WILKENFELD, DAVID A., Ed.D. Effects of an Online Hearing Conservation Program for College Musicians. (2018)
Directed by Dr. William Karper. 73 pp.

The purpose of this study was to develop, implement, and evaluate an online hearing conservation program for college musicians (n = 24), focusing on short-term changes in knowledge about hearing loss, attitudes towards noise, and beliefs about hearing loss and hearing protection. In addition, this study aimed to determine college musicians' perceptions of the course content and design to examine the feasibility of using this online platform for the delivery of healthcare information.

Study participants completed pre-test and post-test surveys evaluating immediate changes in knowledge, attitudes, and beliefs. An additional follow-up survey was administered one month after completion of the online hearing conservation program to assess short-term changes. The participants also completed a post-course evaluation to determine the overall strengths and weaknesses of the online hearing conservation program.

Based on the data analyses, it appeared that following participation in the online hearing conservation program, college musicians demonstrated certain positive changes related to hearing loss. A series of Wilcoxon-signed rank tests used to analyze pre-test, post-test, and follow-up knowledge, attitudes, and beliefs demonstrated statistically significant improvements in knowledge about hearing loss and beliefs about hearing loss and hearing protection use.

Descriptive statistics and a thematic analysis were used to determine college musicians' perceptions of the online hearing conservation program content and design.

Based on these analyses it appeared that the online hearing conservation program was well-received by college musicians. Participants widely agreed that the course increased their knowledge related to hearing loss, presented content in an organized manner, and was organized in a way that helped them learn.

The results of this study suggest that the online hearing conservation program represents a dynamic, interactive, and time- and cost-effective alternative to traditional face-to-face hearing education courses for college musicians. While future research should use larger samples of musicians and focus on long-term changes in knowledge, attitudes, and beliefs, the online hearing conservation program presented in this study will provide music educators with a new and alternative way to promote hearing health, while indirectly cultivating a culture of responsibility and accountability related to hearing health in music.

EFFECTS OF AN ONLINE HEARING CONSERVATION PROGRAM FOR COLLEGE MUSICIANS

by

David A. Wilkenfeld

A Dissertation Submitted to
the Faculty of The Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Education

Greensboro
2018

Approved by

_____
Committee Chair

APPROVAL PAGE

This dissertation written by DAVID A. WILKENFELD has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

Committee Chair_____

Committee Members_____

_____

_____
Date of Acceptance by Committee

_____
Date of Final Oral Examination

TABLE OF CONTENTS

Page

CHAPTER I

PROJECT OVERVIEW

Hearing loss due to noise exposure is the most common work-related illness in the United States (Masterson, 2016). According to the National Institute for Occupational Safety and Health (2013) approximately 22 million U.S. workers are exposed to hazardous levels of noise in the workplace resulting in an estimated $242 million in worker's compensation claims annually. Both a one-time exposure to an intense sound (such as a gunshot) and continuous long-term exposure to loud sounds can result in a type of hearing loss referred to as noise-induced hearing loss (NIHL) (National Institute on Deafness and Other Communication Disorders, 2017; Ramazzini, 1964). In musical environments such as orchestras and concert bands, the potential for both short- and long-term exposure to dangerous noise levels has been well documented. Due to their prolonged exposure to dangerous levels of noise, musicians are reported to be four times more likely to suffer from NIHL than the general population (Schink, Kreutz, Busch, Pigeot, & Ahrens, 2014). As a result of this exposure, the ability for musicians to hear pitch changes, playing loudness, and timbre may be affected, and musicians may begin to hear muffled or distorted sounds (Walter, 2009). This can have a significant impact on a musician's career as well as on their quality of life (Masterson, 2016; Basner et al., 2014). While effective strategies for reducing noise exposure and preventing NIHL are

well documented and widely used in industrial settings (Verbeek, Kateman, Morata, Dreschler, & Mischke, 2014), very few musicians take preventative measures to reduce their risk of noise-induced hearing loss (Olson, Gooding, Shikoh, & Graf, 2016). In addition, musicians are not being taught in school that music is capable of harming hearing (Chesky, 2011) resulting in a lack of knowledge related to noise-induced hearing loss along with unhealthy attitudes and behaviors towards hearing loss and the use of hearing protective devices such as ear plugs.

Statement of the Problem

In order to address the underutilization of preventive measures and increase the knowledge related to NIHL among college musicians, there is a need for increased hearing conservation education. Previous literature supports the implementation of hearing conservation programs (HCPs) for increasing knowledge and improving attitudes related to NIHL and the use of hearing protective devices (HPDs), however only one study to date has evaluated an HCP for musicians (O'Brien, Driscoll, & Ackermann, 2015). The majority of HCPs are in the form of in-person educational sessions. With the growing popularity and effectiveness of online educational platforms however, the effectiveness of an online hearing conservation program (OHCP) for musicians needs to be investigated. The only published OHCP curriculum that was identified (McCullagh, Banerjee, Cohen, & Yang, 2016) showed improvement in the knowledge and attitudes towards NIHL and the use of HPDs, however this study did not measure changes in a population of musicians.

Purpose Statement

To help overcome the deficiencies in the hearing conservation literature, the purpose of this study was to develop, implement, and evaluate an online hearing conservation program for college musicians, focusing on changes in knowledge about hearing loss, attitudes towards noise, and beliefs about hearing loss and hearing protection. Likert scale and multiple-choice questions were used to assess musicians' knowledge, attitudes, and beliefs before, immediately afterwards, and one-month after completing an OHCP. The secondary purpose was to determine college musicians' perceptions of the course content and design. Likert scale and open-ended questions were used to assess musicians' perceptions of the course content and design. Hopefully, results from this study will provide a model for future behavioral intervention research in musicians of all ages and levels.

Aims

Aim #1: Develop an online hearing conservation program for college musicians.

Aim #2: Survey college musicians regarding their knowledge about hearing loss, attitudes towards noise, and beliefs about hearing loss and hearing protection to determine the effectiveness of the online hearing conservation program.

Aim #3: Determine college musicians' perceptions of the course content and design to determine the feasibility of using this online platform for the delivery of healthcare information.

Hypotheses

Hypothesis #1: College musicians' knowledge about hearing loss will increase following participation in the OHCP versus their knowledge before participation.

Hypothesis #2: College musicians' attitudes towards noise will become more healthful (noise will be seen as something harmful; will show a tendency to avoid noisy environments) following participation in the OHCP versus before participation.

Hypothesis #3: College musicians' beliefs about hearing loss and hearing protection will become more healthful (hearing protection will be viewed as a good thing; hearing loss will be seen as something concerning) following participation in the OHCP versus before participation.

Hypothesis #4: College musicians' knowledge about hearing loss, attitudes towards noise, and beliefs about hearing loss and hearing protection will be more healthful one month after participating in the OHCP versus before participation.

Methods

Participants

Study participants were undergraduate and graduate students enrolled in college / university music coursework and / or actively and regularly participating in their institution's marching band. Only students who were 18 years of age or older were eligible to participate. College musicians were recruited for this study because they are at a greater risk for noise-induced hearing loss than other populations due to their long-term exposure to noise levels. In addition, music students—such as those in college—may be at an even greater risk for injury because of their increased exposure to recreational noise,

such as personal music devices (Olson et al., 2016; Gilles & Paul, 2014). Through direct emailing and paper canvassing, college musicians were recruited to participate in this study from institutions across the United States. The study protocol was approved by the Institutional Review Board at the University of North Carolina at Greensboro.

Data Collection

The online hearing conservation program (OHCP) was developed and delivered through the Canvas Learning Management System. Through a review of the literature and consultation with experts on hearing health and music education, educational content was identified for the online hearing conservation program. This included information about hearing loss and the effects of noise on our hearing, the types of hearing loss, and methods of preventing hearing loss. The educational content was used to develop learning objectives and goals which drove the conceptual development of the online hearing conservation program. A visual representation of the theoretical framework behind the OHCP can be found in Appendix A. Learning objectives for the online hearing conservation program were: a) gain a basic understanding of the types and causes of hearing loss; b) understand the different signs and symptoms of hearing loss; c) identify and differentiate between different hearing loss prevention strategies.

To ensure that the OHCP followed best practices in online education, the Quality Matters Higher Education Rubric, Fifth Edition (2017) was consulted. This rubric, which is comprised of eight General Standards and 43 Specific Review Standards, serves as an evaluation tool for the design of online and blended courses and is derived from experienced online teachers and instructional designers as well as best practice guidelines

from accrediting bodies and national and international organizations (QM Higher Education Rubric, 2017). The eight General Standards of this rubric are: Course Overview and Introduction, Learning Objectives, Assessment and Measurement, Instructional Materials, Course Activities and Learner Interaction, Course Technology, Learner Support, and Accessibility and Usability. Following consultation with the QM Higher Education Rubric, the online hearing conservation program was piloted using a group of musicians and music educators. Feedback from these participants was used to improve the delivery and design of the online hearing conservation program.

The online hearing conservation program was comprised of two primary modules. The first module focused on operationally defining noise, discussing the anatomy and physiology of the ear and hearing mechanism, presenting how hearing loss affects our ability to hear and interpret sounds, describing the role noise plays in the performing arts, introducing the types of hearing loss, and presenting common signs and symptoms of hearing loss. The second module focused on how hearing loss can be prevented with specific sections on the Federal Standards for occupational noise exposure, administrative strategies for preventing hearing loss, engineering strategies for preventing hearing loss, and common hearing protective devices available to musicians.

Demographic questions gathered information regarding gender, age, and primary musical instrument (see Appendix B). The dependent variables in this study were knowledge about hearing loss, attitudes towards noise, and beliefs about hearing protection and hearing loss. Dependent variables were measured before participation in the OHCP (pre-test), immediately after participation in the OHCP (post-test), and one-

month after participation in the OHCP (follow-up). Data were collected using Qualtrics (Provo, UT), and stored in a password-protected Box account using 1-Lock (low risk) data storage configuration in accordance with the University of North Carolina at Greensboro Data Classification Policy.

Knowledge about hearing loss was assessed using a 12-item survey (see Appendix B). Survey items were developed from a review of current literature on hearing health. To date, no known validated surveys exist for measuring knowledge related to hearing health. Knowledge scores were measured as continuous variables and totaled out of twelve possible points.

