UTILIZING EFFECTIVE MEDIA, DEMONSTRATIONS AND EXERCISES ON THE PERCEPTION OF SOUND

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One of the key challenges in the development of curriculum for future audio professionals is to achieve a balance between theory and practice that fosters the necessary critical thinking skills in order to be successful in the field. Understanding sound perception is a crucial piece to the development of these skills in audio. In courses focusing on hearing physiology and psychoacoustics, we have utilized and developed a range of media, demonstrations and exercises that reference students' interest, as well as knowledge and experience from practicum courses. These activities reinforce concepts and nurture the development of creative problem solving and evaluation. Examples of effective teaching tools will be discussed, as well as challenges and pitfalls that may arise.

INTRODUCTION

A number of years ago the Audio Arts & Acoustics Department at Columbia College Chicago offered courses related to auditory perception, physiology and hearing disorders as electives for students. More recently, through efforts of several members of the faculty, we have renewed and consolidated our approach based on the philosophy that understanding auditory perception and hearing conservation is so fundamental to our students that we need to ensure every Audio Arts and Acoustics student learns key concepts in auditory perception. Audio expertise is manifested in the ability to systematically and expertly control how sounds are perceived. More specifically, an audio expert, whether a recording engineer, a live sound engineer, a sound system designer/installer, etc. is someone who is able to translate aesthetic intentions, usually expressed in the form of descriptive language/adjectives, into a specific type of sound signals: signals which, when presented to listeners/viewers, elicit responses describable by language/adjectives that largely overlap with those accompanying the aesthetic intention(s). In this context, curriculum in hearing, psychoacoustics, and sound cognition is not simply desired but absolutely necessary to education in audio.

1 APPROACH TO HEARING

The topic of hearing is approached from the philosophy that the studies of audio and hearing inform one another. The organic signal processor and frequency analyzer that is our ears and brain not only can be understood from an audio perspective, but by understanding the perceptual limits of our system we can understand and predict what an audio system can and should do. For many students, these hearing courses change the way they think about audio and hearing. Some even find new career possibilities. Approximately 1-2 graduates a year from the Audio Arts and Acoustics program choose to attend graduate school in audiology. This paper focuses on the most effective media, demonstrations and exercises used in these courses to reinforce concepts and nurture the development of a deeper understanding of hearing principles.

2 HEARING CURRICULUM OVERVIEW

The hearing curriculum offers three courses to students; *Studies in Hearing,* which focuses on hearing physiology and hearing conservation; *Fundamentals of Psychoacoustics and Sound Perception*, which concentrates on perceptual phenomena and the relation to the physical stimulus; and *Perception and Cognition of Sound*, which delves into aspects of perceptual organization, music and speech perception. The first two courses have been part of the core requirements for all Audio Arts & Acoustics students since the fall 2011. They are designed to be taken in the order specified. The course on cognition of sound is an advanced elective. Each of these courses includes student activities and demonstrations that reinforce key concepts.

3 STUDIES IN HEARING COURSE

Studies in Hearing was initially developed many years ago to address sound systems for the hearing impaired, including induction loops and live captioning. In later years, it was modified based on the insight that understanding hearing physiology and conservation issues not only is important for students of audio, but can be learned in the context of the ear as an organic sound system. Understanding audio helps to understand hearing, and hearing helps to understand audio. The

two disciplines inform one another. Based on this perspective, the primary goals of the course today are to allow students to 1) gain an appreciation of hearing as an organic audio system 2) value its functionality and vulnerability 3) become aware of exposure and conservation issues and how to practically address them, and, 4) develop a well-rounded audio perspective to raise awareness to other audio professionals and their clients.

To achieve these learning outcomes, several effective exercises and demonstrations (based on qualitative student feedback and comments) have been incorporated into the course.

3.1 Journaling Exercises

Two journaling assignments take place during the semester. Students are asked to write informally and consider carefully their responses to these exercises. A guest lecture on a related topic takes place at the approximate time that students complete these exercises.

3.1.1 Measure Your Day

The first assignment, titled Measure Your Day, requires students to take an SPL meter and measure several different environments that represent their day's experiences. Typically, students will not have yet performed this exercise in any other class. When students take these measurements, they often are surprised at the results. Many are not aware of the levels that they are exposing themselves to.

The week this assignment is completed, an audiologist gives a guest lecture to the class about hearing loss, music/noise exposure for audio professionals and musicians, and ways to protect hearing. The talk is geared towards the audio professional and contains multiple examples to raise awareness of the need to protect hearing and the tools available. This discussion in conjunction with the measurement assignment provides the first set of activities that are aimed to raise awareness for hearing conservation.

Select quotes from students in recent semesters appear in the following table:

94 dBA: [Earbuds with] volume cranked all the way…This was surprising as I had no idea it would be so high a pressure.
Overall, this has been an interesting exercise, and one that I am glad to have done. It is nice to now have a bit of a sonic calibration.
Before doing this assignment, I would have never known what my ears go through in the course of a day.

