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Research Article

Hearing Loss: Investigating the Comfort, Confidence, Knowledge, and Preparedness of School-Based Speech-Language Pathologists

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Abstract

Due to advances in technology, the number of users with hearing devices has increased. These users are often mainstreamed into classrooms with typical hearing peers. However, even with these devices, speech and language impairments may still persist. This study was conducted to analyze school-based speech-language pathologists' (SLP) comfort, confidence, knowledge, and preparedness in treating students with hearing loss in Kentucky schools. Forty-eight SLPs practicing in all levels of school including elementary, middle, and high, completed an anonymous online survey through the Qualtrics platform. Responses were received from SLPs representing 11 out of the 15 regions throughout Kentucky. Spearman's rank order correlation was r to assess the association between the comfort, confidence, knowledge, and preparedness of SLPs to manage selected hearing devices and providing treatment. Previous research conducted throughout the United States demonstrated that there is an overall lack of comfort, confidence, knowledge, and preparedness of SLPs in treating patients with hearing loss. Previous research has also demonstrated the need for more knowledge and training for treating those who use hearing devices. This study was conducted to compare the results of Kentucky school-based speech-language pathologists to other studies previously conducted in other states. The findings were consistent with previous results demonstrating that overall there is a lack of training in managing students with hearing loss, the need for more collaborations with other professionals, instruction at both the undergraduate and graduate level, and the need for various forms of continuing education.

Keywords: Hearing loss; Schools; Training; Comfort; Confidence

Introduction

A child's brain development is largely influenced by experiences and information that the five senses of taste, touch, smell, sight, and hearing receive and send to the brain [1]. When one of these senses is impaired, a child's brain and cognition may be impacted [2]. For many children born in the United States, their brain development and cognition are directly impacted by hearing loss. According to the National Institute on Deafness and other Communication Disorders, (NIDCD), in the United States, two to three out of every 1,000 children are estimated to have been born with hearing loss in one or both of their ears [3]. Additionally, 16,000-18,000 babies and toddlers are diagnosed with hearing loss per year, making it one of the most common birth defects [4].

Without the ability to hear, a child will miss out on accessibility to environmental acoustics and intelligible spoken language which are both vital for brain growth [4]. Children with normal hearing thresholds acquire language by listening to the 'spoken language that surrounds them daily and interacting with their environment [5]. The brain needs exposure to a variety of sounds to process information and allows responses [1]. Auditory experience changes the way the brain processes future input whether beneficial during developmental shaping of the speech processing circuits or detrimental due to neuro degeneration [6]. Auditory information assists speech production as it allows a child to learn to manage breath support, differentiate speech events, acquire the phonemes specific to their language community, and monitor mistakes [7]. Auditory information also assists in keeping the suprasegmental features of voice under control, including F0, intensity, and quality [8].

While auditory perception is associated with the ears, the ears are just the pathway as the sensation actually occurs in the brain [4]. Auditory signals are transmitted to the brain via the outer, middle, and inner ear. Sound travels down the ear canal as the pinna detects the direction of where the sound is coming from. At the middle ear, vibration of the tympanic membrane occurs, triggering movement of the malleus, incus, and stapes. The bones in the middle ear cause movement of the fluid in the cochlea, stimulating the hair cells and converting the movement into an action potential [9]. The signals are transmitted through the auditory nerve into the auditory cortex of the brain for higher processing [9]. The brain then concludes what the sounds represent and how to respond. According to the American Speech-Language-Hearing Association (ASHA) when problems arise in any of these parts along the pathway, it can lead to a hearing loss [10].

Hearing loss is categorized by type, degree, and configuration displayed on the child's audiogram. Conductive, sensorineural and mixed are the 3 types of hearing loss that indicate which part of the hearing mechanism is damaged whether the outer, middle, inner or a combination [9]. The configuration of the hearing loss demonstrates the degree and pattern across frequencies as described as bilateral, unilateral, symmetrical, asymmetrical, fluctuating, or stable [7]. Erler [11], states that understanding a child with hearing loss's audiogram is critical in helping develop care. While audiologists diagnose hearing loss, the coexistence of hearing disorders and speech and language problems allow for hearing-screenings and basic checks of hearing aid performance to be completed by speech-language pathologist as within their scope of practice [12].

The coexistence of hearing disorders and speech/language deficits cause concerns directly affects academic, emotional, and psychosocial development of young children [4]. Academically, hearing loss affects a child's reading comprehension, theory of mind, problem solving, reading, and decoding [13]. Hearing loss directly impacts a child's overall intelligibility, suprasegmental, language, pragmatics and literacy errors [7]. Research has shown that children with hearing loss exhibit persistent phonological errors that extend beyond the normal age of suppression including cluster reduction, cluster simplification, gliding, stopping, devoicing, velar fronting, assimilation, voicing, deaffrication, final consonant deletion, and weak syllable deletion. Stopping is especially prevalent in this population due to limited access to high-frequency sounds [14].

