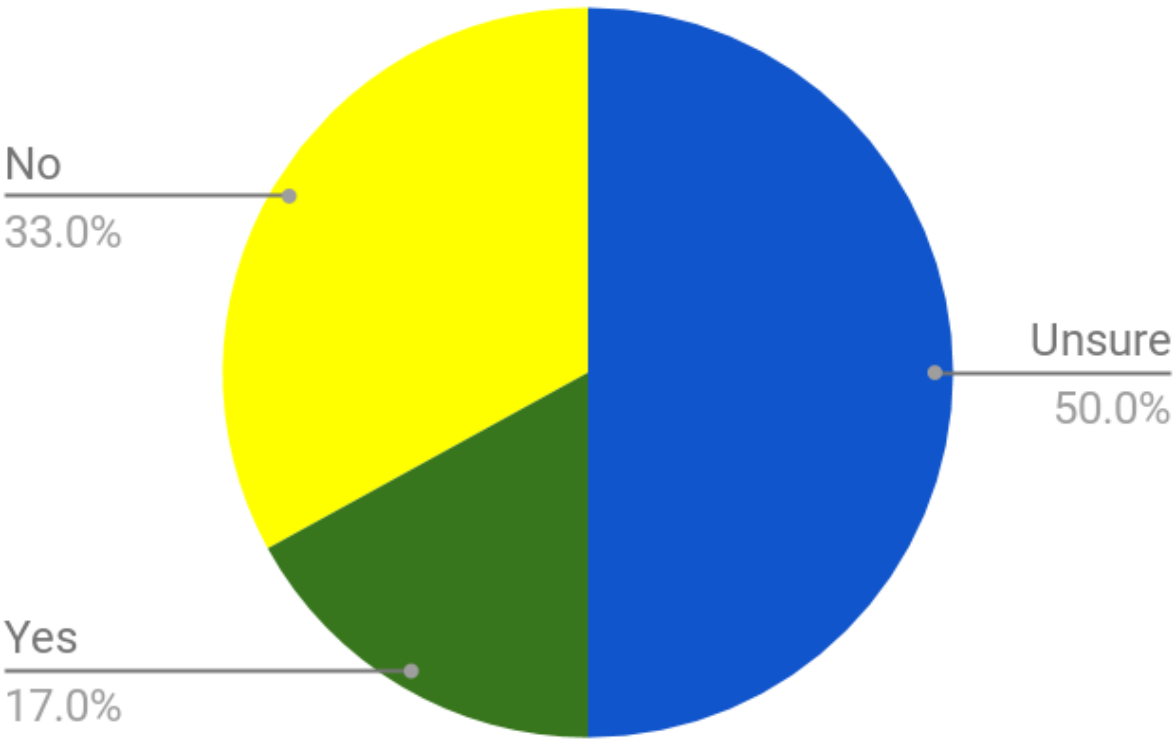

Figure 1. Participant report of hearing status.