Attitudes towards noise were assessed using statements from the validated Youth Attitudes to Noise Scale (see Appendix B). Originally developed by Olsen-Widén and Erlandsson (2004), the Youth Attitudes to Noise Scale contains 19 questions distributed into four categories: attitudes towards noise associated with elements of youth culture; attitudes towards the ability to concentrate in noisy situations; attitudes towards daily noises; attitudes towards influencing the sound environment. Musicians were asked to rate their responses on a five-point Likert scale, with a score of 5 being "I fully agree" and a score of 1 being "I fully disagree." Using the scores from the Youth Attitudes to Noise scale, individuals can be classified as having a negative (lower quartile), a neutral (two middle quartiles), and a positive (upper quartile) attitude towards noise. A negative, more healthful attitude towards noise means that noise is seen as something harmful and as something to avoid. A positive, less healthful attitude towards noise means that noise

is not seen as something dangerous or harmful. A neutral attitude towards noise means that one does not care or is unaware of the possible harm from loud noises.

Beliefs about hearing loss and hearing protection were assessed using statements from the validated Dutch version of the Beliefs About Hearing Protection Hearing Loss (BAHPHL) scale (see Appendix B). Originally developed by the United States National Institute for Occupational Safety and Health (NIOSH) to assess the attitudes towards hearing protection and the beliefs concerning hearing loss impact, the BAHPHL scale was later modified by Keppler (2010) to focus on youth. The BAHPHL scale consists of 24 items divided into seven categories: susceptibility to hearing loss, severity of consequences of hearing loss, benefits of preventative action, barriers to preventative action, behavioral intentions, social norms, and self-efficacy. The BAHPHL was assessed using a five-degree Likert scale from "totally disagree" to "totally agree." A higher score represents a positive, less healthful belief meaning that noise or hearing loss was seen as unproblematic and attitudes or beliefs about hearing protection were worse. A lower score represents a negative, more healthful belief meaning that noise or hearing loss was seen as something to avoid and attitudes or beliefs about hearing protection were better.

Participants recruited to this study completed pre-test and post-test surveys evaluating knowledge about hearing loss, attitudes towards noise, and beliefs about hearing loss and hearing protection. An additional follow-up survey was administered one (1) month after completion of the online hearing conservation program to assess changes in short-term knowledge, attitudes, and beliefs.

Following the completion of the online hearing conservation program, participants were asked to complete a course evaluation through Canvas (see Appendix B). Question formats included 5-degree Likert scales and open-ended questions. Descriptive statistics were used to summarize responses to the Likert scale questions. All responses to the open-ended questions were downloaded into an Excel database and a descriptive thematic analysis was performed using Braun and Clarke's (2006) six phase approach. All coding was double checked by a second coder and any disagreements were resolved through discussion.

Survey data were stored electronically using a Box account, which was password protected. Only the Primary Investigator had access to the data file in Box. Box was configured for 1-Lock (low risk) data storage in accordance with the UNCG Data Classification Policy. De-identified responses from the surveys were downloaded directly into SPSS Version 25 for statistical analysis, and responses to the course evaluation were downloaded into an Excel database for further analysis.

Conduct of the Study

During the Fall (2017) and Spring (2018) music programs and marching bands received an email and phone invitation from the primary investigator to participate in the study. Participants were provided with information about the study, contact information for the Primary Investigator, instructions on how to access the online hearing conservation program in Canvas, and a link to the pretest survey that was administered through Qualtrics (Provo, UT). In addition, Program administrators were asked to post flyers in their buildings to assist with participant recruitment. These flyers contained

information about the study, contact information for the Primary Investigator, and instructions on how to access the online hearing conservation program in Canvas. Following completion of the online hearing conservation program, study participants were asked to immediately complete the post-test survey and course evaluation. One month following completion of the online hearing conservation program, study participants received an email invitation to complete a follow-up survey through Qualtrics.

Findings

Twenty-four participants (18 female, 6 male) were recruited to learn about the effects of an online hearing conservation program on knowledge about hearing loss, attitudes towards noise, and beliefs about hearing loss and hearing protection in college musicians. The average age of participants was 20.17 ± 1.58 years. Primary instruments played were voice (n = 7), saxophone (n = 4), trumpet (n = 3), clarinet (n = 2), flute (n = 2), piano (n = 1), baritone horn (n = 1), French horn (n = 1), bassoon (n = 1), classical guitar (n = 1), and violin (n = 1). Out of the twenty-four participants, one reported currently wearing hearing aids, and two (8.3%) reported currently using hearing protection while playing. Wilcoxon signed-rank tests with a significance level of $p = 0.01$ were used to evaluate the differences between knowledge, attitude, and belief scores from pre-test to post-test, pre-test to follow-up, and post-test to follow-up. An alpha level of $p = 0.01$ was used to correct for the small sample size and multiple analyses. Cohen's d was used to calculate effect sizes for changes between pre-test, post-test, and follow-up. Data analysis was performed using SPSS Version 25.

Knowledge About Hearing Loss

Of the twenty-four participants recruited to the study, post-test knowledge scores increased in nineteen participants (79.2%), with three participants seeing a decrease and two participants seeing no increase in knowledge scores from pre-test to post-test. A Wilcoxon signed-rank test determined that there was a statistically significant increase in post-test knowledge scores ($\mu = 9.71$) compared to pre-test scores ($\mu = 8.08$), $z = 2.951$, $p = .003$, $d = 0.80$. Therefore, the hypothesis that knowledge scores would increase following participation in the OHCP versus before participation was accepted.

Of the twenty-four participants that completed follow-up surveys, knowledge scores increased in sixteen (66.7%), with five participants seeing no increase, and three participants seeing a decrease in knowledge scores from pre-test to follow-up. There was a statistically significant increase in follow-up knowledge scores ($\mu = 9.75$) compared to pre-test scores ($\mu = 8.08$), $z = 3.002$, $p = .003$, $d = 0.94$. Therefore, the hypothesis that knowledge scores would increase one-month following participation in the OHCP versus before participation was accepted.

Compared to post-test scores, follow-up knowledge scores either remained the same or increased in fifteen participants (62.5%), and nine participants saw a decrease in knowledge scores from post-test to follow-up. There was not a statistically significant difference in follow-up knowledge scores compared to post-test scores, $z = 0.106$, $p = .915$, $d = 0.02$.

Attitudes Towards Noise

Twenty-three of the participants recruited to this study demonstrated neutral attitudes towards noise (two middle quartiles) and one participant demonstrated less healthful attitudes towards noise at pre-test. Post-test attitudes towards noise became slightly more healthful (noise was seen as something harmful; showing a tendency to avoid noisy environments) in thirteen participants (54.2%), three participants recorded no change, and eight participants recorded post-test attitudes towards noise that were less healthful than at pre-test. No statistically significant difference was found between post-test attitudes towards noise and pre-test scores, $z = -1.914$, $p = .056$, $d = 0.28$.

Of the twenty-four participants that completed follow-up surveys, fourteen (58.3%) recorded more healthful attitudes towards noise versus at pre-test, four recorded no change, and six recorded less healthful attitudes towards noise. No statistically significant difference was found in attitudes towards noise between pre-test and follow-up, $z = -1.869$, $p = .062$, $d = 0.42$.

Compared to post-test scores, follow-up attitudes towards noise either remained the same or became more healthful in sixteen participants (66.7%). There was not a statistically significant difference between post-test attitudes towards noise and follow-up scores, $z = -.895$, $p = .371$, $d = 0.11$.

Beliefs About Hearing Loss and Hearing Protection

Compared to pre-test scores, post-test beliefs about hearing loss and hearing protection became more healthful (hearing protection is a good thing; hearing loss is seen as something concerning) in seventeen participants (70.8%), three participants recorded

no change, and four participants recorded less healthful post-test beliefs. There was a statistically significant change in post-test belief scores (μ = 2.50) compared to pre-test beliefs scores (μ = 2.81), z = -2.993, p = .003, d = 0.58. Therefore, the hypothesis that beliefs about hearing loss and hearing protection would become more healthful following participation in the online hearing conservation program versus before participation was accepted.

Of the twenty-four participants that completed the follow-up survey, seventeen (70.8%) recorded more healthful beliefs towards hearing loss and hearing protection versus at pre-test, two participants recorded no change, and five participants recorded less healthful beliefs. There was a statistically significant difference in beliefs scores from pre-test (μ = 2.81) to follow-up (μ = 2.49), z = -2.894, p = .004, d = 0.59. Therefore, the hypothesis that beliefs about hearing loss and hearing protection would become more healthful one-month after participating in the OHCP versus before participation was accepted.

Compared to post-test scores, follow-up beliefs about hearing loss and hearing protection either remained the same or became more healthful in sixteen participants (66.7%), and eight recorded beliefs that were less healthful. There was not a statistically significant difference in beliefs scores from post-test to follow-up, z = -.599, p = .549, d = 0.02.

Online Hearing Conservation Program Course Evaluation

Sixteen out of twenty-four participants (66.7%) completed the course evaluation (see Appendix B). Using a five-degree Likert scale from “strongly disagree” to “strongly

agree," 100% of respondents stated that they either agreed or strongly agreed that their knowledge related to hearing loss increased following participation in the course. While fifteen out of the sixteen participants (93.7%) who completed the course evaluation stated that they either agreed or strongly agreed that the course presented content in an organized manner and that the course was organized in a way that helped them learn, one participant (6.3%) stated that they were undecided about these two statements. Nine out of sixteen participants (56.3%) reported that they "strongly agree" that the course presented content in an organized manner. Eleven participants (68.7%) stated that they "strongly agree" that their knowledge of hearing loss increased after participation in the course. Nine of the sixteen participants (56.3%) stated that they "strongly agree" that the course was organized in a way that helped them learn.

An open-ended question asked participants for their views on the strengths of the online hearing conservation program. Using Braun and Clarke's (2006) six phase approach, a descriptive thematic analysis was performed. Initial codes generated were: fun to take, multimedia was enjoyable / helpful, appropriate amount of multimedia, important topic, showed that hearing loss is an issue facing artists, demonstrated the danger noise can pose to artists, learning from others' experiences, informative, logical flow of materials, clear presentation, material was easy to understand and follow, and additional resources. Data are summarized in Appendix C. The major themes for strengths of the course included: informative (twelve responses), organized presentation (seven responses), and effective use of multimedia (ten responses).

