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Is This Thing On? An Investigation of School-Based Speech-Language Pathologists' Knowledge of Hearing Technology

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IS THIS THING ON? AN INVESTIGATION OF SCHOOL-BASED SPEECH-LANGUAGE PATHOLOGISTS' KNOWLEDGE OF HEARING TECHNOLOGY

by
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ABSTRACT

The purpose of this study was to investigate the hearing technology knowledge of speech-language pathologists (SLPs) currently working in public elementary schools in the states of Michigan and Ohio. A total of 95 randomly chosen SLPs completed an online survey regarding their hearing technology training, their perceptions of the need for this type of training, and their clinical experiences working with hearing technology in educational settings. The types of hearing technology included hearing aids, cochlear implants, and FM/Infrared (IR) systems. Overall, participants reported a lack of sufficient hearing technology training and low comfort levels with performing hearing technology tasks, such as changing the battery in a hearing aid or troubleshooting a cochlear implant. These findings suggest a need for a revision of graduate curricula to include more hands-on training and experience with hearing technology to support the growing number of students who use such technology in schools.

Keywords: speech-language pathologist, hearing technology, knowledge of hearing technology

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CHAPTER I: INTRODUCTION

Hearing technology continues to advance and allow more and more children with hearing loss to learn to listen and develop spoken language. For those who choose to utilize the range of developing technology, the importance of these advancements cannot be overstated. Hearing technology is especially important during the school years because children with hearing loss may not learn in the same manner as students with "typical" or "normal" hearing. Hearing technology, among other things, permits students with hearing loss to be mainstreamed and included into regular education classrooms. With this great advancement in hearing technology, however, comes great responsibility.

Like all other technology, hearing technology requires maintenance and troubleshooting from time to time. One must know how to use, repair, and troubleshoot the technology in order for it to be effective. Students with hearing loss often need help from a school professional in regard to their hearing technology and its overall maintenance. Although there may be a variety of professionals capable of performing this task, speech-language pathologists (SLPs) may be the best and most appropriate, available option. This introductory chapter explains the purpose of this study, the study's rationales, important definitions, and the method used to conduct the study.

Purpose Statement

The purpose of this study was to investigate the knowledge school-based speech-language pathologists (SLPs) have concerning hearing technology. Randomly selected SLPs working in public elementary schools in Michigan and Ohio were requested to complete an online survey. The hearing technology focused on were the types most commonly used in school settings, including the following: hearing aids, cochlear implants, and FM/Infrared (IR) systems.

This study addressed questions related to the training received by SLPs regarding hearing technology and when they received the training; their perceptions of the need for this type of training; and their clinical experiences working with hearing technology in educational settings with students with hearing loss.

Rationales

Investigating speech-language pathologists' knowledge of hearing technology is significant for five primary reasons. First, this study extends and updates research on school-based speech-language pathologists (SLPs) and hearing technology. Several previous studies (Ben-Itzhak, Most, & Weisel, 2005, pp. 336-337; Compton, Tucker, & Flynn, 2009, pp. 145-147; Cosby, 2009, p. 7; Watson & Martin, 1999, pp. 3-6) have focused on SLPs' knowledge and experience with cochlear implants. Cochlear implant technology, however, continues to advance and is being utilized by more families as a treatment option, warranting the need for further investigation. With more students in our public schools using cochlear implants, the need for knowledgeable staff members, including SLPs, is apparent. In addition, knowledge of hearing aids and FM/Infrared (IR) systems has not been recently or thoroughly investigated. Woodford (1987) and Lass and his colleagues (1989) researched the knowledge of SLPs in regard to hearing aids, but these studies were completed almost 30 years ago and are arguably less relevant to our understanding of current and vastly advanced hearing aid technology (Lass et al., 1989, p. 119; Woodford, 1987, p. 314). Because hearing technology advances so quickly, it is important to assess knowledge and experience with the current technology. Furthermore, to the best of the researcher's knowledge, an extensive study including several types of hearing technology likely to be found in today's classrooms has yet to be completed. This study, therefore, not only updates the literature, but also provides a more comprehensive overview of the knowledge of school-based SLPs in regard to multiple types of today's hearing technology.

Secondly, the increased number of students with hearing loss attending public schools requires a professional who is knowledgeable about hearing technology. In 2011, 86.5% of students with hearing loss attended public schools, the majority of which spent at least 80% of their time in a mainstreamed regular education classroom (U.S. Department of Education, 2015a). These large numbers can, arguably, be attributed to the success of Universal Newborn Hearing Screenings (UNHS), which has led to the increased and successful provision of Early Intervention (EI) services. Approximately 97.2% of infants born in the year 2013 were reported to have had their hearing screened soon after birth (CDC, 2015, p. 1). With the vast majority of infants screened so early in life, more infants are being identified and diagnosed as having a hearing loss. The early diagnosis often results in earlier provision of services (i.e., Early Intervention). In 2013, 62.1% of infants diagnosed with hearing loss received EI services before 6 months of age (CDC, 2015, p. 1). The combined efforts of UNHS and EI have led to earlier use of hearing technology, such as hearing aids and cochlear implants, for many children with hearing loss (Cheffo, 2014, p. 321). Most of the children who use hearing technology and receive services and therapy early in life are successful in their communication development and go on to attend general education public schools, often with placements in mainstream or inclusive classrooms. The resultant increase in students with hearing loss in these settings thus warrants a greater need for a school professional with the knowledge to assist students and teachers with hearing technology.

A third rationale for this study is that the work has the potential to benefit mainstreamed students with hearing loss. Students with hearing loss, especially during their first years of school, often need extra support and assistance with their hearing technology. It is imperative that students with hearing loss make correct use of their technology at school so that they do not miss out on important material or fall behind academically. Students cannot learn if they cannot hear (ASHA, 2005, para. 3; Flexer, 2004, p. 132). In order to guarantee equal learning opportunities for students with hearing loss, they have to be able to hear their teachers and peers (Flexer & Rollow, 2009, p. 16), and therefore need appropriate and functioning technology. By investigating SLPs' knowledge of and experience with hearing technology, we can learn whether students with hearing loss are receiving the support that they need, thus examining a most important component of their school experience.

Fourth, this study will benefit general education teachers who have, or may in the future have, students with hearing loss in their classrooms. Several studies have reported teachers' lack of knowledge of hearing loss and hearing technology (Dunay & English, 2000, p. 50; Lass, Tecca, & Woodford, 1987, p. 88). This lack of comprehensive knowledge may leave teachers looking for a resource to help them properly accommodate students with hearing loss. By investigating SLPs' knowledge in this area, we can learn if school SLPs can be such a resource to general education teachers.

A final rationale for this study is that the work can help to better prepare SLPs to work in school settings and help to determine whether or not additional preparation is needed to serve students with hearing loss effectively. With many educational audiologists often needing to share their time among several schools (Schafer & Sweeney, 2012, p. 14; Thibodeau & Johnson, 2005, p. 37), school-based SLPs are often the best available on-site resource to students with hearing loss. By investigating what SLPs know about hearing technology, the study will also find out what they do not know. With this information, the study will be able to suggest the necessary knowledge to competently work with and assist children with hearing loss in school settings. Furthermore, this study may be of assistance to suggest if graduate curricula for speech-language pathology should include training, or more training, related to hearing and hearing technology.

Definitions

In order to fully understand this study, several terms must be defined. A *speech-language pathologist* is an individual "who work[s] to prevent, assess, diagnose, and treat speech, language, social communication, cognitive-communication, and swallowing disorders in children and adults" (ASHA, n.d. b, para. 1). An additional component of the scope of practice of a speech-language pathologist relates to providing therapy and training to individuals with *hearing loss*, which refers to "those who experience difficulty receiving stimuli through the auditory channel" (Scheetz, 2012, p. 63). Types of hearing loss include conductive, sensorineural, and mixed. *Conductive hearing loss* is "caused by the attenuation of sound as it travels from the outer ear to the cochlea" (Stach & Ramachandran, 2014, p. 9). *Sensorineural hearing loss* is the "loss of hearing sensitivity produced by damage or alteration of the sensory mechanism of the cochlea or the neural structures that lie beyond" (Martin & Clark, 2012, p. 466). *Mixed hearing loss* refers to the simultaneous occurrence of sensorineural and conductive hearing losses (Martin & Clark, 2012, p. 21). A *student with hearing loss* in the current study refers to a child who is deaf or hard of hearing who has elected to make use of hearing sensory technology.

The varied hearing technologies that will be primarily investigated in this study are hearing aids, cochlear implants, and FM/IR units. A *hearing aid* is "an electronic listening device designed to amplify and deliver sound from the environment to the listener" (Tye-Murray, 2009, p. 678). A *cochlear implant* is a "surgically implanted device with [an] externally worn processor that converts acoustic energy into electrical energy, stimulating the auditory nerve" (Johnson & Seaton, 2012, p. 295). A *frequency modulation (FM) unit* is "a wireless personal listening device that includes a remote wireless microphone placed near the desired sound source … and a receiver for the listener, who can be situated anywhere within [approximately] 50 feet of the talker" (Smaldino & Flexer, 2014, p. 260). *Infrared (IR) systems* operate similarly to FM units, but use infrared light waves rather than radio frequency waves to transmit sounds (Johnson & Seaton, 2012, p. 303; Tye-Murray, 2009, p. 124). The aforementioned technology are the types most commonly used in *public schools*, a clinical setting in which many speech-language pathologists are employed (ASHA, n.d. b, para. 6).

Description of Method

For this study, the researcher utilized the quantitative method of survey research to help understand the knowledge school-based speech-language pathologists (SLPs) have of hearing technology. SLPs currently working in elementary schools in both Michigan and Ohio were surveyed in order to compare the professionals in the two states. More specifically, the SLPs were asked about any training that they may have had with hearing technology, their perceptions of the need for this type of training, and their experience and comfort level working with these forms of technology in educational settings. To recruit participants, the Michigan Speech Language Hearing Association (MSHA) and the Ohio Board of Speech-Language Pathology and Audiology were contacted. MSHA provided the names and emails of the 364 registered members who currently work in public schools in Michigan. The Ohio Board provided an email directory of 1,249 licensed SLPs working in various educational settings. From each email directory, a simple random sample of 200 was chosen. The 400 SLPs were then contacted by email with an electronic link to the survey.

Conclusion

This study focused on the hearing technology knowledge of SLPs who work in elementary school settings in the states of Michigan and Ohio. Through the use of an electronic survey, the researcher investigated the hearing technology training received by SLPs and the experiences they have had with students with hearing loss and their hearing technology. This is a timely and worthwhile study because it updates research on school SLPs and hearing technology in an era of rapid advancement in which more and more children with hearing loss are taking advantage of hearing technology and attending public schools. The investigation has the potential to benefit mainstreamed students with hearing loss and their teachers, and presumably help to better prepare SLPs to work in school settings with these children. The following chapter will provide a foundation of knowledge on the topic by reviewing past scholarly research.

CHAPTER II: LITERATURE REVIEW

It is estimated that 2 to 3 of every 1,000 children are born with a hearing loss (NIDCD, 2015, para. 1). Many of these children's parents will choose hearing technology for their child with the expectation that he/she will develop spoken language and attend school, where interactions with a speech-language pathologist (SLP) are likely. This chapter will begin by providing an overview of the hearing mechanism, measurements of hearing, and hearing loss. The chapter will then explain different communication options and hearing technologies, education placement options for students with hearing loss, services provided in school for these students, as well as examine the past research on teachers' and SLPs' knowledge of hearing technology.

Hearing Mechanism

The foundational knowledge needed to fully understand the current study begins with the hearing mechanism. The hearing mechanism can be classified into three major parts: the outer ear, the middle ear, and the inner ear. The anatomy and physiology of each of these parts will be briefly explained in order to describe the overall process of hearing and how sound travels from the ear to the brain.

Anatomy and Physiology of the Outer Ear

The outer ear consists of three main components: the auricle, external auditory meatus, and the tympanic membrane. The auricle, also known as the pinna, is the visible portion of the ear responsible for collecting, funneling, and localizing sounds (Martin & Clark, 2015, p. 219; Seikel, King, & Drumright, 2010, p. 448; Stach, 1998, p. 53). Its physical shape helps to deliver the acoustic signal and, notably, high frequency sounds (Martin & Clark, 2015, p. 219; Scheetz, 2012, p. 54). Its major parts are the helix, the upper portion; the lobule, the lowermost and "flabby" portion; and the concha, the middle and bowl-shaped portion that serves as the entrance to the external auditory meatus (Martin & Clark, 2015, p. 219; Seikel et al., 2010, p. 448; Stach, 1998, p. 53).

The next portion of the outer ear is the external auditory meatus (EAM), also known as the ear canal. The EAM is a tube that begins with an opening in the side of the head at the concha, and continues to the tympanic membrane, or eardrum (Martin & Clark, 2015, p. 219; Seikel et al., 2010, p. 450; Stach, 1998, p. 53). The EAM has an elliptical shape (Martin & Clark, 2015, p. 219; Stach, 1998, p. 53), and is approximately 25 mm long (Seikel et al., 2010, p. 450; Stach, 1998, p. 53) with a diameter of about 7 mm (Seikel et al., 2010, p. 450). It presents at a downward angle in children and an upward angle in adults (Martin & Clark, 2015, p. 220). Although the entire canal is covered in skin (Martin & Clark, 2015, p. 219; Seikel et al., 2010, p. 448; Stach, 1998, p. 53), the outer and inner portions have different compositions. The outer third is formed by cartilage, whereas the inner two-thirds are composed of bone (Martin & Clark, 2015, p. 220; Seikel et al., 2010, p. 450). The outer third is lined with hairs and glands that secrete cerumen, or earwax, which serves to keep out foreign objects (Martin & Clark, 2015, p. 220; Seikel et al., 2010, p. 450; Stach, 1998, p. 53). The EAM acts as a resonator for sounds, especially for the frequencies between 2000-7000 Hz, enhancing them as they travel to the tympanic membrane (Martin & Clark, 2015, p. 220). It also serves to funnel sounds to and protect the tympanic membrane (Martin & Clark, 2015, p. 220; Seikel et al., 2010, p. 480), the next portion of the outer ear.

The tympanic membrane, known colloquially as the eardrum, is a thin, concave structure that acts as the border between the outer and middle ears (Martin & Clark, 2015, p. 221; Seikel et al., 2010, p. 450). It is made of three layers of tissue (Martin & Clark, 2015, p. 221; Seikel et al., 2010, p. 450; Stach, 1998, p. 53) and functions as a vibrating surface (Martin & Clark, 2015, p. 221). The malleus, a middle ear bone, attaches to the center of the tympanic membrane (Martin & Clark, 2015, p. 221; Seikel et al., 2010, p. 450). This point of attachment causes the membrane to retract, the greatest point of which is called the umbo. The umbo gives the tympanic membrane its concave shape (Martin & Clark, 2015, p. 221; Seikel et al., 2010, p. 452).

After resonating and traveling through the auricle and EAM, sound energy creates pressure waves that cause the tympanic membrane to vibrate (Martin & Clark, 2015, p. 223; Stach, 1998, p. 55). The magnitude and speed of tympanic membrane vibrations are proportional to and representative of the sound's intensity and frequency (Martin & Clark, 2015, p. 223; Stach, 1998, p. 55). The attachment between the tympanic membrane and the malleus continues the transfer of sound energy into the middle ear.

Anatomy and Physiology of the Middle Ear

The middle ear is an oval, air-filled cavity that houses many important parts of the hearing mechanism (Martin & Clark, 2015, p. 239; Stach, 1998, p. 55), as well as non-auditory structures (Martin & Clark, 2015, p. 243). It is separated from the outer ear by the tympanic membrane (Martin & Clark, 2015, p. 239; Stach, 1998, p. 56), and from the inner ear by its medial wall (Martin & Clark, 2015, p. 239; Seikel et al., 2010, p. 458). The middle ear also connects to the nasopharynx, the cavity in the back of the throat, through the Eustachian tube (Martin & Clark, 2015, p. 239; Scheetz, 2012, p. 54; Stach, 1998, p. 56).

The Eustachian tube is responsible for maintaining the pressure equilibrium in the middle ear space (Martin & Clark, 2015, p. 240; Seikel et al., 2010, p. 460; Stach, 1998, p. 56). It is the only means of providing oxygen to the middle ear (Scheetz, 2012, p. 55; Seikel et al., 2010, p.

460). The pressure in this cavity must be equal to the pressure of the EAM, or atmospheric pressure (Martin & Clark, 2015, p. 240; Seikel et al., 2010, p. 460; Stach, 1998, p. 56), in order to maximize the mobility of the tympanic membrane (Martin & Clark, 2015, p. 240).

The middle ear also houses the ossicles: the malleus, the incus, and the stapes. These three bones are the smallest in the body and together form the ossicular chain (Martin & Clark, 2015, p. 243; Seikel et al., 2010, p. 453; Stach, 1998, p. 56). As mentioned previously, the malleus, the largest of the ossicles, attaches to the center of the tympanic membrane at the umbo. Its other side attaches to the next largest ossicle, the incus, which has an attachment to the stapes, the smallest of the three bones. The footplate, or base of the stapes fits into the oval window, one of two connections to the inner ear (Martin & Clark, 2015, p. 241; Scheetz, 2012, p. 55; Stach, 1998, p. 56).

The border between the middle and inner ears is marked by the medial wall of the middle ear, and consists of the promontory, oval window, and round window (Scheetz, 2012, p. 55). The promontory is a protrusion into the middle ear caused by the basal turn of the cochlea (Martin & Clark, 2015, p. 241; Seikel et al., 2010, p. 458). The oval and round windows are located above and below the promontory, respectively, and serve to connect the middle and inner ears (Martin & Clark, 2015, p. 241; Seikel et al., 2010, p. 458).

The overall function of the middle ear is to transfer the sound waves that enter the hearing mechanism through the outer ear, to the fluid-filled inner ear (Martin & Clark, 2015, p. 241; Scheetz, 2012, p. 55). The vibrations of the tympanic membrane set the ossicular chain in motion, thus vibrating the footplate of the stapes, which is located in the oval window of the inner ear. The ossicles serve to set the fluids of the cochlea in motion, therefore transferring the sound wave energy from air to fluid (Martin & Clark, 2015, p. 242; Scheetz, 2012, p. 55; Stach, 1998, p. 57).

Anatomy and Physiology of the Inner Ear and Auditory Nerve

The inner ear houses the sense organs for hearing and balance—the cochlea and vestibular system, respectively. Although serving different functions, these two portions of the inner ear are connected both anatomically and physiologically (Martin & Clark, 2015, p. 274). For the purposes of this study, the cochlear component will be the area of focus. The inner ear is composed of the osseous, or bony, labyrinth that makes up the outer shell, and the inner portion called the membranous labyrinth (Scheetz, 2012, p. 56; Stach, 1998, p. 58).

The entrance to the inner ear is marked by the oval and round windows that connect it to the middle ear. Just past these openings is the vestibule, the entryway into the cochlea (Martin & Clark, 2015, p. 274; Seikel et al., 2010, p. 461). The cochlea, the sense organ of hearing, is the snail-like shell responsible for converting energy from sound waves into a code that can be sent to the brain for interpretation (Martin & Clark, 2015, p. 441; Scheetz, 2012, p. 55). Its basal end begins near the vestibule and coils making approximately 2.5 turns before ending at its apex (Martin & Clark, 2015, p. 278; Scheetz, 2012, p. 57; Seikel et al., 2010, p. 465; Stach, 1998, p. 58). The cochlea consists of three canals: the scala vestibuli, scala tympani, and scala media. The upper portion of the cochlea is the scala vestibuli, which courses from the oval window to the helicotrema at the apex of the cochlea. This canal is filled with perilymph and is bordered by Reissner's membrane (Martin & Clark, 2015, p. 278; Scheetz, 2012, p. 57; Stach, 1998, p. 58). The bottom portion of the cochlea is the scala tympani, coursing from the round window to the helicotrema, where it communicates with the scala vestibuli (Seikel et al., 2010, p. 466). The scala tympani is a perilymph-filled canal bordered by the basilar membrane. Between these two canals and bordered by both Reissner's membrane and the basilar membrane, is the scala media. Also known as the cochlear duct, the scala media is filled with endolymph. Within the scala media and along its lower border, the basilar membrane, is the organ of Corti, the end organ of hearing and location of the sensory cells of hearing (Martin & Clark, 2015, p. 278; Scheetz, 2012, p. 58; Stach, 1998, p. 58).

The organ of Corti contains four rows of hair cells—essentially three rows of outer hair cells and one row of inner hair cells, separated from each other by Corti's arch (Martin & Clark, 2015, p. 279; Stach, 1998, p. 61). Each hair cell is topped with a series of stereocilia, a hair-like projection (Martin & Clark, 2015, p. 279; Seikel et al., 2010, p. 470). There are approximately 12,000 outer hair cells, all of whose stereocilia are embedded into the tectorial membrane, a gelatinous flap that extends over the organ of Corti (Martin & Clark, 2015, pp. 279-280; Seikel et al., 2010, p. 469; Stach, 1998, p. 61). The 3,500 inner hair cells are not directly in contact with the tectorial membrane, but their proximity is significant (Martin & Clark, 2015, p. 279; Seikel et al., 2010, p. 469; Stach, 1998, p. 61). Each inner hair cell is connected to 10 to 20 nerve fibers from the cochlear branch of cranial nerve VIII, whereas 10 outer hair cells may "share" the same cranial nerve VIII nerve fiber (Martin & Clark, 2015, p. 280; Seikel et al., 2010, p. 472). These connections to the auditory nerve send impulses that eventually reach the auditory cortex of the temporal lobe of the brain (Scheetz, 2012, p. 59; Stach, 1998, p. 70).

The physiology of the inner ear demonstrates the pathway of sound energy as it interacts with all of the anatomical landmarks previously explained. The piston-like movement of the stapes in and out of the oval window results in a wave-like fluid motion in the cochlea (Martin & Clark, 2015, p. 280; Seikel et al., 2010, p. 483; Stach, 1998, p. 63). When the wave reaches its maximum energy, a displacement in the basilar membrane occurs (Stach, 1998, p. 64). This displacement occurs near the basal end of the cochlea for high frequency sounds and near the apical end of the cochlea for low frequency sounds (Martin & Clark, 2015, p. 280; Seikel et al., 2010, p. 483; Stach, 1998, p. 65). The basilar membrane displacement serves to stimulate the hair cells (Scheetz, 2012, p. 61; Seikel et al., 2010, p. 487), which then send neural impulses to cranial nerve VIII (Scheetz, 2012, p. 61; Stach, 1998, p. 64). The neural impulses travel through various parts of the brain, eventually reaching the auditory cortex of the temporal lobe (Scheetz, 2012, p. 59; Stach, 1998, p. 70). From the auricle of the outer ear, to the auditory cortex of the brain, the hearing mechanism relies on the proper functioning of many parts. If an issue arises somewhere along this mechanism, hearing measurements must be conducted to identify the source.

Measurement of Hearing

In order to determine if the hearing mechanism is functioning properly, measurements of hearing are conducted. This section will provide an overview of the common measurements of hearing, including pure tone audiometry, behavioral tests, and physiological tests.

Pure Tone Audiometry

Sounds are often described colloquially by their “pitch” and “loudness.” These terms are actually the psychological correlates of the two main classifications of sounds—frequency and intensity. Frequency, thought of as the pitch of a sound, relates to the number of cycles per second and is measured in Hertz (Hz) (Martin & Clark, 2015, p. 49; Scheetz, 2012, p. 50; Stach, 1998, pp. 47-48). Intensity, associated with loudness, is measured in decibels (dB) (Martin & Clark, 2015, p. 50; Scheetz, 2012, p. 50; Stach, 1998, pp. 43-44). No matter the frequency or intensity, we hear sounds in two ways—through air conduction and bone conduction. When we hear a sound by air conduction, it courses through our outer, middle, and inner ears before traveling to the brain via the auditory nerve. A sound traveling through bone conduction skips the outer and middle ears by vibrating the skull and directly stimulating the inner ear (Martin & Clark, 2015, p. 17). Both of these manners of hearing are used in its measurement.

Pure tone audiometry is the measurement of hearing using pure tones to test one frequency at a time. The goal is to find the listener's threshold for each frequency, that is, the "lowest" intensity level or "softness" at which he or she can perceive the pure tone of a given frequency at least 50% of the time (Dalebout, 2009, p. 45; Martin & Clark, 2015, p. 451; Stach, 1998, p. 71). Using a machine called an audiometer (Dalebout, 2009, p. 45; Scheetz, 2012, p. 118), thresholds are obtained for the major audible frequencies (Stach, 1998, p. 199). Pure tone audiometry typically includes both air conduction and bone conduction testing. With air conduction testing, the listener wears ear inserts or earphones so that the signal is delivered through the outer and middle ears before reaching the inner ear. In this way, air conduction testing tests the entire auditory pathway and can specify the degree of hearing loss. Air conduction alone, however, cannot determine the type of hearing loss, as the "cause" or source of the hearing loss could be anywhere in the outer ear, middle ear, inner ear, or along the auditory nerve (Dalebout, 2009, p. 46; Martin & Clark, 2015, p. 77; Scheetz, 2012, p. 119; Stach, 1998, p. 77). Bone conduction testing uses a bone oscillator placed on the mastoid process, a portion of the temporal bone that is palpable behind the ear, to directly stimulate the inner ear. Bone conduction therefore tests only the inner ear and auditory nerve for functioning, and thus can be used with air conduction testing results to determine the type of hearing loss (Dalebout, 2009, p. 48; Martin & Clark, 2015, p. 85; Scheetz, 2012, p. 119; Stach, 1998, pp. 77-78).

Behavioral Tests

A behavioral test requires active participation from the listener. For older children and adults, pure tone audiometry can be used by simply asking the listener to indicate when they hear a sound by either raising their hand or clicking a button. Infants and young children often require other methods of behavioral testing to determine if a hearing loss is present. The following methods can all be completed with a speaker in a sound field, via earphones or ear inserts, or with a bone oscillator if measuring bone conduction. Although these age populations are likely to reject objects placed on their heads or in their ears, the use of earphones or ear inserts is advised because such testing provides information specific to the abilities of each ear (Martin & Clark, 2015, p. 202; Stach, 1998, p. 374). When using a speaker in a sound field, it is impossible to determine which ear heard the stimulus, should a difference between the ears exist.

Behavioral observation audiometry. For the youngest listeners, infants from birth to about 6 months of age, behavioral observation audiometry is employed (Madell, 2014a, p. 71; Martin & Clark, 2015, p. 196; Stach, 1998, p. 370). Most often completed with speakers in a sound field (Madell, 2014a, p. 73; Stach, 1998, p. 371), this form of testing measures infants' hearing by observing head turns or sucking responses, for example, in response to auditory signals (Madell, 2014a, p. 71; Stach, 1998, p. 371). When observing head turns, two clinicians are required. The infant often sits on the lap of a parent with one clinician sitting directly in front of them to keep the infant's attention looking forward. The other clinician discretely presents signals to the infant, who is then observed for head turns toward the signal (Martin & Clark, 2015, p. 196).

Visual reinforcement audiometry. From approximately 6 months to 2 or 3 years of age, visual reinforcement audiometry can be used to measure hearing (Madell, 2014c, p. 79;

Martin & Clark, 2015, p. 199; Stach, 1998, p. 372). In this form of behavioral testing, the child's response to an auditory signal is rewarded with visual stimuli that engage the child. Examples of such stimuli are a light, an animated toy, and/or a video clip (Madell, 2014c, p. 80; Madell & Flexer, 2014, p. 60; Martin & Clark, 2015, p. 198; Stach, 1998, p. 374). Similar to behavioral observation audiometry, a test assistant is needed to sit across from the child and act as a distractor, getting the child's attention back to the center between the presentation times of the auditory signals (Madell, 2014c, p. 81). When a child responds to a signal by turning his or her head in its direction, the visual stimuli is produced and the child is eventually conditioned to respond to signals in that way (Martin & Clark, 2015, p. 198; Stach, 1998, p. 374). When the child does not look toward a sound, it is assumed that he or she did not hear the signal. The auditory signal used in visual reinforcement audiometry can be pure-tones or speech stimuli (Madell, 2014c, p. 84; Stach, 1998, p. 374), and can be delivered through a speaker, earphones or ear inserts, bone oscillator, hearing aid, or cochlear implant (Dalebout, 2009, p. 60; Martin & Clark, 2015, p. 198; Stach, 1998, p. 374).

Conditioned play audiometry. Beginning at approximately 2 or 2 ½ years of age, most children are able to participate in conditioned play audiometry (Madell, 2014b, p. 89; Martin & Clark, 2015, p. 199; Stach, 1998, p. 375). To engage the child in testing, he or she is taught to respond to auditory signals by completing a play or motor activity, such as placing a ring on a peg or a bead in a bucket (Madell & Flexer, 2014, p. 60; Martin & Clark, 2015, p. 202; Stach, 1998, p. 375). By making the hearing test a game, children are more likely to participate for a longer amount of time.

Physiological Tests

When a child or adult is unable to participate in behavioral testing, physiological tests of hearing can be utilized. Often used to screen the hearing of newborns, physiological tests do not require any response or participation from the person being tested. Instead, they measure the actual functionality of a specific portion of the hearing mechanism.

Otoacoustic emissions. Otoacoustic emissions (OAE) are measured to test the cochlea, and thus can be used to identify a hearing loss whose site of lesion is the cochlea. A functioning cochlea produces sounds that are emitted in the external auditory meatus (Dalebout, 2009, p. 52; Martin & Clark, 2015, p. 166; Stach, 1998, p. 313). These emissions can be noted both in the presence of or following auditory stimulation, named evoked OAE; and in the absence of auditory stimulation, named spontaneous OAE (Martin & Clark, 2015, p. 166; Stach, 1998, pp. 313-314). OAEs are measured with a probe in the external auditory meatus (Dalebout, 2009, p. 52; Martin & Clark, 2015, p. 167; Stach, 1998, p. 315) through two types of tests—transient-evoked otoacoustic emissions (TEOAE) and distortion-product otoacoustic emissions (DPOAE) (Martin & Clark, 2015, p. 166).

TEOAE use clicks or tone pips as stimuli that are presented by a probe in the external auditory meatus (Martin & Clark, 2015, p. 166; Stach, 1998, p. 314). If the cochlea responds with emissions, one concludes that there is no hearing loss resulting from issues in the outer ear, middle ear, or cochlea (Martin & Clark, 2015, p. 166); if there is no response, a lesion may be present in any of the three sites (Martin & Clark, 2015, p. 166; Stach, 1998, pp. 317-318). Although this measurement aims to test the cochlea, because the stimuli are presented in the external auditory meatus, an issue in the meatus or middle ear will prevent the sound from even reaching the cochlea, thus testing the function of those components as well. It should also be noted that transient-evoked OAE cannot determine if a problem exists beyond the cochlea, such as with the auditory nerve (Martin & Clark, 2015, p. 166). DPOAE present two "primary tones" of different frequencies in the same manner as TEOAE and similarly measures the cochlea's response (Martin & Clark, 2015, p. 166; Stach, 1998, p. 315). A response from the cochlea can indicate the functioning of the outer and middle ear (Martin & Clark, 2015, p. 166), as well as cochlear function with frequency-specific information (Stach, 1998, p. 318).

Auditory brainstem response. Another physiological test measures the auditory brainstem response (ABR). The ABR originates from cranial nerve VIII (the auditory nerve) and the brainstem within the first 10-15 milliseconds after an auditory signal has been triggered (Martin & Clark, 2015, p. 169; Stach, 1998, p. 300). To measure this response, electrodes are placed on the skull (Dalebout, 2009, p. 53; Martin & Clark, 2015, p. 171; Stach, 1998, p. 300) and an insert is placed in the test ear to present clicks and tone pips as stimuli (Dalebout, 2009, p. 53; Martin & Clark, 2015, p. 171). The automated ABR (AABR) is conducted in the same way, but its automation allows less-skilled personnel, for example, to conduct such screenings (Stach, 1998, p. 307). Whether automated or conducted by an audiologist, the person being tested can be asleep during the measurement (Martin & Clark, 2015, p. 172). This test can indicate if auditory nerve damage or an acoustic neuroma exists, making it a very useful diagnostic tool (Martin & Clark, 2015, p. 172). The type of stimuli used provides further information, as well. A tonal ABR, using tone pips, gives frequency-specific information, and a click ABR evaluates a wider auditory range and can be used to help diagnose auditory neuropathy spectrum disorder (Madell & Flexer, 2014, p. 60). Diagnosis of hearing differences and losses is the purpose of all of the hearing measurements previously described. The diagnosis is not very helpful, however, without an understanding of the different types of hearing loss.

Hearing Loss

With the overview of the hearing mechanism and hearing measurements complete, hearing loss itself can now be explored. This study investigated the situation in schools for students with hearing loss; therefore, hearing loss is an essential topic for study. It is important to have a general understanding of the types of hearing of loss, how hearing loss is depicted in an audiogram, and the degrees of hearing loss, all of which will be described in this section.

Types of Hearing Loss

The three major types of hearing loss are conductive, sensorineural, and mixed. These types of hearing loss result in, for different reasons, a decreased ability to hear sounds. Other types of hearing loss or hearing disorders that are not strictly related to the intensity required to hear a signal will be briefly described as well.

A conductive hearing loss is most easily described as a loss of hearing due to a barrier in the outer and/or middle ear, known as the conductive mechanism (Dalebout, 2009, p. 70; Martin & Clark, 2012, p. 20; Scheetz, 2012, p. 66; Stach, 1998, p. 91). This type of loss results in the attenuation of sound, or its decrease in strength (Martin & Clark, 2012, p. 20; Stach, 1998, p. 92; Stach & Ramachandran, 2014, p. 9). When a purely conductive loss exists, the inner ear, auditory nerve and beyond are all functioning; therefore bone conduction effectively delivers sounds (Dalebout, 2009, p. 70; Martin & Clark, 2012, p. 20; Scheetz, 2012, p. 66). A conductive loss is diagnosed when pure tone audiometry testing presents impaired air conduction and normal bone conduction (Martin & Clark, 2012, p. 20; Stach, 1998, p. 92). Otitis media, an infection in the middle ear space, is just one example of a possible cause of conductive hearing loss (Dalebout, 2009, p. 77; Martin & Clark, 2012, p. 252; Scheetz, 2012, p. 67). Like otitis media, many causes of conductive losses can be treated medically and restore hearing to "normal" (Dalebout, 2009, p. 70; Stach & Ramachandran, 2014, p. 9).

A sensorineural hearing loss occurs when the site of lesion is located in the sensory and/or neural mechanism, which refers to the cochlea and auditory nerve, respectively (Dalebout, 2009, p. 82; Martin & Clark, 2012, p. 20; Scheetz, 2012, p. 67). The term sensorineural has been used as a blanket term for both sensory and neural losses traditionally because it is often difficult to determine if a loss originated in the cochlea or auditory nerve (Dalebout, 2009, p. 82). When pure-tone audiometry presents identically impaired air conduction and bone conduction, a sensorineural loss is diagnosed (Martin & Clark, 2012, p. 20; Stach, 1998, p. 94). Because air conduction tests the entire mechanism, if the site of lesion is the cochlea, for example, air conduction will be affected just as bone conduction will be. Some people with sensorineural hearing losses are born with the loss, known as a hereditary or genetic hearing loss (Dalebout, 2009, p. 82; Stach, 1998, p. 136), although many other causes of sensorineural hearing loss exist as well. One such example is an acoustic neuroma, a tumor on the auditory nerve (Dalebout, 2009, p. 92; Martin & Clark, 2012, p. 329). Whether sensory or neural in origin, most sensorineural hearing losses are permanent (Dalebout, 2009, p. 82; Scheetz, 2012, p. 67).