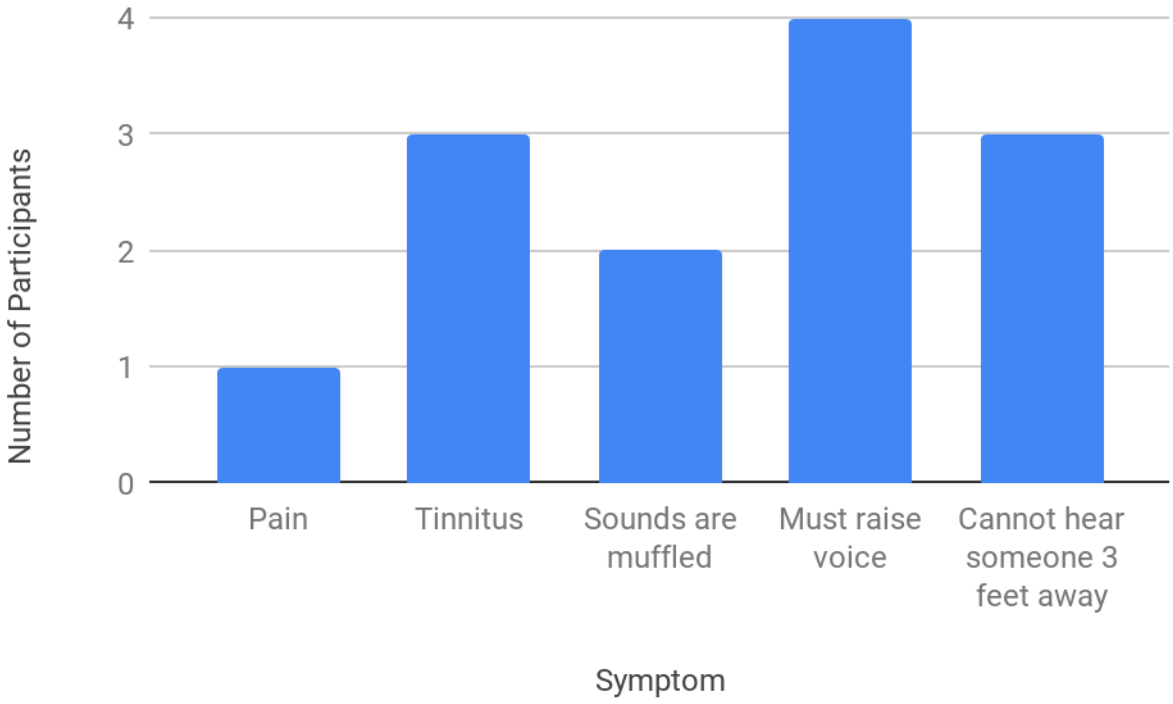

Figure 2. Signs of hearing loss reported by participants.

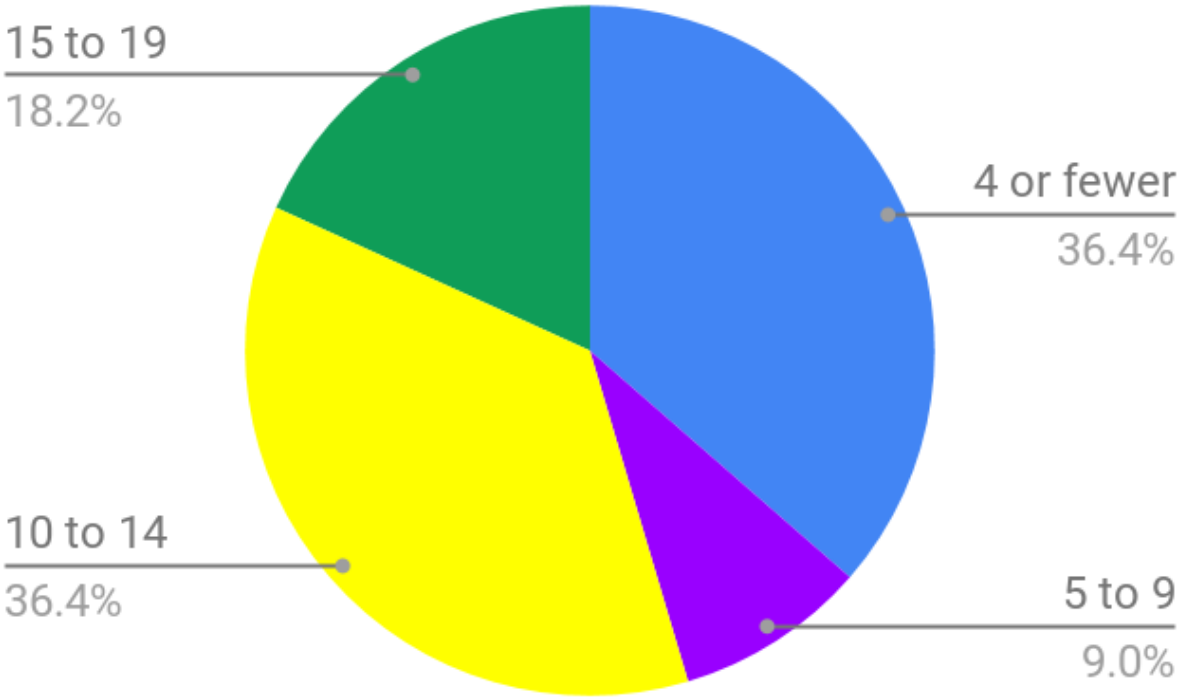

Figure 3. Hour ranges reported working in technical theatre each week.