A second open-ended question asked participants for their views on the area(s) where the online hearing conservation program could be improved. Thematic analysis resulted in the following initial codes being generated: more visuals needed, more interactive material, updated / modern material needed, prefers in-person course over online, additional artist examples needed, further focus needed on preventing hearing loss, and the course is good as-is. Data are summarized in Appendix C. The major themes for course improvement included: more engaging format (nine responses), and hearing loss prevention focus (three responses).

Discussion

Components of an effective hearing conservation program for musicians should be tailored to musicians and should include specific content pertaining to their knowledge of hearing loss and the effects of noise on hearing health, the purpose and importance of an annual hearing examination, and the purpose and importance of wearing hearing protective devices (Sobel & Meikle, 2008; Widén, 2013). Grounded in behavioral theories such as the health belief model, the transtheoretical model, and the theory of planned behavior, effective hearing conservation programs affect behavior change by changing musicians' perceptions of the pros and cons related to noise exposure and the use of hearing protective devices, and through increased awareness of the dangers of noise exposure and hearing loss preventative measures (Gilles & Paul, 2014; Sobel & Meikle, 2008).

This study illustrated some measurable effects following participation in the online hearing conservation program. On the whole, results indicated that college

musicians became more knowledgeable about hearing loss both immediately and one-month following participation in the online hearing conservation program. For example, a majority of participants (79.2% and 75% for post-test and follow-up, respectively) correctly identified that hearing loss cannot be reversed. Moreover, 95.8% of the college musicians knew that excessive noise can cause hearing loss at any age. These overall high percentage scores on questions concerning hearing loss are encouraging and suggest that participation in the online hearing conservation program results in college musicians beginning to move along the stages of change described in the transtheoretical model (Prochaska, & Velicer, 1997) toward the adoption of hearing health promoting behaviors. Despite this, the findings also indicate that there may be a need for more targeted education of college musicians. For example, although over half of participants (66.7% at post-test and 58.3% at follow-up) correctly identified that foam, semi-custom, and custom earplugs are the three best types of earplugs available to musicians, 83.3% reported that they do not wear hearing protective devices while playing. This discrepancy may be explained by a lack of access to hearing protective devices or by cultural and social pressures that outweigh the perceived benefits of using hearing protective devices (Crandell, Mills, & Gauthier, 2004). Therefore, it is imperative that administrators and music educators educate young musicians about the risks associated with exposure and the benefits of using hearing protective devices.

In addition to the increases in knowledge about hearing loss following participation in the online hearing conservation program, more healthful beliefs about hearing loss and hearing protection were reflected by the decrease in beliefs scores

recorded at post-test and follow-up. Keppler, Ingeborg, Sofie, & Bart (2015) also found a significant decrease in beliefs scores in young adults after a hearing conservation program. The present study showed that the same effect may be true in young adult musicians both immediately and one-month following participation in the online hearing conservation program. However, it is possible that those music students who already had more healthful beliefs about noise were more prone to the effects of the online hearing conservation program compared to those who previously had less healthful beliefs about noise. The same can be said for changes in knowledge about hearing loss and attitudes towards noise.

Concerning short-term changes in attitudes towards noise, no measurable changes were found in this study. This is contradictory to previous literature which showed moderate-term changes in both attitudes and beliefs in a sample of young adults (Keppler, Ingeborg, Sofie, & Bart, 2015). A plausible explanation for the lack of measurable change may be that the sample size was too small. While multiple sites were used to recruit participants for this study, the primary investigator found that most college musicians were unwilling to take 1-2 hours of their time to learn about hearing loss and how to protect their hearing. Additionally, previous studies (including the one by Keppler, et al., 2015) provided hearing health education in a one-on-one format whereas the present study provided hearing health education in an asynchronous online format. It is suggested that future research should explore using a shortened version of the online hearing conservation program, and should evaluate changes in knowledge, attitudes, and beliefs over a longer span of time. Finally, questions from the Youth Attitudes Towards

Noise Scale were derived from previous studies of college musicians. These questions may be limited because they did not include specific scenarios involving music rehearsal or performance.

Overall, the content and design of the online hearing conservation program received positive feedback. Participants felt that the course was well-organized, used multimedia effectively, and was informative. Areas for improvement included needing an increased focus on hearing prevention strategies for musicians, and more interactive games / activities. These findings suggest that an online hearing conservation program represents a dynamic and interactive format for delivering healthcare information. Further research should investigate whether modifications to the online hearing conservation program content and design result in increased engagement in the material and awareness of the seriousness hearing loss poses to musicians. It is hypothesized that these changes will result in healthier attitudes and beliefs about noise, hearing loss, and hearing protection.

Lastly, through the process of running an asynchronous online course, several "best practice tips" were identified. These included beta-testing course navigational controls, checking and re-checking that external links and media were still active weeks and months after the course opened, and either learning basic HTML code or consulting an instructional designer to help make the course more dynamic and interactive. Although the course design was based on the eight Standards from the Quality Matters Higher Education Rubric, Fifth Edition (2017) and piloted with musicians and music educators, study participants still provided useful feedback for improving the course.

Changes including the addition of more anecdotes from current musicians about their experiences with hearing loss, additional games and self-assessments throughout the course, and less text will be made as a result of running the online course and feedback from participants. It is the investigator's hope that future iterations of the online hearing conservation program will address these shortfalls through collaboration with the institution's instructional designer and information technology department.

Conclusion

In conclusion, with shrinking budgets and space in music curricula, and an increased emphasis and focus on musician health and wellness through accreditation standards, the online hearing conservation program represents a dynamic, interactive, and time- and cost-effective alternative to traditional face-to-face hearing education courses for college musicians. While future research should use larger samples of musicians and focus on long-term changes in knowledge, attitudes, and beliefs, the online hearing conservation program presented in this study will provide music educators with a new and alternative way to promote hearing health, while indirectly cultivating a culture of responsibility and accountability related to hearing health in music.

CHAPTER II

DISSEMINATION

The plan for initial dissemination of this project is to present the findings to musicians and music educators. While multiple professional conferences exist that would be appropriate for presenting this information, it was decided that this presentation will be submitted to the 2019 Performing Arts Medicine Association's International Symposium. This symposium, which aims to improve the well-being of performing artists, brings together artists, educators, and healthcare providers to discuss and present on current topics in performing arts medicine.

The presentation will consist of the project described in Chapter I. The main objective will be to share the work that was done in order to inspire others to start thinking of ways of incorporating hearing education and hearing health into their music programs. More specifically, this presentation will explain how hearing education can benefit student musicians and how a web-based format provides a dynamic and interactive alternative to the traditional paradigm. Further, this presentation will highlight the significant health concern hearing loss presents to student musicians, and how incorporating wellness programming such as the online hearing conservation course can improve the health and wellness of student musicians. The following is an outline of the PowerPoint presentation that will be submitted to the 2019 Performing Arts Medicine

Association's International Symposium. The presentation slides can also be found in Appendix D.

Presentation Script

Introduction (Slides #1-3)

Good morning. The information presented today is from my dissertation work at the University of North Carolina at Greensboro. This idea was developed as a result of my own experiences with playing-related hearing loss as a student musician, having played the clarinet in both small and large ensembles (including marching bands) from elementary school through college. It was also developed as a result of my experiences working with high school and college-age artists as an athletic trainer over the past 8 years. While at first glance, one may question why athletic trainers should be concerned with hearing loss in musicians, it becomes very clear when you look at the Practice Domains for athletic trainers. Domain One of the 7th edition of the Practice Analysis (2015) is titled *Injury and Illness Prevention and Wellness Protection*. The description of this Domain reads, "promoting healthy lifestyle behaviors with effective education and communication to enhance wellness and minimize risk of injury and illness." (Board of Certification, 2015). Injury and illness prevention is arguably one of the most encompassing domains in the profession of athletic training. It not only includes risk management, but health and wellness promotion. Athletic trainers promote a healthy lifestyle and environment for all of their patients through a holistic approach which includes the promotion of physical, social, emotional, mental and spiritual wellness. Since hearing loss affects musicians physically, emotionally, and socially, athletic

trainers are perfectly positioned as trained health professionals to provide hearing loss prevention education and training.

Background (Slides #4-7)

Before we begin, I want to address a couple of things. When I refer to noise, as in noise-induced hearing loss, I am indeed calling music noise. That is because the term noise is a general term that refers to all sounds, including music. While music itself is not the issue, the loudness and duration for which music is played are the issues related to hearing loss. A noise that is too loud, such as a gunshot, or a noise and that is loud for long periods of time, such as what a musician can be exposed to, are both dangerous no matter what the sound may be.

So why are we talking about hearing loss among student musicians? In the United States, approximately 36 million people suffer from hearing loss, with 1 in 3 suffering from hearing loss as a result of noise exposure. In musical environments such as orchestras and concert bands, the potential for both short- and long-term exposure to dangerous noise levels has also been well documented. Due to their prolonged exposure to dangerous levels of noise, musicians are reported to be four times more likely to suffer from noise-induced hearing loss than the general population. In fact, musicians may be exposed to as much as 17,000 percent of the allowable exposure for one day compared to the average person. As a result of this exposure, the ability for musicians to hear pitch changes, playing loudness, and timbre may be affected, and musicians may begin to hear muffled or distorted sounds. This can not only have a significant impact on a musician's career but also their quality of life.

But what's considered too loud? Both the National Institute for Occupational Safety and Health, or NIOSH, and the Occupational Safety and Health Association, or OSHA, have guidelines for safe noise exposure levels. Using the more conservative NIOSH value, during an 8-hour period, a person should be exposed to, on average, no more than 85 decibels. To put this into context, lawnmowers average 100 decibels, typical sporting events or rock concerts average 110 decibels, and face-to-face conversations average 60 decibels. Previous research measured the sound levels of orchestras at just over 90 decibels. If we were to follow NIOSH guidelines, musicians playing in an orchestra should only be exposed to this level of noise for approximately 2 hours before they begin to risk hearing loss. Unfortunately for musicians, industry safety guidelines such as those published by NIOSH and OSHA do not typically apply to those in the music industry. Further, standard injury prevention strategies that are utilized in industrial settings—such as educational programming and the use of ear plugs—are not widely used by musicians.