Table 1: Student responses to the assignment "Measure Your Day"

3.1.2 Experiencing Hearing Impairment

Another journaling assignment and guest lecture that occurs later in the semester focus on hearing loss. The goal of the journaling assignment, titled Experiencing Hearing Impairment, is to raise awareness of possible consequences of noise exposure and experience what it may be like to live with a hearing impairment. During this assignment, students wear earplugs for an extended period of time and continue with their usual activities, including interacting with family, friends, and others. Students are instructed to write a paper, in journal form, chronicling their experiences and emotional responses as they go through their day. Typically, students will comment on their desire to now protect their hearing in the wake of this assignment. During the week that this assignment is completed, a person with a cochlear implant typically gives a guest lecture to the class about her experience living with profound hearing loss and the cochlear implant. This lecture leads to a highly interactive discussion where students gain an appreciation of hearing loss.

Select quotes from students in recent semesters appear in the following table:

This was such a fun experiment. I definitely have a better understanding of the life of a person with hearing impairment.
I am now more likely to take much better care of my ears in noisy environments because I realize how precious they really are.
[I] could not imagine the torment of deafness and inability to experience the art which you create.

Table 2: Student responses to the assignment "Experiencing Hearing Impairment"

3.2 Audiogram Measurement

During the semester, students have their audiogram measured which is then discussed during class. This practical exercise, in combination with the other activities throughout this semester, is a step towards raising awareness about hearing conservation as a lifelong commitment for the audio professional.

3.3 Animations

In addition to these activities and guest lectures, several excellent animations have been compiled to visualize the anatomy and function of the auditory system. For instance, Brandon Pletsch [1] has created a video called *Auditory Transduction* that, although not completely anatomically correct in every respect, presents the primary functionality of the peripheral auditory system in a compelling way.

3.4 Videos

Moreover, videos related to hearing and hearing loss are shown regularly throughout the semester. One of the most effective videos related to hearing loss that is

shown is *Sound and Fury* [2] which follows a deaf family as they struggle with the decision of whether or not to give their 4 year old deaf daughter a cochlear implant. The value of this video is that it provides students an opportunity to consider the social and cultural issues of Deaf Culture, as well as insight into the technology that is offered for the profoundly hard of hearing.

4 FUNDAMENTALS OF PSYCHOACOUSTICS COURSE

The second course in the series, *Fundamentals of Psychoacoustics and Sound Perception*, relies mostly on auditory demonstrations rather than animations for media and demos. It also includes a journaling assignment that complements the journaling assignments from *Studies in Hearing*.

4.1 Journaling Exercise

The journaling assignment in this course takes place near the beginning of the semester, where students are asked to describe their "Auditory World." In this assignment, students take time to listen to the typical sounds around them and consider where they are coming from, how loud they are, their quality, and how many they hear. They are asked to consider whether or not the auditory system has an "easy" or "challenging" job processing sound. This assignment raises consciousness to everyday sounds and allows students to consider the complexity of hearing. This assignment is then revisited near the end of the semester with the new perspective of how these sounds are processed by the auditory system.

Select quotes from students on the "Auditory World" journaling assignment:

This exercise was interesting in that it made me think about specific situations in my life where sound in processed.
Through the exercise I looked at individual situations and broke them down to really analyze what sounds I hear on an everyday basis that I would normally just take for granted.
This exercise has definitely made me a bit more conscious as to how our auditory system interprets the noises of everyday life.

Table 3: Student responses to the assignment "Auditory World"

4.2 Listening Demonstrations

Listening examples in the course range from simple demonstrations of auditory phenomena such as masking and loudness scaling (ASA compact disc [3] and other sources), to multimodal phenomena such as the McGurk Effect. The use of a wireless headphone system in recent semesters has made these demonstrations even more effective, as a much higher level of control of the auditory stimulus can be obtained.

5 PERCEPTION AND COGNITION OF SOUND COURSE

The third course in the series, *Perception and Cognition of Sound*, includes multiple auditory demonstrations during class and a field trip to a nearby auditory perception and audiology laboratory. Students who complete this course often also participate in internships at this local facility.

5.1 Listening Demonstrations

The in-class demonstrations consist of several well-known sources including Al Bregman's Auditory Scene Analysis demonstrations [4] and Diana Deutsch's Musical Illusions and Other Paradoxes compact disc [5]. Listening examples from David Butler's book, *The Musician's Guide to Perception and Cognition* [6] also provide excellent examples of musical phenomena. In addition to these sources, several listening examples that mirror actual listening studies discussed in class have been developed in-house for use in the classroom. These latter examples provide context for students to grasp experimental methods used in this kind of research. Like in *Fundamentals of Psychoacoustics and Sound Perception*, the use of a wireless headphone system has proven invaluable in presenting these examples. A lecture/discussion format during class where these examples are played and considered as a group encourages participation and interaction that fosters learning.

5.2 Field Trip

The field trip to a local auditory perception and audiology laboratory motivates some students to continue learning about auditory perception through an internship at this lab. Typically 1-2 students a semester are actively working in auditory perception as interns. This experience often reinforces students' interest and awakens a strong interest in pursuing graduate school in the hearing sciences, such as audiology.

6 CONCLUSIONS

Audio Arts and Acoustics students completing the hearing curriculum at Columbia College Chicago leave the program as aurally-aware professionals. They have the tools and understanding to protect themselves and to inform their clients, musicians, and the public. They possess the knowledge needed to make the right audio recommendations from a hearing perspective. Through the use of effective learning experiences, students realize that their ears are an evaluative tool that needs to be protected as well as understood for any discipline related to audio or acoustics.

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