A mixed hearing loss occurs when an individual presents with both conductive and sensorineural losses at the same time (Dalebout, 2009, p. 93; Martin & Clark, 2012, p. 21; Stach, 1998, p. 97). This type of loss consists of an issue with the conductive mechanism (the outer and/or middle ear) and an issue with the sensory and/or neural mechanisms (the cochlea and/or auditory nerve). A mixed hearing loss is diagnosed when pure tone audiometry presents impaired bone conduction and even greater impaired air conduction (Martin & Clark, 2012, p. 21). Air conduction thresholds should be worse than bone conduction thresholds in a mixed hearing loss because air conduction thresholds account for the sound attenuation from both the conductive and sensorineural mechanisms, whereas bone conduction only accounts for the sound attenuation from the sensorineural mechanism.

An emerging hearing disorder that affects approximately 8% of children diagnosed with hearing loss is auditory neuropathy spectrum disorder (ANSD) (Roush, Frymark, Venediktov, & Wang, 2011, p. 159). Although there is still a lot to be learned about this class of disorders (Neault, 2014, p. 356), it can generally be explained as occurring when outer hair cells function normally, but nerve responses to the brain do not occur in synchrony (Martin & Clark, 2012, p. 335; Neault, 2014, p. 356). It is often marked by a mild to profound sensorineural loss that can be asymmetric and fluctuate over time (Dalebout, 2009, p. 92; Martin & Clark, 2012, p. 335; Roush et al., 2011, p. 159), in addition to poor word recognition that is often disproportionate to the degree of hearing loss (Dalebout, 2009, p. 92; Martin & Clark, 2012, p. 335; Roush et al., 2011, p. 159; Scheetz, 2012, p. 67). Many cases have also reported that hearing in noise can be especially difficult (Dalebout, 2009, p. 92; Roush et al., 2011, p. 159). ANSD can typically be diagnosed when OAE test results are normal but ABR results are abnormal or absent (Dalebout, 2009, p. 92; Roush et al., 2011, p. 159).

Another type of hearing loss that does not necessarily result in sound attenuation is central hearing loss. A rare type of hearing loss, central hearing loss occurs when the site of lesion is the brain (Martin & Clark, 2012, p. 340). In the presence of this type of hearing loss, the conductive and sensorineural mechanisms function normally, but the lesion in the pathway to, or in, the brain hinders the individual's ability to process auditory signals.

A final type of hearing loss or hearing difference to mention is non-organic hearing loss. With this type of hearing difference there is no physiologic explanation, as its name suggests

(Martin & Clark, 2012, p. 355). A number of reasons could explain such a hearing difference, for example, the patient could be feigning or exaggerating the severity or degree of the hearing loss, often for some financial gain (Martin & Clark, 2012, p. 356; Stach, 1998, p. 103). Children who present with a non-organic hearing loss may "fake" their hearing loss as an excuse for poor academic performance or to gain attention at home (Stach, 1998, p. 104). It is also possible that a non-organic hearing loss is due to a specific psychological disorder (Martin & Clark, 2012, p. 356).

The Audiogram and Degrees of Hearing Loss

The audiogram is a graph used to depict a person's hearing abilities (Dalebout, 2009, p. 46). Based on pure tone audiometry testing, the audiogram is completed to show the listener's threshold for each frequency tested by air and bone conduction for both ears (Stach, 1998, p. 73). The x-axis, or abscissa, represents frequency measured in Hertz (Hz), typically beginning with 125 Hz and going across to 8000 Hz (Dalebout, 2009, p. 46; Stach, 1998, p. 73). The y-axis, or ordinate, represents intensity measured in decibels (dB Hearing Level or dB HL) and often ranges from -10 dB HL to 120 dB HL (Dalebout, 2009, p. 46; Stach, 1998, p. 73). The audiogram provides a visual representation of one's hearing ability and aids in diagnosing the type and severity or degree of hearing loss.

The degree of hearing loss depends on the thresholds measured or determined from pure tone audiometry. The degree may differ for different frequencies and for each ear. Thresholds within the following ranges of intensities have been identified as noted: -10 to 15 dB HL is within normal limits, meaning that there is no hearing loss; 16 to 25 dB HL is a slight hearing loss; 26 to 40 dB HL is a mild hearing loss; 41 to 55 dB HL is a moderate hearing loss; 56 to 70 dB HL is a moderately severe hearing loss; 71 to 90 dB HL is a severe hearing loss; and 91 dB

HL and above refers to a profound hearing loss (Martin & Clark, 2012, p. 85; Scheetz, 2012, pp. 125-127). No matter the degree of hearing loss, an individual with hearing loss and his/her family must choose the most appropriate option or form of communication for their family and situation.

Communication Options

When a family learns that their child has a hearing loss, they have to choose how they want to teach him or her to communicate. Whether or not the family chooses to take advantage of hearing technology will affect the communication options available to their child. Those who do not use hearing technology will likely be limited to a manual communication option. Those who use hearing technology may choose from listening and spoken language and combined communication options.

Manual Options

Manual communication options are essentially different types of sign language. They do not require the communicator to have hearing abilities and rely on the manual use of the hands and body to communicate. The most common manual communication option in the U.S. is American Sign Language (ASL). ASL is a visual and gestural language often used by people who are deaf in the United States and Canada (Flexer, 2014, p. 293; Scheetz, 2012, p. 100; Stredler-Brown, 2009, p. 950). ASL is not a form of English (Flexer, 2014, p. 293; Scheetz, 2012, p. 100; Stredler-Brown, 2009, p. 950), but instead is a unique, rule-governed language with its own grammar and syntax (Flexer, 2014, p. 293; Scheetz, 2012, p. 100; Stredler-Brown, 2009, p. 950). Individuals who choose ASL as a communication approach generally choose to communicate without any spoken language and instead communicate strictly through signing (Flexer, 2014, p. 293).

The Bilingual-Bicultural (Bi-Bi) communication approach refers to fluency in both ASL and English (Croyle, 2003, p. 284; Scheetz, 2012, p. 111; Stredler-Brown, 2009, p. 949). Although Bi-Bi does not promote the use of spoken English, the development of written English and literacy skills are considered fundamental (Croyle, 2003, p. 284; Sass-Lehrer, 2003, p. 169; Stredler-Brown, 2009, p. 949). The bicultural component of this approach relates to the user's participation in Deaf culture (Croyle, 2003, p. 285).

A type of sign system used in the United States is Manually Coded English (MCE). MCE is a visual representation of English that, through signing, uses English word order and grammatical markers (CDC, 2014, para. 1; Stredler-Brown, 2009, p. 950; U.S. Department of Education, 2006, p. 6). The use of English grammar through signing is advantageous because it gives communicators visual access to messages while, arguably, aiding in the development of English language skills, such as literacy. Like ASL, MCE does not necessarily promote the use of spoken language, but it does encourage the use of written English. There are several types of MCE systems, but the most common form is Signing Exact English (SEE-2) (Cleveland Clinic, 2010, p. 25; Johnson, 2012, p. 346; Scheetz, 2012, p. 103).

Listening and Spoken Language Options

In general, listening and spoken language communication options emphasize the importance of residual hearing and listening with the goal of developing spoken language. An option chosen by more and more families is the auditory-verbal approach. Auditory-verbal relies on the use of hearing technology, such as hearing aids and cochlear implants (Estabrooks, 2012, p. 2; Stredler-Brown, 2009, p. 949), and specific strategies to enable the acquisition of spoken language through active listening (Estabrooks, 2012, p. 2). Unlike manual communication options, auditory input is a very important component of the auditory-verbal approach (Scheetz, 2012, p. 101). To practice listening skills, no visual cues (i.e. speechreading) are typically provided during therapy sessions (Flexer, 2014, p. 295; Scheetz, 2012, p. 101; Stredler-Brown, 2009, p. 949).

Auditory-verbal therapy is often provided by a Certified Listening and Spoken Language Specialist (Cert. LSLS) (Estabrooks, 2012, p. 2), but also takes a "family-centered approach" (p. 4). Parents or caregivers have an active role in the auditory-verbal approach and are coached on therapy strategies and techniques so that they can work with their child and be the primary facilitators of their child's development of listening and spoken language (Estabrooks, 2012, p. 4; Flexer, 2014, p. 295). With the help of the family, listening is integrated into daily activities and play (Estabrooks, 2012, p. 5). Some of the techniques and strategies used to achieve this include use of pause time, acoustic highlighting, excellence in audiologic management, and using verbal listening cues, such as "Listen" (Estabrooks, 2012, pp. 4-5).

Another listening and spoken language communication option is the auditory/oral approach. Historically auditory/oral (A/O) emphasized the use of active listening, spoken language, and speechreading (Flexer, 2014, p. 295; Stredler-Brown, 2009, p. 949). Like the auditory-verbal approach, A/O encourages the use of hearing technology to provide auditory input (Flexer, 2014, p. 295; Scheetz, 2012, p. 99). Communicators using the A/O approach can use natural hand gestures and speechreading to supplement their listening and spoken language, but the use of sign language is not promoted (Flexer, 2014, p. 295; Stredler-Brown, 2009, p. 949). Parental and family involvement is encouraged in this approach (Flexer, 2014, p. 295; Scheetz, 2012, p. 99), particularly to foster listening skills in natural settings (Scheetz, 2012, p. 101).

Combined Options

Combined communication options, as the name suggests, combine aspects from different communication approaches together. The most common combinations involve the use of both spoken language and visual communication (Scheetz, 2012, p. 108). Cued Speech is a combined option that does just that. In this approach, the importance of audition and vision are equal (Scheetz, 2012, p. 109). Cued Speech was developed because the shape of the mouth when producing certain sounds looks identical to an individual who is lipreading (Flexer, 2014, p. 295; Scheetz, 2012, p. 109; Stredler-Brown, 2009, p. 950). An example of such sounds are the phonemes /m, p, b/. To help communicators differentiate between these types of sounds when lipreading, Cued Speech uses different hand gestures to represent different sounds (Flexer, 2014, p. 295; Scheetz, 2012, p. 109; Stredler-Brown, 2009, p. 950). This visual cue is added to spoken language to give visual access and aid with the listening process (Scheetz, 2012, p. 109). Although Cued Speech has a visual component, the goal of this approach is arguably still spoken communication (Flexer, 2014, p. 295; Scheetz, 2012, p. 112; Stredler-Brown, 2009, p. 950).

Total Communication (TC) is more of a philosophy than a strict communication option (Scheetz, 2012, p. 111; Stredler-Brown, 2009, p. 949). TC can consist of any combination of signing, spoken language, listening, visual strategies, and reading and writing (Flexer, 2014, p. 295; Johnson, 2012, p. 346; Stredler-Brown, 2009, p. 949). The actual combination used depends on the individual needs of the child (Flexer, 2014, p. 295; Stredler-Brown, 2009, p. 949). One example of Total Communication is a sign system, such as SEE-2, used simultaneously with spoken language (Scheetz, 2012, p. 111).

Families are often aided in their communication option decision by an Early Intervention specialist. Early Intervention refers to services provided to a child with a disability before three years of age (Scheetz, 2012, p. 38). Children with hearing loss should receive intervention in their chosen mode of communication by 6 months of age (Joint Committee on Infant Hearing, 2007, p. 898). By beginning the process of learning to communicate at this young age, children are more likely to be successful in their respective communication options when it comes time for them to attend their local school. If a family's chosen communication option requires the use of hearing technology, a thorough understanding of the hearing technology options available for their child is also needed.

Hearing Technology

Another important choice for parents of children with hearing loss is the type of hearing technology, if any, that their child will use. As this study investigated SLPs' knowledge of hearing technology, it is important to thoroughly address the specific types of technology studied. The hearing technology most commonly seen in schools includes hearing aids, cochlear implants, and FM/Infrared (IR) systems, which will all be described. Other technology options in schools that do not directly relate to hearing will be noted as well.

Hearing Aids

Hearing aids are by no means the only type of hearing technology, but many individuals with hearing loss of varying severities make use of them. There are several different types and styles of hearing aids, but they all serve to amplify sounds for the listener (Dalebout, 2009, p. 109; Martin & Clark, 2012, p. 377). In general, a microphone picks up the auditory signal, that is then electrically transmitted to a "miniature loudspeaker" located somewhere in the outer ear, resulting in the delivery of amplified sound into the external auditory meatus or ear canal (Martin & Clark, 2012, p. 377).

One of the most-commonly used hearing aid styles for children is the behind-the-ear (BTE) hearing aid. BTE hearing aids get their name from the electrical component that hooks over the ear and rests behind the auricle (Dalebout, 2009, p. 115; Johnson & Seaton, 2012, p. 295; Martin & Clark, 2012, p. 384; Scheetz, 2012, p. 134). This "postauricular" component (Johnson, 2012, p. 159) is enclosed in a plastic case that is coupled, or connected, to the ear through a thin tube and an earmold (Dalebout, 2009, p. 115; Johnson, 2012, p. 159; Johnson & Seaton, 2012, p. 295; Martin & Clark, 2012, p. 384). An earmold is a plastic piece that typically sits inside the concha and the opening to the ear canal. They are custom-made to fit the wearer's concha and canal (Dalebout, 2009, p. 115; Johnson, 2012, p. 158), and serve to channel amplified sound from the hearing aid into the canal (Dalebout, 2009, p. 115). BTE hearing aids tend to have a range of power, including higher gain potential, and more adjustable features (Dalebout, 2009, p. 115), such as the ability for direct audio input, in which another device can be directly plugged into the hearing aid (Johnson, 2012, p. 160). These hearing aids can be used by people of all ages, including infants through the elderly (Dalebout, 2009, p. 115; Johnson, 2012, p. 159), and all degrees of hearing loss (Dalebout, 2009, p. 115; Johnson, 2012, p. 159; Martin & Clark, 2012, p. 384; Scheetz, 2012, p. 134). BTE hearing aids are especially appropriate for children because they are durable (Scheetz, 2012, p. 134) and can be used over time as children grow, only requiring new earmolds as their ears grow (Johnson, 2012, p. 160; Johnson & Seaton, 2012, p. 295).

A popular BTE hearing aid option today is "open fit." Instead of an earmold sitting in the concha, this type of hearing aid consists of a small tube going into the canal and ending as a small ear tip (Dalebout, 2009, p. 118; Martin & Clark, 2012, p. 384) or ear "dome" (Johnson, 2012, p. 164). The processor or electrical component is still located behind the ear (Johnson, 2012, p. 163), but it is usually much smaller (Martin & Clark, 2012, p. 384). This type of hearing aid eliminates the occlusion effect, the plugged up feeling resulting from an obstruction in the concha and opening to the ear canal, and is reported to be more comfortable (Dalebout, 2009, p. 118; Johnson, 2012, p. 164; Martin & Clark, 2012, p. 384). An open fit style also enables natural hearing for any frequencies that can be heard without amplification (Dalebout, 2009, p. 118). Because of its smaller size and lack of ear mold, an open fit hearing aid can typically only benefit slight to moderate hearing losses due to concerns about acoustic feedback, a whistling sound that can occur when the amplified sound from the hearing aid speaker is picked up again by the hearing aid microphone (Johnson, 2012, p. 164).

Other hearing aid styles to mention are completely-in-the-canal, in-the-canal, and in-the-ear hearing aids. The main difference among these styles is their location along the ear canal, which also results in their individual and different sizes. The style farthest along the ear canal is, as its name suggests, the completely-in-the-canal (CIC) hearing aid. This hearing aid fits within the ear canal (Dalebout, 2009, p. 113; Johnson, 2012, p. 163; Martin & Clark, 2012, p. 387; Scheetz, 2012, p. 136) and is barely visible (Dalebout, 2009, p. 113; Johnson, 2012, p. 163; Martin & Clark, 2012, p. 387). It is the smallest type of hearing aid (Dalebout, 2009, p. 113; Martin & Clark, 2012, p. 387), and thus has no external controls (Johnson, 2012, p. 163). CIC hearing aids can only support mild or moderate hearing losses (Martin & Clark, 2012, p. 387). Also sitting in the canal, but slightly extending out into the concha, is the in-the-canal (ITC) style of hearing aid (Dalebout, 2009, p. 114; Johnson, 2012, p. 162; Martin & Clark, 2012, p. 386; Scheetz, 2012, p. 136). Although ITC hearing aids are somewhat larger than CIC hearing aids (Dalebout, 2009, p. 114; Johnson, 2012, p. 162; Martin & Clark, 2012, p. 386; Scheetz, 2012, p. 136), they can only support up to a moderate hearing loss for most people (Johnson, 2012, p.

162). Lastly, in-the-ear (ITE) hearing aids are the larger style of the three and often sit in and fill the concha (Dalebout, 2009, p. 114; Johnson, 2012, p. 161; Martin & Clark, 2012, p. 386; Scheetz, 2012, p. 135). This style has more power for more severe hearing losses, as well as more features and "programming" options (Dalebout, 2009, p. 114). ITE hearing aids can often support up to a severe hearing loss (Johnson, 2012, p. 161). It is important to note that although CIC, ITC, and ITE hearing aids are all styles used by adults, it is unlikely that a child would use one of these hearing aids. A growing child would need frequent replacements of the entire CIC, ITC, or ITE hearing aid so that it could fit and function properly.

Cochlear Implants

Another type of hearing technology being chosen by more and more individuals, especially those with more significant hearing losses, is the cochlear implant. This surgically implanted device enables those with a severe to profound hearing loss, individuals who essentially cannot hear well or at all, to hear again or for the first time. In the absence of sufficient functioning hair cells in the cochlea (Advanced Bionics, 2003, p. 2), a cochlear implant converts sound (acoustic energy) into electrical pulses (electrical energy), which directly stimulate the auditory nerve to carry this auditory information to the brain (Dalebout, 2009, p. 156; Johnson & Seaton, 2012, p. 295). This device differs from a hearing aid in that it does not amplify sound, but rather produces a "representation of sound" for the wearer (Alexiades et al., 2008, p. 183).

Cochlear implants consist of both external and internal parts. Externally are the microphone, speech processor, and transmitting coil. Internally and surgically implanted are the internal receiver and electrode array. The functions of these parts and the cochlear implant overall are described as follows. First, the microphone picks up sound and sends it to the speech processor (Advanced Bionics, 2003, p. 5; Alexiades et al., 2008, p. 184; Johnson, 2012, p. 268). The speech processor is typically positioned behind the ear (Martin & Clark, 2012, p. 391), changes the sound into an electrical code, and then sends the signal to the transmitting coil (Advanced Bionics, 2003, p. 5; Alexiades et al., 2008, p. 184; Johnson, 2012, p. 268). The transmitting coil is attached via magnet to the internal receiver that is implanted under the skin (Dalebout, 2009, p. 157; Johnson, 2012, p. 266). The coil sends the code to the internal receiver via an FM carrier wave (Alexiades et al., 2008, p. 184; Johnson, 2012, p. 268), which sends the code to the electrode array (Advanced Bionics, 2003, p. 5; Alexiades et al., 2008, p. 184; Dalebout, 2009, p. 158; Johnson, 2012, p. 268). The electrode array is a wire with electrodes that has been surgically inserted into the scala tympani of the cochlea (Johnson, 2012, p. 266; Martin & Clark, 2012, p. 391). These electrodes stimulate the auditory nerve, which sends the auditory information onto the brain where it can be processed (Advanced Bionics, 2003, p. 5; Alexiades et al., 2008, p. 184; Johnson, 2012, p. 268).

Cochlear implants and the candidacy to receive them are regulated in the U.S. by the Food and Drug Administration (Alexiades et al., 2008, p. 185; Dalebout, 2009, p. 158; Johnson, 2012, p. 269; Johnson & Seaton, 2012, p. 295). Because cochlear implants require surgery, there are many factors and criteria to consider (Johnson, 2012, p. 271). Children must be 12 months old (Dalebout, 2009, p. 158; Johnson, 2012, p. 270; Johnson & Seaton, 2012, p. 295) with a severe to profound sensorineural hearing loss in both ears (Advanced Bionics, 2003, p. 3; Johnson, 2012, p. 270; Johnson & Seaton, 2012, p. 295). Children are also required to participate in a hearing aid trial before cochlear implantation to establish that personal amplification is not sufficient for the child's hearing needs (Advanced Bionics, 2003, p. 3; Johnson, 2012, p. 272). Specific criteria for adult implantation also exist, including a range of sensorineural hearing loss severities and varying speech recognition abilities (Johnson, 2012, p. 271). It should be noted that in general, studies have shown that children who receive two cochlear implants at a young age can achieve academic outcomes similar to children with "typical" hearing (Sarant, Harris, & Bennet, 2015, p. 1028), and have improved speech perception in both quiet and noise (Sparreboom et al., 2010, pp. 1069-1070).

FM/IR Systems

A frequency modulation (FM) system consists of a wireless transmission of sound from a microphone to a receiver using FM radio waves (Dalebout, 2009, p. 179; Johnson, 2012, p. 244; Johnson & Seaton, 2012, p. 302; Martin & Clark, 2012, p. 403; Scheetz, 2012, p. 143). Infrared (IR) systems function similarly, but transmit sound via IR light waves (Johnson & Seaton, 2012, p. 303; Scheetz, 2012, p. 143; Tye-Murray, 2009, p. 124). Both systems are used in schools, but IR systems are limited to a "line of sight" as light waves cannot pass through obstructions, such as walls (Scheetz, 2012, p. 143; Tye-Murray, 2009, p. 124). IR systems are also not effective options in settings where sunlight pervades the space and disrupts the IR signal (Scheetz, 2012, p. 143). Although use of IR systems is increasing in school settings, FM systems are still the main form of hearing assistive technology that is commonly referenced. As such, the remainder of this section will focus on FM systems in particular, noting that many of the features apply to IR systems as well.

FM systems are often employed in settings where one speaker is addressing a group of people. Examples of such settings include classrooms, places of worship, and public meetings. The speaker wears a microphone so that his or her voice can be better delivered to any individual with hearing loss. FM systems are convenient to use because they are portable (Dalebout, 2009, p. 180; Johnson, 2012, p. 246) and have many different options for the receivers. A receiver can be coupled, or connected, directly to a hearing aid (Dalebout, 2009, p. 182; Johnson & Seaton, 2012, p. 302; Martin & Clark, 2012, p. 404) or cochlear implant (Dalebout, 2009, p. 182) via direct audio input. Some miniature FM receivers are made specially to snap onto a BTE hearing aid (Johnson, 2012, p. 246). Hearing aids (Dalebout, 2009, p. 180; Johnson & Seaton, 2012, p. 302) and cochlear implants (Dalebout, 2009, p. 189) are also being made with FM receivers built in. FM systems can also benefit those who do not use a hearing aid or cochlear implant. In this case, the listener can use earbuds or headphones that are plugged into the receiver (Dalebout, 2009, p. 182; Johnson, 2012, p. 245; Johnson & Seaton, 2012, p. 302; Martin & Clark, 2012, p. 403).

Regardless of the type of receiver, one microphone can deliver to an unlimited number of receivers (Johnson, 2012, p. 246), meaning that multiple people can use their own FM receiver to listen to the same speaker. This is especially helpful in classrooms with more than one student with hearing loss. Another FM option for delivering the speaker's amplified voice to multiple people is a soundfield speaker. In this case, the microphone is coupled to strategically placed speaker(s) to amplify the talker's voice for all in attendance (Johnson, 2012, p. 246; Martin & Clark, 2012, p. 405). Soundfield speaker(s) can also be helpful in classroom settings because they benefit all of the students by amplifying the teacher's voice (Chute & Nevins, 2006, p. 170). Although helpful for the class overall, soundfield speakers are not as acoustically beneficial for students with hearing loss as are personal FM systems (Chute & Nevins, 2006, p. 170; Martin & Clark, 2012, p. 405).

Other Technology Options in Schools

There are many other technology options in schools to benefit students with hearing loss that do not strictly relate to hearing. Computer-assisted real-time transcription (CART) and computer-assisted note-taking (CAN) are examples of two options for the classroom, especially for older students. Both give a visual representation of what is being said, which is helpful to students with hearing loss as an immediate resource while the teacher is speaking in the classroom for lecture and instruction, in addition to as a resource to review at a later time.

CART offers a "real-time translation" of speech to written text (Johnson & Seaton, 2012, p. 313). To achieve this, a "reporter" types everything that is said with special codes that are converted to written text by software (Cheffo, 2014, p. 327; Dalebout, 2009, p. 205). The text can then be displayed on a large screen, laptop, or tablet in real time, as well as saved as an electronic file (Dalebout, 2009, p. 205). An added convenience is that the reporter does not have to be physically in the same room and can report remotely (Cheffo, 2014, p. 327; Dalebout, 2009, p. 206). CAN is very similar to CART, but the transcription is not verbatim (Cheffo, 2014, p. 327; Dalebout, 2009, p. 206). The reporter focuses on the major points and may not necessarily report every word (Dalebout, 2009, p. 206). CAN does not require any special software, making it a less expensive choice (Dalebout, 2009, p. 206). It also provides the option to save the text so that students can review it at a later time (Cheffo, 2014, p. 327).

It is important to keep in mind that although hearing technology has come a long way, it does not perfect hearing or allow the user to hear "normally" as eye-glasses do for vision. Hearing technology can greatly improve hearing and the school environment for students, but only if they also receive the necessary support.

Education Placement Options for Students with Hearing Loss

Along with the choices of which mode of communication a child with hearing loss should use and which, if any, types of hearing technology should be utilized, parents or caregivers have to choose their child's education placement. The family's Early Intervention specialist and school professionals help the family with this decision by evaluating and predicting the child's potential success in the placement options available. Not all education placement options are a possibility for all children with hearing loss due to the child's communicative and learning abilities, as well as the available placements in the area. Ideally, a family can choose whether their child will be placed in a school for the deaf, a self-contained classroom in a public school, or a mainstreamed or inclusive classroom in a public school.

School for the Deaf

The traditional education placement for students with significant hearing loss was a school for the deaf. Before the mid-1970s and the introduction of special education laws, most children with hearing loss were placed in this setting (Scheetz, 2012, p. 259). The name is fairly self-explanatory in that these schools had been designed for and attended by students who were deaf or hard of hearing. There are two main types of schools for the deaf: residential schools and day schools (Scheetz, 2012, p. 30). At residential schools, students actually reside at the school, often living in dormitories and traveling home for weekends and holidays (Johnson, 2012, p. 373; Scheetz, 2012, p. 29). In this setting, students are constantly surrounded by other students with hearing loss (Tye-Murray, 2009, p. 612), which some would describe as "complete segregation" from the hearing world (Johnson, 2012, p. 373). A day school is very similar to a residential school in that the students all have some degree of hearing loss (Scheetz, 2012, pp. 154-155). The only notable difference between the two settings is that students attending day schools live at home with their families and travel to school daily (Scheetz, 2012, pp. 154-155; Tye-Murray, 2009, p. 612).

Whether residential or day schools, schools for the deaf employ teachers who specialize in deaf education (Scheetz, 2012, p. 153; Tye-Murray, 2009, p. 612). In some cases the teachers are deaf themselves, providing adult models and interactions for the students (Scheetz, 2012, p. 30). Other staff members often include teachers with "typical" hearing, audiologists, counselors, and psychologists (Scheetz, 2012, p. 153). Communication modes such as Auditory/Oral (Cheffo, 2014, p. 323), American Sign Language, Total Communication, and Bilingual-Bicultural are usually all accepted and utilized at various schools for the deaf (Scheetz, 2012, p. 154). Staff members are expected to communicate fluently with students in their chosen mode of communication (Tye-Murray, 2009, p. 612). Classes are generally small, with only 3 to 8 students per teacher, to provide more attention to each student and better visual access (Scheetz, 2012, p. 153).

Students who attend schools for the deaf (notably manual programs) are often guaranteed plentiful interactions in a variety of settings with both peers and adults with hearing loss (Scheetz, 2012, p. 154). The resulting ease of communication and inclusion often has been suggested to lead to better social development and self esteem (Angelides & Aravi, 2007, pp. 481-482; Scheetz, 2012, p. 154). The generally smaller enrollments and potential lack of resources at these schools, however, often result in fewer academic and extracurricular opportunities for the students (Knoors & Marschark, 2014, p. 223). Students attending schools for the deaf often have more severe disabilities or have the need for greater educational support (Cheffo, 2014, pp. 322-323).

Self-Contained Classroom

Students with special needs, specifically hearing loss, now have the option and legal rights to attend their neighborhood public schools. Within public schools there are usually two types of classrooms: the general education classes and the self-contained, or special needs, classes. Generally, a self-contained classroom is one in which students with the same, or similar disability, are taught together in one class by a teacher certified in special education (Cheffo, 2014, p. 322; Stewart & Kluwin, 2001, p. 15). In the case of hearing loss, a self-contained classroom would only include students with hearing loss who spend the majority, if not all, of the school day in that classroom with a teacher who specializes in deaf education (Scheetz, 2012, p. 156, p. 260; Stewart & Kluwin, 2001, p. 5; Tye-Murray, 2009, p. 613). There tend to be a small number of students in self-contained classrooms (Cheffo, 2014, p. 322), but they may be of all different ages and grade levels (Stewart & Kluwin, 2001, p. 7).

Mainstreaming and Inclusion in the Public School

Mainstreaming and inclusion involve the placement of students with disabilities in the general education classroom with students without disabilities. There is often some discrepancy over the terminology of *mainstream* and *inclusive* classes, so the two terms will be defined from the literature. Mainstreaming first became a prominent option with the passing of Public Law 94-142, the Education for All Handicapped Children Act, in 1975 (Scheetz, 2012, p. 29, p. 155; Stewart & Kluwin, 2001, p. 6). This landmark law required equal education opportunities for all students, including students with disabilities, such as those with hearing loss (Scheetz, 2012, pp. 155). This federal regulation resulted in more students with hearing loss attending general education public schools and being placed in mainstream classrooms with students with "typical" hearing. These placements, however, were not necessarily for the entire school day. Mainstreaming meant that students with hearing loss spent at least part of their day in the general education classroom, which oftentimes was for just one class (Croyle, 2003, p. 265; Eriks-Brophy & Whittingham, 2013, p. 64; Nowell & Innes, 1997, p. 2; Stinson & Antia, 1999, p. 164). The shift away from mainstreaming and toward inclusion occurred in 1997 with the passing of the Individuals with Disabilities Education Act (IDEA) (Scheetz, 2012, p. 156;

Stewart & Kluwin, 2001, p. 6). This update in federal legislation called for the true inclusion of students with disabilities into general education classrooms, such that the classroom adapts to include all students, rather than requiring students with disabilities to adapt to visit the general education classroom for just a few specific classes (Scheetz, 2012, p. 156).

The terms mainstream classroom and inclusive classroom are sometimes used interchangeably. They both exist in public schools and involve general education classrooms, and as such can philosophically be treated as one when compared to schools for the deaf. These two placement options differ, however, in theory and practice. A student with hearing loss who chooses mainstreaming for their education placement will have contact with their peers with typical hearing and will spend at least some time in the general education classroom (Croyle, 2003, p. 265; Johnson, 2012, p. 373; Nowell & Innes, 1997, p. 2; Stinson & Antia, 1999, p. 164; Tye-Murray, 2009, p. 613). This mainstreamed student is often more like a visitor who must adapt to the general education classroom, rather than a full member of the class (Stinson & Antia, 1999, pp. 164-165). A student with hearing loss placed in an inclusive classroom spends the majority, if not all, of the school day in a general education classroom with students with typical hearing (Croyle, 2003, p. 265; Nowell & Innes, 1997, pp. 1-2; Stinson & Antia, 1999, p. 164; Tye-Murray, 2009, p. 613). In this setting, the class adapts to the needs of the student with hearing loss, which may include the provision of extra services within the classroom (Nowell & Innes, 1997, pp. 1-2; Stinson & Antia, 1999, pp. 164-165).

Whether the placement is officially considered to be mainstreaming or inclusion, students with hearing loss in the general education, public school setting should expect the large majority of their peers to have typical hearing. The mainstream/inclusive classroom often only includes one student with hearing loss (Scheetz, 2012, p. 157), who may feel isolated if their communication abilities are far behind that of their peers. This serves to caution parents and school administrators against automatically assuming that mainstreaming or full inclusion is the best placement for a given student with hearing loss (Knoors & Marschark, 2014, p. 232).

To determine if mainstreaming/inclusion is a viable option, many aspects of the student's abilities must be analyzed (Knoors & Marschark, 2014, p. 232). For example, if a student's spoken language ability is near the typical ability for their chronological age, then mainstreaming/inclusion may warrant consideration (Chute & Nevins, 2009, p. 12). Even more helpful in the education placement decision are assessments for readiness and potential success in mainstreaming/inclusion, such as the Listening Inventories for Education (LIFE) (Anderson & Smaldino, 1999, p. 74), or the Screening Identification for Targeting Education Risk (SIFTER) (Anderson, 1989). That being said, the least restrictive environment for a student with a cochlear implant is often the inclusive general education classroom, provided that the student receives the appropriate accommodations and services (Chute & Nevins, 2006, p. 49). In such classrooms, it is the school's responsibility to make the necessary physical adaptations to the room, supply and support the use of assistive devices, and provide additional services to the student with hearing loss, as well as the general education teacher (Chute & Nevins, 2006, p. 49; Eriks-Brophy & Whittingham, 2003, p. 64).

As noted previously, students with hearing loss in mainstream/inclusive classrooms may feel isolated or marginalized due to their possible difficulty communicating with both students and teachers with typical hearing (Angelides & Aravi, 2007, pp. 482-483; Croyle, 2003, p. 259; Nowell & Innes, 1997, pp. 4-5). But if a student with hearing loss is appropriately placed in an inclusive classroom and is provided with the necessary reasonable accommodations, they may receive some benefits that their counterparts at a school for the deaf may not receive. In the public schools, students with hearing loss are experiencing and communicating in the "hearing world," which may provide useful skills for later in life (Nowell & Innes, 1997, pp. 3-4). Attending general education public schools typically provide students with greater academic, extracurricular, and vocational opportunities (Angelides & Aravi, 2007, pp. 480-481; Nowell & Innes, 1997, pp. 3-4). These opportunities, however, are only accessible if schools also maintain the necessary services and accommodations for students with hearing loss.

Services in School for Students with Hearing Loss

It is crucial to explain the services provided to students with hearing loss as well as their specific needs in order to fully understand the importance of the school-based SLP in the academic experience of students with hearing loss, particularly those in the mainstream/inclusive classroom. This section will begin by describing the special education laws guiding the services provided to individuals with hearing loss. The roles of both educational audiologists and school-based SLPs will be discussed, as well as the necessary collaboration among them and other school professionals. Lastly, the school services provided to students with hearing loss and pertaining to hearing technology, teaching strategies, and classroom acoustics and modifications will be explained.

Special Education Laws

The services provided in schools for students with hearing loss are guided by the legislation that declares the rights of all students with disabilities. The landmark law that changed the face of special education is Public Law 94-142 (P.L. 94-142), passed in 1975 and originally named the "Education for All Handicapped Children Act" (Johnson & Seaton, 2012, p. 8; Scheetz, 2012, p. 29; Tye-Murray, 2009, p. 557). P.L. 94-142 was the first of many amendments and reauthorizations calling for a Free and Appropriate Public Education (FAPE) for students with disabilities in the Least Restrictive Environment (LRE) possible (Scheetz, 2012, p. 37; Stewart & Kluwin, 2001, p. 6; Tye-Murray, 2009, p. 557). In order to receive federal funding for public schools, all states had to ensure that the requirements of this law were being met (Johnson, 2012, p. 352).