Purpose (Slide #8)

In order to address the underutilization of preventive measures and increase the knowledge related to hearing loss among college musicians, there is a need for increased hearing conservation education. Therefore, the purpose of this study was to develop, implement, and evaluate a web-based hearing conservation program for college musicians, focusing on pre-test, post-test, and short-term follow-up changes in college musicians' knowledge, attitudes, and beliefs related to noise, hearing loss and the use of hearing protective devices such as ear plugs. The secondary purpose was to determine

college musicians' perceptions of the course content and design. I hypothesized that college musicians' knowledge, attitudes, and beliefs related to noise, hearing loss and the use of hearing protective devices would become more healthful both immediately and one-month following participation in the online hearing conservation program versus before participation.

Program Design (Slides #9-15)

The online hearing conservation program was developed and delivered through the Canvas Learning Management System. Through a review of the literature and consultation with experts on hearing health and music education, educational content was identified for the online hearing conservation program. The educational content was used to develop learning objectives and goals which drove the conceptual development of the online hearing conservation program. The first module of the program is broken down into sections which operationally define noise, briefly describe the anatomy of the ear and the physiology of how we hear noises, illustrate the role noises play in the arts, discuss the effects of noise on our ability to hear and interpret other sounds, describe the types of hearing loss as well as the signs and symptoms of hearing loss. The second module of the program focuses on how hearing loss can be prevented and is broken into three main sections: federal standards occupational hearing health, administrative and engineering controls, and hearing protective devices.

Study participants completed surveys before and after taking the online course, and then were surveyed again one month following the completion of the online program. The surveys were based upon the previously studied Youth Attitudes to Noise Scale and

the Dutch version of the Beliefs About Hearing Protection and Hearing Loss. Additional questions asked about participants' demographics and knowledge related to hearing health. The one-month follow-up survey was utilized to assess short-term changes in knowledge, attitudes, and beliefs following participation in the online program. Lastly, participants completed a course evaluation which consisted of scaled and open-ended questions.

Findings (Slides #16-18)

Twenty-four musicians (18 female, 6 male) participated in this study. The average age of participants was 20.17 ± 1.58 years. Primary instruments reported were voice (n = 7), saxophone (n = 4), trumpet (n = 3), clarinet (n = 2), flute (n = 2), piano (n = 1), baritone horn (n = 1), French horn (n = 1), bassoon (n = 1), classical guitar (n = 1), and violin (n = 1). Out of the twenty-four study participants, only two reported currently using hearing protection while playing. Data from the surveys were collated and evaluated using SPSS, and data from the course evaluation were downloaded into an Excel database. Wilcoxon signed rank tests were performed to evaluate the differences between knowledge, attitudes, and beliefs at the pre-test, post-test, and follow-up time points. Descriptive statistics and a descriptive thematic analysis were performed on the data from the course evaluation.

With an alpha level set at $p = .01$, a statistically significant difference was found between pre-test and post-test, and pre-test and follow-up for knowledge and beliefs scores. Although the alpha level was approaching significance, no statistically significant

difference was found between pre-test and post-test attitudes towards noise (p = .056) or between pre-test and follow-up attitudes towards noise (p = .062).

Of the sixteen participants that completed the course evaluation, fifteen replied that they either "agree" or "strongly agree" to each of the three scaled questions. When asked about their views on the strengths of the online course, descriptive thematic analysis resulted in major themes of increased awareness, organized presentation, and effective use of multimedia. A second open-ended question asked participants for their views on the area(s) where the online hearing conservation course could be improved. The major themes for course improvement included: additional media, hearing loss prevention focus, and engagement.

Discussion and Conclusions (Slides #19-21)

Changes in knowledge and beliefs related to noise, hearing loss, and the use of hearing protection following participation in the online hearing conservation program suggest that the course was effective in positively affecting college musicians' knowledge about hearing loss and beliefs about hearing loss and hearing protection. While not statistically significant, the results of this study suggest that participation in the online hearing conservation program may play a role in influencing attitudes towards noise. Limitations of this study include its small sample size as well as the asynchronous nature of the online hearing conservation program.

While some areas for improvement were identified, participant views of the course content and design suggest that the dynamic and interactive format of the online hearing conservation course was well received and effective for delivering healthcare

information. In addition, through the process of running an asynchronous online course, several “best practice tips” were identified. These included beta-testing course navigational controls, checking and re-checking that external links and media were still active weeks and months after the course opened, and either learning basic HTML code or consulting an instructional designer to help make the course more dynamic and interactive. It is our hope that future iterations of the online hearing conservation program will address these shortfalls through collaboration with the institution’s information technology department.

In conclusion, with shrinking budgets and space in music curricula, and an increased emphasis and focus on musician health and wellness through accreditation standards, the online hearing conservation program represents a dynamic, interactive, and time- and cost-effective alternative to traditional face-to-face hearing education courses for college musicians. While future research should use larger samples of musicians and focus on long-term changes in knowledge, attitudes, and beliefs, the online hearing conservation program presented in this study will provide music educators with a new and alternative way to promote hearing health, while indirectly cultivating a culture of responsibility and accountability related to hearing health in music.

CHAPTER III

ACTION PLAN

Demonstrating the effectiveness and feasibility of an online hearing conservation program for student musicians will help academic programs improve the overall health and wellness of their students. Recently, organizations such as the National Association of Schools of Music and the International Society for Music Education began to address the occupational hazards as a result of a career in music and partnered with professional healthcare organizations to develop recommendations for the prevention of noise-induced hearing loss. One of these recommendations is for tailored educational programming about hearing loss and the purpose and importance of using hearing protective devices. The online hearing conservation program presented in this original study could meet the recommendation by providing tailored information to the student musician in a format that is dynamic and interactive. Further, the online hearing conservation program could be made publicly available to academic institutions nationwide, removing any financial or time burden that might prevent an institution from establishing their own hearing conservation program. This, in turn, is expected to make it easier for music educators to promote hearing health, as well as cultivate a culture of responsibility and accountability related to hearing health. Therefore, the positive impact on the field of music is anticipated to be significant.

In order to have this positive impact on the field of music, the following action plan is proposed. This plan consists of multiple steps consisting of both short term and long-term goals leading to educating the music community about the benefits of good hearing conservation practices. The first step has been to write a detailed outline for a presentation (see Chapter 2) that can be used across multiple disciplines and tailored to meet the needs of various audiences. The goal of this presentation is to share the work with the academic community across the disciplines of music and music education. Further, presentations to other audiences including allied health professions that work with musicians (e.g., speech-language pathology, athletic training, audiology, physical therapy, occupational therapy) will allow for wider dissemination of this information. An example of this is the annual Performing Arts Medicine Association International Symposium, which is a multidisciplinary meeting that aims to improve the well-being of performing artists. Additionally, presenting this project at the 2019 National Athletic Trainers' Association Annual Meeting and Clinical Symposia, which has a primary theme of *performing arts medicine,* will allow me to share the results with other athletic trainers who work with musicians and may be interested in including a web-based hearing education program at their own institutions. At the same time, there exists additional speaking opportunities to a broader audience of educators on the development of quality online courses using the course feedback provided by the participants in the original study. This may include speaking at professional meetings such as the Athletic Training Educators' Conference, the iNACOL Blended and Online Learning Symposium, and the NAKHE Annual Conference.

The next step of the action plan is to use the presentation as an outline to write a manuscript for publication. Academic journals that would be ideal for publication of this work include, but are not limited to, the Medical Problems of Performing Artists Journal, the Music Educators Journal, the Music Teachers National Association e-Journal, and the American Journal of Audiology. The goal of this manuscript will be to disseminate the results from the original project to a broader audience who might not have attended one of the platform presentations. As an extension of the original project, the online hearing conservation program is currently being used by the Music Department at a Liberal Arts College in Pennsylvania as part of an initiative to promote health and wellness among their musicians. Music students complete the online hearing conservation program at the beginning of the academic year and are asked to re-take it annually. Results of this larger study will also be published in at least one of the aforementioned peer-reviewed journals.

All of this work, along with the original project, is part of the longer-term goal of developing a comprehensive wellness program for student musicians. Much like traditional athletes, musicians are at risk for injuries as a result of their activity. Unlike traditional athletes however, musicians are not required to participate in pre-participation physicals that are designed to screen for injury or illness risk factors, nor do many of them have easy access to quality healthcare. Further, accrediting bodies for music education have raised the standard for musician wellness by mandating that academic music programs offer education regarding the maintenance of hearing health and injury prevention. Given the national emphasis on prevention in health care, developing a hearing health education course as part of a greater comprehensive wellness program for

musicians appears to be very important, and will exceed current accreditation standards and help prevent injuries among musicians.

This wellness program should include multiple components starting with a comprehensive physical examination that is reviewed by a medical doctor. The physical examination will collect information pertaining to family medical history, diet and sleep habits, cardiac health, visual acuity, depression and anxiety, and injury history. The second component should include educational programming such as the web-based hearing conservation course, and information pertaining to vocal hygiene and managing performance anxiety. Lastly, the wellness program should include injury screening tests such as the Beighton Score for hypermobility and the 90-second musculoskeletal screening examination, which are designed to help identify predisposing factors for injury.