Social functioning and behavioral problems are also prevalent in the deaf and hard of hearing population secondary to the lack of acquisition of social/emotional competencies [15]. A study conducted by Authors [16], found an increased prevalence for behavior difficulties in children with hearing loss that manifest as emotional symptoms, conduct problems, hyperactivity, and peer problems. Poor speech and language skills may exacerbate the aforementioned behaviors because a child may experience difficulty expressing themselves as well as managing peer interactions [16]. Moreover, those with hearing loss have difficulty with pragmatics due to lack of practice with communication partners, difficulty hearing with background noise, different modes of communication, and lack of formal instruction [7].

Advances in hearing technology such as hearing aids, bone conduction devices, and cochlear implants, have aided in the reduction of the aforementioned maladaptive behaviors associated with hearing loss [4]. Hearing aids, bone conduction devices, and cochlear implants all vary in the type of hearing loss they assist, with cochlear implants providing assistance to the greatest hearing deficits [7]. The purpose of these devices is to "access, activate, stimulate, and grow auditory neural connections throughout the brain as the foundation for spoken language, reading, and academics" [4]. The Food and Drug Administration (FDA) identifies the two types of hearing aids as analog and digital which both amplify sound. Bone conduction devices assist those with conductive/mixed hearing loss or unilateral hearing loss [17]. Cochlear implants provide sound to those with severe to profound hearing loss by bypassing the damaged portions of the ear to stimulate the auditory nerve [18]. The external part of the cochlear implant utilizes a microphone and converts it into electrical stimulation code with a digital signal processing unit [19]. This is then transmitted to the internal part via a radio frequency link where electricity conveys the timing, intensity, and frequency characteristics of sound directly to the auditory nerve [19]. For some students, or when they are in environments with varying levels of background noise, sometimes a hearing aid, bone conduction device, or even cochlear implants are not enough.

According to ASHA [20], hearing assistive technology (HATS) are devices that assist a person hear in loud or busy places and can be used with or without hearing aids and cochlear implants. Individual frequency modulated (FM systems) are a type of HAT frequently used in the classroom to decrease the negative effects of hearing loss by transmitting a signal via FM radio waves through a microphone from the speaker's mouth to a receiver on the listener [21]. ASHA lists other HATS as infrared systems, induction loop systems, one to one communicators, and other devices used on technology such as cellphones or doorbells [20].

Since first introduced in 1972, cochlear implants have helped change the prognosis and academic success for the deaf and hard of hearing [22]. According to the National Institute on Deafness and Other Communication Disorders (NIDCD) [3], as of 2012, 324,200 registered devices have been implanted worldwide and this number is rapidly increasing with an estimated 58,000 adults and 38,000 children implanted [18]. In 2000, the U.S. Food and Drug Administration (FDA) deemed children as young as 12 months eligible for implantations after research determined that children implanted before three had better speech and language outcomes [23]. However, receiving a cochlear implant does not automatically guarantee success. It is a lengthy process that extends past the preoperative care and surgery. "Although the technology itself is awe inspiring, improvements in oral communication are not ensured simply by using the device alone. Intensive intervention is critical [24]. While the devices improve access to auditory information otherwise not received, they are not singly responsible for speech and language development. As implantations increase, it is vital that professionals who work with patients that have assistive hearing devices be familiar with the pre- and post-operative processes, current research findings, how to troubleshoot issues when they occur and making referrals to other professionals when necessary [24].

The pre-operative and actual implantation are primarily handled by the surgeon, (e.g. otologist), and audiologist, while speech-language pathologists play a critical role in post-implantation care. Speech-language pathologists are responsible for evaluating spoken or signed communication abilities and to make recommendations for intervention [25]. After implantation, the therapist is responsible for direct speech/language therapy, auditory training, and troubleshooting/maintaining devices [26]. If a child's device is not working properly, their speech and the auditory input received in may be unintelligible, thus altering the way information is stored in their brains [4]. Professionals involved with the child's care should be familiar with and able to carry out basic troubleshooting and maintenance procedures including changing cords or batteries as well as conducting functional listening checks [26]. It is recommended that school-based professionals who work and interact with those who use hearing devices work have a copy of the guides and manuals specific to the child's device as they are readily available for free [27]. ASHA [28], lists the knowledge and skills required for the practice of audiologic/aural rehabilitation which includes performing routine visual inspection and listening checks of client's hearing devices to troubleshoot causes of malfunction such as dead or corroded battery obstruction or damage to visible parts of the system within the SLP's scope of practice. Speech-language pathologists need to acquaint themselves to the individual's device and its functionality as well as conduct listening checks using the Ling Six-Sound test to regulate the consistency of a child's access across the range of frequencies used in speech [11]. This is necessary as auditory learning only occurs if the function of the implant is consistently maintained [11]. Their speech is directly impacted by what they hear and will often reciprocate the word and intonation pattern. If they are unable to hear the differences in intonation and other suprasegmental aspects of speech than they will not be able to produce them correctly [7].