Public Law 94-142. When P.L. 94-142 was first passed into law, the legislation was limited to students with disabilities ages 6 to 21 years, known then as “school-age children” (Scheetz, 2012, p. 37). With P.L. 94-142, the services, accommodations, and education plan for each of these children began to be compiled into one legal document—the Individual Education Program (IEP) (Johnson & Seaton, 2012, p. 9). This program, based on individual needs, serves to define what a FAPE in the least restrictive environment means for each student (Benedict & Raimondo, 2003, pp. 67-68; Johnson & Seaton, 2012, p. 8). IEPs should also include the student’s current performance, goals, educational placement, and progress (Johnson, 2012, p. 378; Johnson & Seaton, 2012, p. 515; Sorkin, 2014, p. 337)

In general, a FAPE calls for each student to receive the necessary “special education and supporting services at the public’s expense and under public supervision” (Tye-Murray, 2009, p. 557), so that all students receive full access to their education with the appropriate services and accommodations based on their individual needs (Sorkin, 2014, p. 337). This applies to all students with disabilities and does not allow for any students to be rejected – known as the “zero-reject policy” (Johnson & Seaton, 2012, p. 8). The least restrictive environment refers to placing students with disabilities with their nondisabled peers, unless such placement would prevent successful education (Johnson & Seaton, 2012, p. 8). In order to accommodate for cases in which full inclusion is not the best option for a given student, alternative placements must be available, ranging from fully segregated self-contained classrooms to placement in a mainstream classroom for a specific subject (Johnson & Seaton, 2012, p. 8; Sorkin, 2014, p. 337). P.L. 94-142 additionally served to protect the rights of students with disabilities and their families through procedural safeguards that called for confidentiality, parental consent to services, and due process, among other things (Benedict & Raimondo, 2003, pp. 67-68; Johnson & Seaton, 2012, p. 8; Scheetz, 2012, p. 37).

Public Law 99-457. The next major law to impact the services provided to children with disabilities was Public Law 99-457 (P.L. 99-457), passed in 1986 as an amendment of the Education for all Handicapped Children Act (Johnson & Seaton, 2012, p. 10). This law initially changed the age requirement of students with disabilities who receive school services to include those from the ages of 3 to 21 years (Johnson & Seaton, 2012, p. 10). P.L. 99-457's main contribution was arguably, the introduction of the Individualized Family Service Plan (IFSP) and the new requirement of early intervention services for infants and toddlers with disabilities from birth to 3 years of age (Johnson & Seaton, 2012, p. 10, pp. 12-13; Scheetz, 2012, p. 38). Similar to the IEP, the IFSP is a legal document that states the programs, services, and equipment to be provided to the family by a given public agency in order to meet the family's projected goals for their child during the infant and toddler years—also known as their "Early Intervention Plan" (Johnson, 2012, pp. 353-354; Johnson & Seaton, 2012, p. 33; Tye-Murray, 2009, p. 561). The IFSP emphasizes the involvement of the family and addresses the needs of the family, as well as the child with a disability (Johnson & Seaton, 2012, p. 33; Sorkin, 2014, p. 339; Tye-Murray, 2009, p. 561)

Individuals with Disabilities Education Act. The most recent special education law was passed in 1990, but then was first reauthorized in 1997, and reauthorized again in 2004. The Individuals with Disabilities Education Act (IDEA) replaced P.L. 94-142 and was first passed as

P.L. 101-476 (Scheetz, 2012, p. 41). IDEA combined all of the amendments concerning the rights and services of children and students with disabilities from birth to 21 years into one law (Johnson & Seaton, 2012, p. 15). The first passage of the law in 1990 also introduced the idea of people first language, the requirement for transition planning to help students transition from school to the workforce, and the provision of assistive technology if necessary for a student's FAPE (Johnson & Seaton, 2012, p. 15; Scheetz, 2012, p. 41).

The 1997 reauthorization of IDEA also encompassed its predecessors, but included some new requirements as well (Tye-Murray, 2009, p. 558). The service plans and major contributions of Public Laws 94-142 and 99-457 were represented in Parts B and C of IDEA, respectively (Benedict & Raimondo, 2003, p. 68). Thus, Part B relates to students with disabilities ages 3 to 21 years and their IEPs, and Part C relates to the early intervention services of infants and toddlers from birth to 3 years and their IFSPs (Sorkin, 2014, p. 337, p. 339). Among other things, this reauthorization added the provision for the "consideration of special factors," which for students with hearing loss often relates to their communication needs (Johnson & Seaton, 2012, p. 16). These students were now guaranteed instruction and communication opportunities in their chosen mode of communication, and were better provided with assistive technology, such as an FM/IR system, due to new requirements (Johnson & Seaton, 2012, p. 16). The reauthorization of IDEA in 1997 also initiated the push toward inclusion and inclusive classrooms that adapt the classroom to accommodate all students, rather than forcing the student with a disability to adapt to the classroom and attend as a "visitor" for a small portion of the school day (Scheetz, 2012, p. 156).

The most recent reauthorization of IDEA occurred in 2004 and was named the Individuals with Disabilities Education *Improvement* Act (Johnson & Seaton, 2012, p. 18;

Scheetz, 2012, p. 42). The new additions to the law have a greater focus on academic results, early intervention, and parental choice (Scheetz, 2012, p. 42). IDEA was also reissued at this time to better align with the "No Child Left Behind Act" of 2001 (Tye-Murray, 2009, p. 558). The core principles of the earlier laws are still present in IDEA: a FAPE for all students in the least restrictive environment (Johnson, 2012, p. 352; Sorkin, 2014, p. 336). Updates to the law that expanded the services provided to students with hearing loss include, but are not limited to, the requirement for routine monitoring of cochlear implants and hearing aids to ensure functioning, reiteration of the need for assistive technology in the classroom, the use of school-provided assistive technology at home or outside of school if deemed necessary to meet IEP goals, and interpreting services (Johnson & Seaton, 2012, p. 18). The services and accommodations mandated by these laws, however, would not be properly provided to students with hearing loss without the support, cooperation, and work of school professionals and personnel.

Professionals

The school professional one would most likely associate with working with students with hearing loss is an educational audiologist. Audiologists working in school settings are responsible for conducting hearing screenings as a part of the identification of hearing loss in school-aged children, conducting diagnostic evaluations, and educating and assisting school personnel with hearing technology and concerns about students with hearing loss (Carney & Moeller, 1998, p. S65; Johnson, Benson, & Seaton, 1997, p. 17). Educational audiologists usually do not work full time at one school, but typically divide their time among several schools (Schafer & Sweeney, 2012, p. 14; Thibodeau & Johnson, 2005, p. 37). This can be problematic for students with hearing loss and their teachers, especially at the beginning of the school year when hearing assistive technology may need to be set up and thoroughly explained to teachers who have not used such systems previously (Thibodeau & Johnson, 2005, p. 37). Watson and Martin (1999) asked SLPs working in public schools about the available audiological support at their place of employment. Few (13%) worked at a school that had an educational audiologist on staff, while many (37%) had no audiological services available to them at all (Watson & Martin, 1999, p. 4).

Blair, EuDaly, and Benson (1999) investigated the sources of information available to teachers of students with hearing loss and found that approximately 13% of teachers received information directly from educational audiologists (p. 176). By contrast, 24% of the teachers surveyed reported that SLPs provided them with information about their students with hearing loss. Many schools employ a full-time SLP who often assists students with hearing loss and their teachers. According to Katz, Maag, Fallon, Blenkarn and Smith (2010), 69.6% of public school SLPs work in one or two schools (p. 143). Working in only one or two settings, as opposed to several, may mean that SLPs have more time to work directly with such students and their teachers.

School-based SLPs have a broad function because their “roles and responsibilities” call them to work with several different populations within schools (ASHA, 2010, para. 2; Schraeder, 2013, p. 17). For the purposes of this study, however, the literature review will focus only on the roles of SLPs regarding students with hearing loss. SLPs may provide direct therapy to students with hearing loss, often focusing on language development and speech production (Teagle & Moore, 2002, p. 166; Watson & Martin, 1999, p. 1). To that end, Sorkin and Zwolan (2004) reported that 75% of children ages 7-14 years old with cochlear implants, received speech and language services in school (p. 419). The SLP may be more likely than an educational audiologist to spend direct therapy contact time with a student with hearing loss on a regular basis. Given their familiarity with students with hearing loss, SLPs can easily identify when students seem to be struggling to listen or are especially fatigued, which could indicate a problem with their device (Thibodeau & Johnson, 2005, p. 38).

Although educational audiologists and school-based SLPs each have specific roles in their own scopes of practice, there is quite a bit of overlap in the services that they provide to students with hearing loss. Ideally, this overlap lends itself nicely to a collaborative approach to working with students with hearing loss.

Collaboration

Collaboration among school professionals is included as part of the roles of SLPs and audiologists (ASHA, 2010, para. 5; Carney & Moeller, 1998, p. S65; Okalidou et al., 2014, p. 1050; Thibodeau & Johnson, 2005, p. 7). It is important for the success of students with hearing loss that different school personnel are aware of the students' needs and work together to provide appropriate services. Students with hearing loss who are mainstreamed into regular education, public school classrooms will often find themselves in a new class with a new teacher each school year. Although the students' teachers will not be consistent throughout their education, the SLP and audiologist may be more likely to remain the same, thus giving them the responsibility of collaborating with the students' teachers each year to ensure that all of the students' classroom and other related educational needs are met (Teagle & Moore, 2002, p. 166). Therefore, it is important for the SLP or educational audiologist to communicate the needs of the students to the teachers. In addition, SLPs, audiologists, and deaf educators can work with teachers with the purpose of integrating material being covered in the classroom into the students' individual therapy (Schafer & Sweeney, 2012, p. 16). Collaboration is especially important in terms of educating teachers and administrators about hearing loss, hearing technology, and the unique needs of students with hearing loss (Thibodeau & Johnson, 2005, p. 36). The fact is, all of these professionals are important in the provision of services related to hearing loss and hearing technology.

Hearing Technology Services

Services related to hearing technology are among the most essential services provided to children with hearing loss in school. Without properly functioning hearing technology, students with hearing loss are not able to fully participate in the classroom. A first service related to hearing technology is recommending that students receive some type of hearing technology. For students already diagnosed with a hearing loss and fitted for either hearing aid(s) or cochlear implant(s), an obvious recommendation should include an FM or Infrared (IR) system to be used in the classroom (Johnson et al., 1997, p. 89; Schafer & Sweeney, 2012, pp. 15-16; Teagle & Moore, 2002, p. 167; Thibodeau & Johnson, 2005, p. 36). FM/IR systems are beneficial in classroom settings because they deliver the teacher's voice, at an appropriate intensity, directly to the student, thus bypassing the ambient noise that is impossible to completely eliminate in a room with more than one student (Thibodeau & Johnson, 2005, p. 36). School-based SLPs and educational audiologists are responsible for including hearing assistive technology, such as an FM/IR system, in the Individual Education Plan (IEP) (Schafer & Sweeney, 2012, pp. 15-16; Thibodeau & Johnson, 2005, pp. 36-37).

A second hearing technology service is the verification of device functioning through "sound checks" or listening checks, which must be completed on a daily basis (Hohla & Switzer, 2014, p. 84; Schafer & Sweeney, 2012, p. 14; Thibodeau & Johnson, 2005, p. 37). Hearing technology does not benefit the wearer if it is not functioning properly. Hearing aids and cochlear implants go through batteries quickly, and therefore need to be checked often (Teagle & Moore, 2002, p. 167). Although the students' parents are responsible for device maintenance (Teagle & Moore, 2002, p. 166), the Individuals with Disabilities Education Act (IDEA) states that the proper functioning of hearing technology worn by children in school must be ensured (Johnson & Seaton, 2012, p. 18). In order to confirm this functioning, an educational audiologist, SLP, school aide, or teacher can perform daily listening checks of devices with or without help from the students (Schafer & Sweeney, 2012, p.14).

If the child is capable of helping with the listening check, a behavioral check can be completed (Schafer & Sweeney, 2012, p. 14). In a behavioral listening check, the child is asked to repeat certain sounds or words after hearing them without any visual cues, meaning that the child cannot see the speaker's mouth to ensure that he/she is hearing the sound and is not lipreading or speechreading (Schafer & Sweeney, 2012, p. 14). If the child can repeat all of the words and sounds correctly, then the device is considered to be functioning properly. Another method is an objective verification in which the child does not participate in the technology check due to his/her young age or limited cognitive functioning. In an objective or "biologic" check, the professional uses a listening stethoscope attached to the device to hear what the wearer hears. This is done to ensure that sound is correctly being amplified (Schafer & Sweeney, 2012, p. 14). As the students get older, they can be more responsible for their technology maintenance and inform teachers or staff members if there is a problem (Teagle & Moore, 2002, pp. 166-167; Thibodeau & Johnson, 2005, p. 38). Langan and Blair (2000) conducted a longitudinal study on hearing aid monitoring in classrooms in which hearing aids were checked daily upon the students' arrival at school. This daily check resulted in less than 6% of hearing aids found to be malfunctioning (Langan & Blair, 2000, p. 36). Daily checks of hearing assistive technology, such as an FM system, should be similarly completed to confirm functioning (Schafer & Sweeney, 2012, p. 15; Thibodeau & Johnson, 2005, p. 37).

A third service related to hearing technology is technology troubleshooting. If a problem arises with a personal hearing device, such as a hearing aid or cochlear implant, a staff member needs to be knowledgeable enough to troubleshoot it (Schafer & Sweeney, 2012, pp. 14-15; Watson & Martin, 1999, p. 2). The educational audiologist, or child's parent in some cases, can educate the SLP or other staff member on how to best maintain the device at school and solve minor issues that the technology may have (Schafer & Sweeney, 2012, pp. 14-15).

A fourth technology-related service provided in schools to benefit students with hearing loss is educating teachers, staff, and other students about hearing technology and its importance (Thibodeau & Johnson, 2005, pp. 36-37). Educational audiologists and SLPs understand the importance of hearing technology for the success of students with hearing loss. Given this knowledge, these professionals are responsible for sharing this information with other staff members, especially teachers. Teachers need to understand that access to communication through correctly functioning hearing technology is imperative for students' social integration and academic success, especially in regard to language and literacy development (Thibodeau & Johnson, 2005, pp. 37-38). Furthermore, teachers should be educated about the benefits of using an FM/IR system over simply seating students with hearing loss in the front of the classroom (i.e., preferential seating) (Flexer, Wray, & Ireland, 1989, pp. 14-15). Although preferential seating seems like a good solution, teachers move throughout their classrooms, making it difficult to consistently stand near the students with hearing loss (Flexer et al., 1989, pp. 14-15; Richburg & Goldberg, 2005, p. 14). Therefore, educational audiologists and SLPs need to advocate for the use of an FM/IR system in classrooms with students with hearing loss. The educational audiologist or SLP can also come into these classrooms and educate the other students about FM/IR systems (Thibodeau & Johnson, 2005, p. 37). This classroom education can be important for the social integration of students with hearing loss by helping students with "typical" hearing to understand and accept the differences of other students. Although technology is advantageous for the academic success of students with hearing loss, it should also be supplemented by teaching strategies that are specifically appropriate for these students.

Teaching Strategies

If a teacher has never taught students with hearing loss, he or she may be unaware of the extra assistance that these students often need. By better equipping teachers to teach students with hearing loss, students' opportunities to perform and outcomes can be maximized. As previously mentioned, audiologists and SLPs working in schools can educate teachers about hearing loss and the importance of hearing assistive technology in classrooms (Flexer et al., 1989, p. 13). In order to teach students with hearing loss effectively, teachers need to understand that there is a link between hearing and academic performance (ASHA, 2005, par. 3; Flexer, 2004, p. 133) and that even a mild hearing loss can be debilitative in school settings (Flexer et al., 1989, p. 13). Audiologists and SLPs can encourage teachers to implement a number of strategies to aid students with hearing loss as well as students with "typical" hearing (Teagle & Moore, 2002, pp. 167-168).

A first teaching strategy that audiologists and SLPs can share with teachers is the increased use of visual cues (Flexer et al., 1989, p. 18; Schafer & Sweeney, 2012, p.16; Teagle & Moore, 2002, pp. 167-168). By providing visuals, such as a written outline, and taking advantage of boards and projectors, teachers give all students additional access to the material being covered auditorily (ASHA, n.d. a, p. 7; Teagle & Moore, 2002, pp. 167-168; Stewart &

Kluwin, 2001, p. 267; Stith & Drasgow, 2005, p. 9). Visual prompts and nonverbal cues, such as flashing or turning off lights and pointing, can also be used to indicate a transition to a new activity (ASHA, n.d. a, p. 7; Borders, Barnett, & Bauer, 2010, p. 349; Croyle, 2003, p. 278; Stith & Drasgow, 2005, p. 8). Use of these visual cuing techniques especially benefits students with hearing loss who may struggle following along.

A second teaching strategy that teachers can be advised to implement is the use of auditory cues and signals (Flexer et al., 1989, p. 17; Teagle & Moore, 2002, pp. 167-168). Teachers can integrate listening skills into the classroom by using signals, such as the word, "Listen," to indicate to students that they need to pay attention to the information that will follow. By including this auditory focus, all students will be aided in the classroom, as well as given further opportunity to practice their listening skills.

A third teaching strategy found to be helpful for teaching students with hearing loss is verbal repetition (Flexer et al., 1989, p. 18; Hohla & Switzer, 2014, p. 82; Johnson, 2012, p. 396). Repetition gives all students in the class another chance to hear and process what has been said. It is especially important for the teacher to repeat what other students in the class have said so that the students with hearing loss do not miss out on questions, comments, or class discussion (Flexer et al., 1989, p. 18).

A fourth suggestion for teachers is to enlist another student in the class to act as a "listening buddy" for students with hearing loss (ASHA, n.d. a, p. 7; Stewart & Kluwin, 2001, p. 267; Stith & Drasgow, 2005, p. 9). The listening buddy can repeat or clarify directions, as well as take notes for the students with hearing loss (Cheffo, 2014, p. 327; Chute & Nevins, 2006, p. 50; Hohla & Switzer, 2014, p. 82; Schafer & Sweeney, 2012, p. 16). Without the task of note taking, students with hearing loss are better able to focus on listening and watching the teacher, specifically for speechreading (Hohla & Switzer, 2014, p. 82; Schafer & Sweeney, 2012, p. 16).

A fifth strategy is to implement a secret or nonverbal signal between the teacher and students with hearing loss to indicate comprehension of materials or a breakdown of understanding, without pointing out the students with hearing loss by verbally asking about comprehension in front of all of the other students (Schafer & Sweeney, 2012, p. 16). A sixth strategy is maximizing the success of verbal communication with students with hearing loss by adhering to the following suggestions. Teachers should attempt to make eye contact with students with hearing loss before making important announcements or giving directions to ensure that the students are attentive and prepared to listen (Stith & Drasgow, 2005, p. 8). Teachers should also face students when speaking to better project their voices, as well as give facial and lip- or speechreading cues (ASHA, n.d. a, p. 7). Good lighting in classrooms is similarly important so that students can easily see the teacher (p. 4). Lastly, teachers should try not to speak too quickly, so that students have enough time to process what is being said (Stith & Drasgow, 2005, p. 8).

A seventh and final suggestion that audiologists and SLPs can make to teachers is to utilize pre- and post-tutoring with the students with hearing loss (Chute & Nevins, 2006, p. 50; Flexer et al., 1989, p. 18; Stewart & Kluwin, 2001, p. 258; Stith & Drasgow, 2005, p. 9). Students with hearing loss can meet with the teacher or a tutor both before and after lessons to aid with and/or verify comprehension. Additional tutoring over class material gives students with hearing loss more practice and familiarity with topics, thus making the academic material easier to process and understand when it is taught in the classroom (Flexer et al., 1989, p. 18). In addition to teaching strategies that should be utilized to support students with hearing loss, other services provided in schools to benefit these students include assessing classroom acoustics and implementing the necessary classroom modifications.

Classroom Acoustics and Modifications

Classrooms tend to have an increased degree of ambient noise that can make hearing difficult even for students with "typical" hearing (Teagle & Moore, 2002, p. 167). In an educational setting, noise may originate from outside of the school building, perhaps due to traffic or playground noise; outside of the classroom, from other classes or hallway noise; or from inside of the classroom, often due to noisy appliances and student-created noise (Anderson, 2004, p. 117; ASHA, n.d. a, p. 2; Johnson, 2012, p. 392). The major factors to consider when evaluating the acoustics of a classroom and its effects on all students are the signal-to-noise ratio (SNR); reverberation; the distance between the "talker" and "listeners"; and the students' hearing abilities (Flexer, 2004, p. 131; Palmer, 1997, p. 213; Rosenberg, 2012, p. 245).

The SNR is defined as the relationship between the desired auditory signal and the competing background noise (Anderson, 2004, p. 119; Flexer & Rollow, 2009, p. 16; Ricketts & Dittberner, 2002, p. 275; Rosenberg, 2012, p. 248). In a classroom, the teacher's voice is considered to be the signal that should be at a higher intensity than the background noises (Flexer, 2004, p. 135; Palmer, 1997, p. 214). A favorable SNR is one in which the signal is louder than the noise, which is indicated by a positive number (Palmer, 1997, p. 214). A positive SNR is so critically important in the classroom because background noise makes speech recognition difficult, especially for a student with hearing loss (Palmer, 1997, p. 214; Ricketts & Dittberner, 2002, p. 279). An improved SNR, however, results in better speech intelligibility (Ricketts & Dittberner, 2002, p. 274). Children in particular need a positive SNR because they often are not able to "fill in the blanks" if they miss part of a message because of competing background noise (Palmer, 1997, p. 215). Adults, on the other hand, are usually able to use context clues and prior experiences to help them understand a message, even if they miss a few key words. But if background noise prevents a child from hearing important components of a new concept, the child may not gain a full understanding of the concept and can easily fall behind (p. 215). Typical classrooms have been reported to have a SNR ranging from +5 dB to -20 dB (Flexer & Rollow, 2009, p. 17). According to the American Speech-Language-Hearing Association (ASHA), however, these numbers are not acceptable. The ASHA guidelines for acoustics in educational settings require a SNR of +15 dB and a noise level of less than 35 dB (ASHA, 2005, para. 4).

Reverberation of sound occurs when sound persists in a room due to its repeated reflection against hard, non-absorbent surfaces in an enclosed space (Rosenberg, 2012, p. 248). Reverberation time refers to the amount of time it takes for a sound to diminish 60 dB in intensity (Anderson, 2004, p. 120; Palmer, 1997, p. 214). A high reverberation time indicates more reverberation and an increased difficulty in understanding the signal (Palmer, 1997, p. 214). Studies have shown that reverberation affects children more than it affects adults, due to the incomplete maturation of the auditory mechanism (Anderson, 2004, p. 119). The guidelines set by ASHA require that the reverberation time in classrooms not exceed 0.6-0.7 seconds (ASHA, 2005, para. 4).

Because the majority of learning in school occurs through listening, it is clear that students need to be able to hear in order to learn (Flexer, 2004, p. 132; Flexer & Rollow, 2009, p. 16). Developmentally, if a child cannot hear certain speech sounds, they will not be able to produce those speech sounds, resulting in difficulties with spoken language. When spoken language skills suffer, literacy skills are often hindered as well, which has been shown to negatively impact a student's overall academic performance (ASHA, 2005, par. 3; Flexer, 2004, p. 133). Background noise and reverberation affect the listening, learning, and behavior of all students, regardless of hearing ability (Anderson, 2004, p. 124). It is essential, therefore, that students are able to hear both inside and outside of the classroom.

There are several modifications that the SLP or educational audiologist should advise and try to implement in all classrooms, but especially those with students with hearing loss (Teagle & Moore, 2002, p. 167). Arguably the key modification that can be introduced into a classroom to improve the SNR is the use of an FM/IR system (Flexer & Rollow, 2009, p. 18; Johnson, 2012, p. 395; Ricketts & Dittberner, 2002, p. 279). As mentioned previously, FM/IR systems deliver the teacher's voice directly to the student, thus creating a favorable SNR. An FM/IR system helps to ensure that information is not missed, regardless of the teacher's location in the room (Flexer, 2004, p. 134; Stith & Drasgow, 2005, p. 7).

Other common modifications include use of heavy drapes over windows, carpeting, acoustic ceiling and wall tiles, corkboards or other absorbent materials to cover walls, and coverings over the bottoms of chair legs (ASHA, n.d. a, p. 3; Cheffo, 2014, p. 326; Chute & Nevins, 2006, p. 49; Oticon, n.d., p. 13; Schafer & Sweeney, 2012, p. 16; Teagle & Moore, 2002, p. 167). These physical modifications help to dampen any background noise that might distract students from hearing the teacher.

There are some aspects of classrooms that cannot be changed, however, such as fans, heaters, projectors, and the classroom's physical location near a busy hallway, for example. To help diminish the negative effects of these unavoidable sources of noise, SLPs and educational audiologists can recommend that students with hearing loss be seated away from the noisier areas of the classroom (Schafer & Sweeney, 2012, p. 16; Teagle & Moore, 2002, p. 167). All students can benefit from well-fitting doors and windows that are closed during class time (ASHA, n.d. a, p. 3; Oticon, n.d., p. 13). Teachers can also monitor student-created classroom noise by using hand signals or a noise meter chart to indicate when the noise level becomes too high (Schafer & Sweeney, 2012, p. 16).

Teachers have a large responsibility when it comes to the services provided in school to students with hearing loss. Although SLPs and educational audiologists have important roles as well, the support and cooperation of teachers is necessary for students with hearing loss to succeed in school.

Teachers and Hearing Technology

Of all school professionals, teachers have the most contact with students with hearing loss. Therefore, past research on teachers' training and knowledge of hearing technology should be reviewed in order to determine their involvement and capabilities in the provision of services to students with hearing loss related to their hearing technology. In addition, the awareness teachers have of their own students with hearing loss and the resources available to them will be considered.

Teachers' Hearing Technology Training

Lass, Tecca, and Woodford (1987) investigated "teachers' knowledge of, exposure to, and attitudes toward hearing aids and hearing aid wearers" (p. 86). The authors found that 80.5% of the teachers surveyed had never taken a course related to hearing aids (p. 87). They suggested that training regarding hearing aid function and troubleshooting also be provided (p. 89). Dunay and English (2000) found that overall, teachers have insufficient knowledge of hearing technology and need a knowledgeable professional as a resource when they are responsible for a student with hearing loss (p. 50).

Teachers' Hearing Technology Knowledge

To the best of the researcher's knowledge, the literature lacks research specifically relating to teachers' ability to check, troubleshoot, and maintain hearing technology. Lass and his colleagues (1987) found that the majority of teachers were able to correctly answer general questions about the purpose and function of hearing aids, such as, "hearing aids are powered by batteries," and "not everyone with a hearing loss can benefit from a hearing aid" (p. 88). Many of the teachers surveyed (46.9%) did not know, however, that "the nonmedical professional who tests people's hearing and makes recommendations regarding use of hearing aids is called an audiologist" (p. 88). This finding suggested that although teachers may have a general understanding of hearing aids, this did not necessarily demonstrate adequate competence or indicate their ability to work with and/or troubleshoot hearing technology.

Teachers' Awareness of Students with Hearing Loss

Another important aspect to consider relating to teachers and hearing technology is teachers' knowledge of the specific needs of each student with hearing loss. Blair and his colleagues (1999) examined what teachers of all grade levels knew about their students with hearing loss and how they learned that information. They found that only 74% of the teachers knew about their students' hearing loss (p. 175). Although it should be noted that almost all of the elementary school teachers reported knowing of their students' hearing loss (p. 175), the overall percentage for teachers of all grades (74%) was not acceptable. The 26% of teachers who did not know about their students' hearing loss arguably could not provide the necessary additional services needed by these students. In addition, of the teachers who knew about their students' hearing loss, only 68% knew if their student with hearing loss should be using some type of hearing technology and only 61% knew which ear presented with a hearing loss (p. 178).

This information is important for teachers to know for seating placement as well as technology maintenance (p. 178). It seems that teachers not only need to be better informed about hearing technology, but also need to be more knowledgeable about their specific students with hearing loss.

Resources Available to Teachers

When teachers have students with hearing loss in their classes, they should know what resources are available to them. Blair and his colleagues (1999) found that 54% of teachers received the hearing evaluation report for their students with hearing loss from some school professional, but the remaining 46% did not (p. 177). All teachers of students with hearing loss should receive their students' hearing evaluation reports, as well as additional resources from other school professionals. Of the teachers who did receive the reports, only 45% indicated that they understood all of the information (Blair et al., 1999, p. 177). The remaining teachers suggested that less "technical jargon" be used in the report to aid their understanding (p. 177). Teachers indicated that the three most preferred choices as information sources about their students' with hearing loss would be a form letter, the student's parents, and an SLP (p. 177). If an SLP is a preferred resource for teachers in regard to students with hearing loss, then SLPs should be knowledgeable of and comfortable with working with students with hearing loss and their technology.

Speech-Language Pathologists and Hearing Technology

In order to assess the role of SLPs as a resource to students with hearing loss it is important to examine past studies on the knowledge of school-based SLPs with hearing technology. SLPs' training and knowledge of hearing aids and cochlear implants will be described in the sections that follow.

Speech-Language Pathologists' Hearing Technology Training

As explained in previous sections, functioning hearing technology is essential to students with hearing loss. SLPs may find it difficult, however, to provide services related to this technology if they have not received adequate training. Compton, Tucker, and Flynn (2009) found that of SLPs who were studied working in public schools in North Carolina, 32% received no undergraduate training related to hearing aids and 33.6% received either no instruction or very limited instruction about hearing aids in graduate school (p. 146). Receiving even minimal training may not be sufficient as Lass and his colleagues (1989) found that the majority of SLPs felt as though they had received inadequate training and experience with hearing aids (p.117). This lack of training suggests an inadequacy in the higher education of SLPs related to hearing aids, particularly with a deficiency of hands-on experience (Woodford, 1987, p. 316). SLPs themselves reported that graduate education should include instruction on and a clinical practicum with hearing aids (Lass et al., 1989, p. 117). In addition, continuing education programs were suggested to keep practicing SLPs knowledgeable about the current technology (Lass et al., 1989, p. 119). It should be noted that these three studies reported similar findings regarding the insufficient training of SLPs to work with hearing technology even though there is a 20-year gap among them. To the best of the researcher's knowledge, there has been no research on this topic in the intervening years or in more recent years. Therefore, there is a critical need for updated research on this topic so that the current status of SLP training can be assessed.

Compton and her colleagues (2009) found that of the same SLPs working in public schools in North Carolina, 52% received no undergraduate training for cochlear implants and 47.4% received either no instruction or only one lecture about cochlear implants, as a part of their graduate studies (pp. 145-146). Cosby (2009) conducted a similar study of school-based SLPs in North Carolina and found that 80.5% reported no graduate training related to working with children with cochlear implants (p. 6). Furthermore, Pakulski (2011) indicated that hearing technology training, specifically relating to cochlear implants, is currently a "professional preparedness issue" (p. S206).

The number of SLPs with inadequate training related to cochlear implants appears to be higher than those with insufficient training related to hearing aids. This is to be expected because hearing aids have been in use for longer than cochlear implants. The lack of cochlear implant training, however, should be even more concerning because of the increased complexity of this type of device. Without training in this area, it would be difficult for SLPs to maintain and troubleshoot cochlear implants, a service that should be provided to students with hearing loss. Continuing education and in-services could be the solution to this problem, but Watson and Martin (1999) reported that only 31% of SLPs surveyed attended a cochlear implant in-service (p. 4). Similarly, Compton and her colleagues (2009) reported that only 26% of SLPS received post-graduate training on cochlear implant operation and 4% attended training for cochlear implant troubleshooting techniques (p. 147).

The lack of formal training relating to most hearing technology begs the question as to what hearing technology resources are available to school SLPs. Investigating this topic, Compton and colleagues (2009) found that 90% of the SLPs responded that they had no answer to the question of who they would contact if a problem arose with a student's cochlear implant (p. 147). Even more concerning, only 2.6% of the SLPs stated that they would contact an audiologist if this situation arose (p. 147). Furthermore, 33.3% reported that they had no contact with an audiologist and 15.7% indicated that they may have contact with an audiologist just one or two times per year (p. 147). The situation in many public schools, where the SLP has little to no contact with an educational audiologist, is troubling when you consider the seriously deficient hearing technology training of SLPs. This further indicates the necessity of formal training in this area.

Speech-Language Pathologists' Hearing Technology Knowledge

Regardless of the training received, it is important to consider the knowledge that SLPs have about various aspects of hearing technology. Woodford (1987) investigated this knowledge through written and practical examinations about hearing aids. The SLPs who participated in the examinations received a mean score of 51.28% on the written exam and a mean score of 18.33% on the practical exam (Woodford, 1987, p. 314). Lass and his colleagues (1989) also asked SLPs about hearing aids, but only through a written survey. A mean score of 78.8% was found, which is less concerning, but still not ideal (p. 119). Woodford (1987) also found that SLPs who had received more than two hours of instruction regarding hearing aids performed better on the written test than those with fewer than two hours of training (p. 315), suggesting that hearing aid instruction and training can be beneficial. Hearing aid training did not greatly improve SLPs' scores on the practical test, further suggesting a lack of "hands on" instruction (Woodford, 1987, p. 315). Although training was helpful for the written examination, even the SLPs with training did not perform well on the practical examination. SLPs with experience working with students with hearing loss, however, performed better on both written and practical tests than those without this experience (Woodford, 1987, p. 315). Although hearing aid instruction and experience with students with hearing loss may improve knowledge of hearing technology, these studies still suggest that overall, SLPs are not knowledgeable enough about hearing technology.

More importantly, the dated nature of these studies demands the need for more current investigations on this topic.

Watson and Martin (1999) surveyed school-based SLPs in the Mid-Western region of the U.S. in order to assess their knowledge of cochlear implants. They found that on average, SLPs self-reported minimal to slight knowledge of "how a cochlear implant functions," minimal to no knowledge on "ability to troubleshoot a malfunctioning implant," and minimal knowledge on "knowledge of similarities and differences between a cochlear implant and hearing aid" (p. 3). Watson and Martin (1999) also asked SLPs with experience working with children with cochlear implants to self-report their knowledge of cochlear implants. These experienced SLPs indicated slight to moderate knowledge of the different aspects of cochlear implants at best (p. 3). It is concerning that SLPs who have worked with children with cochlear implants are still not confident in their knowledge of them.

A decade later, other studies have yielded similar results. Cosby (2009) investigated SLPs' knowledge of cochlear implants and found that 60-85% of the SLPs in the study reported little or no knowledge of cochlear implant "device components, … function, troubleshooting, and use" (p. 7). Furthermore, 15.3% of the SLPs in the study noted that they had worked with children with cochlear implants but had not received formal training related to the device (p. 7). Compton and colleagues (2009) similarly found that 79% of SLPs reported little to no confidence in working with children with cochlear implants and their technology. SLPs have reported insufficient knowledge of cochlear implants since 1999 (see Watson & Martin, 1999). The fact that, as of 2009, this was still a concern indicates that graduate curricula must be reviewed to better incorporate more practical knowledge about hearing technology.

Conclusion

This chapter provided the foundational knowledge necessary for understanding the current study of school-based speech-language pathologists' knowledge concerning hearing technology. Relevant past research on this topic was explored as well, and indicated a need for current and more comprehensive work in this area. Such work is explored in the following chapter, which provides a description of the methodology of the current study.

CHAPTER III: METHOD

This study made use of quantitative research in which speech-language pathologists (SLPs) working in public elementary schools in the states of Michigan and Ohio completed an online survey. This chapter will further explain the method by which this study was conducted by justifying the use of online survey research, describing the participants and the survey instrument used to conduct the study, as well as providing a detailed description of the procedures.