Looking beyond musicians, an online hearing conservation program may also be applicable to sports medicine personnel. Having spent several years providing medical coverage for both NCAA Division I and professional football teams, I experienced first-hand the noise level that a stadium of 40,000 to 60,000 fans can produce. While no studies to date have evaluated the noise exposure of sports medicine personnel at sporting events, multiple studies examined the noise exposure of game officials and sports fans. Adams and Brazile (2017) evaluated the noise exposure of indoor hockey games and found that the officials were exposed to noise levels which exceeded allowable limits and experienced temporary hearing loss after officiating games. It has also been reported that sports fans (Cranston, Brazile, Sandfort, & Gotshall, 2012) and venue workers (Engard,

Sandfort, Gotshall, & Brazile, 2010) may be overexposed to noise during athletic events. In addition to crowd noise, sports medicine personnel are subjected to noise from earpieces they wear for interpersonal communication during a game. Having never received formal education about hearing loss or the proper use of hearing protective devices, there were many weeks when I would experience tinnitus, or ringing in the ears, following a football game. Noise exposure during athletic competitions may pose a significant health risk to both the athletes and sports medicine personnel. Therefore, another long-term goal will be to conduct research that identifies sports medicine professionals' risk for hearing loss as a result of their occupation. From this research, an intervention which positively impacts health behaviors related to hearing loss and reduces the risk of injury will be designed. Providing hearing education in an internet-based format may be the first step in promoting hearing health among sports medicine professionals and would align with other initiatives currently in place that promote wellness in this field. For example, the National Athletic Trainers' Association (2018) recently launched *ATs Care* as a peer-to-peer support program that offers crisis management for athletic trainers dealing with the aftermath of a critical event (i.e., patient death). It is becoming increasingly apparent that in order to remain successful as an athletic trainer, one must take care of him/herself mentally, physically, emotionally, socially, and spiritually. While stress and crisis management are important components of professional wellness, injury/illness prevention and wellness protection are also important for increasing career longevity. Hearing health is one component of physical wellness that is not currently being addressed in the sports medicine field. Therefore,

evaluating the noise exposure of sports medicine professionals during athletic competitions, and utilizing online hearing conservation programming will positively impact the health and wellness of sports medicine professionals.

REFERENCES

Adams, K. L., & Brazile, W. J. (2017). A faceoff with hazardous noise: Noise exposure and hearing threshold shifts of indoor hockey officials. *J Occup Environ Hyg, 14*(2), 104-112. doi: 10.1080/15459624.2016.1225158

Basner, M., Babisch, W., Davis, A., Brink, M., Clark, C., Janssen, S., & Stansfeld, S. (2014). Auditory and non-auditory effects of noise on health. *Lancet, 383*(9925), 1325–1332. http://doi.org/10.1016/S0140-6736(13)61613-X

Board of Certification, Inc. (2015). *Practice analysis, 7th edition*. Retrieved from: http://www.bocatc.org/system/document_versions/versions/24/original/boc-pa7-content-outline-20170612.pdf?1497279231

Braun, V., & Clark, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101. http://dx.doi.org/10.1191/1478088706qp063oa

Callahan, A. J., Lass, N. J., Foster, L. B., Poe, J. E., Steinberg, E. L., & Duffe, K. A. (2011). Collegiate musicians' noise exposure and attitudes on hearing protection. *The Hearing Review (Online).* Los Angeles: Anthem Media Group. Retrieved from https://login.libproxy.uncg.edu/login?url=http://search.proquest.com/docview/1644520196?accountid=14604

Chesky, K. (2011). Schools of music and conservatories and hearing loss prevention. *International Journal of Audiology, 50 Suppl 1*, S32–37. http://doi.org/10.3109/14992027.2010.540583

Crandell, C., Mills, T. L., & Gauthier, R. (2004). Knowledge, behaviors, and attitudes about hearing loss and hearing protectors among racial/ethnically diverse young adults. *J Natl Med Assoc, 96*(2), 176-184

Cranston, C. J., Brazile, W. J., Sandfort, D. R., & Gotshall, R. W. (2012). Occupational and recreational noise exposure from indoor arena hockey games. *J Occup Environ Hyg, 10*(1), 11-16

Dudarewicz, A., Pawlaczyk-Łuszczyńska, M., Zamojska-Daniszewska, M., & Zaborowski, K. (2015). Exposure to excessive sounds during orchestra rehearsals and temporary hearing changes in hearing among musicians. *Medycyna Pracy*, 479–486. https://doi.org/10.13075/mp.5893.00163

Engard, D. J., Sandfort, D. R., Gotshall, R. W., & Brazile, W. J. (2010). Noise exposure, characterization, and comparison of three football stadiums. *J Occup Environ Hyg, 7*(11), 616-621. doi: 10.1080/15459624.2010.510107

Gilles, A., & Paul, V. H. (2014). Effectiveness of a preventive campaign for noise-induced hearing damage in adolescents. *International Journal of Pediatric Otorhinolaryngology*, *78*(4), 604-609. https://doi.org/10.1016/j.ijporl.2014.01.009

Keppler, H. (2010). *Optimization of the diagnosis of noise-induced hearing loss with otoacoustic emissions.* Ghent University. Faculty of Medicine and Health Sciences, Ghent, Belgium

Keppler, H., Ingeborg, D., Sofie, D., & Bart, V. (2015). The effects of a hearing education program on recreational noise exposure, attitudes and beliefs toward noise, hearing loss, and hearing protector devices in young adults. *Noise & Health*, *17*(78), 253–262. http://doi.org/10.4103/1463-1741.165028

McCullagh, M. C., Banerjee, T., Cohen, M. A., & Yang, J. J. (2016). Effects of interventions on use of hearing protectors among farm operators: A randomized controlled trial. *International Journal of Audiology*, *55*(sup1), S3–S12. http://doi.org/10.3109/14992027.2015.1122239

McIlvaine, D., Stewart, M., & Anderson, R. (2012). Noise exposure levels for musicians during rehearsal and performance times. *Medical Problems of Performing Artists*, *27*(1), 31–36

Masterson, E. (2016). *Measuring the impact of hearing loss on quality of Life. NIOSH Science Blog*. Retrieved from http://blogs.cdc.gov/niosh-science-blog/2016/04/27/hearing-loss-years-lost/

National Athletic Trainers' Association. (2018). *ATs Care.* Retrieved from https://www.nata.org/

National Institute for Occupational Safety and Health. (2013). *Noise and Hearing Loss Prevention.* Retrieved from: http://www.cdc.gov/niosh/topics/noise/about.html

National Institute on Deafness and Other Communication Disorders. (2017). *Noise-Induced Hearing Loss.* Retrieved from: https://www.nidcd.nih.gov/health/noise-induced-hearing-loss

O'Brien, I., Ackermann, B. J., & Driscoll, T. (2014). Hearing and hearing conservation practices among Australia's professional orchestral musicians. *Noise Health, 16*(70), 189-195. doi: 10.4103/1463-1741.134920

Olsen-Widén, S. E., & Erlandsson, S. I. (2004). Self-reported tinnitus and noise sensitivity among adolescents in Sweden. *Noise Health, 7*(25), 29-40

Olson, A. D., Gooding, L. F., Shikoh, F., & Graf, J. (2016). Hearing health in college instrumental musicians and prevention of hearing loss. *Med Probl Perform Art, 31*(1), 29-36

Phillips, S. L., & Mace, S. (2008). Sound level measurements in music practice rooms. *Music Performance Research, 2*, 36–47

Quality Matters. (2017). *Non-annotated standards from the QM higher education rubric, fifth edition*. Retrieved from: https://www.qualitymatters.org/sites/default/files/PDFs/StandardsfromtheQMHigherEducationRubric.pdf

Ramazzini, B. (1964). *Diseases of workers*. *Translated from the Latin text De morbis artificum of 1713 by Wilmer Cave Wright, with an introduction by George Rosen*. New York, London: Hafner

Prochaska, J. O., & Velicer, W. F. (1997). The Transtheoretical Model of Health Behavior Change. *American Journal of Health Promotion, 12*(1), 38–48. http://doi.org/10.4278/0890-1171- 12.1.38

Schink, T., Kreutz, G., Busch, V., Pigeot, I., & Ahrens, W. (2014). Incidence and relative risk of hearing disorders in professional musicians. *Occup Environ Med, 71*(7), 472-476

Seixas, N. S., Neitzel, R., Stover, B., Sheppard, L. Daniell, B., Edelson, J., & Meischke, H. (2011). A multi-component intervention to promote hearing protector use among construction workers. *Int J Audiol, 50*(0 1), S46-S56. doi:10.3109/14992027.2010.525754

Sobel, J., & Meikle, M. (2008). Applying health behavior theory to hearing-conservation interventions. *Semin Hear, 29*(1), 81-89

Smith, C., Beamer, S., Hall, S., Helfer, T., & Kluchinsky, T. A. (2015). A preliminary analysis of noise exposure and medical outcomes for department of defense military musicians. *U.S. Army Medical Department Journal*, 76–82

Verbeek, J. H., Kateman, E., Morata, T. C., Dreschler, W. A., & Mischke, C. (2014). Interventions to prevent occupational noise-induced hearing loss: A Cochrane systematic review. *International Journal of Audiology*, *53*(0 2), S84–S96. http://doi.org/10.3109/14992027.2013.857436

Walter, J. S. (2009). Sound exposure levels experienced by university wind band members. *Medical Problems of Performing Artists*, *24*(2), 63–70

Widén, S. E. (2013). A suggested model for decision-making regarding hearing conservation: Towards a systems theory approach. *Int J Audiol*, *52*(1), 57-64

APPENDIX A

ONLINE HEARING CONSERVATION PROGRAM THEORETICAL FRAMEWORK

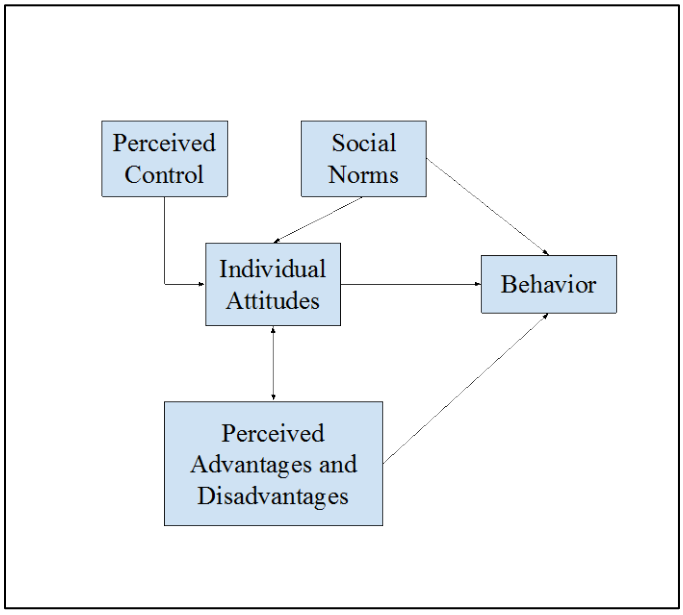


Figure 1. Online Hearing Conservation Program Theoretical Framework

While knowledge can play a role in influencing hearing-related behaviors, previous research has demonstrated that knowledge alone does not necessarily result in behavior change. Instead, we must take a more systems-based approach to understanding hearing behavior change. Social norms about the use of hearing protection, perceived control over the sound environment, and perceived advantages and disadvantages to hearing protection device use are factors that influence an individual's attitudes toward noise. This in turn influences an individual's behavioral intentions to use hearing protection and to avoid noisy environments. Research provides support for focusing on social norms and attitudes towards noise as mediators in hearing conservation programs. Therefore, the purpose of this study was to develop, implement, and evaluate an online hearing conservation program for college musicians, focusing on changes in knowledge about hearing loss, attitudes towards noise, and beliefs about hearing loss and hearing protection.