Cochlear implants have improved the adverse effects of hearing loss on speech and language; however there are still areas in need of improvement. Cochlear implants have increased accuracy with articulation however; fricatives and affricates continue to prove difficult due to their high-frequency nature [7]. Cochlear implant users have difficulty with suprasegmentals as the devices do not support pitch perception thus affecting their development of prosody [7]. Language development varies depending on age of implantation and experience [7]. Those with hearing loss have difficulty with pragmatics due to lack of practice with communication partners, difficulty hearing with background noise, different modes of communication, and lack of formal instruction [7]. Continued difficulty is seen with cochlear implant users as research has shown struggles with repairing communication breakdowns [29]. With a background in articulation training and language development, speech-language pathologists possess the skills to work with hearing impaired children in these areas [26].

While speech-language pathologists receive training in articulation and language development, previous research has shown a lack of training specific to those suffering from hearing loss [25,30,31]. Speech-language pathologists are often unaware of the auditory hierarchy and the effect that the lack of mastering the various levels has on language, articulation, and auditory development [27]. This includes the progression of the child's awareness of sound, suprasegmental discrimination/association, segmental association/identification, identification, and processing/comprehension [27].

According to the ASHA [32] survey, in the United States, 51.4% of speech-language pathologists work in the public-school sector. Moreover, the percentage of SLPs that regularly serve children with hearing loss was reported as 44.8% with an average of 2.3 children served per SLP [32]. As speech-language pathologists play a vital role in the habilitation/rehabilitation processes for individuals with cochlear implants and hearing loss, it is important to address their level of comfort, confidence, knowledge of professionals' roles, and perception of preparedness to work with this population group. These areas have previously been investigated in studies in different parts of the United States including states in the upper midwest, the northeast, and the south [25,30,31].

ASHA's membership and affiliation profile for state-level data, year-end 2018, revealed that 45.1% of the speech-language pathologists working in Kentucky listed their primary employment facility as school-based [32]. While data is not available regarding the percentage of children served with hearing loss, it is probable that the numbers are consistent with ASHA's 2018 schools survey. The purpose of this study was to investigate the comfort, confidence, knowledge of professionals' roles, and perception of preparedness of Kentucky's school-based speech-language pathologists working with children with hearing loss, specifically those with cochlear implants.

Methods

Participants

This non-experimental study utilized a convenience sample (N=48) to investigate associations between the comfort, confidence, knowledge of professionals' roles, and perception of preparedness levels of Kentucky's school-based speech-language pathologists working with children with hearing loss, specifically those with cochlear implants. Respondents were asked to complete an online survey querying their comfort (8 questions), confidence (6 questions), knowledge of roles and responsibilities (5 questions), and perception of preparedness (3 questions) levels. The survey used a seven-point Likert scale for comfort and confidence targets and a five-point Likert scale for knowledge and preparedness items. The researchers used both within and between group designs to analyze responses. Approval was granted by the Institutional Review Board (IRB) of the University of Louisville.

The researchers recruited participants through their district Director of Special Education (DoSE) via email blast. Each DoSE received an explanation of the current study and a link to the survey instrument via Qualtrics. DoSE's were requested to forward an explanatory email to their speech-language pathologists. The email included possible risks or benefits of the study, informed consent, and the aforementioned link to the survey. A total of 49 responses were received between August 20, 2019 and September 20, 2019. Inclusionary criteria included licensure as an SLP in a Kentucky public school system and a minimum of a Master's degree. There was no gender, age-related, ethnic background, or health status requirements per this study. This study excluded all other non-therapy disciplines, teachers, and school-based audiologists. After data screening, 1 response was excluded, with 48 eligible responses remaining.

Setting and instrumentation

School-based speech-language pathologists completed an online survey via the Qualtrics platform. The survey was accessible by tablet, laptop, smartphone, or desktop computer, and was designed to take 15 minutes or less. The survey was open for approximately one month; respondents were asked to complete the survey once. Prior to accessing the survey, participants were informed of the possible risks and benefits of the study, and that the opening, completion, or submission of the survey implied consent for inclusion. Participants were advised that there were no foreseeable risks. The survey requested no personal identifying information. Responses were stored on a password protected computer behind a locked door.