Justification of Method

The researcher chose the method of survey research to conduct this quantitative study because, according to Babbie (2014), survey research is the "best method available … for describing a population too large to observe directly" (p. 261). Due to the large size of the sample (400 SLPs working in public elementary schools in Michigan and Ohio), online survey research was the most time efficient method. Along with their usefulness for describing and obtaining large samples (p. 294), online surveys are also cost-effective (p. 293). Lastly, this study made use of random selection of participants through a random integer generator, which eliminates any bias from the researcher in the sample selection process, and according to the probability theory, produces a more representative sample (p. 207).

Participants

The participants desired for this study were licensed SLPs currently working in public elementary schools in the states of Michigan and Ohio. Michigan and Ohio were chosen as the work sites because of the personal interest and access of the researcher, who is a Michigan resident, but attended an undergraduate institution in Ohio. The Michigan Speech Language Hearing Association (MSHA) provided the names and emails of the 364 registered members who self-reported their work site as a public school. It is important to note that not all SLPs in Michigan are members of MSHA. MSHA members are SLPs who choose to join the organization and pay a yearly membership fee to do so. The Ohio Board of Speech-Language Pathology and Audiology provided an email directory of 1,289 SLPs licensed in Ohio and currently working in education settings. The Ohio email directory included the specific work site of each SLP, so the researcher was able to eliminate SLPs who clearly did not fit the study's participation requirements, such as those employed at secondary or post-secondary institutions. Other SLPs were listed as working in a specific school district or at an educational services center. These SLPs were not eliminated from the directory because their exact work site was unknown. After the elimination of SLPs who were obviously ineligible, 1,246 SLPs working in public schools in Ohio remained. A total of 200 SLPs were then chosen from each email list using random selection, and more specifically, through a random integer generator. Therefore 200 out of the 364 SLPs from Michigan and 200 out of the 1,246 SLPs from Ohio were provided with the initial opportunity to participate in this study by completing a survey, which will be described in the following section.

Instrument

The instrument used to conduct this study was an online survey (see Appendix A) designed using Qualtrics, an online survey generator. The survey consisted of 59 total items and made use of multiple choice, select all that apply, Likert-type, and open-ended questions. The key areas of focus were demographics, clinical experience in educational settings, education and training, and knowledge and comfort with hearing technology.

The brief demographic section of the survey asked participants which of the two states they currently work in, whether they were certified by the American Speech-Language-Hearing

Association (ASHA), and their gender. The following section regarding participants' clinical experience in educational settings included questions relating to the participant's work site and caseload. For example, participants were asked about the number of children with hearing loss on their caseload and the frequency of their contact with educational audiologists.

The education and training component of the survey provided information regarding the participant's highest degree as well as the training received in six different areas related to the services and support provided to individuals with hearing loss: diagnostic audiology, aural/auditory rehabilitation, hearing aids, cochlear implants, FM/IR systems, and acoustic modifications of classrooms. This section also included Likert-type questions asking participants whether they felt they received an "appropriate" amount of training in the aforementioned six areas, and whether training in each of the six areas is necessary. Additionally, participants were asked to report which, if any, of the areas they were in most need of training or additional training.

The knowledge and comfort with technology section comprised of questions regarding several different tasks relating to the management of hearing technology, such as changing the battery in a hearing aid, completing a listening check with a cochlear implant, and troubleshooting an FM/IR system. Participants were asked to indicate their comfort level with completing each of these tasks on a Likert-type scale, as well as whether they had performed each task during the current school year, and who is typically responsible for performing each task at school. This section also included two open-ended questions asking participants to share the top two acoustic modifications and top two teaching strategies that they would recommend to a teacher with a student with hearing loss in his/her class. The survey concluded by asking participants if they would like to share any additional comments or questions.

Procedures

This study received approval from the College of Wooster's Human Subjects Research Committee (HSRC) following the "Expedited Review" procedures. On December 17, 2015, the researcher sent a recruitment email (see Appendix B) to the 200 randomly chosen SLPs from Michigan. The recruitment email provided a brief summary of the study, the requirements to participate, the researcher's and advisor's contact information, as well as the direct link to the survey. Of the initial 200 emails sent, 16 were not delivered because the email addresses could not be found. The researcher also received 2 responses indicating that each participant had retired from working in public schools and was therefore ineligible to participate. Due to these losses, the researcher chose 18 new participants from the Michigan email directory, again with a random integer generator, so that the sample size could remain at 200.

The researcher received the Ohio email directory on December 17, 2015, and proceeded to eliminate ineligible participants from the list as described in the Participants section of this chapter. On December 18, 2015, the researcher sent the recruitment email (see Appendix B) to the 200 randomly chosen SLPs from Ohio. Similarly to the Michigan emails, 19 of the initial 200 were not delivered because the email addresses could not be found. The researcher then chose 19 new participants from the Ohio email directory with a random integer generator and sent them the recruitment email.

The researcher sent a reminder email to all 400 participants on January 4, 2016 (see Appendix C). Due to the anonymous nature of the study, the researcher had to send the email to all 400 participants, even though several had already completed the survey. On January 15, 2016, the researcher sent a final reminder email (see Appendix D) to all 400 participants. This final reminder informed the participants that the survey would remain open until January 19, 2016, until 11:00 PM. At that time, the survey was deactivated on Qualtrics, making it inaccessible. The researcher then downloaded data from the completed surveys to be subjected to analysis with SPSS software, which will be fully described in the chapter that follows.

CHAPTER IV: RESULTS AND DISCUSSION

The purpose of this study was to investigate school-based speech-language pathologists' hearing technology knowledge by examining their education and training, as well as their level of comfort and their clinical experiences working with hearing technology. A total of 400 speech-language pathologists (SLPs) working in the states of Michigan or Ohio were contacted to participate in this study, resulting in 95 total participants. This chapter will provide a detailed analysis of the data obtained from the study, along with a discussion of the results.

Demographics

A total of 200 SLPs identified as working in public schools in Michigan and 200 identified as working in public schools in Ohio were given the opportunity to participate in this study. A total of 107 attempted to complete the survey, resulting in a 26.8% response rate. Attempts to complete the survey include opening the survey and answering at least one question. Thus, the response rate includes 12 participants who attempted to complete the survey, but were ineligible to participate in the study because they responded that they did not currently work in an elementary school. These 12 ineligible participants who began the survey were eliminated from the data set, resulting in a total number of 95 participants and a response rate of 23.8%. Although 95 participants are considered to have completed the survey, some participants chose not to respond to various isolated questions. Thus, the total number of responses for each question is provided with the following data to be presented. Of the 95 total participants, 45.3% (n=43) currently work in public schools in Michigan, and 54.7% (n=52) currently work in public schools in Ohio. The state of employment of participants will also be included in the following descriptive statistics.

ASHA Certification

Survey Question 1 asked participants whether or not they had obtained the Certificate of Clinical Competence in Speech-Language Pathology (CCC-SLP) from the American Speech-Language-Hearing Association (ASHA). This question also served to indicate whether any of the participants were dually certified as a SLP *and* an Audiologist. Of the 95 total participants, 94.7% (n=90) had obtained the CCC-SLP; 5.3% (n=5) did not obtain the CCC-SLP; and no participants were dually certified in Speech-Language Pathology and Audiology. Of the 43 participants from Michigan, 95.3% (n=41) had the CCC-SLP and 4.7% (n=2) did not. Of the 52 participants from Ohio, 94.2% (n=49) had the CCC-SLP and 5.8% (n=3) did not.

Gender

Participants were asked to report their gender. Of the 95 total participants, 96.8% (n=92) identified as female; 2.1% (n=2) identified as male; and 1.1% (n=1) preferred not to respond. From the 43 Michigan participants, 95.3% (n=41) identified as female; 2.3% (n=1) identified as male; and 2.3% (n=1) preferred not to respond. From the 52 Ohio participants, 98.1% (n=51) identified as female and 1.9% (n=1) identified as male.

Clinical Experience in Educational Settings

Work Status and Experience

All but one of the 95 total participants indicated that they currently work in an elementary school. One of the participants from Ohio chose not to answer this particular question. Participants were asked to more specifically describe their work status as either full time or part time, and at either one elementary school or more than one school. Of the 94 total participants who answered this question, 29.8% (n=28) work full time at one elementary school; 56.4%

(n=53) work full time at more than one school; 7.4% (n=7) work part time at one elementary school; and 6.4% (n=6) work part time at more than one school.

Of the 43 Michigan respondents, 32.6% (n=14) work full time at one elementary school; 55.8% (n=24) work full time at more than one school; 4.7% (n=2) work part time at one elementary school; and 7.0% (n=3) work part time at more than one school. Of the 51 Ohio respondents, 27.5% (n=14) work full time at one elementary school; 56.9% (n=29) work full time at more than one school; 9.8% (n=5) work part time at one elementary school; and 5.9% (n=3) work part time at more than one school. See Figure 1 for a visual representation of these results.

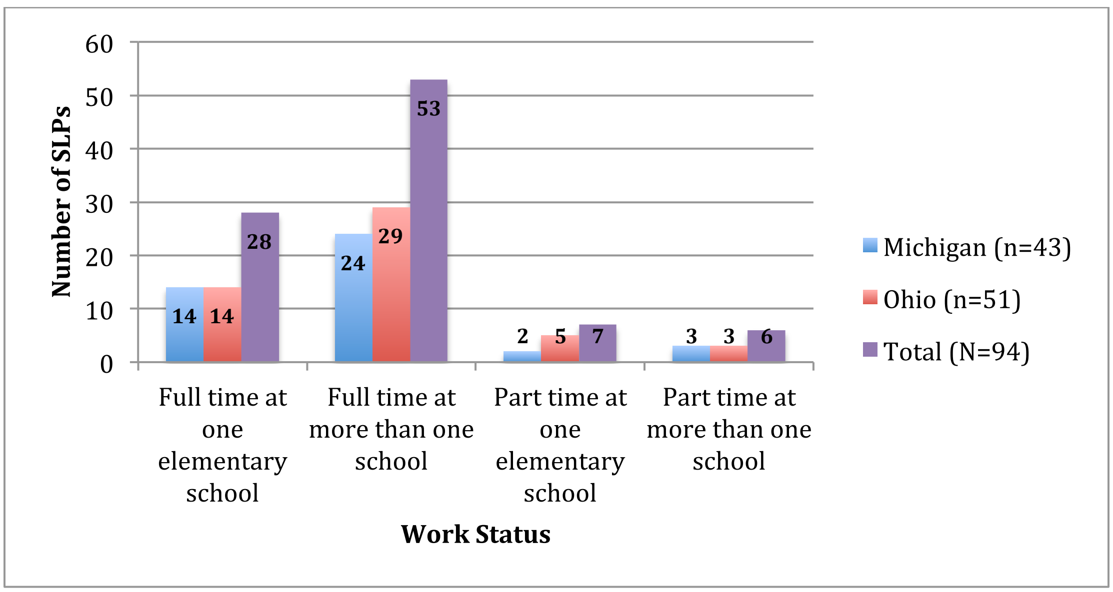

Figure 1. Work status of participating SLPs.

Participants reported the number of years that they have worked in an elementary school, ranging from 0.5 to 42 years. Respondents from both states (n=88) have worked in elementary schools for an average of 14.8 years (*M*=14.8, *SD*=9.6). Michigan respondents (n=39) reported working in elementary schools for an average of 13.8 (*M*=13.8, *SD*=9.5) years, and Ohio respondents (n=49) have worked for an average of 15.3 (*M*=15.3, *SD*=9.8) years.

Students with Hearing Loss on the Caseload

Participants were asked if they have ever had a student with hearing loss on their caseload. If they responded Yes, they were then asked to report the approximate number of such students they have *ever had* on their caseload, as well as the number of students with hearing loss they *currently have* on their caseload. Of the 94 total respondents, 96.8% (n=91) have had a student with hearing loss on their caseload, and 3.2% (n=3) have not. Of the 42 Michigan respondents, 92.9% (n=39) have had a student with hearing loss on their caseload, and 7.1% (n=3) have not. A total of 100.0% (n=52) of the Ohio respondents have had a student with hearing loss on their caseload.

Of the 90 total participants who responded to the additional caseload questions, 57.8% (n=52) have had 1-5 students with hearing loss on their caseload ever; 22.2% (n=20) have had 6-10 students with hearing loss; 10.0% (n=9) have 11-15 students with hearing loss; 2.2% (n=2) have had 16-20 students with hearing loss; and 7.8% (n=7) have had 21 or more students with hearing loss. Of the 39 Michigan respondents, 61.5% (n=24) have had 1-5 students with hearing loss on their caseload; 17.9% (n=7) have had 6-10 students with hearing loss; 5.1% (n=2) have had 11-15 students with hearing loss; 5.1% (n=2) have had 16-20 students with hearing loss; and 10.3% (n=4) have had 21 or more students with hearing loss. Of the 51 Ohio respondents, 54.9% (n=28) have had 1-5 students with hearing loss on their caseload; 25.5% (n=13) have had 6-10 students with hearing loss; 13.7% (n=7) have had 11-15 students with hearing loss; 5.9% 0.0% (n=0) have had 16-20 students with hearing loss; and 5.9% (n=3) have had 21 or more students with hearing loss. See Figure 2 for a visual representation of these results.

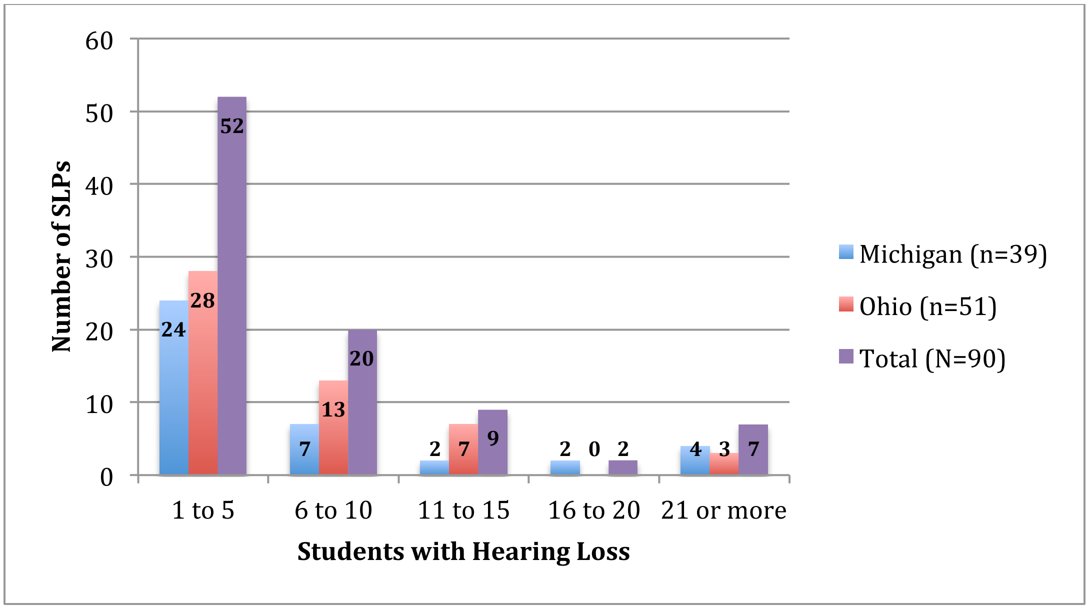

Figure 2. Number of students with hearing loss *ever* on the caseloads of participating SLPs.

Participants were asked to report the exact number of students with hearing loss that they *currently* have on their caseload, ranging from 1 to 16. The 90 participants who responded to this question currently have an average of 2.3 (*M*=2.3, *SD*=2.27) students with hearing loss on their caseload. The Michigan respondents (n=39) currently have an average of 2.5 (*M*=2.5, *SD*=2.63) students with hearing loss, and the Ohio respondents (n=51) currently have an average of 2.2 (*M*=2.2, *SD*=1.97) students with hearing loss.

Contact with an Educational Audiologist

Participants were asked about the frequency of their face-to-face and spoken or written contact with educational audiologists. When asked about face-to-face contact, 37.6% (n=35) of the 93 total respondents reported that their school or school district *does not* have an educational audiologist; 17.2% (n=16) reported that their school or school district does have an educational audiologist, but that they have *never* had face-to-face contact with him/her; 24.7% (n=23) reported face-to-face contact 1-2 times per school year; 12.9% (n=12) reported face-to-face contact 3-4 times per school year; 6.5% (n=6) reported face-to-face contact 1-3 times per month; and 1.1% (n=1) reported weekly face-to-face contact with an educational audiologist.

When asked about face-to-face contact, 38.1% (n=16) of the 42 Michigan respondents reported that their school or school district *does not* have an educational audiologist; 21.4% (n=9) reported that their school or school district does have an educational audiologist, but that they have *never* had face-to-face contact with him/her; 21.4% (n=9) reported face-to-face contact 1-2 times per school year; 9.5% (n=4) reported face-to-face contact 3-4 times per school year; and 9.5% (n=4) reported face-to-face contact 1-3 times per month.

When asked about face-to-face contact, 37.3% (n=19) of the 51 Ohio respondents reported that their school or school district *does not* have an educational audiologist; 13.7% (n=7) reported that their school or school district does have an educational audiologist, but that they have *never* had face-to-face contact with him/her; 27.5% (n=14) reported face-to-face contact 1-2 times per school year; 15.7% (n=8) reported face-to-face contact 3-4 times per school year; 3.9% (n=2) reported face-to-face contact 1-3 times per month; and 2.0% (n=1) reported weekly face-to-face contact with an educational audiologist. See Figure 3 for a visual representation of the frequency of face-to-face contact with an educational audiologist.

When asked about spoken or written contact (over the telephone or through email) with an educational audiologist, 37.0% (n=34) of the 92 total respondents reported that their school or school district *does not* have an educational audiologist; 9.8% (n=9) reported that their school or school district does have an educational audiologist, but that they have *never* had spoken or written contact with him/her; 22.8% (n=21) reported spoken or written contact 1-2 times per school year; 18.5% (n=17) reported spoken or written contact 3-4 times per school year; and 12.0% (n=11) reported spoken or written contact 1-3 times per month. It should be noted that "weekly" contact was also an option for this question, but it is not included in the results because none of the participants reported weekly spoken or written contact with an educational audiologist.

When asked about spoken or written contact, 38.1% (n=16) of the 42 Michigan respondents reported that their school or school district *does not* have an educational audiologist; 11.9% (n=5) reported that their school or school district does have an educational audiologist, but that they have *never* had spoken or written contact with him/her; 23.8% (n=10) reported spoken or written contact 1-2 times per school year; 16.7% (n=7) reported spoken or written contact 3-4 times per school year; and 9.5% (n=4) reported spoken or written contact 1-3 times per month.

When asked about spoken or written contact, 36.0% (n=18) of the 50 Ohio respondents reported that their school or school district *does not* have an educational audiologist; 8.0% (n=4) reported that their school or school district does have an educational audiologist, but that they have *never* had spoken or written contact with him/her; 22.0% (n=11) reported spoken or written contact 1-2 times per school year; 20.0% (n=10) reported spoken or written contact 3-4 times per school year; and 14.0% (n=7) reported spoken or written contact 1-3 times per month. See Figure 4 for a visual representation of the frequency of spoken or written contact with an educational audiologist.

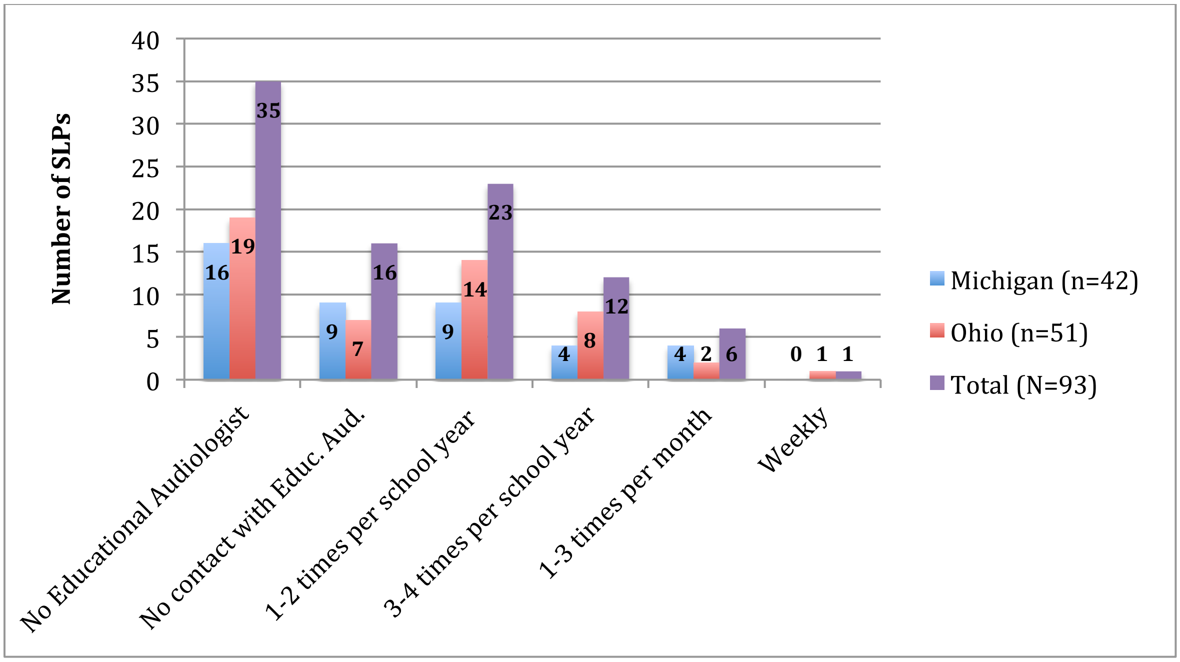

Figure 3. Frequency of face-to-face contact with an educational audiologist.

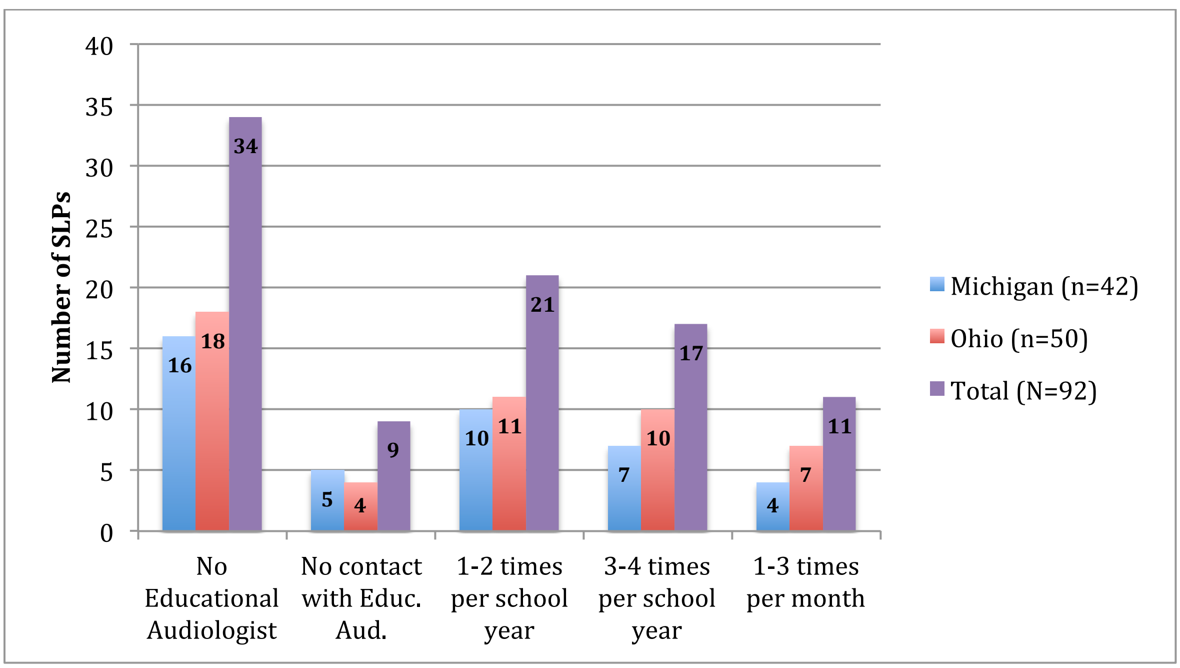

Figure 4. Frequency of spoken or written contact with an educational audiologist. No participants reported “weekly” spoken or written contact with an educational audiologist.

Students with Cochlear Implants on the Caseload

Participants were then asked how many students with cochlear implants they have ever had on their caseload. Of the 93 total respondents, 50.5% (n=47) have not had any students with cochlear implants on their caseload; 48.4% (n=45) have had 1-5 students with cochlear implants; and 1.1% (n=1) have had 11 or more students with cochlear implants. Of the 42 respondents from Michigan, 45.2% (n=19) have not had any students with cochlear implants on their caseload and 54.8% (n=23) have had 1-5 students with cochlear implants on their caseload. Of the 51 participants from Ohio, 54.9% (n=28) have not had any students with cochlear implants on their caseload; 43.1% (n=22) have had 1-5 students with cochlear implants; and 2.0% (n=1) have had 11 or more students with cochlear implants on their caseload.

Cochlear Implant Resources

The participants who responded as ever having a student with a cochlear implant on their caseload were then asked what cochlear implant resources they have used. Participants were given seven options and were asked to select ALL that apply. The options included diagnostic reports, in-person workshops or conferences, printed materials from cochlear implant manufacturers, electronic training materials, in-service training, no resources, and other resources. Participants who selected the "Other Resources" option were provided with the opportunity to describe the resource they were referring to. A common example was an "Audiologist," but the full list of verbatim responses of other resources can be found in Appendix E. See Figure 5 for an overview of the results.

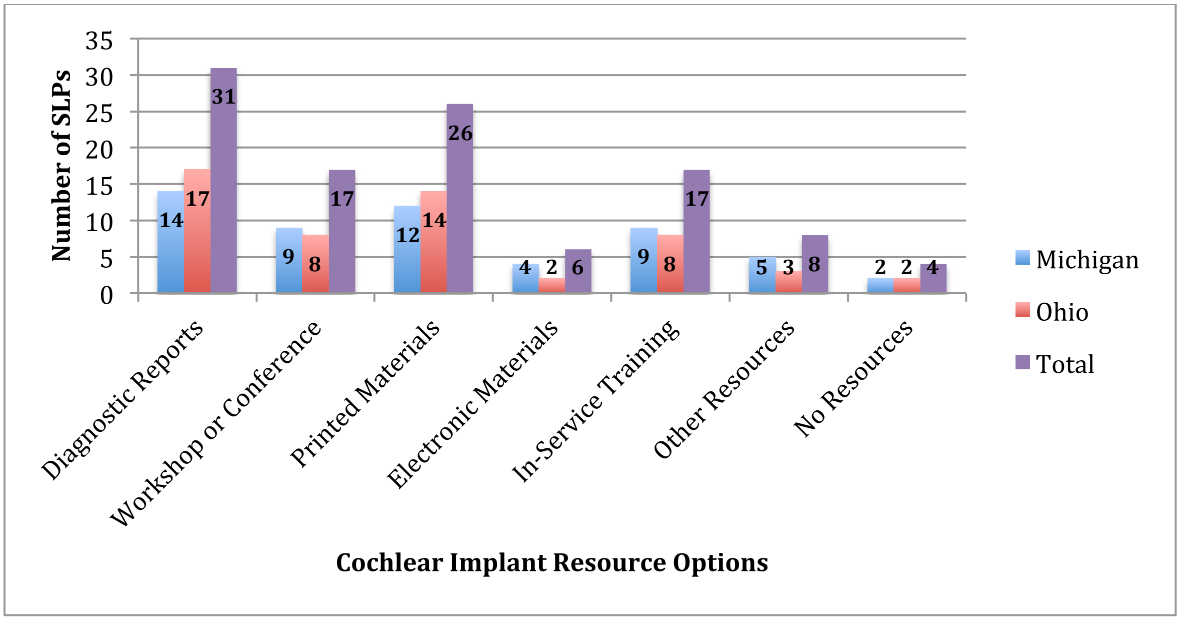

Figure 5. Cochlear implant resources used by participating SLPs. A total of 46 participants made 109 selections.

Education and Training

Highest-Earned Degree and Degree Year

Participants were asked to report their highest earned degree and its year of completion. Of the 91 total respondents, 2.2% (n=2) earned a Bachelor's degree; 95.6% (n=87) earned a Master's degree; 1.1% (n=1) earned a Ph.D./Ed.D; and 1.1% (n=1) responded "other" and shared that his/her highest earned degree was as an "educational specialist." Of the 42 Michigan respondents, 97.6% (n=41) earned a Master's degree and 2.4% (n=1) earned a degree as an educational specialist. Of the 49 Ohio respondents, 93.9% (n=46) earned a Master's degree; 4.1% (n=2) earned a Bachelor's degree; and 2.0% (n=1) earned a Ph.D./Ed.D.

Participants additionally reported the year they completed their highest earned degree. Of the 91 total respondents, 22.0% (n=20) earned their degree between 2010 and 2014 or later; 29.7% (n=27) earned their degree between 2000 and 2009; 30.8% (n=28) earned their degree between 1990 and 1999; and 17.6% (n=16) earned their degree between 1980 and 1989. Of the

42 total Michigan respondents, 28.6% (n=12) earned their degree between 2010 and 2014 or later; 21.4% (n=9) earned their degree between 2000 and 2009; 33.3% (n=14) earned their degree between 1990 and 1999; and 16.7% (n=7) earned their degree between 1980 and 1989. Of the 49 total Ohio respondents, 16.3% (n=8) earned their degree between 2010 and 2014 or later; 36.7% (n=18) earned their degree between 2000 and 2009; 28.6% (n=14) earned their degree between 1990 and 1999; and 18.4% (n=9) earned their degree between 1980 and 1989. See Figure 6 for a visual representation of participants' degree years.

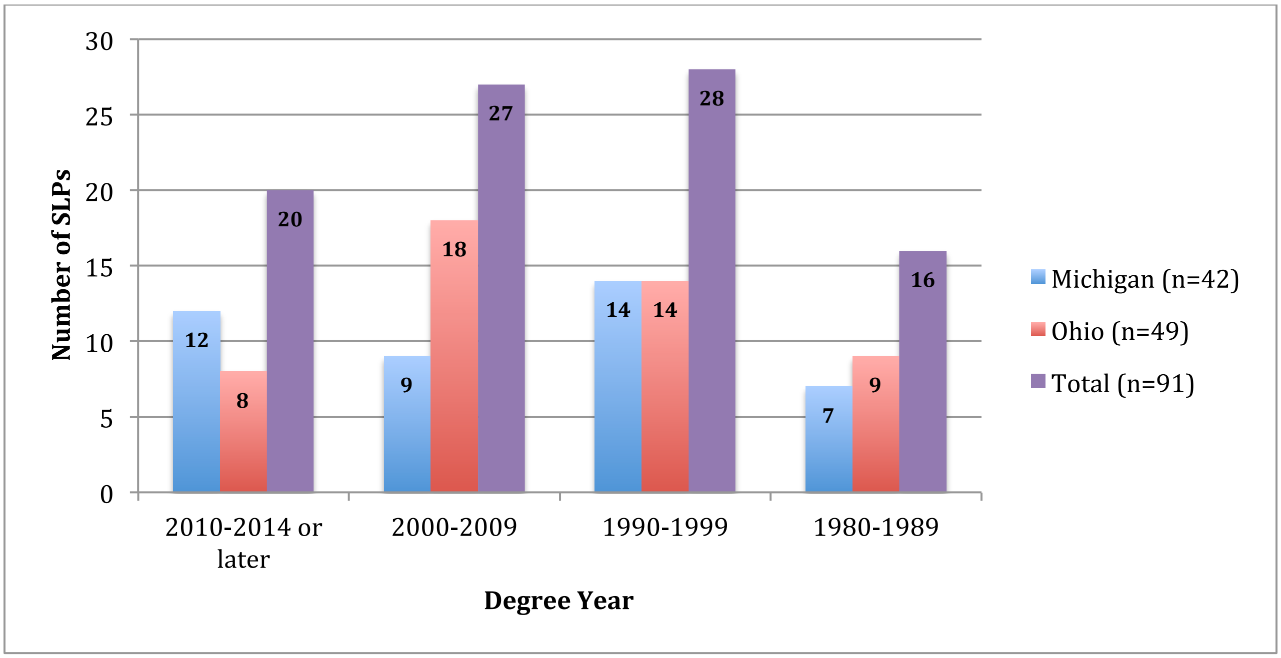

Figure 6. Year participants graduated with their highest earned degree.

Academic Training Received

Participants reported the types of training they received in six different areas: diagnostic audiology, aural/auditory rehabilitation, hearing aids, cochlear implants, FM/IR (InfraRed) systems, and acoustic modifications of classrooms. Participants were asked to indicate the type of training they received in each of these areas by choosing from the following five options—

none; required graduate course(s); elective graduate course(s); continuing education course(s); and on-site training from professional(s). In choosing from these options, participants were asked to select ALL training options that apply. See Figures 7 through 12 for an overview of the results.

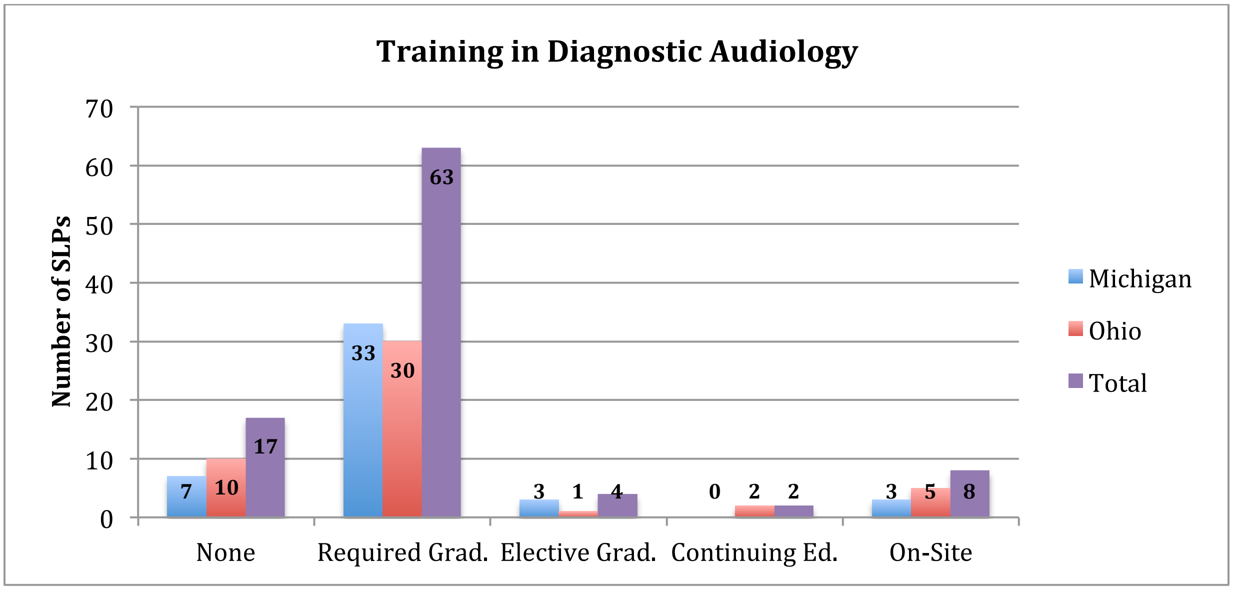

Figure 7. Types of training participating SLPs received in diagnostic audiology. A total of 84 participants made 94 selections.