APPENDIX B

SURVEY INSTRUMENTS

Demographic Questions/Statements

1. What is your age in years?

2. What is your gender?
   Male Female Other

3. What is your present college status?
   Freshman Sophomore Junior Senior Graduate Student

4. What is your primary instrument of study?

5. Do you currently wear hearing aids?
   Yes No

6. Do you currently use hearing protection such as ear plugs while playing?
   Yes No

Knowledge of Hearing Health Questions/Statements

1. **Hearing loss can be reversed by wearing hearing protection, such as ear plugs**.
   True False

2. **Sounds measuring____and over are damaging to human hearing.**
   65 decibels (dBA) 70 decibels (dBA)
   85 decibels (dBA) 50 decibels (dBA)

3. **Sounds that are too loud can cause irreversible damage to the__, resulting in hearing loss.**
   Ear drum Ear canal
   Hair cells of the inner ear All of the above

4. **Hearing loss caused by loud sounds is something people_may have.**
   Over age 40 Over age 20
   Over age 30 At any age

5. **Do you think that people who have preexisting hearing loss do not have to worry about future hazardous noise levels because the damage has already been done?**
   Yes No

6. **Do you think that hearing loss caused by noise can be prevented?**
   Yes No

7. **Do you think ringing in the ears is a warning sign for overexposure to potentially hazardous sound?**
   Yes No

8. **Is having to turn up the volume on TVs or radios a sign of hearing loss?**
   Yes No

9. **Hearing loss is reversible.**
   True False

10. **The three best types of earplugs available to musicians are:**
    Ear muffs, foam earplugs, noise-cancelling headsets
    Custom fit earplugs, noise-cancelling headsets, earbuds
    Foam earplugs, semi-custom fit earplugs, custom fit earplugs
    Earbuds, foam earplugs, custom fit earplugs

11. **The three main parts of the ear are the:**
    Outer ear, middle ear, inner ear
    Outer ear, medial ear, lateral ear
    Upper ear, middle ear, lower ear
    Auricle, ear drum, cochlea

12. **Hearing loss can be prevented by:**
    Limiting exposure to loud noises
    Wearing earplugs during rehearsals/performances
    Getting an annual hearing examination
    All of the above

Attitudes Towards Noise Questions/Statements

1. I think that the sound level at clubs, dances, rock concerts and sporting events, in general, is too loud.

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

2. I think it is unnecessary to use earplugs when I am at a club, rock concert, dance, or sporting event.

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

3. I am prepared to do something to make the school environment quieter.

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

4. I consider leaving a club, rock concert, dance or sporting event if the sound level is too loud.

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

5. It is important for me to make my sound environment more comfortable.

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

6. When I cannot get rid of sounds that bother me, I feel helpless.

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

7. I can concentrate even if there are many different sounds around me

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

8. I don’t like when it is quiet around me.

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

9. The sound level at clubs, dances, rock concerts or sporting events is not a problem.

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

10. The sound level should be lowered at clubs, rock concerts, dances or sporting events.

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

11. I am prepared to give up activities where the sound level is too loud.

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

12. There should be more rules or regulations for the sound levels in society.
totally agree partially agree neither agree or disagree partially disagree totally disagree
1 2 3 4 5

Beliefs About Hearing Loss and Hearing Protection Statements

1. I think earplugs put too much pressure on my ears
totally agree partially agree neither agree or disagree partially disagree totally disagree
1 2 3 4 5

2. I believe I know how to fit and wear earplugs
totally agree partially agree neither agree or disagree partially disagree totally disagree
1 2 3 4 5

3. I do not intend to wear hearing protectors when I am in loud environments
totally agree partially agree neither agree or disagree partially disagree totally disagree
1 2 3 4 5

4. I think wearing hearing protectors every time I am in loud environments is important
totally agree partially agree neither agree or disagree partially disagree totally disagree
1 2 3 4 5

5. I wear hearing protectors whenever I am in loud environments
totally agree partially agree neither agree or disagree partially disagree totally disagree
1 2 3 4 5

6. Hearing protectors are uncomfortable to wear
totally agree partially agree neither agree or disagree partially disagree totally disagree
1 2 3 4 5

7. My friends don’t wear hearing protectors
totally agree partially agree neither agree or disagree partially disagree totally disagree
1 2 3 4 5

8. I know when I should use hearing protectors
totally agree partially agree neither agree or disagree partially disagree totally disagree
1 2 3 4 5

9. I am convinced I can prevent hearing loss by wearing hearing protectors whenever I am in loud environments.
totally agree partially agree neither agree or disagree partially disagree totally disagree
1 2 3 4 5

10. Hearing protectors limit my ability to communicate with others
totally agree partially agree neither agree or disagree partially disagree totally disagree
1 2 3 4 5

11. Hearing protectors limit my ability to hear my pitch and intonation

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

12. If I wear hearing protection, I can protect my hearing

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

13. Wearing hearing protectors is annoying

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

14. My friends think it is a good idea to wear hearing protectors in hazardous noise

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

15. I don't have to wear hearing protectors every time I am in loud environments

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

16. I plan to wear hearing protectors when I am in loud environments.

totally agree	partially agree	neither agree or disagree	partially disagree	totally disagree
1	2	3	4	5

Online Hearing Conservation Program Course Survey

1. This course increased my knowledge of hearing loss and its effects on artistic expression.

strongly agree	partially agree	neither agree or disagree	partially disagree	strongly disagree
5	4	3	2	1

2. The course presented content in an organized manner.

strongly agree	partially agree	neither agree or disagree	partially disagree	strongly disagree
5	4	3	2	1

3. The course was organized in a way that helped me learn.

strongly agree	partially agree	neither agree or disagree	partially disagree	strongly disagree
5	4	3	2	1

4. Please identify what you consider to be strengths of the course.

5. Please identify area(s) where you think the course could be improved.

APPENDIX C

DESCRIPTIVE THEMATIC ANALYSIS

PERCEPTIONS OF ONLINE HEARING CONSERVATION PROGRAM STRENGTHS

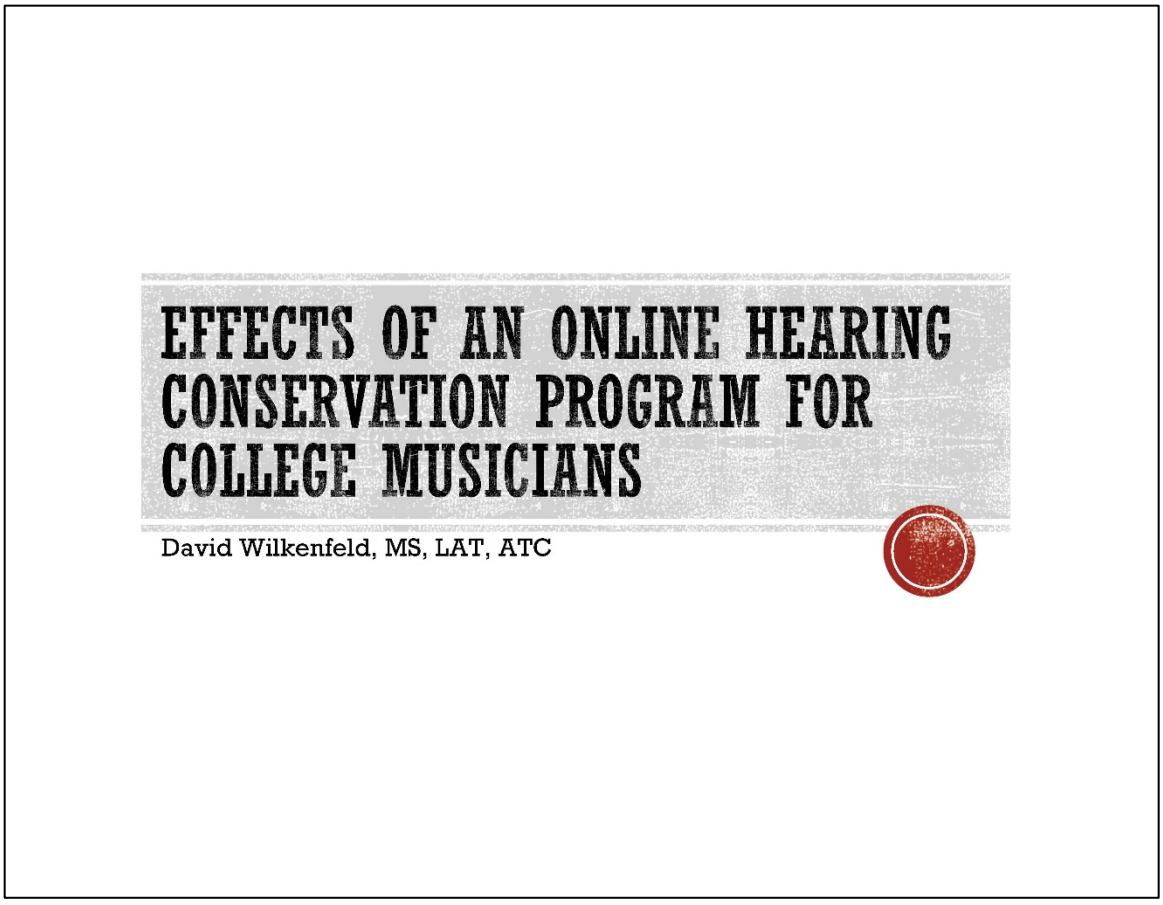
Major Themes	Key quotes / responses
Informative • Increased awareness • Learning from others' experiences • Understand the importance of learning about this topic	The final video of artists discussing their take on hearing health assured me that this is a [real] issue.
Organized presentation • Logical flow of course content • Clear • Concise • Easy to follow and understand	The course was well mapped out sequentially. The knowledge is important and yet presented in an easy to understand way.
Effective use of multimedia • Outside resources provided • Informative • Enjoyable / fun • Appropriate amount • Engaging activities	The video to text ratio was good. The inclusion of fun activities and videos. I liked how there were lots of videos and audio examples included.