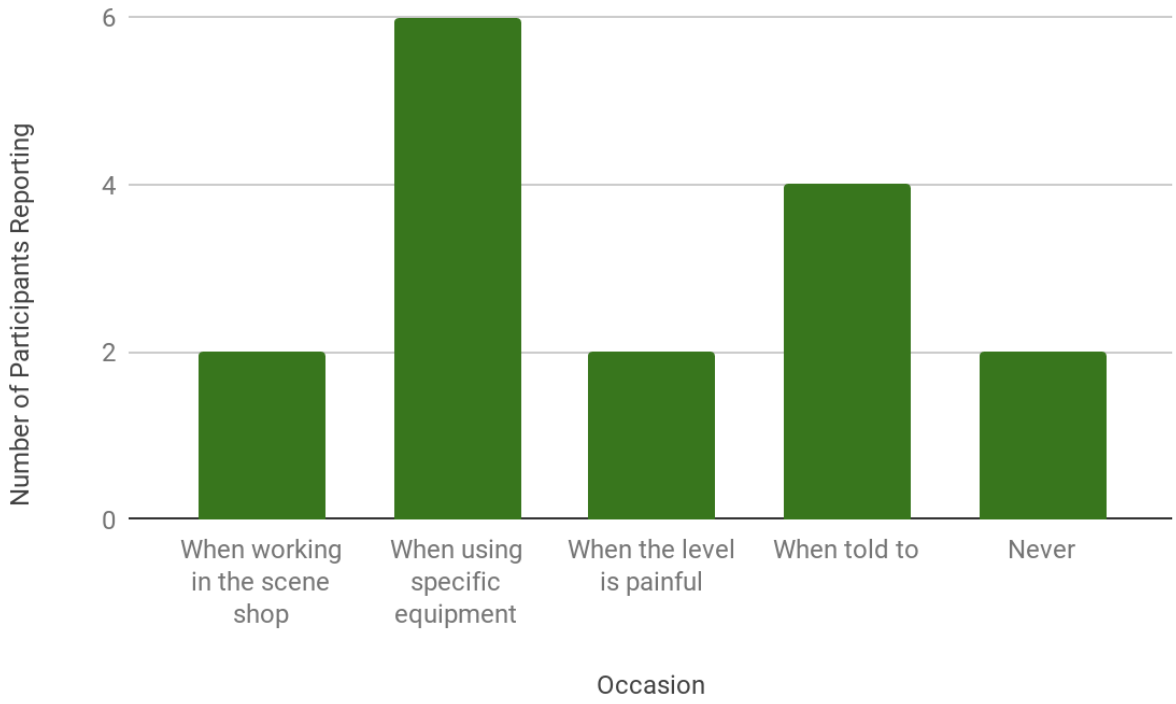

Figure 4. Circumstances under which participants reported using hearing protection.