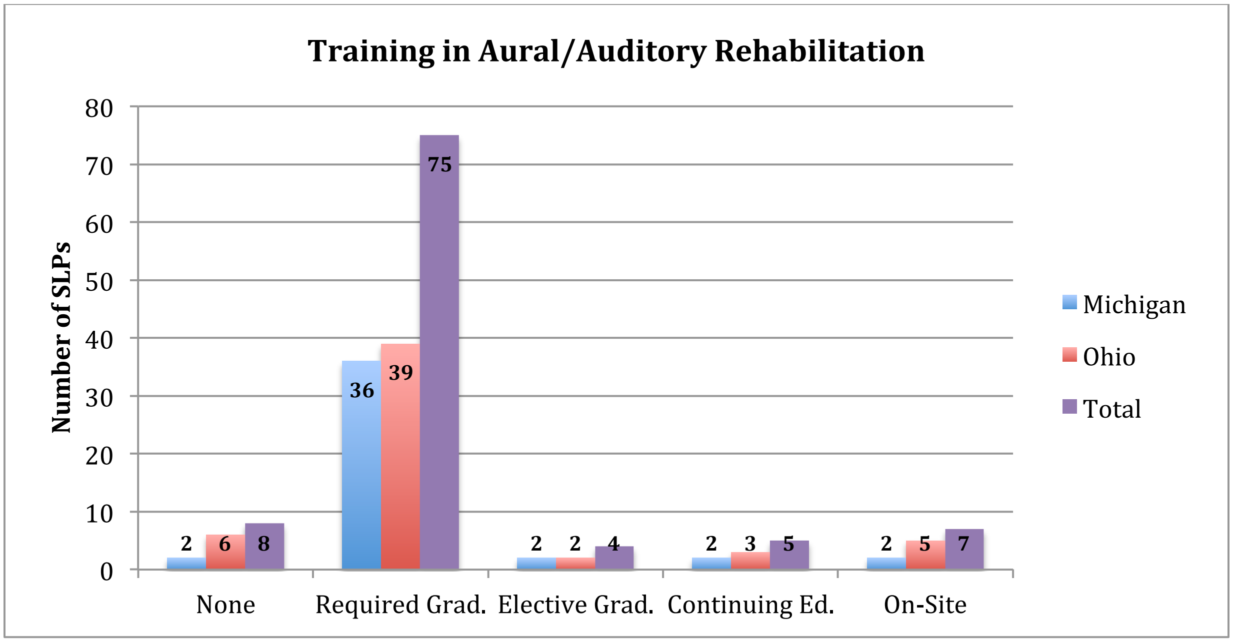

Figure 8. Types of training participating SLPs received in aural/auditory rehabilitation. A total of 88 participants made 99 selections.

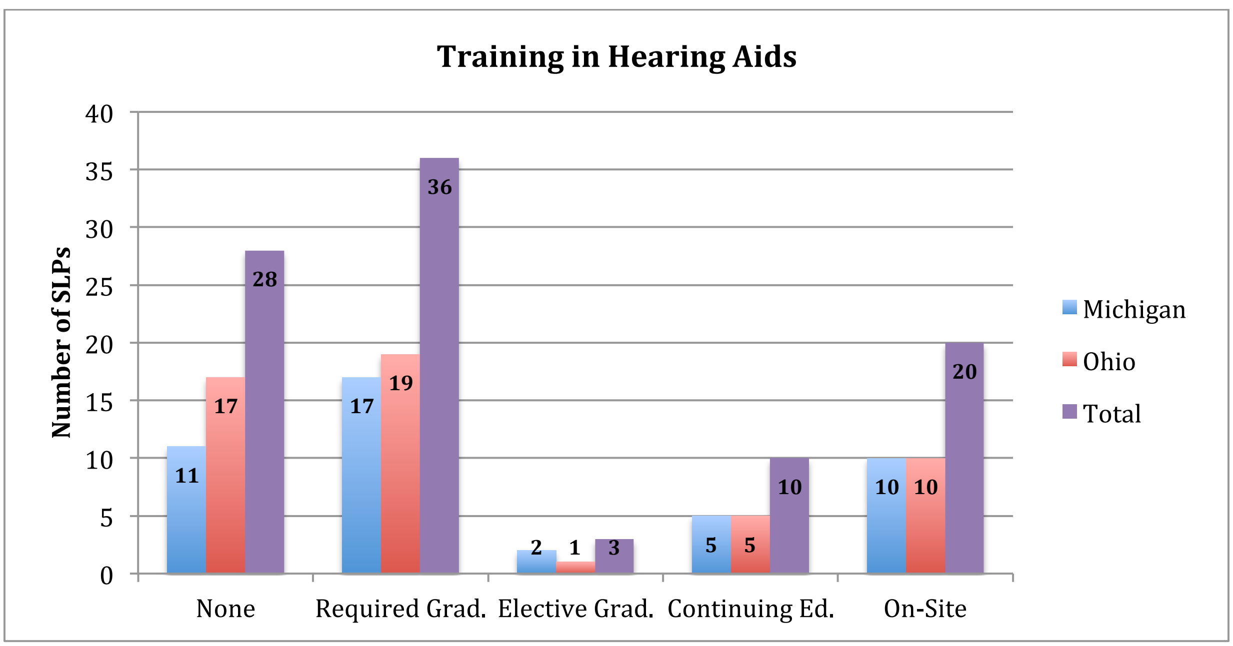

Figure 9. Types of training participating SLPs received in hearing aids. A total of 83 participants made 97 selections.

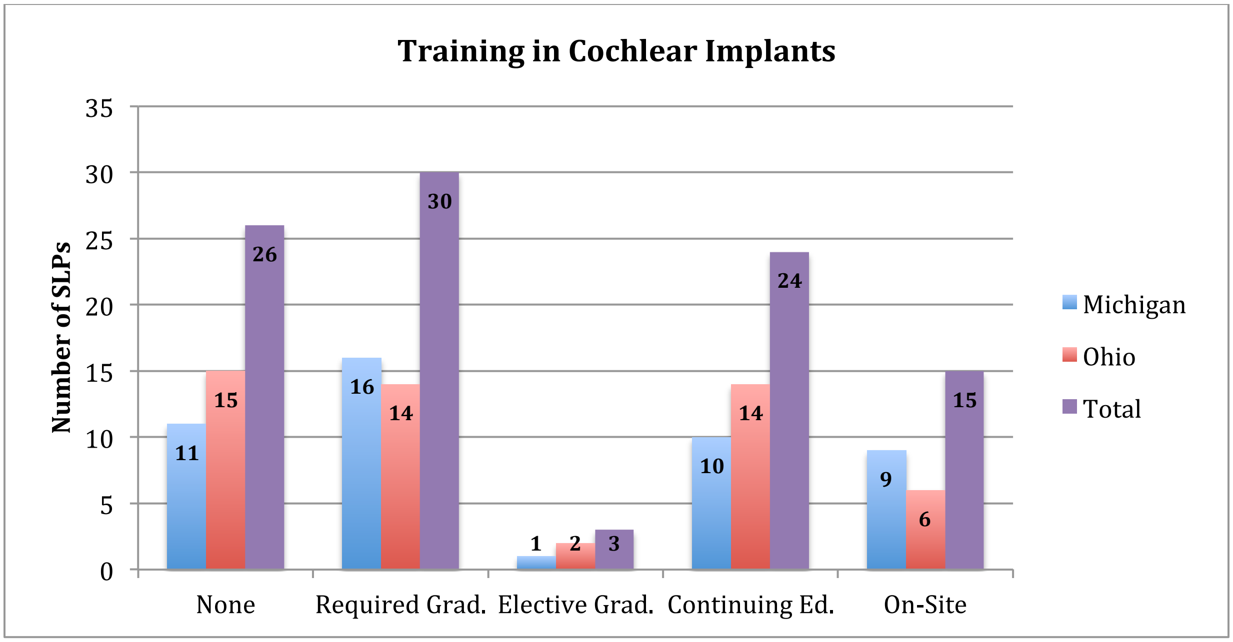

Figure 10. Types of training participating SLPs received in cochlear implants. A total of 86 participants made 98 selections.

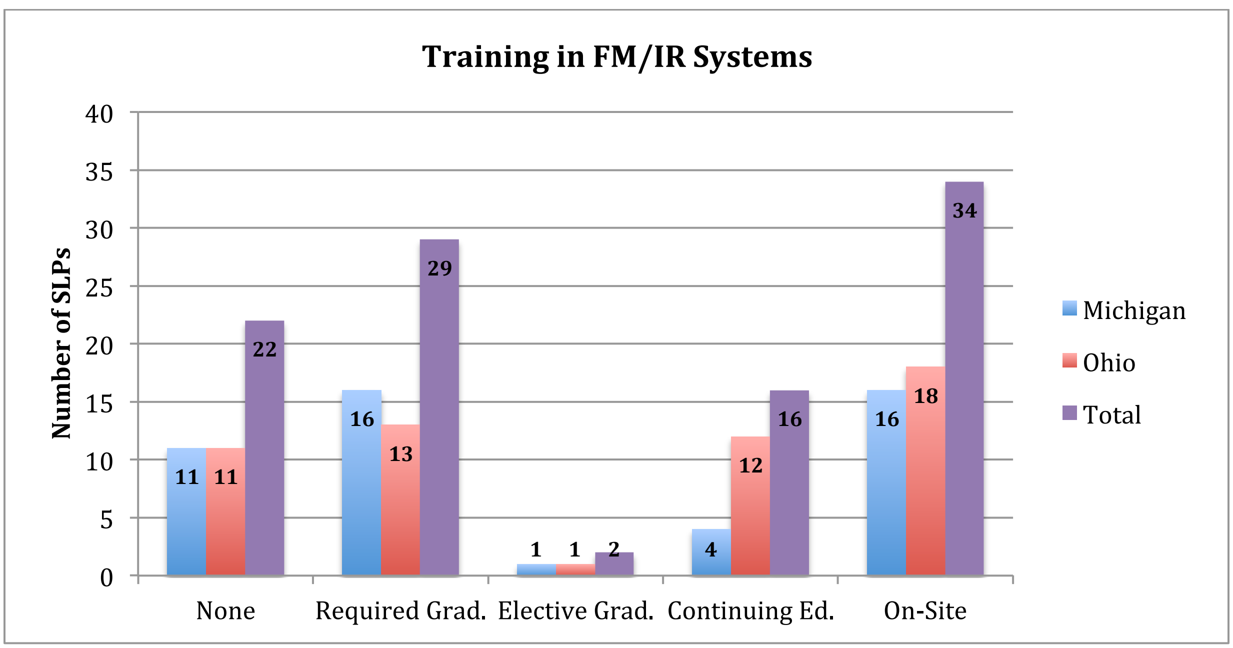

Figure 11. Types of training participating SLPs received in FM/IR systems. A total of 87 participants made 103 selections.

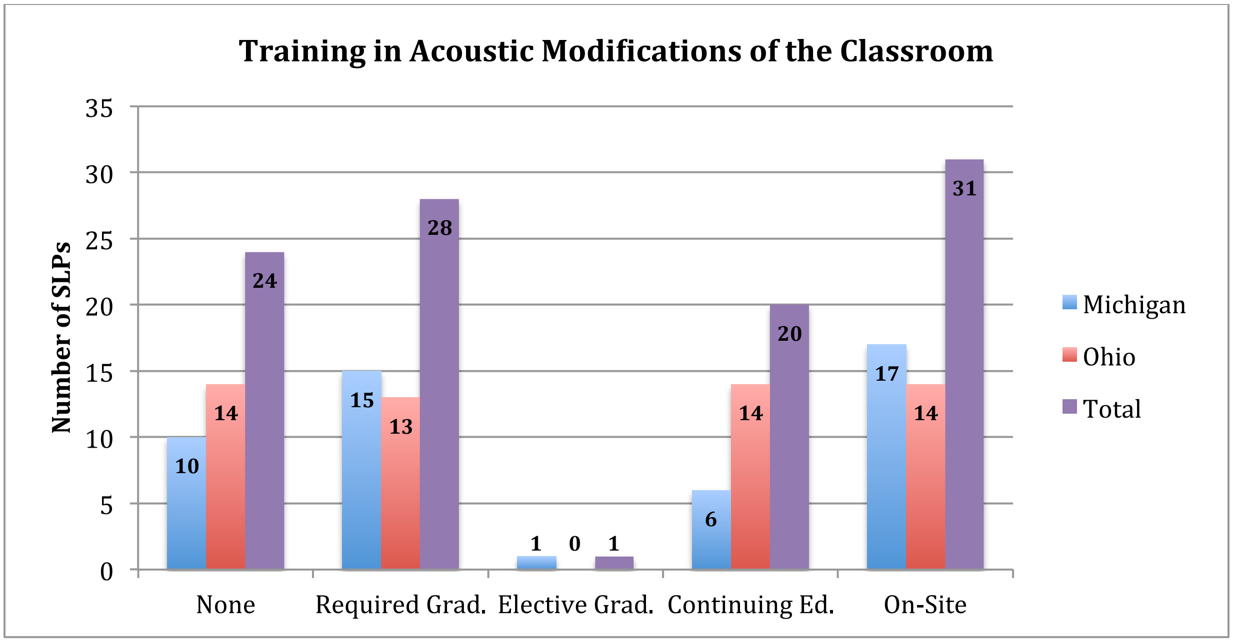

Figure 12. Types of training participating SLPs received in acoustic modifications of the classroom. A total of 86 participants made 104 selections.

Appropriateness of Academic Training

Participants were asked if they felt they had received an "appropriate" amount of training in the same six areas that have been focused on: diagnostic audiology, aural/auditory rehabilitation, hearing aids, cochlear implants, FM/IR systems, and acoustic modifications of classrooms. Participants were provided with a Likert scale ranging from 1-7 to answer this question, with 1 indicating that they "Strongly Disagreed" and 7 indicating that they "Strongly Agreed." See Tables 1 to 6 for an overview of the results, and Table 7 for a summary of the mean scores for all training areas.

Table 1

Appropriate Training in Diagnostic Audiology

State	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7	Mean	Standard Deviation
MI (n=42)	7.1% (n=3)	14.3% (n=6)	7.1% (n=3)	23.8% (n=10)	21.4% (n=9)	23.8% (n=10)	2.4% (n=1)	4.19	1.64
OH (n=48)	14.6% (n=7)	16.7% (n=8)	12.5% (n=6)	18.8% (n=9)	14.6% (n=7)	16.7% (n=8)	6.3% (n=3)	3.77	1.87
Total (N=90)	11.1% (n=10)	15.6% (n=14)	10.0% (n=9)	21.1% (n=19)	17.8% (n=16)	20.0% (n=18)	4.4% (n=4)	3.97	1.77

Table 2

Appropriate Training in Aural/Auditory Rehabilitation

State	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7	Mean	Standard Deviation
MI (n=42)	4.8% (n=2)	11.9% (n=5)	16.7% (n=7)	14.3% (n=6)	31.0% (n=13)	16.7% (n=7)	4.8% (n=2)	4.24	1.57
OH (n=48)	12.5% (n=6)	18.8% (n=9)	10.4% (n=5)	6.3% (n=3)	25.0% (n=12)	25.0% (n=12)	2.1% (n=1)	3.96	1.87
Total (N=90)	8.9% (n=8)	15.6% (n=14)	13.3% (n=12)	10.0% (n=9)	27.8% (n=25)	21.1% (n=19)	3.3% (n=3)	4.09	1.73

Table 3

Appropriate Training in Hearing Aids

State	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7	Mean	Standard Deviation
MI (n=41)	2.4% (n=1)	17.1% (n=7)	26.8% (n=11)	19.5% (n=8)	19.5% (n=8)	12.2% (n=5)	2.4% (n=1)	3.83	1.45
OH (n=49)	14.3% (n=7)	24.5% (n=12)	20.4% (n=10)	8.2% (n=4)	20.4% (n=10)	10.2% (n=5)	2.0% (n=1)	3.35	1.70
Total (N=90)	8.9% (n=8)	21.1% (n=19)	23.3% (n=21)	13.3% (n=12)	20.0% (n=18)	11.1% (n=10)	2.2% (n=2)	3.57	1.60

Table 4

Appropriate Training in Cochlear Implants

State	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7	Mean	Standard Deviation
MI (n=42)	9.5% (n=4)	19.0% (n=8)	21.4% (n=9)	23.8% (n=10)	11.9% (n=5)	14.3% (n=6)	0.0% (n=0)	3.52	1.53
OH (n=49)	22.4% (n=11)	24.5% (n=12)	16.3% (n=8)	8.2% (n=4)	18.4% (n=9)	8.2% (n=4)	2.0% (n=1)	3.08	1.75
Total (N=91)	16.5% (n=15)	22.0% (n=20)	18.7% (n=17)	15.4% (n=14)	15.4% (n=14)	11.0% (n=10)	1.1% (n=1)	3.29	1.66

Table 5

Appropriate Training in FM/IR Systems

State	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7	Mean	Standard Deviation
MI (n=41)	9.8% (n=4)	19.5% (n=8)	17.1% (n=7)	14.6% (n=6)	17.1% (n=7)	22.0% (n=9)	0.0% (n=0)	3.76	1.70
OH (n=49)	12.2% (n=6)	18.4% (n=9)	30.6% (n=15)	8.2% (n=4)	24.5% (n=12)	4.1% (n=2)	2.0% (n=1)	3.35	1.53
Total (N=90)	11.1% (n=10)	18.9% (n=17)	24.4% (n=22)	11.1% (n=10)	21.1% (n=19)	12.2% (n=11)	1.1% (n=1)	3.53	1.62

Table 6

Appropriate Training in Acoustic Modifications of Classrooms

State	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7	Mean	Standard Deviation
MI (n=41)	7.3% (n=3)	22.0% (n=9)	19.5% (n=8)	17.1% (n=7)	12.2% (n=5)	22.0% (n=9)	0.0% (n=0)	3.71	1.65
OH (n=49)	8.2% (n=4)	24.5% (n=12)	30.6% (n=15)	12.2% (n=6)	14.3% (n=7)	8.2% (n=4)	2.0% (n=1)	3.33	1.51
Total (N=90)	7.8% (n=7)	23.3% (n=21)	25.6% (n=23)	14.4% (n=13)	13.3% (n=12)	14.4% (n=13)	1.1% (n=1)	3.50	1.57

Table 7

*Summary of **Appropriate** Training Means*

	MI	OH	Total
Diagnostic Audiology	4.19	3.77	3.97
Auditory Rehabilitation	4.24	3.96	4.09
Hearing Aids	3.83	3.35	3.57
Cochlear Implants	3.52	3.08	3.29
FM/IR Systems	3.76	3.35	3.53
Acoustic Modifications	3.71	3.33	3.50

Note. 1=Strongly Disagree, 7=Strongly Agree

Necessity of Academic Training

To ascertain participants' perception of the need for hearing technology training, the survey asked if participants felt that training in the same six areas is necessary. Again, a Likert scale ranging from 1-7 was provided. A score of 1 indicated that training was "Not At All Necessary," and 7 indicated that training was "Extremely Necessary." See Tables 8 to 13 for an overview of the results for each area, and Table 14 for a summary of the mean scores for all training areas.

Table 8

Necessary Training in Diagnostic Audiology

State	Not At All Necessary			Neutral			Extremely Necessary	Mean	Standard Deviation
	1	2	3	4	5	6	7		
MI (n=41)	4.9% (n=2)	4.9% (n=2)	4.9% (n=2)	12.2% (n=5)	29.3% (n=12)	34.1% (n=14)	9.8% (n=4)	4.98	1.53
OH (n=49)	2.0% (n=1)	4.1% (n=2)	6.1% (n=3)	10.2% (n=5)	26.5% (n=13)	34.7% (n=17)	16.3% (n=8)	5.24	1.42
Total (N=90)	3.3% (n=3)	4.4% (n=4)	5.6% (n=5)	11.1% (n=10)	27.8% (n=25)	34.4% (n=31)	13.3% (n=12)	5.12	1.47

Table 9

Necessary Training in Aural/Auditory Rehabilitation

State	Not At All Necessary			Neutral			Extremely Necessary	Mean	Standard Deviation
	1	2	3	4	5	6	7		
MI (n=40)	2.5% (n=1)	2.5% (n=1)	0.0% (n=0)	2.5% (n=1)	37.5% (n=15)	37.5% (n=15)	17.5% (n=7)	5.53	1.22
OH (n=49)	0.0% (n=0)	2.0% (n=1)	2.0% (n=1)	2.0% (n=1)	24.5% (n=12)	46.9% (n=23)	22.4% (n=11)	5.80	1.02
Total (N=89)	1.1% (n=1)	2.2% (n=2)	1.1% (n=1)	2.2% (n=2)	30.3% (n=27)	42.7% (n=38)	20.2% (n=18)	5.67	1.12

Table 10

Necessary Training in Hearing Aids

State	Not At All Necessary			Neutral			Extremely Necessary	Mean	Standard Deviation
	1	2	3	4	5	6	7		
MI (n=41)	0.0% (n=0)	2.4% (n=1)	7.3% (n=3)	14.6% (n=6)	24.4% (n=10)	39.0% (n=16)	12.2% (n=5)	5.27	1.23
OH (n=49)	0.0% (n=0)	0.0% (n=0)	0.0% (n=0)	2.0% (n=1)	18.4% (n=9)	59.2% (n=29)	20.4% (n=10)	5.98	0.69
Total (N=90)	0.0% (n=0)	1.1% (n=1)	3.3% (n=3)	7.8% (n=7)	21.1% (n=19)	50.0% (n=45)	16.7% (n=15)	5.66	1.03

Table 11

Necessary Training in Cochlear Implants

State	Not At All Necessary			Neutral			Extremely Necessary	Mean	Standard Deviation
	1	2	3	4	5	6	7		
MI (n=41)	0.0% (n=0)	2.4% (n=1)	4.9% (n=2)	19.5% (n=8)	29.3% (n=12)	36.6% (n=15)	7.3% (n=3)	5.15	1.13
OH (n=49)	0.0% (n=0)	0.0% (n=0)	0.0% (n=0)	4.1% (n=2)	22.4% (n=11)	46.9% (n=23)	26.5% (n=13)	5.96	0.82
Total (N=90)	0.0% (n=0)	1.1% (n=1)	2.2% (n=2)	11.1% (n=10)	25.6% (n=23)	42.2% (n=38)	17.8% (n=16)	5.59	1.05

Table 12

Necessary Training in FM/IR Systems

State	Not At All Necessary			Neutral			Extremely Necessary	Mean	Standard Deviation
	1	2	3	4	5	6	7		
MI (n=39)	0.0% (n=0)	2.6% (n=1)	7.7% (n=3)	10.3% (n=4)	20.5% (n=8)	46.2% (n=18)	12.8% (n=5)	5.38	1.23
OH (n=49)	0.0% (n=0)	0.0% (n=0)	0.0% (n=0)	2.0% (n=1)	18.4% (n=9)	44.9% (n=22)	34.7% (n=17)	6.12	0.78
Total (N=88)	0.0% (n=0)	1.1% (n=1)	3.4% (n=3)	5.7% (n=5)	19.3% (n=17)	45.5% (n=40)	25.0% (n=22)	5.80	1.06

Table 13

Necessary Training in Acoustic Modifications of Classrooms

State	Not At All Necessary			Neutral			Extremely Necessary	Mean	Standard Deviation
	1	2	3	4	5	6	7		
MI (n=41)	0.0% (n=0)	0.0% (n=0)	4.9% (n=2)	7.3% (n=3)	17.1% (n=7)	43.9% (n=18)	26.8% (n=11)	5.80	1.08
OH (n=49)	0.0% (n=0)	0.0% (n=0)	0.0% (n=0)	8.2% (n=4)	14.3% (n=7)	40.8% (n=20)	36.7% (n=18)	6.06	0.92
Total (N=90)	0.0% (n=0)	0.0% (n=0)	2.2% (n=2)	7.8% (n=7)	15.6% (n=14)	42.2% (n=38)	32.2% (n=29)	5.94	1.00

Table 14

*Summary of **Necessary** Training Means*

	MI	OH	Total
Diagnostic Audiology	4.98	5.24	5.12
Auditory Rehabilitation	5.53	5.80	5.67
Hearing Aids	5.27	5.98	5.66
Cochlear Implants	5.15	5.96	5.59
FM/IR Systems	5.38	6.12	5.80
Acoustic Modifications	5.80	6.06	5.94

Note. 1=Not At All Necessary, 7=Extremely Necessary

Preparedness to Work with Hearing Technology

Participants reported their overall graduate training preparedness to work with hearing technology by responding to the following Likert-scale question: "Do you agree that, overall, your graduate curricula prepared you to work with the range of currently available hearing technology?" A score of 1 indicated that the participant "Strongly Disagreed" with the statement and does not feel that his/her graduate curricula prepared him/her to work with such technology. A score of 7 indicated that the participant "Strongly Agreed" with the statement and feels that his/her graduate curricula did prepare him/her to work with this technology. The results for the Michigan, Ohio, and total respondents are provided in Table 15.

Table 15

Graduate Curricula Preparedness to Work with Hearing Technology

State	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7	Mean	Standard Deviation
MI (n=39)	2.6% (n=1)	25.6% (n=10)	20.5% (n=8)	15.4% (n=6)	23.1% (n=9)	10.3% (n=4)	2.6% (n=1)	3.72	1.52
OH (n=47)	8.5% (n=4)	19.1% (n=9)	25.5% (n=12)	8.5% (n=4)	21.3% (n=10)	17.0% (n=8)	0.0% (n=0)	3.66	1.62
Total (N=86)	5.8% (n=5)	22.1% (n=19)	23.3% (n=20)	11.6% (n=10)	22.1% (n=19)	14.0% (n=12)	1.2% (n=1)	3.69	1.57

Areas in Need of Training

Provided with the same six areas of training (diagnostic audiology, aural/auditory rehabilitation, hearing aids, cochlear implants, FM/IR systems, and acoustic modifications), participants were asked to report what area(s) they are currently in most need of training. Participants were encouraged to select ALL areas that apply, and were also given an “Other” option. The number of SLPs who indicated a need for training in each of the areas can be seen in Figure 13. The five participants who selected the “Other” option shared further explanation for their choice. Two of the five explained that they rely on “hearing consultants” for help in these areas, and thus do not feel that they are in need of training in any of these areas. One participant was “not sure” of other specific areas, and the remaining two participants gave explanations for their selections rather than naming another area of training. A list of verbatim responses from those who selected “Other” is provided in Appendix F.

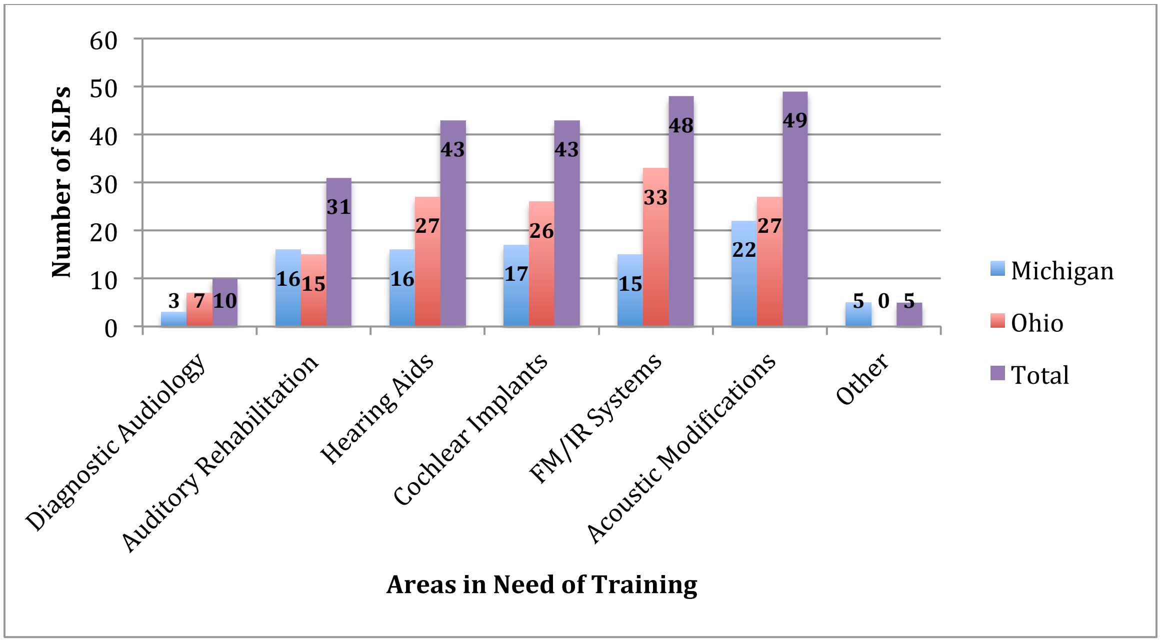

Figure 13. Areas in most need of training reported by participating SLPs. A total of 90 participants made 229 selections.

Knowledge and Comfort with Technology

Comfort Level with Hearing Technology Tasks

Participants were then asked to report their comfort level with performing various hearing technology tasks on a Likert-scale from 1-7, with a score of 1 indicating they are "Not At All Comfortable" and a score of 7 indicating they are "Extremely Comfortable" with performing each task. The researcher chose the following 11 hearing technology tasks because they are indicative of the types of tasks that may need to be, and often should be, performed on a regular basis at school. Tasks relating to hearing aids, cochlear implants, and FM (IR) systems were included as they are the three types of hearing technology specifically under investigation in this study. See Tables 16 to 26 for the results for each task from the Michigan, Ohio, and the total number of respondents. And see Table 27 for a summary of the mean scores for all hearing technology tasks.

Table 16

Comfort Level with Changing the Battery in a Hearing Aid

State	Not At All Comfortable			Neutral			Extremely Comfortable	Mean	Standard Deviation
	1	2	3	4	5	6	7		
MI (n=42)	11.9% (n=5)	14.3% (n=6)	11.9% (n=5)	7.1% (n=3)	23.8% (n=10)	19.0% (n=8)	11.9% (n=5)	4.21	1.97
OH (n=49)	4.1% (n=2)	8.2% (n=4)	8.2% (n=4)	2.0% (n=1)	36.7% (n=18)	30.6% (n=15)	10.2% (n=5)	4.92	1.58
Total (N=91)	7.7% (n=7)	11.0% (n=10)	9.9% (n=9)	4.4% (n=4)	30.8% (n=28)	25.3% (n=23)	11.0% (n=10)	4.59	1.80

Table 17

Comfort Level with Changing the Battery in a Cochlear Implant

State	Not At All Comfortable			Neutral			Extremely Comfortable	Mean	Standard Deviation
	1	2	3	4	5	6	7		
MI (n=42)	61.9% (n=26)	4.8% (n=2)	16.7% (n=7)	2.4% (n=1)	9.5% (n=4)	2.4% (n=1)	2.4% (n=1)	2.10	1.67
OH (n=49)	46.9% (n=23)	18.4% (n=9)	6.1% (n=3)	4.1% (n=2)	8.2% (n=4)	12.2 % (n=6)	4.1% (n=2)	2.61	2.03
Total (N=91)	53.8% (n=49)	12.1% (n=11)	11.0% (n=10)	3.3% (n=3)	12.2% (n=6)	7.7% (n=7)	3.3% (n=3)	2.37	1.88

Table 18

Comfort Level with Changing the Battery in an FM/IR System

State	Not At All Comfortable 1	2	3	Neutral 4	5	6	Extremely Comfortable 7	Mean	Standard Deviation
MI (n=42)	23.8% (n=10)	7.1% (n=3)	11.9% (n=5)	14.3% (n=6)	14.3% (n=6)	21.4% (n=9)	7.1% (n=3)	3.81	2.06
OH (n=49)	8.2% (n=4)	12.2% (n=6)	20.4% (n=10)	4.1% (n=2)	16.3% (n=8)	26.5% (n=13)	12.2% (n=6)	4.37	1.92
Total (N=91)	15.4% (n=14)	9.9% (n=9)	16.5% (n=15)	8.8% (n=8)	15.4% (n=14)	24.2% (n=22)	9.9% (n=9)	4.11	2.00

Table 19

Comfort Level with Completing a Listening Check with a Hearing Aid

State	Not At All Comfortable 1	2	3	Neutral 4	5	6	Extremely Comfortable 7	Mean	Standard Deviation
MI (n=42)	28.6% (n=12)	16.7% (n=7)	9.5% (n=4)	11.9% (n=5)	14.3% (n=6)	11.9% (n=5)	7.1% (n=3)	3.31	2.05
OH (n=49)	8.2% (n=4)	10.2% (n=5)	16.3% (n=8)	4.1% (n=2)	22.4% (n=11)	24.5% (n=12)	14.3% (n=7)	4.53	1.89
Total (N=91)	17.6% (n=16)	13.2% (n=12)	13.2% (n=12)	7.7% (n=7)	18.7% (n=17)	18.7% (n=17)	11.0% (n=10)	3.97	2.05

Table 20

Comfort Level with Completing a Listening Check with a Cochlear Implant

State	Not At All Comfortable 1	2	3	Neutral 4	5	6	Extremely Comfortable 7	Mean	Standard Deviation
MI (n=42)	54.8% (n=23)	11.9% (n=5)	9.5% (n=4)	9.5% (n=4)	4.8% (n=2)	7.1% (n=3)	2.4% (n=1)	2.29	1.79
OH (n=49)	44.9% (n=22)	16.3% (n=8)	14.3% (n=7)	2.0% (n=1)	8.2% (n=4)	8.2% (n=4)	6.1% (n=3)	2.61	1.99
Total (N=91)	49.5% (n=45)	14.3% (n=13)	12.1% (n=11)	5.5% (n=5)	6.6% (n=6)	7.7% (n=7)	4.4% (n=4)	2.46	1.89

Table 21

Comfort Level with Completing a Listening Check with an FM/IR System

State	Not At All Comfortable 1	2	3	Neutral 4	5	6	Extremely Comfortable 7	Mean	Standard Deviation
MI (n=42)	33.3% (n=14)	9.5% (n=4)	16.7% (n=7)	14.3% (n=6)	11.9% (n=5)	7.1% (n=3)	7.1% (n=3)	3.12	1.98
OH (n=49)	10.2% (n=5)	16.3% (n=8)	18.4% (n=9)	8.2% (n=4)	14.3% (n=7)	22.4% (n=11)	10.2% (n=5)	4.08	1.95
Total (N=91)	20.9% (n=19)	13.2% (n=12)	17.6% (n=16)	11.0% (n=10)	13.2% (n=12)	15.4% (n=14)	8.8% (n=8)	3.64	2.01

Table 22

Comfort Level with Troubleshooting a Hearing Aid

State	Not At All Comfortable			Neutral			Extremely Comfortable	Mean	Standard Deviation
	1	2	3	4	5	6	7		
MI (n=42)	42.9% (n=18)	16.7% (n=7)	16.7% (n=7)	9.5% (n=4)	7.1% (n=3)	2.4% (n=1)	4.8% (n=2)	2.48	1.74
OH (n=49)	24.5% (n=12)	24.5% (n=12)	20.4% (n=10)	4.1% (n=2)	16.3% (n=8)	6.1% (n=3)	4.1% (n=2)	2.98	1.79
Total (N=91)	33.0% (n=30)	20.9% (n=19)	18.7% (n=17)	6.6% (n=6)	12.1% (n=11)	4.4% (n=4)	4.4% (n=4)	2.75	1.77

Table 23

Comfort Level with Troubleshooting a Cochlear Implant

State	Not At All Comfortable			Neutral			Extremely Comfortable	Mean	Standard Deviation
	1	2	3	4	5	6	7		
MI (n=42)	59.5% (n=25)	19.0% (n=8)	11.9% (n=5)	2.4% (n=1)	2.4% (n=1)	2.4% (n=1)	2.4% (n=1)	1.86	1.42
OH (n=49)	53.1% (n=26)	18.4% (n=9)	14.3% (n=7)	2.0% (n=1)	8.2% (n=4)	2.0% (n=1)	2.0% (n=1)	2.08	1.54
Total (N=91)	56.0% (n=51)	18.7% (n=17)	13.2% (n=12)	2.2% (n=2)	5.5% (n=5)	2.2% (n=2)	2.2% (n=2)	1.98	1.48

Table 24

Comfort Level with Troubleshooting an FM/IR System

State	Not At All Comfortable			Neutral			Extremely Comfortable	Mean	Standard Deviation
	1	2	3	4	5	6	7		
MI (n=42)	38.1% (n=16)	19.0% (n=8)	16.7% (n=7)	7.1% (n=3)	2.4% (n=1)	9.5% (n=4)	7.1% (n=3)	2.74	1.98
OH (n=49)	24.5% (n=12)	18.4% (n=9)	16.3% (n=8)	6.1% (n=3)	22.4% (n=11)	6.1% (n=3)	6.1% (n=3)	3.27	1.91
Total (N=91)	30.8% (n=28)	18.7% (n=17)	16.5% (n=15)	6.6% (n=6)	13.2% (n=12)	7.7% (n=7)	6.6% (n=6)	3.02	1.95

Table 25

Comfort Level with Explaining How to Use an FM/IR System to a Teacher or Other Staff Member

State	Not At All Comfortable			Neutral			Extremely Comfortable	Mean	Standard Deviation
	1	2	3	4	5	6	7		
MI (n=41)	19.5% (n=8)	19.5% (n=8)	12.2% (n=5)	17.1% (n=7)	14.6% (n=6)	14.6% (n=6)	2.4% (n=1)	3.41	1.83
OH (n=49)	6.1% (n=3)	16.3% (n=8)	14.3% (n=7)	8.2% (n=4)	18.4% (n=9)	26.5% (n=13)	10.2% (n=5)	4.37	1.86
Total (N=90)	12.2% (n=11)	17.8% (n=16)	13.3% (n=12)	12.2% (n=11)	16.7% (n=15)	21.1% (n=19)	6.7% (n=6)	3.93	1.90

Table 26

Comfort Level with Recommending Acoustic Modifications for a Classroom

State	Not At All Comfortable			Neutral			Extremely Comfortable	Mean	Standard Deviation
	1	2	3	4	5	6	7		
MI (n=42)	23.8% (n=10)	11.9% (n=5)	11.9% (n=5)	11.9% (n=5)	28.6% (n=12)	11.9% (n=5)	0.0% (n=0)	3.45	1.81
OH (n=49)	6.1% (n=3)	16.3% (n=8)	14.3% (n=7)	12.2% (n=6)	28.6% (n=14)	16.3% (n=8)	6.1% (n=3)	4.14	1.70
Total (N=91)	14.3% (n=13)	14.3% (n=13)	13.2% (n=12)	12.1% (n=11)	28.6% (n=26)	14.3% (n=13)	3.3% (n=3)	3.82	1.77

Table 27

Summary of Comfort Levels with Hearing Technology Tasks Means

	MI	OH	Total
Changing the battery in a HA	4.21	4.92	4.59
Changing the battery in a CI	2.10	2.61	2.37
Changing the battery in an FM/IR System	3.81	4.37	4.11
Completing a Listening Check with a Hearing Aid	3.31	4.53	3.97
Completing a Listening Check with a Cochlear Implant	2.29	2.61	2.46
Completing a Listening Check with an FM/IR System	3.12	4.08	3.64
Troubleshooting a HA	2.48	2.98	2.75
Troubleshooting a CI	1.86	2.08	1.98
Troubleshooting an FM/IR System	2.74	3.27	3.02
Explaining an FM/IR System	3.41	4.37	3.93
Recommending Acoustic Modifications	3.45	4.14	3.82

Note. 1=Not At All Comfortable, 7=Extremely Comfortable

SLP Performance of Hearing Technology Tasks

To determine the types of hearing technology tasks that SLPs working in public elementary schools might complete, participants were asked to select ALL of the tasks that they have performed during the current school year. The same 11 hearing technology tasks relating to hearing aids, cochlear implants, and FM/IR systems were provided. The number of SLPs who have completed each of the tasks at least once during the current school year can be seen in Figure 14.