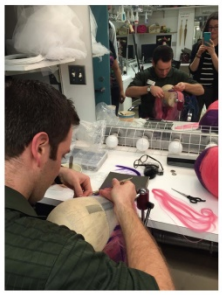
PERCEPTIONS OF ONLINE HEARING CONSERVATION PROGRAM AREAS FOR IMPROVEMENT

Major Themes	Key quotes / responses
More engaging format • Less text, more visuals • Updated interactive material • Face-to-face component (discussion)	There was a lot to read. Find a video that summarizes the effects of hearing loss that was more current than the 1990's video. A face-to-face discussion with this topic would be more exciting and interesting.
Focus on hearing loss prevention • More in-depth discussion • More artist examples	More examples of artists who have been affected by hearing loss. More discussion about how to protect yourself at a concert. The topic [hearing loss prevention] wasn't given the level of detail I was hoping for.

APPENDIX D

POWERPOINT PRESENTATION SLIDES





PRACTICE ANALYSIS, 7TH EDITION

- Domain 1 – Injury and Illness Prevention and Wellness Protection
  - Promoting healthy lifestyle behaviors with effective education and communication to enhance wellness and minimize the risk of injury and illness

TASK	DESCRIPTION
0101	Identify risk factors by administering assessment, pre-participation examination and other screening instruments, and reviewing individual and group history and injury surveillance data.
0102	Implement plans to aid in risk reduction using currently accepted and applicable guidelines.
0103	Educate individuals and stakeholders about the appropriate use of personal equipment.
0104	Minimize the risk of injury and illness by monitoring and implementing plans to comply with regulatory requirements and standard operating procedures for physical environments and equipment.
0105	Facilitate individual and group safety by monitoring and responding to environmental conditions (e.g., weather, surfaces and client work setting).
0106	Optimize wellness (e.g., social, emotional, spiritual, environmental, occupational, intellectual, physical) for individuals and groups.

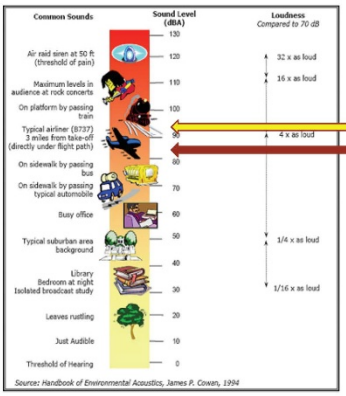
SOME FIRST THOUGHTS

- "Noise" is a general term that refers to all sounds
  - Music is one kind of sound
- A sound that is too loud, or too loud for too long, is dangerous no matter what kind of sound it is
- Music itself is not the issue; loudness and duration are

THE PROBLEM...

- ~ 36 million Americans suffer from hearing loss
  - 1 out of 3 as a result of noise exposure
- Musicians are 4x as likely to suffer hearing loss than the general population
  - up to 17,000% of allowable exposure (dose) for one day
- Affects the ability to hear pitch changes, playing loudness, and timbre
- Not only a hearing issue
  - Emotional, social, and psychological affects as well

WHAT IS CONSIDERED TOO LOUD?



Recommended Maximum Daily Exposure Times to Instances of Continuous Noise at Various Decibel Levels*

Decibel Level	NIOSH	OSHA
85 dB	8 hours	16 hours
88 dB	4 hours	10.6 hours
91 dB	2 hours	7 hours
94 dB	1 hour	4.6 hours
97 dB	30 minutes	3 hours
100 dB	15 minutes	2 hours
110 dB	2 minutes	30 minutes
120 dB (close-range)	almost immediate	almost immediate

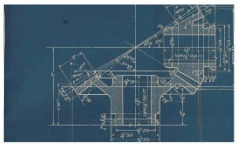
*NIOSH and OSHA maintain that the risk for hearing loss is increased when continuous exposure time exceeds these recommended maximums.

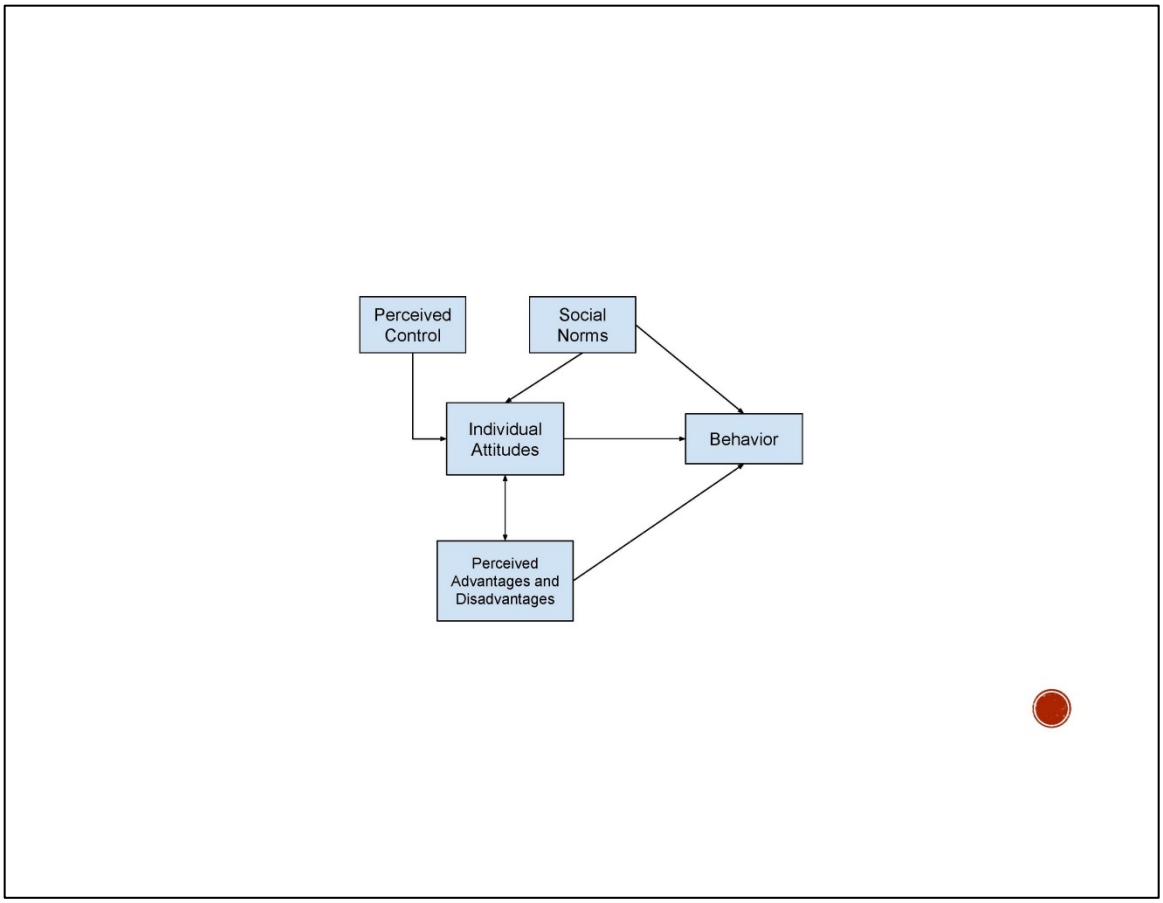
PURPOSE

- Develop, implement, and evaluate a web-based hearing conservation program for college musicians, focusing on short-term changes in knowledge about hearing loss, attitudes towards noise, and beliefs about hearing loss and hearing protection.
- Determine college musicians' perceptions of the instructional content and design.

PROGRAM DESIGN

- Developed and delivered through the Canvas Learning Management System
- Educational content
  - Information about hearing loss and the effect of noise on hearing, the types of hearing loss, and how hearing loss can be prevented.
- Learning objectives
  - Gain a basic understanding of the types and causes of hearing loss
  - Understand different signs and symptoms of hearing loss
  - Identify and differentiate different hearing loss prevention strategies

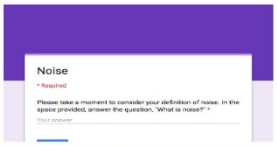



Perceived Control
Social Norms
Individual Attitudes
Behavior
Perceived Advantages and Disadvantages

PROGRAM DESIGN – MODULE 1

- Operationally define "noise"
- Anatomy and physiology of the ear and hearing mechanism
- Role noise plays in the arts
- Hearing loss affects on our ability to hear and interpret sounds
- Type of hearing loss
- Signs and symptoms of hearing loss

What is noise?



Reflecting on your answer, what adjectives did you use to describe noise: good, bad, loud, quiet, normal, an everyday occurrence? And would you consider noise to be any sound you encounter, or just the ones that are unpleasant?

Noise can be any sound we encounter in our environment, whether wanted or unwanted. Noise, or sound, moves through the air or other medium as a wave of pressure changes or vibrations (see figure 1).

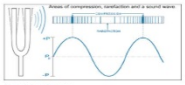


Figure 1. Sound Waves

Much of hearing in humans is a mechanical event.

Varying pressure waves (vibrations) in the air cause vibrations in our ears. The movement is detected by sensory receptors of the nervous system that are adapted to respond to this mechanical stimulus. This works a little like our sense of touch. We can feel a movement and can tell where it occurred in the body. Particular sound frequencies cause a vibration in a specific location in the sensory part of our inner ear. This is the basic concept behind sonar: when sound waves reflect off of an object we can detect where it is located. Dolphins and bats are particularly good at using echolocation.