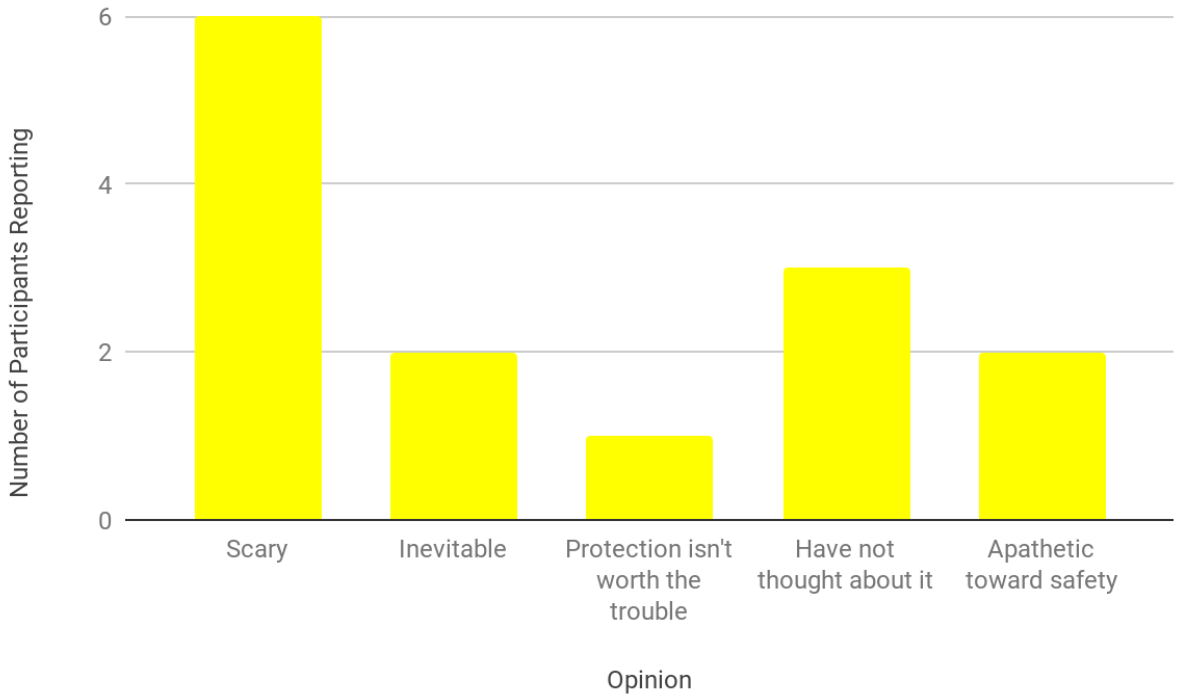

Figure 5. Opinions reported about hearing loss.

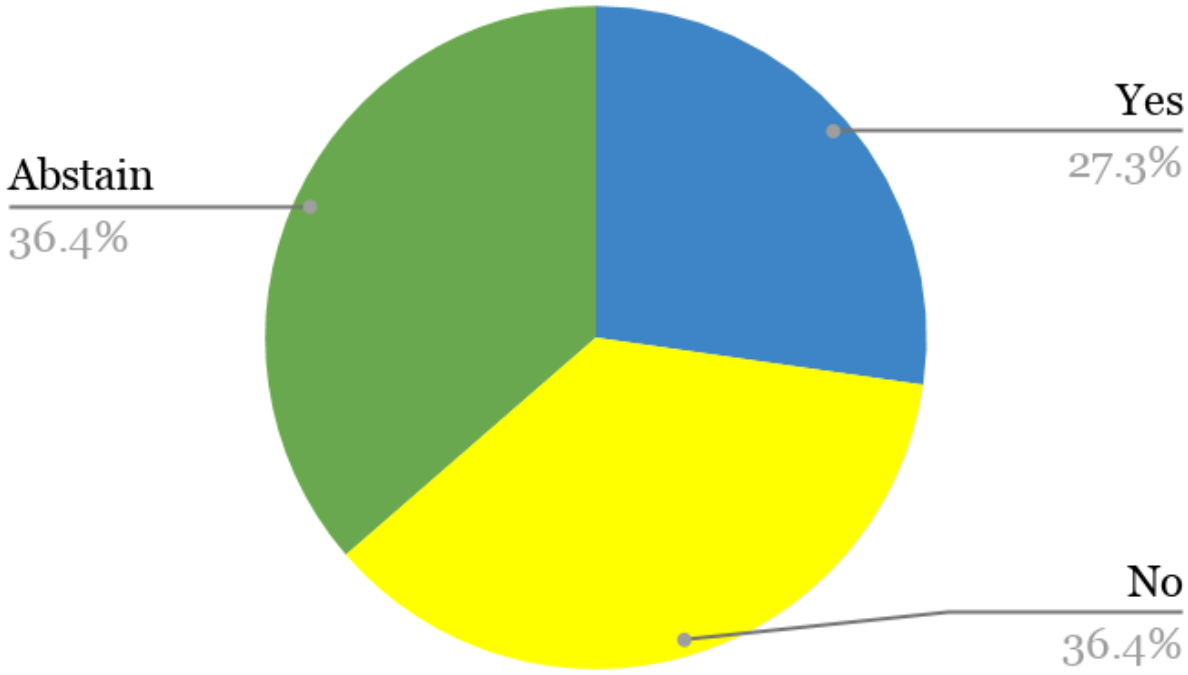

Figure 6. Proportion of students who feel they have received adequate education regarding hearing loss and hearing loss prevention from Theatre UNI.

Table 1

Tool	Sewing Machine	Vent	Table Saw	Panel Saw	Chop Saw
Sound Level	63.0	74.6	90.0	101.3	105.2

Note. Sound levels are in dB SPL. All measurements were taken three feet from the tool.