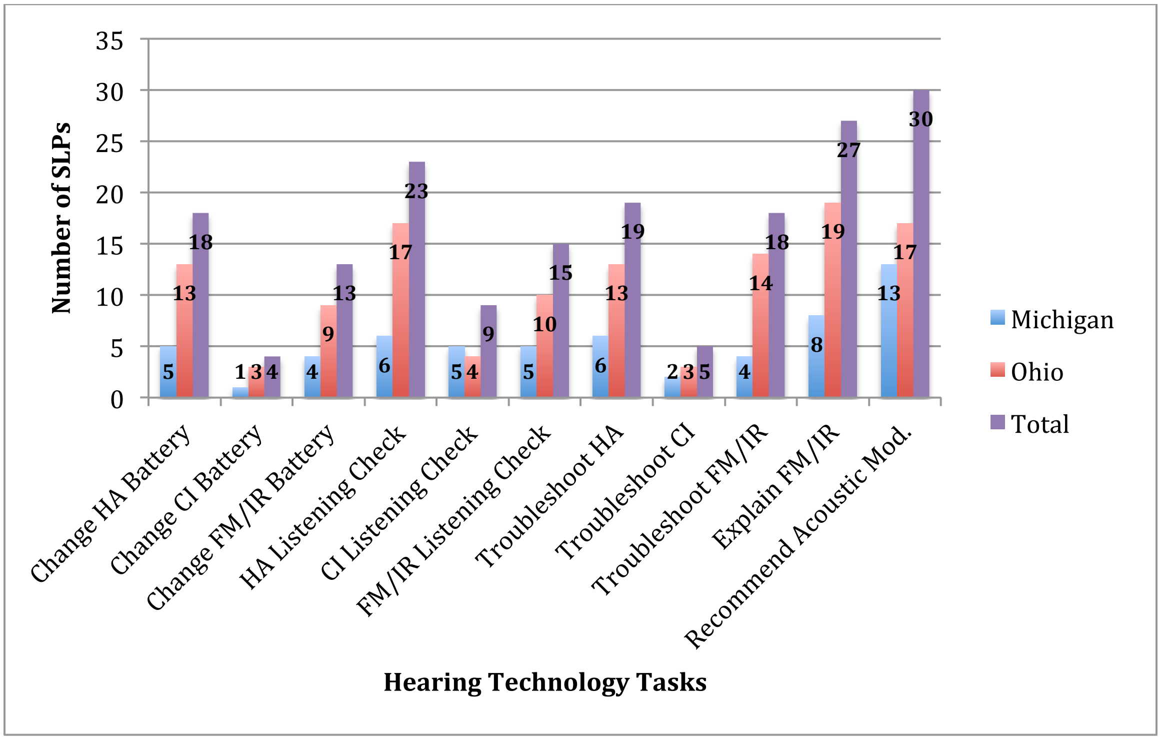

Figure 14. SLP performance of hearing technology tasks. A total of 48 participants made 181 selections.

Person Responsible for Regular Performance of Hearing Technology Tasks

Participants were then asked to report who completes the hearing technology tasks on a regular basis at school. A total of seven options (Not Sure, Parent, School Nurse, Educational Audiologist, SLP, Other Professional, and Not Applicable) were given for each of the nine hearing technology tasks included in this section. As it is possible that more than one person regularly completes these tasks, participants were encouraged to select ALL that apply. See Figures 15 through 23 for an overview of the results for each hearing technology task.

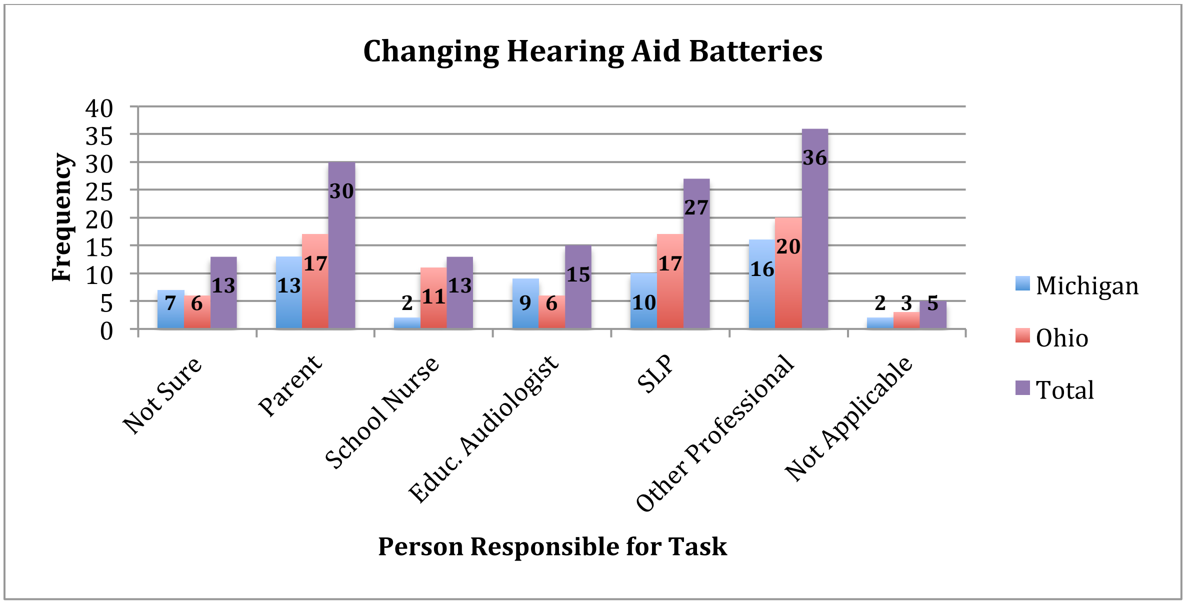

Figure 15. Person responsible for changing hearing aid batteries on a regular basis at school. A total of 89 participants made 139 selections.

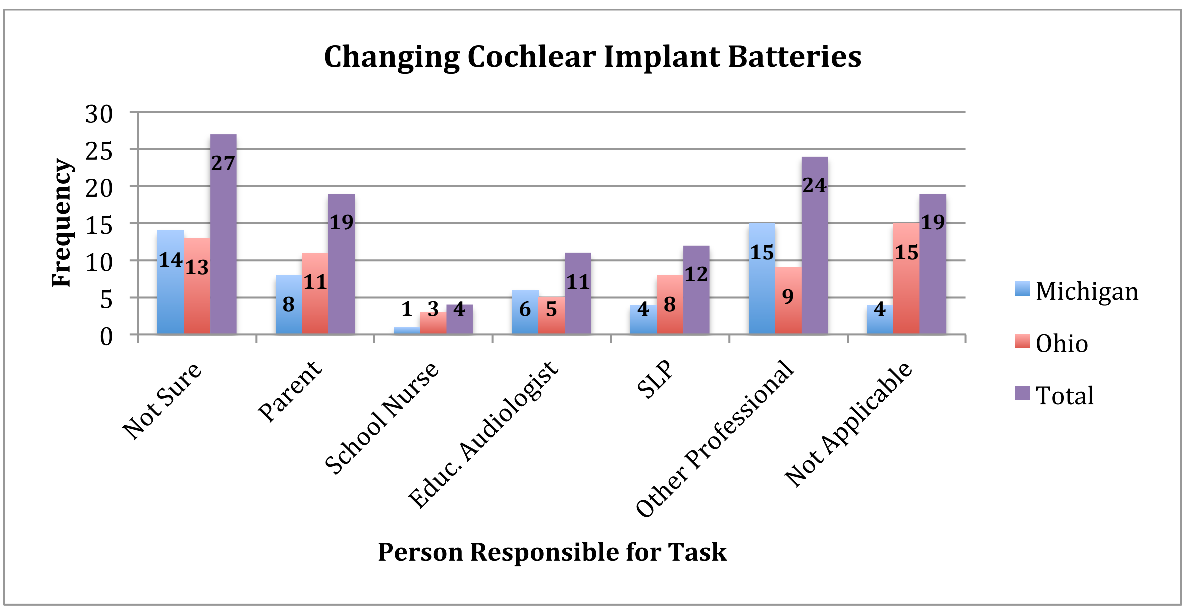

Figure 16. Person responsible for changing cochlear implant batteries on a regular basis at school. A total of 90 participants made 116 selections.

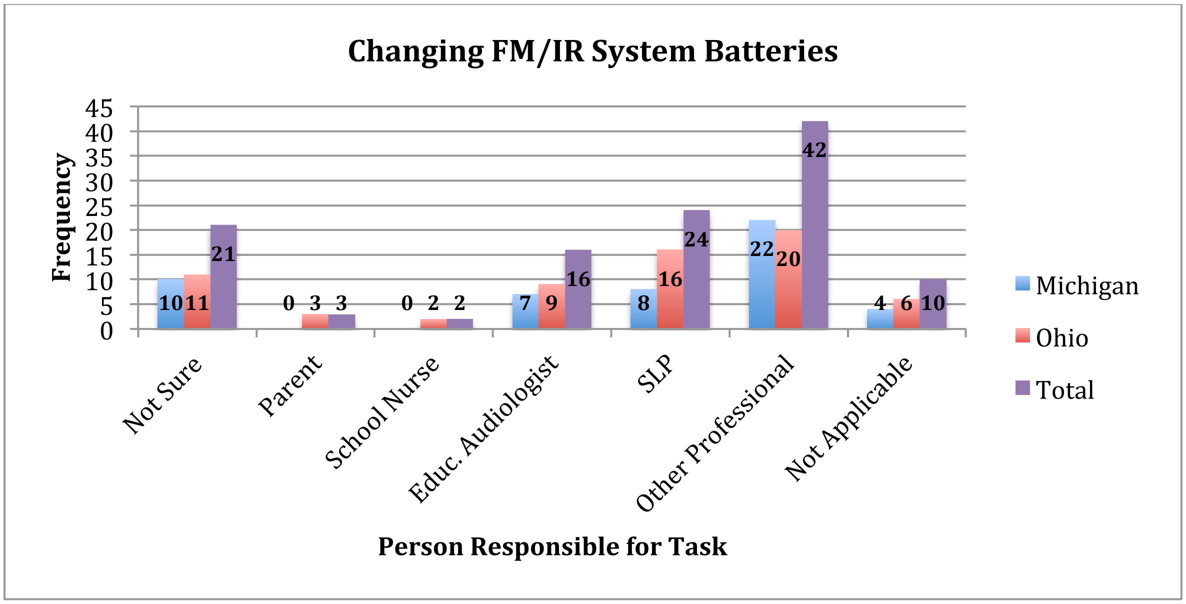

Figure 17. Person responsible for changing FM/IR system batteries on a regular basis at school. A total 90 participants made 118 selections.

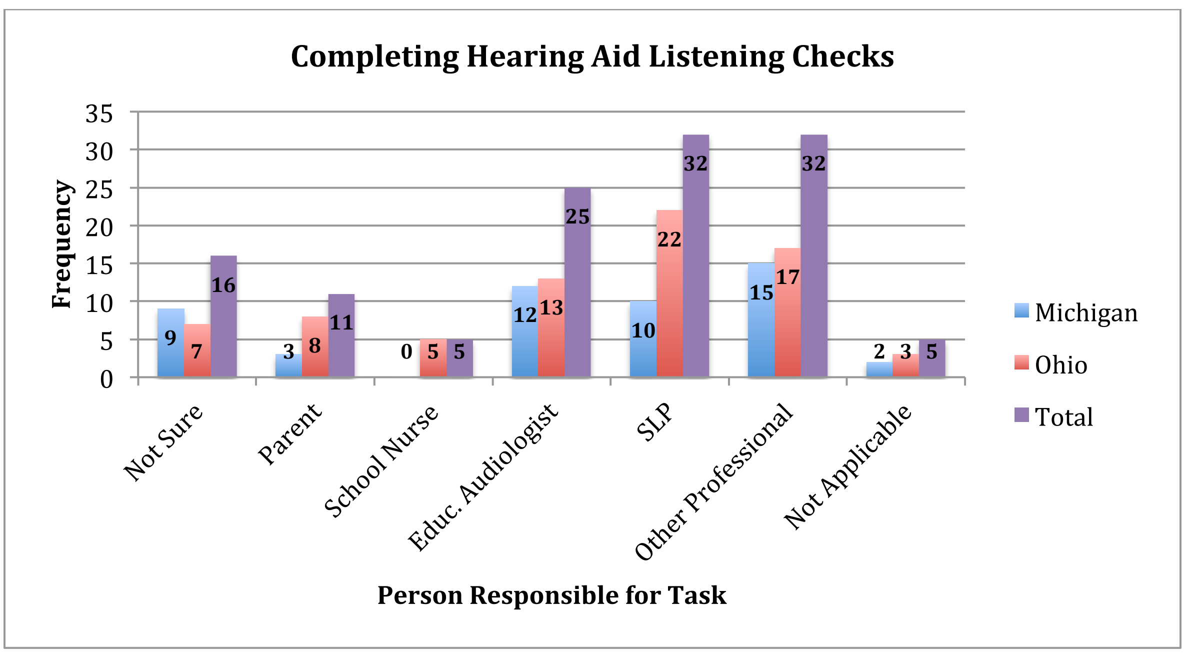

Figure 18. Person responsible for completing hearing aid listening checks on a regular basis at school. A total of 88 participants made 126 selections.

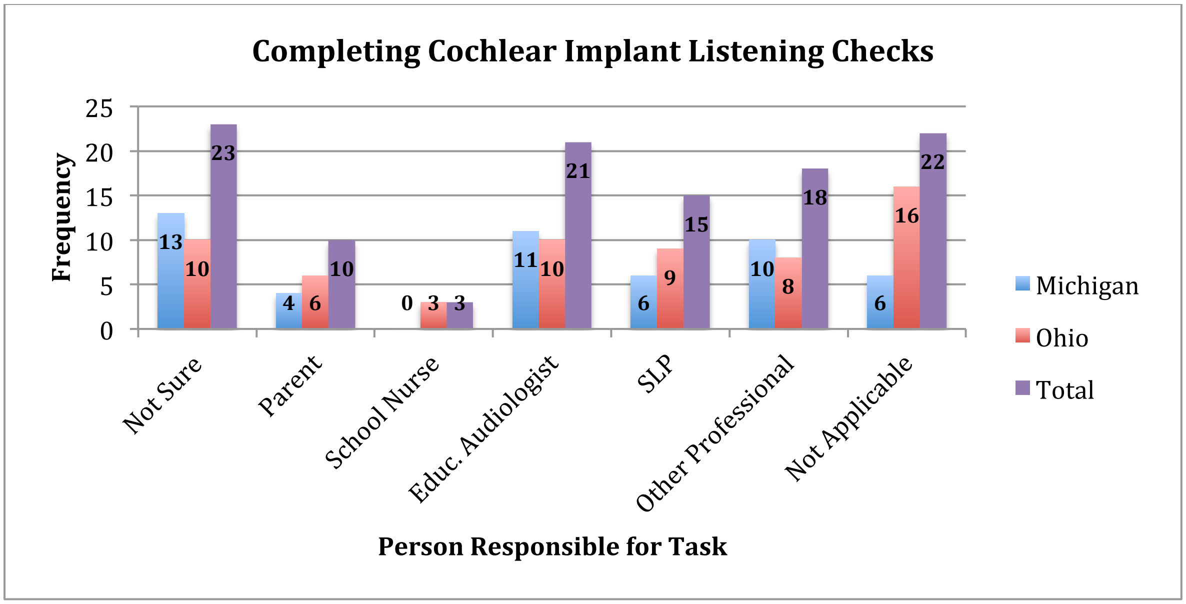

Figure 19. Person responsible for completing cochlear implant listening checks on a regular basis at school. A total of 89 participants made 112 selections.

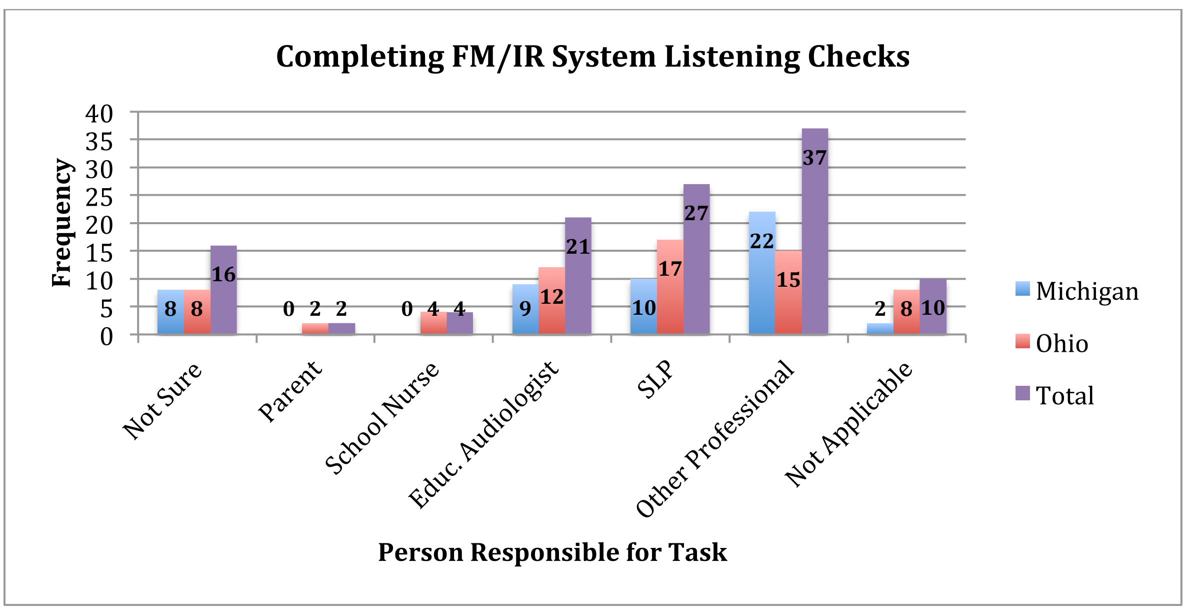

Figure 20. Person responsible for completing FM/IR listening checks on a regular basis at school. A total of 90 participants made 117 selections.

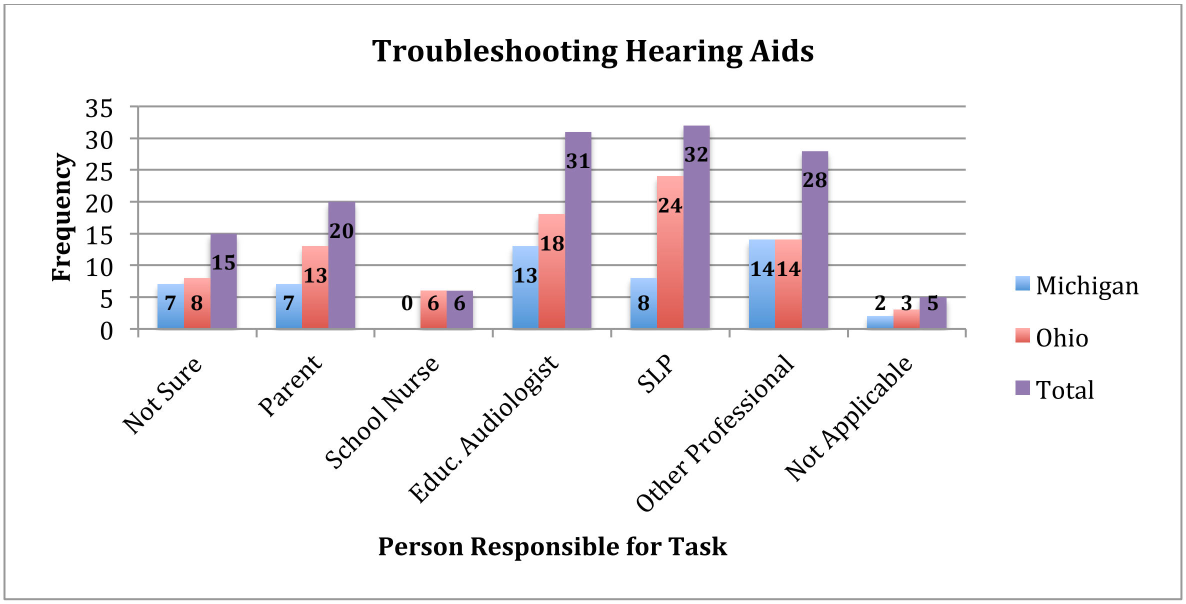

Figure 21. Person responsible for troubleshooting hearing aids on a regular basis at school. A total of 90 participants made 137 selections.

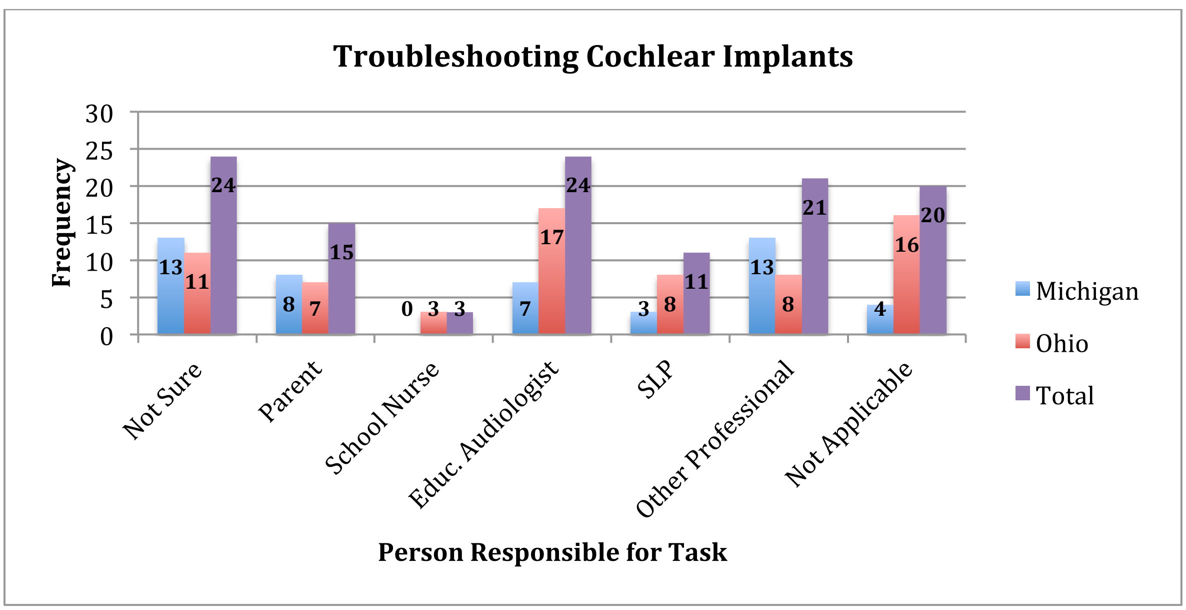

Figure 22. Person responsible for troubleshooting cochlear implants on a regular basis at school. A total of 90 participants made 118 selections.

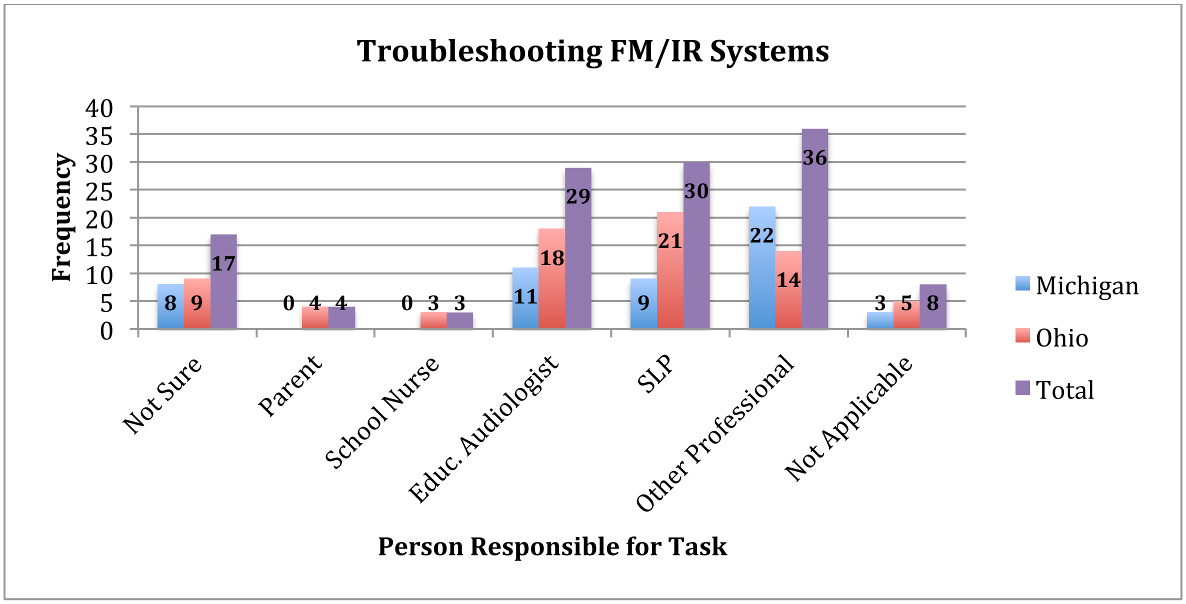

Figure 23. Person responsible for troubleshooting FM/IR systems on a regular basis at school. A total of 89 participants made 127 selections.

Knowledge of Pediatric Cochlear Implant Candidacy

To further examine participant knowledge of cochlear implants, the survey asked participants to indicate their knowledge of pediatric cochlear implant candidacy criteria on a Likert-scale from 1-7. A score of 1 indicated that the participant did not know the candidacy criteria at all, and a score of 7 indicated that the participant was "Extremely Knowledgeable" about cochlear implant candidacy criteria. See Table 28 for the results.

Table 28

Knowledge of Pediatric Cochlear Implant Candidacy Criteria

State	Do Not Know At All			Neutral			Extremely Knowledgeable	Mean	Standard Deviation
	1	2	3	4	5	6	7		
MI (n=42)	19.0% (n=8)	31.0% (n=13)	26.2% (n=11)	4.8% (n=2)	16.7% (n=7)	2.4% (n=1)	0.0% (n=0)	2.76	1.41
OH (n=48)	22.9% (n=11)	20.8% (n=10)	27.1% (n=13)	4.2% (n=2)	18.8% (n=9)	6.3% (n=3)	0.0% (n=0)	2.94	1.59
Total (N=90)	21.1% (n=19)	25.6% (n=23)	26.7% (n=24)	4.4% (n=4)	17.8% (n=16)	4.4% (n=4)	0.0% (n=0)	2.86	1.50

Knowledge of Acoustic Modifications

To assess the participants' knowledge of appropriate acoustic modifications to be made in classrooms, the researcher asked the participants to list the top two acoustic modifications (other than using an FM/IR system) that they would recommend for the physical structure of the classroom to a teacher who has a student with hearing loss in his/her class. A total of 64 participants responded to this question, although 20 of the respondents only shared one acoustic modification. Common responses to this question included the reduction of background or ambient noise (n=16); preferential seating (n=15); seating location near the teacher (n=15); carpeting (n=11); seating location away from noise (n=8); sound absorbing materials (n=6); covering the bottoms of chair legs (n=5); closing classroom doors (n=4); and facing the class while speaking (n=3), among others. Few participants (n=4) shared responses relating to important acoustic characteristics, such as the signal-to-noise ratio, reverberation time, and actually checking the noise levels and acoustic conditions of the classroom. Response lengths varied from one or two words to more descriptive phrases and sentences. Examples of lengthier and descriptive responses are provided below:

> "Preferential seating and strategically setting the room up for instruction to be direct and away from external/environmental noise sources"
>
> "Noise reduction strategies in the classroom--tennis balls on chairs, closing doors to the hallway, reduce use of fans, etc. in the classroom, etc."
>
> "Class room [sic] location if possible – avoid the class next to the gym or cafeteria"

A total of four participants stated that they did not know of two acoustic modifications, while one participant shared that "it is not [his/her] role to do this or know this information." See Appendix G for a full summary of the verbatim responses of participants.

Knowledge of Teaching Strategies

To assess the participants' knowledge of appropriate teaching strategies for students with hearing loss, the researcher asked the participants to list the top two teaching strategies (other than using an FM/IR system) that they would recommend to a teacher who has a student with hearing loss in his/her class. A total of 67 participants responded to this question, but 11 participants only shared one teaching strategy. Common responses included preferential seating or seating location near the teacher (n=25); use of visual aids and cues (n=24); facing the students when speaking (n=16); frequent comprehension checks (n=13); gaining students' attention before speaking (n=10); repetition (n=9); and providing a written copy of instructions and class notes (n=8), among others. A selection of notable responses is provided below:

> "Always talk facing the student (do not turn your back and talk), repeating/rephrasing information/directions as needed, promote self-advocacy (make sure student is very free to ask for clarification/repetition as needed)"
>
> "Using visual cues, closed captioning, and repetition"
>
> "Teachers should repeat what peers say or pass the FM microphone to the speaker"
>
> "Teachers should ask WHAT the student heard vs. IF the student heard"

A total of two participants shared that at their school, a different professional is responsible for suggesting teaching strategies, and one participant was unsure of appropriate teaching strategies. See Appendix H for a full summary of the verbatim responses.

Conclusion of Survey

The final question of the survey asked participants to share any additional questions or comments that were not previously addressed during the survey. This question served to provide constructive feedback to the researcher. A total of 32 participants responded to this question with varying comments relating to the shortage of educational audiologists, as well as explanations of the participant's specific situation at his/her work site, among other things. Survey suggestions were to include an option to indicate the undergraduate training received in audiology coursework (n=1), as well as an "as needed" option to indicate the frequency of contact with an educational audiologist (n=2). A total of two participants raised important questions relating to the funding and support available in schools to provide the necessary services to students with hearing loss. An example of one participant's questions is provided below:

> "What support is received by the school's principal or administrators when modifying a room? How do you convince a school board to pay for an FM system or other means necessary to create acoustically sound room(s)?"

See Appendix I for the full summary of verbatim responses to this question.

Relationships Among Variables

For analysis purposes, the remainder of the study will consider the combined responses of participants from Michigan and Ohio in order to gain a better understanding of the hearing technology knowledge of SLPs working in the Midwestern region overall.

Relationship Between Degree Year and Survey Responses

Data were analyzed by the researcher using several one-way ANOVA tests in order to see if an SLP's degree year had any impact on their responses to the following survey items: appropriateness of training in the six areas; necessity of training in the six areas; overall preparedness to work with hearing technology; and comfort level with performing the 11 hearing technology tasks. Of the 24 ANOVA tests run by the researcher, 2 resulted in significant differences ($p < 0.05$) between the degree year groups. Recall that the four degree year groups reported by participants were 2010-2014 or later (n=20); 2000-2009 (n=27); 1990-1999 (n=28); and 1980-1989 (n=16).

The results revealed a significant difference among the degree year groups on their reported *appropriateness* of training in hearing aids, F (3, 86) = 3.89, p = 0.012. The Tukey HSD post hoc analyses indicated that the 2010-2014 or later graduates (*M*=4.15, *SD*=1.73) were significantly different than the 1980-1989 graduates (*M*=2.60, *SD*=0.99) on the appropriateness of hearing aid training. More specifically, the 2010-2014 or later graduates neither agreed nor disagreed that they received an "appropriate" amount of training in hearing aids, whereas the 1980-1989 graduates disagreed and thus did *not* feel that they received an "appropriate" amount of training in hearing aids. The Tukey HSD post hoc analyses also revealed a significant difference between the 2000-2009 graduates (*M*=3.96, *SD*=1.58) and the 1980-1989 graduates (*M*=2.60, *SD*=0.99). The 2000-2009 graduates somewhat disagreed that their training in hearing aids was "appropriate," while the 1980-1989 graduates again disagreed. No significant differences were found among the degree year groups on the appropriateness of training in the other five areas probed (i.e., diagnostic audiology, aural/auditory rehabilitation, cochlear implants, FM/IR systems, acoustic modifications).