Activity:

Follow along with Daniel Kish, who has been blind since he was 13 months old but has learned to "see" through the use echolocation, to discover your own sonar.

Were you able to hear the difference in pitch when Daniel moved the board closer or farther away from his face? This activity helps demonstrate the sensitivity of our ears and ability to interpret minute changes in the location, intensity, and pitch of noises we encounter. As a musician, hearing is vital to your success. It allows you to know whether your instrument is in-tune, whether you are, in fact, playing *forte* or *mezzo piano*, and whether the overall timbre of your sound production is acceptable.

Therefore, when something goes wrong with our hearing, musical performance declines. Through the rest of this course, you will learn how we hear, the role of noise in the arts, how the loudness of and exposure time to noises can result in hearing loss, some common signs and symptoms of hearing loss, and how noise-induced hearing loss can be prevented.

PROGRAM DESIGN – MODULE 2

- How hearing loss can be prevented
  - Federal standards for noise exposure
  - Administrative strategies
  - Engineering strategies
  - Hearing protective devices

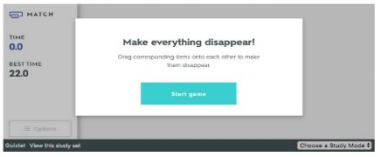
Federal standards for occupational hearing health

The Occupational Safety and Health Association (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) have established guidelines for maximum daily exposure to noise.

Averaged over an 8-hour day, OSHA and NIOSH recommend that employees be exposed to no more than 85 dB. To put this into perspective, consider that normal conversation ranges from 50-60 dB, a lawn mower averages 90 dB, and rock concerts max out at 150 dB. Remember that noise-induced hearing loss can be a result of prolonged exposure to loud noises and not just a result of a one-time exposure to a very loud sounds. The table below gives recommendations of safe continuous sound exposure. With music performance ranging anywhere from 80-100+ decibels, how long do you think it would take before your unprotected ears start to show signs / symptoms of hearing loss?

NIOSH Recommended levels of safe continuous sound exposure for UNPROTECTED ears.	
85 decibels (dB) – 8 hours	103 dB – 8 minutes
88 dB – 4 hours	106 dB – less than 4 minutes
91 dB – 2 hours	109 dB – less than 2 minutes
94 dB – 1 hour	112 dB – about 1 minute
97 dB – 30 minutes	115 dB – about 30 seconds

Match these common sources of noise with their appropriate decibel level. Keep trying until you have matched them all correctly.



When we talk about noise exposure in the arts consider the following photos of real musicians warming up:

Trombonist warming up - mf (93 dB)

Violist warming up - mf (91 dB)

Marimba - f (101 dB)

Then consider how long a typical musician spends practicing/rehearsing during a week. An artist (in particular musicians) very quickly reach their daily limit for noise exposure. This puts them at a risk for hearing loss that is similar if not more than industrial workers. The difference between industrial workers and performing artists? **There are currently no federal regulations for preventing noise exposure in the arts.** Therefore, it is up to the artists, and their instructors/conductors/employers to take steps in reducing noise exposure.

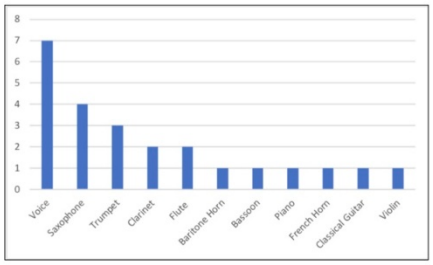
The next few sections will focus on how hearing loss in the arts can be prevented, and what faculty/administration can do to support hearing health in young artists.

SURVEYS

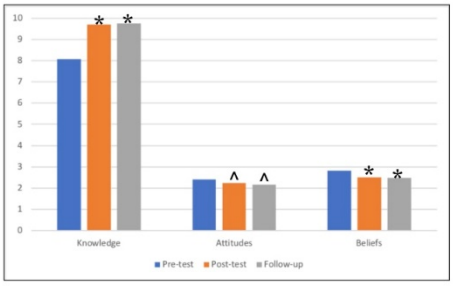
- Pre-test, post-test, 1-month follow-up
  - Participant demographics
    - Primary instrument, use of ear plugs
  - Knowledge about hearing loss
  - Attitudes towards noise (YANS)
  - Beliefs about hearing loss and hearing protection (BAHPHL)
  - Completed through Qualtrics
- Course Evaluation
  - Completed in Canvas LMS
  - Likert scaled and open-ended questions

RESULTS

- 24 participants
  - Average age: 20.17 ± 1.58 years
  - 18 females, 6 males
  - 2 were currently using hearing protection while playing



RESULTS



*Pre-test → Post-test knowledge about hearing loss, $z = 2.951$, $p = .003$, $d = 0.80$

*Pre-test → Follow-up knowledge about hearing loss, $z = 3.002$, $p = .003$, $d = 0.94$

*Pre-test → Post-test beliefs about hearing loss and hearing protection, $z = -2.993$, $p = .003$, $d = 0.58$

*Pre-test → Follow-up beliefs about hearing loss and hearing protection, $z = -2.894$, $p = .004$, $d = 0.59$

^ Pre-test → Post-test attitudes towards noise, $z = -1.914$, $p = .056$, $d = 0.28$

^ Pre-test → Follow-up attitudes towards noise, $z = -1.869$, $p = .062$, $d = 0.11$

RESULTS

Course evaluation

- 16/24 participants completed (66.7%)
- 93.7% stated that they either "agree" or "strongly agree" to each of the following:
  - The course presented content in an organized manner
  - My knowledge of hearing loss increased following the completion of this course
  - The course was organized in a way that helped me learn
- Course Strengths
  - Major themes: informative, organized presentation, and effective use of multimedia
- Areas for improvement
  - Major themes: hearing loss prevention focus, and more engaging format

DISCUSSION

- The online hearing conservation program appeared to positively affect
  - Knowledge about hearing loss
  - Beliefs about hearing loss and hearing protection
- Participation in an online hearing conservation program may play a role in influencing attitudes towards noise
- Healthful knowledge and beliefs were present one-month following participation in online hearing conservation program
- Course content and design were positively reviewed by participants

DISCUSSION

- "Best practice" tips for online teaching
  - Beta-testing course navigational controls
  - Checking and re-checking that external links and media remain active
  - Learning basic HTML code or consulting an instructional designer to help make the course more dynamic and interactive

- Limitations
  - Small sample size
  - Self-guided nature of online hearing conservation program
  - Did not control for previous exposure to hearing health education

CONCLUSION

- Online hearing conservation program represents a dynamic, interactive, and time- and cost-effective alternative to traditional face-to-face hearing education courses for college musicians
- Future research should use larger samples of musicians and focus on long-term changes in knowledge, attitudes, and beliefs
- Online hearing conservation program will provide music educators with a new and alternative way to promote hearing health, while indirectly cultivating a culture of responsibility and accountability related to hearing health in music

REFERENCES

Basner, M., Babisch, W., Davis, A., Brink, M., Clark, C., Janssen, S., & Stansfeld, S. (2014). Auditory and non-auditory effects of noise on health. *Lancet, 383*(9925), 1325–1332. http://doi.org/10.1016/S0140-6736(13)61613-X

Callahan, A. J., Lass, N. J., Foster, L. B., Poe, J. E., Steinberg, E. L., & Duffe, K. A. (2011). Collegiate musicians' noise exposure and attitudes on hearing protection. *The Hearing Review (Online)*. Los Angeles: Anthem Media Group. Retrieved from https://login.libproxy.uncg.edu/login?url=http://search.proquest.com/docview/1644520196?accountid=14604

Chesky, K. (2011). Schools of music and conservatories and hearing loss prevention. *International Journal of Audiology, 50 Suppl 1*, S32–37. http://doi.org/10.3109/14992027.2010.540583

Dudarewicz, A., Pawlaczyk-Łuszczyńska, M., Zamojska-Daniszewska, M., & Zaborowski, K. (2015). Exposure to excessive sounds during orchestra rehearsals and temporary hearing changes in hearing among musicians. *Medycyna Pracy*, 479–486. https://doi.org/10.13075/mp.5893.00163

Keppler, H., Ingeborg, D., Sofie, D., & Bart, V. (2015). The effects of a hearing education program on recreational noise exposure, attitudes and beliefs toward noise, hearing loss, and hearing protector devices in young adults. *Noise & Health*, *17*(78), 253–262. http://doi.org/10.4103/1463-1741.165028

McIlvaine, D., Stewart, M., & Anderson, R. (2012). Noise exposure levels for musicians during rehearsal and performance times. *Medical Problems of Performing Artists*, *27*(1), 31–36

Masterson, E. (2016). "Measuring the impact of hearing loss on quality of Life. NIOSH Science Blog. Retrieved from http://blogs.cdc.gov/niosh-science-blog/2016/04/27/hearing-loss-years-lost/

National Institute for Occupational Safety and Health. (2013). *Noise and Hearing Loss Prevention*. Retrieved from: http://www.cdc.gov/niosh/topics/noise/about.html

O'Brien, I., Ackermann, B. J., & Driscoll, T. (2014). Hearing and hearing conservation practices among Australia's professional orchestral musicians. *Noise Health, 16*(70), 189-195. doi: 10.4103/1463-1741.134920

Phillips, S. L., & Mace, S. (2008). Sound level measurements in music practice rooms. *Music Performance Research*, *2*, 36–47

Smith, C., Beamer, S., Hall, S., Helfer, T., & Kluchinsky, T. A. (2015). A preliminary analysis of noise exposure and medical outcomes for department of defense military musicians. *U.S. Army Medical Department Journal*, 76–82

Verbeek, J. H., Kateman, E., Morata, T. C., Dreschler, W. A., & Mischke, C. (2014). Interventions to prevent occupational noise-induced hearing loss: A Cochrane systematic review. *International Journal of Audiology, 53*(0 2), S84–S96. http://doi.org/10.3109/14992027.2013.857436

Walter, J. S. (2009). Sound exposure levels experienced by university wind band members. *Medical Problems of Performing Artists*, *24*(2), 63–70