The results also revealed a significant difference among the degree year groups on their reported *necessity* of training in hearing aids, F (3, 86) = 2.92, p = 0.039. The Tukey HSD post hoc analyses showed a significant difference between the 2010-2014 or later graduates (M=6.20, SD=0.70) and the 1980-1989 graduates (M=5.27, SD=0.96). More specifically, the 2010-2014 or later graduates felt that training in hearing aids is more necessary than the 1980-1989 graduates did, although both groups felt that the training is at least somewhat necessary. No significant differences were found among the four degree year groups on the necessity of training in the other five areas; on the overall preparedness to work with hearing technology, F (3, 82) = 1.58, p = 0.201; or on the comfort level with performing each of the 11 hearing technology tasks.

Relationship Between Students with Hearing Loss on the Caseload and Comfort Levels

The researcher ran 11 independent sample t-tests in order to examine any differences between the SLPs who reported ever having 1-5 students with hearing loss on their caseload (n=50) and SLPs who reported ever having 6-21 or more students with hearing loss on their caseload (n=38) on their *comfort levels with hearing technology tasks*. It should be noted that the participants were grouped in this way because the sizes of the initial five groups were not comparable: 1-5 students (n=50); 6-10 students (n=20); 11-15 students (n=9); 16-20 students (n=2); and 21 or more students (n=7). Participants were asked to use a 7-point Likert scale with 1 representing “Not At All Comfortable” and 7 representing “Extremely Comfortable.” The results revealed that SLPs who have had 6-21 or more students with hearing loss on their caseload were more comfortable with hearing technology tasks, with significant differences (p < 0.05) on four of the tasks—changing the battery in a cochlear implant, changing the battery in an FM/IR system, troubleshooting a hearing aid, and troubleshooting a cochlear implant (see Table 29).

Table 29

Comfort Level with Hearing Technology Tasks Depending on Students with Hearing Loss on the Caseload

Task	1-5 Students		6-21 or more Students		t	df	p
	M	SD	M	SD			
Changing the battery in a HA	4.46	(1.66)	4.89	(1.87)	1.13	74.29	0.261
Changing the battery in a CI	1.96	(1.56)	2.92	(2.12)	2.35	65.43	*0.022
Changing the battery in an FM/IR System	3.76	(1.95)	4.74	(1.91)	2.35	80.66	*0.021
Completing a Listening Check with a Hearing Aid	3.78	(1.88)	4.32	(2.20)	1.21	72.62	0.232
Completing a Listening Check with a Cochlear Implant	2.16	(1.74)	2.89	(2.05)	1.78	72.30	0.080
Completing a Listening Check with an FM/IR System	3.46	(1.91)	4.03	(2.10)	1.30	75.57	0.196
Troubleshooting a HA	2.44	(1.51)	3.24	(2.02)	2.04	66.24	*0.046
Troubleshooting a CI	1.66	(1.24)	2.42	(1.70)	2.33	64.84	*0.023
Troubleshooting an FM/IR System	2.78	(1.80)	3.45	(2.11)	1.56	72.37	0.122
Explaining an FM/IR System	3.74	(1.76)	4.38	(1.98)	1.56	72.31	0.123
Recommending Acoustic Modifications	3.60	(1.68)	4.24	(1.79)	1.70	76.94	0.094

Note. $p < 0.05$ indicates significance*

Relationship Between Training and Comfort Level

The researcher ran 16 independent sample t-tests to examine the differences between SLPs with no training in a given hearing technology and SLPs with some type of training in the same technology on their comfort level with performing tasks related to that technology.

Comfort level was reported with a 7-point Likert scale with 1 representing "Not At All Comfortable" and 7 representing "Extremely Comfortable." Three of the t-tests examined differences between SLPs with no training in hearing aids (n=28) and SLPs with varying degrees and types of training in hearing aids (n=55) on their comfort level with changing the battery in a hearing aid, completing a listening check with a hearing aid, and troubleshooting a hearing aid. The results revealed that SLPs with some type of hearing aid training were significantly more comfortable ($p < 0.05$) with all three tasks than SLPs with no hearing aid training (see Table 30).

Table 30

Comfort Level with Hearing Aid Tasks Depending on Hearing Aid Training

	No HA Training		HA Training				
Task	M	SD	M	SD	t	df	p
Changing the battery in a HA	3.93	(1.88)	4.98	(1.72)	-2.48	50.14	*0.017
Completing a Listening Check with a Hearing Aid	3.21	(1.85)	4.31	(2.17)	-2.40	62.55	*0.019
Troubleshooting a HA	2.14	(1.60)	3.04	(1.85)	-2.28	61.67	*0.026

Note. $p < 0.05$ indicates significance*

Three t-tests examined the differences between SLPs with no training in cochlear implants (n=26) and SLPs with varying degrees and types of training in cochlear implants (n=60) on their comfort level with changing the battery in a cochlear implant, completing a listening check with a cochlear implant, and troubleshooting a cochlear implant. The results revealed that SLPs with some type of cochlear implant training were significantly more comfortable ($p < 0.05$) with all three tasks than SLPs with no cochlear implant training (see Table 31).

Table 31

Comfort Level with Cochlear Implant Tasks Depending on Cochlear Implant Training

	No CI Training		CI Training				
Task	M	SD	M	SD	t	df	p
Changing the battery in a CI	1.81	(1.67)	2.72	(1.95)	-2.20	54.98	*0.032
Completing a Listening Check with a Cochlear Implant	1.58	(1.03)	2.87	(2.05)	-3.88	82.08	*<0.001
Troubleshooting a CI	1.27	(0.53)	2.30	(1.64)	-4.37	80.07	*<0.001

Note. p < 0.05 indicates significance*

Four t-tests examined the differences between SLPs with no training in FM/IR systems (n=22) and SLPs with varying degrees and types of training in FM/IR systems (n=65) on their comfort level with changing the battery in an FM/IR system, completing a listening check with an FM/IR system, troubleshooting an FM/IR system, and explaining how to use an FM/IR system. The results revealed that SLPs with some type of FM/IR training were significantly more comfortable ($p < 0.05$) with all four tasks than SLPs with no FM/IR training (see Table 32).

An additional four t-tests examined the differences between SLPs with *on-site* training in FM/IR systems (n=34) and SLPs with *no* on-site training in FM/IR systems (n=53) on their comfort level with the same four FM/IR tasks noted above. These additional tests were run because the group sizes of SLPs with on-site training (n=34) and SLPs with no on-site training (n=53) were more comparable than the group sizes of no training at all (n=22) and some type of training (n=65). The results revealed that SLPs with *on-site* FM/IR training were more comfortable performing the FM/IR tasks than SLPs with *no* on-site training, with significant differences ($p < 0.05$) on three of the four tasks (see Table 32).

Table 32

Comfort Level with FM/IR Tasks Depending on FM/IR Training

Task	No FM/IR Training M	SD	FM/IR Training M	SD	t	df	p
Changing the battery in a FM	3.00	(1.80)	4.57	(1.91)	-3.48	38.28	*0.001
Completing a Listening Check with an FM/IR System	2.82	(1.87)	3.97	(2.00)	-2.45	38.55	*0.019
Troubleshooting an FM/IR System	2.23	(1.54)	3.35	(2.03)	-2.72	47.45	*0.009
Explaining an FM/IR System	2.95	(1.68)	4.38	(1.84)	-3.34	39.72	*0.002

Task	No FM/IR On-Site M	SD	FM/IR On-Site M	SD	t	df	p
Changing the battery in a FM	3.64	(1.93)	5.00	(1.83)	3.31	73.41	*0.001
Completing a Listening Check with an FM/IR System	3.40	(1.95)	4.12	(2.09)	1.62	66.88	0.111
Troubleshooting an FM/IR System	2.66	(1.75)	3.71	(2.14)	2.38	60.45	*0.020
Explaining an FM/IR System	3.53	(1.88)	4.79	(1.67)	3.24	73.90	*0.002

Note. p < 0.05 indicates significance*

Another t-test examined the differences between SLPs with no training in the acoustic modifications of classrooms (n=24) and SLPs with some training in the acoustic modifications of classrooms (n=62) on their comfort level with recommending such modifications. The results revealed a significant difference ($p < 0.05$) between the two, t (35.11) = -3.72, $p = 0.001$, such that SLPs with some type of acoustic modification training (M=4.34, SD=1.50) were more comfortable recommending the modifications than SLPs with no training (M=2.75, SD=1.87).

The final t-test examined the differences between SLPs with *on-site* training in acoustic modifications (n=31) and SLPs with *no* on-site training in acoustic modifications (n=55) on their comfort level with recommending such modifications. Again, this additional test was run because the group sizes of SLPs with on-site training (n=31) and SLPs with no on-site training (n=55) were more comparable than the group sizes of no training at all (n=24) and some type of training (n=62). The results revealed a significant difference ($p < 0.05$) between the two, t (79.39) = 3.76, $p < 0.001$, such that SLPs with *on-site* acoustic modification training (M=4.71, SD=1.30) were more comfortable recommending acoustic modifications than SLPs with *no* on-site acoustic modification training (M=3.44, SD=1.82).

Discussion

The remainder of this chapter will provide a discussion of the statistical findings previously reported. An explanation of how these findings relate to past literature on the training, knowledge, and comfort of SLPs regarding hearing technology will be included as well.

Clinical Experience in Educational Settings

Work Status

The two largest groups of participants work full time at more than one school (56.4%) or work full time at only one school (29.8%). In comparison, few of the participants work part time at either one or more than one school (13.8%). These results somewhat support the findings of Katz, Maag, Fallon, Blenkarn and Smith (2010) that 69.6% of public school SLPs work in one or two schools (p. 143). If more SLPs are working full time at one or two schools, they may have more time to work directly with students with hearing loss and thus should be able to serve as a resource for them regarding their hearing technology.

Students with Hearing Loss on the Caseload

The clear majority of SLPs surveyed (96.8%) have had at least one student with hearing loss on their caseload during their time working at a public elementary school. Although many report having worked with just 1-5 students with hearing loss (57.8%), one student should be enough to warrant at least a basic understanding of hearing technology. Furthermore, *currently* having a student with hearing loss on one's caseload should be an even greater reason to be knowledgeable of and comfortable with hearing technology. A total of 90 participants fit into this category of currently working with a student with hearing loss, and yet many had reportedly not received sufficient training in these areas and many do not feel very comfortable working with hearing technology.

Contact with an Educational Audiologist

Educational audiologists are important professionals when it comes to supporting students with hearing loss. Unfortunately, many participants (37.6%) reported that their school or school district does not have an educational audiologist. Although this result does not represent all schools and school districts across the country, Watson and Martin (1999) identified similar findings more than 15 years ago (p. 4). Even if participants' schools did employ an educational audiologist in the current study, 17.2% and 9.8% reported no face-to-face *or* spoken or written contact with that professional, respectively. Although Compton, Tucker, and Flynn (2009) found slightly higher (i.e., "worse") reports of no contact with an educational audiologist (33.3%), the results from the current study are still quite concerning (p. 147). A total of 24.7% of participants reported face-to-face contact with an educational audiologist 1-2 times per school year, which is slightly better than Compton and colleagues' (2009) finding of 15.7% (p. 147). Because educational audiologists are oftentimes either not employed by schools or not always available, it is imperative that an on-site professional is familiar enough with hearing technology to provide the appropriate and necessary services to students with hearing loss.

Students with Cochlear Implants on the Caseload

Approximately half of the respondents (50.5%) have never had a student with a cochlear implant on his/her caseload, while most of the other half (48.4%) have worked with just 1-5 students with cochlear implants. Although cochlear implants are not yet "incredibly" common in public schools, these results suggest that SLPs working in schools may come across a student who utilizes one or two cochlear implants, making it important for them to have a working knowledge of and comfort with these devices.

Cochlear Implant Resources

When working with a student with a cochlear implant, SLPs may find themselves in need of resources on cochlear implants to better enable them to provide services to such a student. The most commonly reported resources were diagnostic reports (n=31) and printed materials from cochlear implant manufacturers (n=26). These resource types are likely provided to the SLP through the students' IEP and from cochlear implant manufacturers. These findings may suggest that such resources are more accessible to school-based SLPs than other resources. Furthermore, cochlear implant manufacturers should be aware that they have the opportunity to benefit students with cochlear implants and school professionals by providing schools with more of their product materials.

Education and Training

Academic Training Received

Participants reported the type of training they received in six different areas relating to hearing loss and technology. *Required graduate courses* were the largest sources of training in diagnostic audiology, aural/auditory rehabilitation, hearing aids, and cochlear implants. The largest sources of training in FM/IR systems and acoustic modifications of the classroom were *on-site training*. Although many participants reported graduate training in diagnostic audiology (n=63) and aural/auditory rehabilitation (n=75), fewer reported graduate training in hearing aids (n=36); cochlear implants (n=30); and FM/IR systems (n=28). These three areas also had higher reports of no training. These results in total indicate that although the foundational knowledge from training in diagnostic audiology and aural/auditory rehabilitation appeared to be common, specific training regarding the various forms of hearing technology is much less common. It is this training, arguably, that will produce SLPs who are confident and capable to work with and assist students with hearing loss who are most often using the range of technologies noted above.

Past studies reporting on SLPs' training in hearing technology overall similarly reported a lack of sufficient training. Compton and colleagues (2009) found that 33.6% of SLPs working in public schools in North Carolina received either no graduate instruction or very limited graduate instruction regarding hearing aids (p. 146). Similarly, a total of 28 participants in this study reported no training in hearing aids. Lass and colleagues' (1989) landmark study on SLPs' knowledge of and exposure to hearing aids suggested continuing education programs in order to keep practicing SLPs knowledgeable of the current technology (p. 117). Although few participants reported receiving continuing education training in diagnostic audiology and aural/auditory rehabilitation, larger numbers reported continuing education training in the other four areas probed in this study.

Past studies on cochlear implant training in particular have indicated that many SLPs do not receive graduate training in this area (Compton et al., 2009, pp. 145-146; Cosby, 2009, p. 6). As cochlear implants were only formally approved for use in children approximately 25 years ago (NIH, 2010, p. 1), this finding is not incredibly surprising. The training results for cochlear implants in this study, however, are fairly comparable to the results for training in hearing aids. The number of SLPs who reported no training in cochlear implants (n=26) is similar to the number of SLPs who reported no training in hearing aids (n=28), and the number with required graduate training in cochlear implants (n=30) is similar to the number with required graduate training in hearing aids (n=36). This finding suggests that cochlear implants are being considered as minimally important as hearing aids when it comes to hearing technology training.

Appropriateness of Academic Training

In order to more fully examine participants' training regarding hearing technology, participants were asked to rate the appropriateness of their training in six areas by indicating the extent they agreed that the amount of training they received was deemed "appropriate." Overall, participants' responses ranged from somewhat disagreeing to neither agreeing nor disagreeing (3.0-4.0). Translating these ratings into "appropriateness," the most appropriate amount of training was received in aural/auditory rehabilitation and diagnostic audiology, and the least appropriate amount of training was in cochlear implants. It should be noted, however, that most participants reported neutral responses of 4.0, while few reported the more extreme responses of "Strongly Disagree" (1.0) or "Strongly Agree" (7.0). These findings further suggest that even if SLPs are receiving training in these areas, it may not be sufficient to work with hearing technology. More than 20 years ago, Lass and colleagues (1989) also reported inadequate hearing aid training (p. 117). Despite the increased awareness of hearing aids and the increasing number of students with hearing loss in schools, training in this area appears to still not be appropriate.

Necessity of Academic Training

Determining SLPs' perception of the necessity of training in these hearing technology related areas is helpful as a justification to include these areas in future graduate curricula. If SLPs currently working in schools believe that this type of training is necessary to their job, then graduate curricula should adapt to better prepare SLPs for their future jobs.

The overall mean scores reported by participants range between somewhat necessary and necessary (5.0-6.0) for the six training areas. Training in acoustic modifications and FM/IR systems received the highest mean scores and thus were considered slightly more necessary, whereas diagnostic audiology received the lowest mean score and was considered "least" necessary. Interestingly, the least necessary area (diagnostic audiology) often receives the most training in graduate programs. The lower ratings may reflect that the foundational knowledge gained from training in diagnostic audiology is perceived as not as relevant when working with these students and their specific technologies. Diagnostic audiology, however, is still considered an important training area necessary to fully and better understand the other, more specialized areas. Acoustic modifications and FM/IR systems are perceived as slightly more necessary, suggesting that these are important, timely, and relevant areas for SLPs working in schools. Another interesting result was that ratings of necessary training in cochlear implants received a lower mean score than necessary training in hearing aids. Perhaps because hearing aids are more prevalent than cochlear implants in schools, SLPs found training in them more necessary.

Preparedness to Work with Hearing Technology

Participants reported their "overall" graduate training preparedness by reporting the extent to which they agreed that their graduate curricula prepared them to work with the range of currently available hearing technology. The mean scores indicated that participants "Somewhat

Disagreed" with the statement (*M*=3.69), meaning that their graduate training only somewhat prepared them to work with such hearing technology. Overall, the responses were fairly equally spread across the Likert-scale, with few participants responding "Strongly Disagree" (5.8%) and even fewer responding "Strongly Agree" (1.1%). Although these results do not indicate a profound deficiency in graduate training on hearing technology, there is clearly still the need for better preparation.

Areas in Need of Training

Participants indicated the areas that they felt most in need of training. The largest number of responses were for training in acoustic modifications (n=49), FM/IR systems (n=48), cochlear implants (n=43), and hearing aids (n=43). Slightly fewer participants reported being in need of training in aural/auditory rehabilitation (n=31), and very few felt that they need training in diagnostic audiology (n=10). The last result indicates that either diagnostic audiology training is unnecessary, or that there is already sufficient or adequate training provided in the area. The results are also further evidence that current hearing technology training appears to be inadequate.

Knowledge and Comfort with Technology

Comfort Level with Hearing Technology Tasks

The highest comfort level reported by participants on any of the hearing technology tasks ranged from neutral to somewhat comfortable (changing the battery in hearing aid, *M*=4.59), indicating that overall, participants are not comfortable performing any of these tasks. The lowest comfort level mean score reported was for troubleshooting a cochlear implant (*M*=1.98). Overall, the participants were most comfortable with changing batteries in devices, followed by performing listening checks, and then troubleshooting devices. This finding seems logical because changing the batteries in a device is arguably the easiest task of the three and requires the least amount of training. Troubleshooting a device, on the other hand, often requires more direct instruction and experiences. Regarding the types of hearing technology focused on, the participants were most comfortable with hearing aids, closely followed by FM/IR systems, and least comfortable with cochlear implants. These findings are likely indicative of the prevalence of each of these devices in schools. Although some comparisons can be made, it is important to note that the comfort levels were not considered high enough for any of the tasks or pieces of technology. The participants were also somewhat uncomfortable with explaining an FM/IR system to a teacher and recommending acoustic modifications for classrooms. These findings may suggest the need for a change in graduate curricula and the requirement of clinical experiences working with hearing technology in order to help to improve comfort levels with such tasks.

SLP Performance of Hearing Technology Tasks

The most commonly performed tasks by participants were recommending acoustic modifications (n=30) and explaining how to use an FM/IR system (n=27). The least commonly performed tasks by participants were changing the batteries in and troubleshooting a cochlear implant (n=4 and n=5, respectively). The frequency of performance of all of these tasks were generally low, but even the tasks performed more frequently by SLPs were not reported as having high comfort levels or having received appropriate training. Although SLPs may not be performing all of these tasks themselves, for better or worse, they are performing some of them despite their unpreparedness to do so.

Person Responsible for Regular Performance of Hearing Technology Tasks

Many of the hearing technology tasks were reported to be performed regularly in most cases by "Other Professional." SLPs were reported as most often being the professional to complete listening checks for hearing aids and troubleshooting hearing aids, while educational audiologists were reported to be responsible for troubleshooting cochlear implants. Interestingly, school nurses were not largely responsible for any of the tasks, and parents were only largely responsible for changing hearing aid batteries.

The regular performance of many of these tasks varies, but they are clearly not always completed by SLPs or educational audiologists, as might be expected. These tasks are probably not performed by educational audiologists because as previously described, many schools do not have an educational audiologist. The "Other Professional" chosen for many of the tasks could be a specialist other than an educational audiologist. A suggestion for future research would be to probe survey participants to further specify or describe this "Other Professional."

Knowledge of Cochlear Implant Candidacy

Another indicator of participants' knowledge regarding cochlear implants is their self-reported level of knowledge of pediatric cochlear implant candidacy criteria. Overall, participants' knowledge ranged between unknowledgeable and somewhat unknowledgeable (M=2.86). The participants seem to, overall, have the least experience with cochlear implants; thus their low knowledge of candidacy criteria was not considered surprising. Knowledge of cochlear implant candidacy, furthermore, does not directly relate to the school services provided to students with cochlear implants, making it less important to know, therefore less likely to be known by SLPs working in public schools.

Knowledge of Acoustic Modifications

Among the many services and support provided to students with hearing loss, should be appropriate acoustic modifications of the classroom. If classrooms are not acoustically appropriate, SLPs or educational audiologists, if present, should advise and implement modifications that will improve the acoustic environment for students with hearing loss (Teagle & Moore, 2002, p. 167). In order to suggest or make such modifications, SLPs need to be knowledgeable about them. To assess this knowledge, the researcher asked participants to share the top two acoustic modifications that they would recommend for the physical structure of the classroom to a teacher who has a student with hearing loss in his/her class. One of the most important modifications in this type of classroom is of course an FM/IR system (Flexer & Rollow, 2009, p. 18; Johnson, 2012, p. 395). As this modification is hopefully an obvious choice for SLPs, especially because of its reference on previous survey items, the researcher chose to ask specifically for modifications *other than* using an FM/IR system.

Several participants gave “preferential seating” as one of their top two modifications. Although a good idea in theory, placing a student near the front of the classroom or near the teacher is not always feasible because teachers are often required to move throughout the classroom (Flexer, Wray, & Ireland, 1989, pp. 14-15; Richburg & Goldberg, 2005, p. 14). Some participants wrote about the student’s seating location in general, as well as seating them near the teacher and away from noisy parts of the classroom. When performed in conjunction with using an FM/IR system, seating students in this way would be helpful to improving the acoustic environment for that child (Schafer & Sweeney, 2012, p. 16). Participants shared recommendations for carpeting, using sound absorbing materials, covering the bottoms of chair legs, closing classroom doors, and reducing background noise by turning off noisy appliances when they are not in use—all of which are recognized in the literature as beneficial acoustic modifications (ASHA, n.d. a, p. 3; Oticon, n.d., p. 13; Schafer & Sweeney, 2012, p. 16). Few participants (n=4) stated that they did not know of acoustic modifications, and several participants (n=20) only thought of one response. Additionally, many participants (n=31) did not attempt to answer the question at all. These results suggest that although many SLPs may be aware of some appropriate acoustic modifications to be made, this is not an area with which all SLPs are completely familiar. Another possibility for these results is that another professional is more likely than the SLP to advise and implement acoustic modifications in classrooms. One participant shared that "it is not [his/her] role to do this or know this information," further suggesting the possibility of another responsible professional, and arguably, the plea for more educational audiologists to be available to serve these children in inclusive settings today.

Knowledge of Teaching Strategies

Along with an appropriate acoustic environment, students with hearing loss also benefit from specific teaching strategies employed by their teacher. A school professional, possibly an SLP or educational audiologist, needs to encourage teachers to implement such teaching strategies to benefit both students with hearing loss *and* students with "typical" hearing (Teagle & Moore, 2002, p. 167). In order to examine participants' ability to complete this task and their knowledge of these teaching strategies, participants were asked to list two teaching strategies that they would recommend to a teacher with a student with hearing loss in his/her class. Again, participants were requested to share recommendations *other than* an FM/IR system because of its reference on previous survey items.

One of the most common responses from participants related to preferential seating and strategically seating the student near the teacher or point of instruction. Although the researcher considers student seating to be more related to classroom modifications than to teaching strategies, it could be considered a teaching strategy. As previously mentioned, preferential seating without also using an FM/IR system is not always practical or beneficial because teachers often move around classrooms (Flexer, et al., 1989, pp. 14-15; Richburg & Goldberg, 2005, p. 14). Another common response shared by participants was to always face students when speaking. This is beneficial acoustically because it projects the teacher's voice better, and is helpful for providing speechreading and facial cues (ASHA, n.d. a, p. 7). Participants also suggested that teachers gain students' attention before they start speaking, possibly by making eye contact with them. Gaining students' attention in this way helps to ensure that they are attentive and prepared to listen (Stith & Drasgow, 2005, p. 8).

Other recognized and beneficial teaching strategies shared by participants included the use of visuals (Schafer & Sweeney, 2012, p. 16; Teagle & Moore, 2002, p. 167); written outlines, notes, and instructions (ASHA, n.d. a, p. 7; Stith & Drasgow, 2005, p. 9); verbal repetition (Flexer et al., 1989, p. 18); and checking with students for comprehension (Schafer & Sweeney, 2012, p. 16). Another teaching strategy recommended in the literature is pre- and post-tutoring of materials (Chute & Nevins, 2006, p. 50; Stewart & Kluwin, 2001, p. 258). Only one participant suggested the related strategy of "preteaching of vocabulary pertaining to subject matter." Interestingly, two participants responded that recommending teaching strategies was not their role and one participant reported that they were "not sure" of any strategies. Additionally, a fairly large number of participants chose not to respond to the question at all (n=28). These responses suggest that many SLPs are familiar enough with appropriate teaching strategies to advise a teacher with a student with hearing loss in his/her class.

Relationships Among Variables

Degree Year and Appropriateness of Training

In general, the more recent or "newer" graduates perceived they had received a more "appropriate" amount of hearing and hearing technology training than "older" graduates, with significant differences specifically for training in hearing aids between the 2010-2014 or later graduates and the 1980-1989 graduates, as well as between the 2000-2009 and 1980-1989 graduates. Hearing aids have been utilized to "improve" hearing abilities for many years. As the use of hearing aids became more common over the years, the need for hearing aid training increased. It is likely, therefore, that more recent graduates received more hearing aid training because when they were graduate students, the need to understand and be able to work with hearing aids was greater than it was when the older graduates were being trained. Cochlear implants, on the other hand, are a fairly new technology in comparison. The lack of significant differences found between "young" and "old" graduates on cochlear implant training, therefore, is not surprising because even new graduates are unlikely to have received a lot of training relating to this newer technology. The lack of significant differences between degree year groups on the appropriateness of FM/IR training is likely attributed to the fact that training in these areas has been lacking consistently over the years. It should be noted that due to the large number of statistical tests that were completed using the same data, the researcher could have chosen a lower *p*-value to determine significance. Because running multiple statistical tests increases the chance of committing a Type I error, lowering the *p*-value is often suggested. Although the researcher did not choose to lower the significance level, the majority of the relationships noted were significant at $p < 0.03$ and several were significant at $p < 0.01$.

Degree Year and Necessity of Training

In general, "newer" graduates indicated that hearing and hearing technology training was more necessary than "older" graduates, with one significant difference between the 2010-2014 or later graduates and 1980-1989 graduates regarding the necessity of hearing aid training. Newer graduates are likely to be more familiar with current practices, current research findings, and current technologies. With this increased familiarity, ideally comes a more realistic understanding of what is necessary for SLPs to appropriately work with or treat different populations, thus explaining the differences between degree year groups on the necessity of hearing technology training.

Students with Hearing Loss on the Caseload and Comfort Levels

It is generally accepted that more experience with something results in a perception of being more comfortable. The study's findings suggest the same when it comes to experience with students with hearing loss and comfort levels with performing hearing technology tasks. SLPs who have ever had 6-21 or more students with hearing loss on their caseload were overall more comfortable performing hearing technology tasks than SLPs who have had only 1-5 students with hearing loss on their caseload. These differences were significant for four hearing technology tasks in particular: changing the battery in a cochlear implant, changing the battery in an FM/IR system, troubleshooting a hearing aid, and troubleshooting a cochlear implant. Woodford (1987) similarly found that SLPs with experience working with students with hearing loss performed better on practical tests regarding hearing aids than SLPs without this experience (p. 315). A larger number of students with hearing loss on the caseload presumably means more experience working with them and their hearing technology, resulting in a higher comfort level with and better capability of performing hearing technology tasks.

Training and Comfort Levels

Overall, SLPs with hearing technology training were more comfortable performing hearing technology tasks. Survey responses showed this to be true for hearing aid, cochlear implant, FM/IR system, and acoustic modification training. In fact, significant differences on reported comfort levels were found between SLPs with training and SLPs with no training for almost all of the hearing technology tasks. Significant differences were also found between SLPs with and without on-site training in FM/IR systems and acoustic modifications—areas of training that are more likely to be provided "on-site" than as a part of graduate training. Although most mean comfort levels ranged from 3.0-4.0 ("Somewhat Uncomfortable" to "Neutral") even with training, it is still significant that receiving training improved SLPs' comfort levels with hearing technology tasks.

Conclusion

This chapter provided the statistical findings from the current study regarding SLPs' hearing technology knowledge, as well as a discussion of those findings. The overall explanation of the current study's major conclusions and how they relate to the field of speech-language pathology will be included in the following, final chapter.

CHAPTER V: CONCLUSIONS AND RECOMMENDATIONS

The current study has investigated school-based speech-language pathologists' knowledge of hearing technology by electronically surveying speech-language pathologists (SLPs) currently working in elementary schools in the states of Michigan and Ohio. This final chapter will describe the major conclusions of the study and their implications, the limitations of the study, recommendations for future research, as well as a brief reflection of final thoughts.

Major Conclusions

The first major conclusion of this study was that SLPs working in public schools are likely to come across a student with hearing loss at some point in their careers. For many SLPs, those students will include cochlear implant users. The success of Universal Newborn Hearing Screenings (UNHS) and the resulting increased provision of Early Intervention (EI) services are arguably the cause of the increased number of students with hearing loss who choose to utilize hearing technology and are placed in the mainstream classroom at least 80% of the school day (U.S. Department of Education, 2015a). Although hearing loss is still considered a "low-incidence" exceptionality nationally (U.S. Department of Education, 2015b), SLPs should still be prepared to work with this population.

SLPs who do not feel prepared to work with students with hearing loss, especially regarding their hearing technology, may hope to turn to an educational audiologist for assistance and support. Unfortunately, the second major conclusion of this study is that many SLPs have little to no contact with an educational audiologist. This has been the case for some time (Compton, Tucker, & Flynn, 2009, p. 147; Watson & Martin, 1999, p. 4), further warranting the need for SLPs to be comfortable working with students with hearing loss and their technology.

The third major conclusion of this study was that hearing technology training has many shortcomings. The most obvious issue is a lack of training in many, and in some cases all, types of hearing technology. The SLPs that have received training in some of these areas, however, often reported that it was insufficient and that their graduate curricula did not, overall, prepare them to work with hearing technology. Many also reported a need for training in hearing aids, cochlear implants, FM systems, as well as acoustic modifications of classrooms.

Further evidence of the hearing technology training shortcomings is that SLPs are not comfortable performing hearing technology tasks (e.g., battery changes, listening checks, troubleshooting), the fourth major conclusion of this study. The hearing technology tasks included in the study are those that need to be completed in order to appropriately provide services to students with hearing loss (Johnson & Seaton, 2012, p. 18; Schafer & Sweeney, 2012, pp. 14-16; Thibodeau & Johnson, 2005, p. 37). Because many SLPs reported little to no contact with educational audiologists, the question becomes, who is performing these tasks? Although SLPs did not self-report themselves as having sole responsibility for completing the majority of tasks, they did report performing many hearing technology tasks at least once during the current school year.

Comfort levels with hearing technology tasks were affected by two things—experience working with students with hearing loss and hearing technology training. The fifth major conclusion of the current study is that working with more students with hearing loss and receiving some type of hearing technology training resulted in significantly higher levels of comfort with performing hearing technology tasks. This finding serves as evidence that it is possible for comfort with hearing technology to be increased and improved.

The sixth and final major conclusion of this study relates to cochlear implants. Of all of the training areas probed, SLPs reported receiving the least "appropriate" amount of training in cochlear implants. Of all hearing technology tasks performed by participants, cochlear implant tasks were performed the least. And of the comfort levels with performing hearing technology tasks, participants reported being the least comfortable with cochlear implant tasks. Cochlear implants are clearly the most difficult hearing technologies for SLPs, even though almost half of the participants reported ever having 1-5 students with a cochlear implant on their caseload.

Implications of the Research Findings

The conclusions from the results of this study lend themselves to one major implication for those who provide training to SLPs—a needed revision or adaptation to graduate curricula to include more training relating to hearing and hearing technology. Approximately 40% of SLPs work in schools (U.S. Department of Labor, 2015, para. 2), and as previously noted, these SLPs are likely to work with students with hearing loss. Even one student with hearing loss on a caseload should be justification enough to be at least familiar with hearing technology. As such, SLPs working in schools perceive hearing technology training as necessary. Despite the necessity of this training, SLPs either do not receive such training, or do not feel well enough prepared by their training. Further evidence of this unpreparedness is that SLPs do not feel comfortable performing the necessary hearing technology tasks, even though some SLPs actually report performing them regularly. When SLPs do receive training in a particular hearing technology (e.g., hearing aids), they tend to be more comfortable performing related hearing technology tasks (e.g., troubleshooting a hearing aid). Training, therefore, does impact comfort levels with hearing technology tasks. Training should also include clinical experiences, because past studies, as well as the current study, have shown that SLPs who have worked with more students with hearing loss feel more comfortable performing hearing technology tasks. To better prepare SLPs to effectively support students with hearing loss, and their teachers, graduate curricula needs to include hands-on training in the skills necessary to do so.

Although a change in graduate curricula is believed to be beneficial, we cannot ignore the needs of SLPs who have already completed their graduate training. Another important implication is that more needs to be done in order to support SLPs currently working in schools in regard to hearing technology—particularly cochlear implants. Continuing education courses and on-site training from educational audiologists would be very beneficial to the already practicing SLP. Cochlear implant manufacturers, additionally, could reach out to schools with some of the many resources that they have available. Such materials would be helpful for performing typical cochlear implant tasks, such as changing the external processor battery or troubleshooting tasks. Furthermore, manufacturers should consider making online video tutorials for performing such tasks for each individual device. This type of support would be easily accessible to school professionals and very beneficial for students with cochlear implants.

The final implication for this study is that students with hearing loss and their general education teachers may not be supported adequately regarding hearing technology. The shortage of and lack of contact with educational audiologists is only partially responsible. Even if SLPs perform some hearing technology tasks in the absence of the educational audiologist, SLPs' lack of training and low comfort with performing such tasks may indicate that students with hearing loss are not being provided the appropriate, necessary support for their hearing technology. A revision or adaptation to graduate curricula and the provision of continuing education programs and on-site training is expected to *eventually* improve the services and support provided to students with hearing loss. These changes may take time to come into effect, however, thus underlying the importance of a timely review of this area of training.

Limitations

The main limitations of this study relate to the sample procedures and the survey instrument. The limitation of this study's sample was two-fold. First, the school-based SLPs randomly selected from the states of Michigan and Ohio are not, presumably, completely representative of all school-based SLPs from the two states. The Michigan participants in particular are likely not the most representative because of the nature of their recruitment. All Michigan participants were members of the Michigan Speech Language Hearing Association (MSHA), a voluntary membership organization that participants paid to join. Because access to all school-based SLPs working in Michigan was not possible, the results are not generalizable to all Michigan SLPs working in elementary schools. Second, the samples from Michigan and Ohio together are presumably not representative of school-based SLPs nationally. It is very possible that SLPs trained in and working in other parts of the country have had different types of clinical experiences, resulting in different perceptions of the need for hearing technology training and different comfort levels with performing hearing technology tasks. Both of these limitations impact the generalizability of the findings, but also may suggest that future research be expanded to include other parts of the country.

The instrument limitations largely relate to the response choices provided for certain questions. Questions 10 and 11, for example, ask about the frequency of face-to-face and spoken or written contact with an educational audiologist. Including the additional response choice of "Contact As Needed" to these questions would have been beneficial for SLPs who may not regularly contact an educational audiologist, but have access to an educational audiologist if needed. Question 16, which asks about the types of training received in six different hearing technology related areas, could be improved by providing an "Undergraduate Course" choice option. Although the researcher chose not to include this response choice in order to focus on more recent training, it could provide valuable information and allow for comparison between the training provided at the undergraduate and graduate levels.

Finally, Question 23 was limited in several ways. This question asked the participants to select ALL of the persons responsible for completing various hearing technology tasks on a regular basis at school. The additional response choice of "Student" would provide further insight into who performs hearing technology tasks in schools. It is possible that students from the older grades might complete some of these tasks, such as changing batteries and troubleshooting, themselves. Including "Student" as a response choice would provide a better understanding of the hearing technology tasks performed at schools and further guidance on how to best support students with hearing loss. Despite these limitations, the study provided a great deal of valuable information to evaluate the hearing technology knowledge of school-based SLPs. The limitations of the current study can, additionally, be used as a basis to recommend future research.

Recommendations for Future Research

There are several recommendations for future research, both directly related to the topic of school-based SLPs' knowledge of hearing technology, as well as more broadly related to the hearing technology support provided in school to students with hearing loss. The first, and most obvious recommendation is to repeat the study with a larger sample size, particularly including SLPs from different parts of the country. This would allow for comparison, as well as create a sample that is more representative of school-based SLPs nationally.

The second recommendation for future research is to find out where participants received their graduate training. Naming the actual graduate institution would likely result in a potential bias from the participant; but reporting the state in which they were trained would enable a regional comparison of some of the graduate training completed. This information would provide a better understanding of graduate curricula and how it might be improved.

The third recommendation is to expand the study's scope to school-based SLPs working with different grades and age levels. A future study could, for example, examine SLPs working in preschools and their knowledge and comfort with hearing technology. Preschool students likely need even more help and support with their hearing technology as they are too young to adjust or fix their devices themselves, and are probably more likely to inadvertently damage their devices. A study of SLPs working in middle or high schools might also examine the number of students who personally maintain and troubleshoot their own hearing technology.

The fourth recommendation for future research is to investigate the administrative side of hearing technology services provided in schools. Possible foci could include administrative professionals' knowledge and comfort with hearing technology; school administrators' perception of the need for an educational audiologist; and the school administration's perception of what hearing technology services should be provided to students with hearing loss, who should provide those services, and how frequently they should be provided.

The fifth recommendation is to examine current classroom teachers' knowledge and comfort with hearing technology. The higher numbers of students with hearing loss being placed in inclusive classrooms makes this topic and area of research very timely. Several past studies have focused on the general education teacher who may have a student with hearing loss in his/her class, but a study focusing on the hearing technologies most often found in the classroom and on how to best proceed when the teacher is not at all familiar with such hearing technology, would be a beneficial contribution to the literature.

The sixth and final recommendation for future research is to investigate whether hearing technology tasks are actually being completed regularly, and who is responsible for completing them. Some participants from the current study expressed that it was not their role to perform such tasks, and named an "Other Professional" as being responsible for completing them regularly. Select participants mentioned that a "hearing impaired specialist" or "hearing impaired consultant" is the professional responsible for being trained in and comfortable with hearing technology. Future research could focus on this professional to investigate how many schools actually employ them; their roles regarding hearing technology; and the frequency of their contact with students with hearing loss, their teachers, and other professionals—such as SLPs. A study of this nature would prove to be beneficial because it would help to ensure that students with hearing loss are receiving the necessary support for their hearing technology, thus enabling them to fully participate in inclusive classrooms.

Final Thoughts

Language, speech, and hearing are connected on a biologic, acoustic, physical, and psychological level. So it does not seem unreasonable that the professionals individually responsible for language, speech, and hearing should be familiar, knowledgeable, and comfortable with all three. In an ideal world, all schools would have SLPs and educational audiologists on-site full time to provide "their" specific services to students with hearing loss and collaborate with each other to best support them. Unfortunately, that is most often not the case. In the absence of educational audiologists, another professional needs to be able to provide hearing technology services. It is unfair for a student who relies on hearing technology to sit through a class without being able to hear because his/her technology is not functioning properly and no one thought to check it or knew how to fix the device. Such a student loses the opportunity to listen and learn. As a future speech-language pathologist hoping to eventually work with children with hearing loss, it is my hope that this study brings to light the very real situation that exists in schools with students with hearing loss who utilize hearing technology so that we, as speech-language pathologists *and* audiologists, can collaborate to improve these challenges.

The Independent Study process has been a very enriching experience. The ability to conduct my own research under the careful guidance of my adviser has further shown me that I have the skills, motivation, and desire to pursue speech-language pathology at the graduate level, and, hopefully, eventually at the doctoral level. Devoting so much time and effort to the study of hearing, hearing loss, and hearing technology has also made me realize that I do not want to "give up" on audiology as many communication sciences and disorders undergraduate students do once they choose to pursue speech-language pathology over audiology. The connection between the two professions, particularly relating to clinical work, has been made so very clear to me that I am often surprised to hear that some practicing SLPs are unfamiliar with audiologic practices or did not receive any or much audiologic graduate training. If nothing else, my Independent Study has instilled in me the desire to become a speech-language pathologist fully aware of the audiologic implications of providing speech and language services, as well as the desire to some day work with children with hearing loss and hearing differences.

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APPENDIX A: SURVEY

Hello, my name is Marissa Kobylas and I am a senior Communication Sciences and Disorders major at the College of Wooster (Wooster, OH). I am completing my senior thesis on elementary school speech-language pathologists' knowledge of hearing technology. This protocol has been approved by the College of Wooster's Human Subjects Research Committee or "IRB." There are no direct risks or benefits to participating in this study, and your participation is entirely voluntary. If you decide to participate in this study, you will be asked to complete the following survey. All survey responses will remain anonymous. Please answer each question completely and honestly. If at any time you want to skip a question or terminate your participation in the study, you may do so without penalty or consequence. This survey will take about 10 minutes to complete. If you have any questions about this study or your rights as a participant, you can contact me (mkobylas16@wooster.edu) or my advisor, Donald M. Goldberg, Ph.D., CCC-SLP/A (dgoldberg@wooster.edu; goldbed@ccf.org; 216-312-6804). By completing this survey you are indicating that you are at least 18 years of age, have read and understand the above information, and that you consent to allow the information you provide to be reported in an aggregate or group form for research purposes. Thank you for your anticipated participation.

Do you accept these terms and choose to willingly participate in this study?

- ❍ Yes
- ❍ No

If No is selected, then skip to end of survey.

Q1 Are you an ASHA-certified Speech-Language Pathologist?

- ❍ Yes: CCC-SLP
- ❍ Yes: CCC-SLP/A or CCC-A/SLP
- ❍ No

Q2 Do you currently work in an **elementary** school?

- ❍ Yes
- ❍ No

If No is selected, then skip to end of survey.

Q3 Select the state you work in.

- ❍ Michigan
- ❍ Ohio
- ❍ Other

If Other is selected, then skip to end of survey.

Q4 Gender?

- ❍ Male
- ❍ Female
- ❍ Prefer not to respond

Q5 Current work status?

- ❍ Full time at one elementary school
- ❍ Full time at more than one school
- ❍ Part time at one elementary school
- ❍ Part time at more than one school

Q6 Years you have worked in an elementary school?

Drop-down list with response options ranging from 0.5 to 50 years.

Q7 Have you **ever** had a student with hearing loss on your caseload?

- ❍ Yes
- ❍ No

If No is selected, then skip to Q10.

Q8 Approximately how many students with hearing loss have you **ever** had on your caseload?

- ❍ 1-5
- ❍ 6-10
- ❍ 11-15
- ❍ 16-20
- ❍ 21 or more

Q9 How many students with hearing loss are on your caseload during the **current** school year?

Drop-down list with response options ranging from 0 to 50 students.

Q10 How often do you have face-to-face contact with your school's, or school district's educational audiologist?

- ❍ My school or my school district does not have an educational audiologist
- ❍ My school or my school district has an educational audiologist, but I have never had face-to-face contact with this professional
- ❍ 1-2 times per school year
- ❍ 3-4 times per school year
- ❍ 1-3 times per month
- ❍ Weekly
- ❍ 2-4 times per week
- ❍ Daily

Q11 How often do you have spoken or written contact (over the telephone or through email) with your school's, or school district's educational audiologist?

- ❍ My school or my school district does not have an educational audiologist
- ❍ My school or my school district has an educational audiologist, but I have never had spoken or written contact with this professional
- ❍ 1-2 times per school year
- ❍ 3-4 times per school year
- ❍ 1-3 times per month
- ❍ Weekly
- ❍ 2-4 times per week
- ❍ Daily

Q12 How many students with **cochlear implants** have you **ever** had on your caseload?

- ❍ 0
- ❍ 1-5
- ❍ 6-10
- ❍ 11 or more

If 0 is selected, then skip to Q14.

Q13 Which cochlear implant resources have you made use of? Please select **ALL** that apply.

- ❑ Diagnostic reports
- ❑ In-person workshops or conferences
- ❑ Printed materials from cochlear implant manufacturers
- ❑ Electronic training materials
- ❑ In-service training
- ❑ Other. Please describe: ____________________
- ❑ None of the above

Q14 Highest earned degree in speech-language pathology?

- ❍ Bachelor's Degree
- ❍ Master's Degree
- ❍ Ph.D./Ed.D.
- ❍ Other. Please describe: ____________________

Q15 Year you completed your highest earned degree?

Drop-down list with response options ranging from “2014 or Later” to “Before 1980.”

Q16 Please indicate the type of academic training you received in the following areas. Please select ALL that apply.

	None	Required graduate course(s)	Elective graduate course(s)	Continuing education course(s)	On-site training from professional(s)
Diagnostic Audiology	❑	❑	❑	❑	❑
Aural/Auditory Rehabilitation	❑	❑	❑	❑	❑
Hearing Aids	❑	❑	❑	❑	❑
Cochlear Implants	❑	❑	❑	❑	❑
FM (IR-InfraRed) Systems	❑	❑	❑	❑	❑
Acoustic Modifications of Classroom	❑	❑	❑	❑	❑

Q17 Do you feel that you received an "appropriate" amount of training in the following areas?

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Diagnostic Audiology	❍	❍	❍	❍	❍	❍	❍
Aural/Auditory Rehabilitation	❍	❍	❍	❍	❍	❍	❍
Hearing Aids	❍	❍	❍	❍	❍	❍	❍
Cochlear Implants	❍	❍	❍	❍	❍	❍	❍
FM (IR) Systems	❍	❍	❍	❍	❍	❍	❍
Acoustic Modifications of Classroom	❍	❍	❍	❍	❍	❍	❍

Q18 Do you feel that training in the following areas is necessary?

	Not At All Necessary	Unnecessary	Somewhat Unnecessary	Neutral	Somewhat Necessary	Necessary	Extremely Necessary
Diagnostic Audiology	❍	❍	❍	❍	❍	❍	❍
Aural/Auditory Rehabilitation	❍	❍	❍	❍	❍	❍	❍
Hearing Aids	❍	❍	❍	❍	❍	❍	❍
Cochlear Implants	❍	❍	❍	❍	❍	❍	❍
FM (IR) Systems	❍	❍	❍	❍	❍	❍	❍
Acoustic Modifications of Classroom	❍	❍	❍	❍	❍	❍	❍

Q19 Do you agree that, overall, your graduate curricula prepared you to work with the range of currently available hearing technology?

- ❍ Strongly Disagree
- ❍ Disagree
- ❍ Somewhat Disagree
- ❍ Neither Agree nor Disagree
- ❍ Somewhat Agree
- ❍ Agree
- ❍ Strongly Agree

Q20 What area(s) do you currently feel that you are in most need of training? Please select **ALL** that apply.

- ❑ Diagnostic Audiology
- ❑ Aural/Auditory Rehabilitation
- ❑ Hearing Aids
- ❑ Cochlear Implants
- ❑ FM (IR) Systems
- ❑ Acoustic Modifications of Classroom
- ❑ Other. Please describe: ____________________

Q21 Please indicate your comfort level with:

	Not At All Comfortable	Uncomfortable	Somewhat Uncomfortable	Neutral	Somewhat Comfortable	Comfortable	Extremely Comfortable
Changing the battery in a hearing aid	❍	❍	❍	❍	❍	❍	❍
Changing the battery in a cochlear implant	❍	❍	❍	❍	❍	❍	❍
Changing the battery in an FM (IR) system	❍	❍	❍	❍	❍	❍	❍
Completing a listening check with a hearing aid	❍	❍	❍	❍	❍	❍	❍
Completing a listening check with a cochlear implant	❍	❍	❍	❍	❍	❍	❍
Completing a listening check with an FM (IR) system	❍	❍	❍	❍	❍	❍	❍
Troubleshooting a hearing aid	❍	❍	❍	❍	❍	❍	❍
Troubleshooting a cochlear implant	❍	❍	❍	❍	❍	❍	❍
Troubleshooting an FM (IR) system	❍	❍	❍	❍	❍	❍	❍
Explaining how to use an FM (IR) system to a teacher or other staff member	❍	❍	❍	❍	❍	❍	❍
Recommending acoustic modifications for a classroom	❍	❍	❍	❍	❍	❍	❍

Q22 In the current school year, have you performed the following tasks? Please select **ALL** that apply.

- ❑ Changed the battery in a hearing aid
- ❑ Changed the battery in a cochlear implant
- ❑ Changed the battery in an FM (IR) system
- ❑ Completed a listening check with a hearing aid
- ❑ Completed a listening check with a cochlear implant
- ❑ Completed a listening check with an FM (IR) system
- ❑ Had to troubleshoot a hearing aid
- ❑ Had to troubleshoot a cochlear implant
- ❑ Had to troubleshoot an FM (IR) system
- ❑ Explained how to use an FM (IR) system to a teacher or other staff member
- ❑ Recommended acoustic modifications for a classroom

Q23 What person is responsible for completing the following tasks on a regular basis at school? Please select **ALL** that apply.

	Not Sure	Parent	School Nurse	Educational Audiologist	SLP	Other Professional	Not Applicable
Changing the battery in a hearing aid	❑	❑	❑	❑	❑	❑	❑
Changing the battery in a cochlear implant	❑	❑	❑	❑	❑	❑	❑
Changing the battery in an FM (IR) system	❑	❑	❑	❑	❑	❑	❑
Completing a listening check with a hearing aid	❑	❑	❑	❑	❑	❑	❑
Completing a listening check with a cochlear implant	❑	❑	❑	❑	❑	❑	❑
Completing a listening check with an FM (IR) system	❑	❑	❑	❑	❑	❑	❑
Troubleshooting a hearing aid	❑	❑	❑	❑	❑	❑	❑
Troubleshooting a cochlear implant	❑	❑	❑	❑	❑	❑	❑
Troubleshooting an FM (IR) system	❑	❑	❑	❑	❑	❑	❑

Q24 Indicate your knowledge level of the candidacy criteria for pediatric cochlear implants.

- Do Not Know At All
- Unknowledgeable
- Somewhat Unknowledgeable
- Neutral
- Somewhat Knowledgeable
- Knowledgeable
- Extremely Knowledgeable

Q25 What are the top two acoustic modifications (other than using an FM/IR system) you would recommend for the physical structure of the classroom to a teacher who has a student with hearing loss in his/her class?

Q26 What are the top two teaching strategies (other than using an FM/IR system) you would recommend to a teacher who has a student with hearing loss in his/her class?

Q27 Are there any additional questions or comments you would care to share that were NOT asked during this survey?

Thank you for taking the time to participate in this study. As mentioned before, all responses will be kept anonymous. If you have any questions or concerns, please contact me, Marissa Kobylas **(mkobylas16@wooster.edu)** or my advisor, Donald M. Goldberg, Ph.D., CCC-SLP/A **(dgoldberg@wooster.edu; goldbed@ccf.org; 216-312-6804)**. Additionally, if you would like to receive a summary of the study results (which will be completed in April 2016) or a list of resources on hearing technology, please forward a separate email to me at the above contact address.

APPENDIX B: RECRUITMENT EMAIL

Hello,

My name is Marissa Kobylas and I am a senior studying Communication Sciences and Disorders at the College of Wooster (Wooster, Ohio). I am working with my advisor, Donald M. Goldberg, Ph.D., CCC-SLP/A, on my senior thesis investigating school-based speech-language pathologists working in Michigan and Ohio and their knowledge of hearing technology.

If you are a licensed speech-language pathologist currently working in an elementary school in MI or OH, please consider participating in this study by completing my short survey.

This survey was approved by the College of Wooster's Human Subjects Research Committee or "IRB" and will take approximately 10 minutes to complete. Your participation is entirely voluntary and risk-free. If at any time you want to skip a question or terminate your participation in the study, you may do so without any consequence. Your name and other identifying information will **not** be used in this study. All survey responses will remain confidential.

The survey link is provided below. It will be open from 12/17/2015 until early 2016. If you have any questions or concerns, please contact me or my advisor, Donald M. Goldberg, Ph.D., CCC-SLP/A (dgoldberg@wooster.edu; goldbed@ccf.org; 216-312-6804). Additionally, if you would like to receive a summary of the study results (which will be completed in April 2016) or a list of resources on hearing technology, please feel free to contact me by phone or email.

Survey Link:
https://wooster.co1.qualtrics.com/SE/?SID=SV_eJWnGKklmbLiMnj

Thank you for your time and consideration,

Marissa Kobylas
mkobylas16@wooster.edu
248-660-4161

APPENDIX C: REMINDER EMAIL

Hello,

If you have already completed the following survey, thank you! Please disregard this message.

If you have NOT yet completed this survey and are a licensed speech-language pathologist currently working in an elementary school in MI or OH, please consider participating in my study.

My name is Marissa Kobylas and I am a senior studying Communication Sciences and Disorders at the College of Wooster (Wooster, Ohio). I am working with my advisor, Donald M. Goldberg, Ph.D., CCC-SLP/A, on my senior thesis investigating school-based speech-language pathologists working in Michigan and Ohio and their knowledge of hearing technology.

This survey was approved by the College of Wooster's Human Subjects Research Committee or "IRB" and will take approximately 10 minutes to complete. Your participation is entirely voluntary and risk-free. If at any time you want to skip a question or terminate your participation in the study, you may do so without any consequence. Your name and other identifying information will **not** be used in this study. All survey responses will remain confidential.

The survey link is provided below. It will be open until mid-January. If you have any questions or concerns, please contact me or my advisor, Donald M. Goldberg, Ph.D., CCC-SLP/A (dgoldberg@wooster.edu; goldbed@ccf.org; 216-312-6804). Additionally, if you would like to receive a summary of the study results (which will be completed in April 2016) or a list of resources on hearing technology, please feel free to contact me by phone or email.

Survey Link:
https://wooster.co1.qualtrics.com/SE/?SID=SV_eJWnGKklmbLiMnj

Thank you for your time and consideration,

Marissa Kobylas
mkobylas16@wooster.edu
248-660-4161

APPENDIX D: FINAL REMINDER EMAIL

Hello,

I'd like to give one final chance to participate in my study, so the following survey will close on **Tuesday, January 19th at 11pm**. If you have already completed this survey, thank you! Your time and effort are greatly appreciated.

If you have NOT yet completed this survey and are a licensed speech-language pathologist currently working in an elementary school in MI or OH, please consider this last opportunity to participate in my study.

My name is Marissa Kobylas and I am a senior studying Communication Sciences and Disorders at the College of Wooster (Wooster, Ohio). I am working with my advisor, Donald M. Goldberg, Ph.D., CCC-SLP/A, on my senior thesis investigating school-based speech-language pathologists working in Michigan and Ohio and their knowledge of hearing technology.

This survey was approved by the College of Wooster's Human Subjects Research Committee or "IRB" and will take approximately 10 minutes to complete. Your participation is entirely voluntary and risk-free. If at any time you want to skip a question or terminate your participation in the study, you may do so without any consequence. Your name and other identifying information will **not** be used in this study. All survey responses will remain confidential.

The survey link is provided below. If you have any questions or concerns, please contact me or my advisor, Donald M. Goldberg, Ph.D., CCC-SLP/A (dgoldberg@wooster.edu; goldbed@ccf.org; 216-312-6804). Additionally, if you would like to receive a summary of the study results (which will be completed in April 2016) or a list of resources on hearing technology, please feel free to contact me by phone or email.

Survey Link:
https://wooster.co1.qualtrics.com/SE/?SID=SV_eJWnGKklmbLiMnj

Thank you for your time and consideration,

Marissa Kobylas
mkobylas16@wooster.edu
248-660-4161

APPENDIX E: QUESTION 13, COCHLEAR IMPLANT RESOURCES

Q13 *Which cochlear implant resources have you made use of?* "Other" responses: (n = 8)

Verbatim responses:

- Webinars from U of M
- My private client's school
- Parent
- Trainee from the University of Akron Hearing Impairment Grant
- Training from audiologist
- Consult with TC for HI [Hearing Impaired]
- Staffing with hospital staff present/training us
- Audiologist information

APPENDIX F: QUESTION 20, TRAINING NEEDS

Q20 *What area(s) do you currently feel that you are in most need of training?* "Other" responses: (n = 5)

Verbatim Responses:

- Not sure
- Our HI consultant is the expert in these areas so I use her expertise to teach me what is needed.
- I'm more experienced at this time, but would've needed these in the past more so
- Above checked b/c it is always helpful to have training on the most up-to-date technology available for our students.
- None. We have hearing consultants who specialize in these areas. They are not audiologists.

APPENDIX G: QUESTION 25, ACOUSTIC MODIFICATION RECOMMENDATIONS

Q25 *What are the top two acoustic modifications (other than using an FM/IR system) you would recommend for the physical structure of the classroom to a teacher who has a student with hearing loss in his/her class?* (n = 64)

Note: The following responses include 20 participants who gave one response to the question instead of two.

Verbatim Responses:

- Preferential seating (n = 9)
- Preferential seating near teacher
- Preferential seating away from noises and toward pt (sic) of instruction
- Preferential seating for the student near instruction, close to visuals
- Preferential seating close to speaker/away from extraneous noise
- Preferential seating/staggered seating arrangement
- Preferential seating and strategically setting the room up for instruction to be direct and away from external/environmental noise sources

- Keep the student within view of the speakers and near positive academic role models
- Have the student in close proximity to the teacher and able to move around in chair to see the teacher if lip reading needs to occur.
- Moving child closer to speakers or teachers
- Child seat in proximity to the speaker
- Sitting close to the person talking
- Seating close to teacher
- Student placed near teacher
- Seat student near teacher (where they will be speaking)
- Place student's chair closer to teacher
- Location/proximity of student to teacher and/or peers
- Seating student facing the teacher
- Seating location
- Student seating in classroom
- Student's seating
- Seating that meets the need of student

- Keep student away from noisy fans, heaters, etc.
- Student be seated away from noise sources (fans, hallways, etc...)
- Seating away from noise such as heaters fans hallway doors
- Position students away from high noise sources such as fans, A/C, windows, etc.
- Seating changes away from noise as possible
- Sit away from the door, pencil sharpener or other noise sources.
- Keep the student away from bathroom, hallway, other noise
- Student needs to be away from hallway and other noise sources within the room.

- Carpet/rugs (n = 2)
- Carpet (n = 4)
- Carpeting or covering the desk/chair feet appropriately - no tennis balls
- Carpet vs. tile floors
- Increase carpeting if allowed / appropriate
- Use carpet, rugs to reduce reverberation
- Carpeted flooring
- Adding carpeting or other materials to improve acoustics

- Sound absorbing matetials (sic)
- Use of material to lessen background noise (carpet, curtains...)
- Add noise dampening devices (carpets, etc.)
- Use more soft materials (rugs, soft furniture, fabric wall hangings or shades)
- Strategically place bullentin (sic) boards, partitions, and bookshelves for better sound around students
- Limit echo in class as much as possible by putting absorbent materials on walls

- Talk only facing the class
- Face to face while teacher
- Teacher faces the student when instructing the class

- Have tennis balls or other soft covers for chair legs to minimize extraneous chair noise, having student sit away from noise producers (e.g. (sic) pencil sharpener, seat next to door way)
- Placing noise reducing materials on chairs/furniture
- Put tennis balls on bottoms of chair legs to minimize noise
- Tennis balls on the bottoms of chairs (n = 2)
- Covering noisy surfaces with fabric or rubber (chair legs, desks, etc.)

- Reduction of background noise (n = 2)
- Limit background noise (n = 2)
- Minimizing background noise
- Minimal / reduced background/environmental noises
- Reduce ambient noise in the classroom such as fans, open windows, etc.
- Turn off noisy things like computers when not in use
- Replacing or limiting use of devices that produce noise that are non-essential or replaceable.
- Decrease background noise as much as possible - ie: (sic) closing windows if noise outside
- Noise reduction strategies in the classroom--tennis balls on chairs, closing doors to the hallway, reduce use of fans, etc. in the classroom, etc.
- Improve signal/noise ratio by reducing environmental sound sources
- Reduce intrusion of unwanted noise- fans, rubbers on chair legs

- Eliminate excess noise (eg. (sic) fans) or seat student in quiet area of room
- Overall control of noise level in classroom
- Monitor classroom noise and keep at a minimum

- Door/windows closed to reduce extraneous noise
- Closed does (sic) to eliminate extraneous noise. Modifications if possible to size and structure of the room.
- Keep the door shut
- Close the door in the room.

- Use of visuals
- Provide direct line of vision to student (e.g., seating, proximity)
- Student should be given optimal visual access to visual supports
- Student in direct line of sight to teacher

- Closed classroom
- Class room [sic] location if possible - avoid the class next to the gym or cafeteria
- Reverberation times should not exceed 0.4 seconds
- Check noise levels to determine modifications to determine what needs modified
- Surveying classroom acoustic conditions
- Closed captioning
- Stronger hearing side toward teacher
- Student buddy
- Teacher check for understanding with student when oral directions given
- Given notes/outlines of materials prior to lesson

- Our schools are equipped with whole classroom FM systems.
- Classroom soundfield
- Microphone
- We do not have many to choose from. It would be whatever is available.

- It is not my role to do this or know this information
- I do not know
- I am not sure.
- I don't know anything about this.
- No (sic) sure

APPENDIX H: QUESTION 26, TEACHING STRATEGY RECOMMENDATIONS

Q26 *What are the top two teaching strategies (other than using an FM/IR system) you would recommend to a teacher who has a student with hearing loss in his/her class?* (n = 67)

Note: The following responses include 11 participants who gave one response to the question instead of two.

Verbatim Responses:

- Preferential seating (n = 9)
- Preferential seating (near the teacher)
- Preferential seating close to the point of instruction
- Seating near point of instruction
- Have the student near the point of instruction so he can see the instructor's face.
- Have student sit close to you in class.
- Seat near teacher
- Seating student facing the teacher
- Having the student seated close to the teacher so the teachers face can be seen.
- Seated close to teacher so the student can also use the lip-reading
- Student seated in closest proximity to instruction area
- Place them close to where you are going to be doing the majority of your teaching
- Proximity of you to them when teaching a concept
- Where teacher stands in proximity to student
- Seat student near teacher or move to student to check understanding
- Moving the student to the front of the room (closest to instruction and able to see lips)
- Placement in the front row with visual view of the teacher.

- Face the student when speaking (n = 4)
- Face the student (n = 2)
- Face-to-face presentation of instruction
- Face to face instruction (sic)
- Face to face when speaking
- Make sure student can see your face when speaking (n = 2)
- Turn towards student when speaking
- Teaching to the class instead of to the whiteboard
- Teacher faces the student when instructing the class
- Face student, ensure engagement
- Teacher to not move throughout the room as they are teaching unless the student is able to see the teacher's facial expressions and read his/her lips.
- Always talk facing the student (do not turn your back and talk), Repeating/rephrasing information/directions as needed, promote self-advocacy (make sure student is very free to ask for clarification/repetition as needed)

- Gain student's attention before speaking (n = 3)

- Gaining the students attention prior to question or instruction
- Gain students attention first
- Gain eye contact before speaking.
- Wait until you have the child's attention/eye contact before giving instructions.
- Get students (sic) attention/eye contact before speaking to them
- Make sure have students attention before presenting important info
- Say the students (sic) name before giving directions

- Use visuals (n = 2)
- Visual supports (n = 2)
- Use of visual supports throughout instruction
- Visual cues (n = 2)
- Visual aids (n = 2)
- Visuals
- Lots of visuals and hands on activities
- Use of visual cues - gesture/sign, modeling, pictures
- Use lots of visual aids/demonstration in teaching
- Use visuals for notes
- Using whiteboard outline of notes/content of lecture
- Visual supports for notes/classroom discussion
- Applying use of more visuals
- Use visual prompts or resources.
- Provide visuals for instructions and assignments
- Visual cues to gain attention and make teacher's face visible (proximity, lighting...)
- Coupled oral language with pictures if needed
- Provide visual cues when possible to accompany auditory information.
- Use visuals when possible, especially with complicated material
- Provide visual information, repeat directions, shorter phrases, slower speaking rate
- Using visuals, closed captioning, and repetition

- Written directions
- Providing instructions in writing as well as verbal
- Provide written directions, in addition to oral directions
- Write important directions on the board along with verbally presenting them. Teacher to personally check with student to make sure that they understand the directions.
- Provide written copies of info
- Provided a copy of notes/written directions
- Hard copy of classroom notes
- Provide written notes about lessons

- Recasting/repetitions
- Teachers should repeat what peers say or pass the FM microphone to the speaker.
- Restate and rephrase instructions and other student responses (clearly and at relaxed rate of speech)

- Repeating or having the student repeat directions, etc.
- Repetition of material with listening checks
- Frequent repetition and checks for understanding

- Frequent Checks for comprehension of material
- Frequently checking for comprehension
- Frequent check ins with student for understanding of spoken instructions.
- Comprehensions checks
- Check for direction comprehension
- Check for understanding of directions
- Checking for understanding
- Checks for understanding
- Checking in with student to ensure knowledge
- Ask student open ended questions frequently to check for understanding
- Requesting repetition of information to check for understanding
- Check to see if the child heard the information by asking them to repeat information

- Checking for listening/comprehension
- Listening checks

- Make sure equipment is working
- Show the teacher how to do a hearing aid check to ensure it is working properly

- Active listening strategies
- Demonstrate/explain information in more than one way
- Slow, easy rate of speech
- Teacher addressing student from the side of the strongest ear
- Preteaching of vocabulary pertaining to subject matter
- Appoint peer helper
- Multi-modal communication
- Chunking sentences into smaller pieces.
- Microphone
- Teachers should ask WHAT the student heard vs. IF the student heard
- Have an interpreter available for the student.
- Make sure the student can hear them and understand what they are saying
- Turn-off HVAC, fans, etc (sic) when lecturing to the class

- No (sic) sure

- We have a hearing impaired teacher consultant who does this at my school
- Again, not my role. I would make a referral to the right professional.

APPENDIX I: QUESTION 27, ADDITIONAL QUESTIONS OR COMMENTS

Q27 *Are there any additional questions or comments you would care to share that were NOT asked during this survey?*

(n = 32)

Verbatim Responses:

- Curious as to how a district decides whether or not it needs to employ / consult with an Educational Audiologist

- What support is received by the school's principal or administrators when modifying a room? How do you convince a school board to pay for an FM system or other means necessary to create acoustically sound room(s)?

- For some items there was not an option that fit my situation (ex. how often contact w/audiologist? might not be a regularly scheduled thing so not necessarily so many times a month or year)

- I was unable to select an appropriate answer to the question about contact with an audiologist--I have contact "as needed" which could be never in a year or many times. Also, audiology coursework was completed as an undergraduate but no answer choice was available for that.

- This survey has reminded me that I should find out who our district audiologist is. Hearing and vision screens are performed twice a year by someone, but I don't believe she's and (sic) AuD. I, unfortunately, do not have access (that I know of) to an audiometer to screen students myself.

- I would love to have the ability to converse with an educational audiologist about student's (sic) school needs.

- We used to have an audiologist available who served our school district and county, but no longer have her services in the same manner due to budget constraints.

- There is not an educational audiologist that follows my student.

- My student with a hearing age (sic) is in middle school and he has the full responsibility for battery replacement and checks.

- The students I currently work with are old enough now to take care of their own hearing aids, and cochlear implants so they do their own battery changes, troubleshooting, etc.

- Just a note that when my partner (SLP) and I calibrated our audiometer and started doing hearing screenings as a part of all of our initial and 3 year re-evals, our educational audiologist told us to be careful who we told, since she thought that several audiologists in the area would feel that we were practicing outside of our scope of practice, and might be resentful.

- I don't remember most of the audiology information I learned in undergrad and grad school because I don't use it at my job. I do hearing screenings once in a while.

- When I did have a student with an implant many years ago I consulted with the districts (sic) audiologist a few times a month or when there was an issue. It's been a number of years since I have had HI student.

- I have only had one hearing impaired student, who attended my school fro [for] 2 months.

- I have a student that I see for intervention that is not officially on my caseload. Another student in one of my schools has a unilateral hearing loss. She receives services through an intervention specialist for LD. I serve at two private schools.

- We have an educational ASL interpreter who is in the classroom with one of our students with cochlear implants. She is responsible for daily listening checks, troubleshooting, batteries, etc. for that student. This is definitely an area that I have had to learn with experience mainly because it isn't very common to have a student with hearing aids or cochlear implants on my caseload.

- I had several course in my undergraduate degree thst addressed these issues. The classes were not at the graduate level. I have a hearing impaired daughter so I am very familiar with hearing aids. She wears a BAHA that is completely different from most. Most people including SLPs do not understand the effects that hearing has on children and learning. I have learned first hand and through my daughters (sic) ENT and audiologist. Training is lacking

- Our intermediate school district employs a hearing impaired teacher consultant who is responsible for providing support and education to staff for any student who has a significant hearing impairment. There are 21 local school districts that she has to monitor. When I have had students with hearing impairments, her support has been helpful. At those times, she was readily available by e-mail and came to the school at least twice per month.

- I am a CF [Clinical Fellow] not yet ccc [Certificate of Clinical Competence] certified. That option was not given.

- I didn't have specific courses for learning some of the information, but did my own research, or called other professionals to learn more about how to help my students. I have worked in a district with an educational audiologist and I really appreciated her help to understand hearing issues. I am unhappy at the trend of eliminating them due to budget cuts. In our district, we have only a few Hearing Impaired Teacher Consultants for our whole county. They used to visit students monthly to check equipment, etc., but now come when student is initially identified, and then only if needed for a consult.

- When I checked graduate course for each of those pieces of audiology, we had two courses that covered all those topics.
- No (n=8)
- n/a
- No, however it is scary to think that I should know this. I feel so incompetent in this area.
- Good luck with your thesis! :)