The survey was comprised of demographic probes and previously used questionnaires regarding respondents' comfort, confidence, knowledge of roles and responsibilities, and perception of preparedness levels to work with children with hearing loss, specifically those with cochlear implants. The survey included several demographic related questions. Demographic questions included those related to gender, age, ethnicity, highest degree, Kentucky licensure, year of graduation with the Master's degree, teacher certification, school-district location (i.e., region), grades served, years at current school, number of students on caseload, number of students with hearing aids, FM systems, and cochlear implants.

Comfort level questions (8 questions) were modeled after instruments used by Watson and Martin [25], Ward, Grubbs, and Biswas [31], Compton, Tucker, and Flynn [33], and Babeu [30]. Confidence level questions (6 questions) were modeled after instruments used by Watson and Martin [25] and Babeu [30]. Knowledge of roles and responsibilities of professionals' working with children with hearing loss were modeled after questionnaires used by Watson and Martin [25]. Perception of preparation to work with children with hearing loss questions were modeled after questionnaires used by Babeu [30] and Compton, Tucker, and Flynn [33]. As previously indicated, the instrument for this study used a seven-point Likert scale for comfort and confidence targets. Elections ranged from extremely uncomfortable to extremely comfortable and extremely inadequate (confidence) to extremely adequate (confidence). Questions involving knowledge of roles and responsibilities of professional's working with children with hearing loss, including cochlear implants and perception of preparedness used a five-point Likert scale. The scale ranged from not knowledgeable at all to extremely knowledgeable and not well at all (preparedness) to extremely well (preparedness), respectively. The survey instrument is included as Appendix A.

Data analysis

All completed surveys were exported to Microsoft Excel and numerically coded in preparation for analysis. The data were then exported to SPSS Version 25 for statistical analyses. Descriptive and summary statistics characterized the aforementioned demographic items. The overall sample size was small and evidenced a monotonic relationship during assumption testing. As such, non-parametric analyses consistent with Spearman's rank-order correlations were completed for both within and between group items. Interpretation of the correlation coefficients was based on Mukaka [34] with only statistically significant positive and negative correlations ≥ .500 included.

Results

This study used a convenience sample of school-based speech-language pathologists (SLP) working in Kentucky's public-school system, inclusive of preschool, elementary, middle school, and high school settings. Respondents completed an online anonymous survey via the Qualtrics platform that queried their comfort, confidence, knowledge of roles and responsibilities, and perception of preparedness for working with children with hearing loss, specifically those with cochlear implants. Forty-eight (48) participants completed the survey in its entirety; 2.1% (n = 1) were male and 97.9% (n = 47) were female. Years practicing as an SLP ranged from 1 year to 34 years (M = 14.2, SD = 9.3). Total caseload size ranged from 24 students to 68 students (M = 52.8, SD = 11.6). Respondent age ranges and years at their current school (i.e., range) are presented in Tables 1 and 2 respectively (Tables 1 and 2).

Table 3 presents frequency counts of those students served with hearing aids, FM systems, and/or cochlear implants. This study was not limited to school districts or regions with known high numbers of children with hearing loss (Table 3). The survey was distributed across the 15 regions of Kentucky (e.g., Purchase, Pennyrile, Green River, Barren River, Bluegrass, Cumberland Valley, Northern Kentucky, Kentucky River, Gateway, Buffalo Trace, Fivco, Big Sandy, KIPDA, Lincoln Trail, Lake Cumberland) with representation from 11 regions (73%).

Table 1: Participant Age Ranges (N=48).

Range	Frequency	Percent	Cumulative Percent
<24 Years	3	6.3%	6.3
25-34 Years	16	33.3	39.6
35-44 Years	14	29.2	68.8
45-54 Years	10	20.8	89.6
>55 Years	5	10.4	100.0

Table 2: Years at Current School (N=48).

Range	Frequency	Percent	Cumulative Percent
<1 Year	10	20.8	20.8
1-5 Years	13	27.1	47.9
6-10 Years	7	14.6	62.5
11-15 Years	8	16.7	79.2
>16 Years	10	20.8	100.0

Table 3: Students with Hearing Aids, FM Systems, and/or Cochlear Implants.

# of Students	Hearing Aids	FM Systems	Cochlear Implants
0	26	30	38
1-5	22	17	10
6-10	0	0	0
11-15	0	0	0
>16	0	1	0
Totals	48	48	48

Tables 4-7 present descriptive statistics regarding respondents' comfort (8 questions), confidence (6 questions), knowledge of roles and responsibilities (5 questions), and perception of preparedness (3 questions) levels. The survey used a seven-point Likert scale for comfort and confidence targets and a five-point Likert scale for knowledge and preparedness items. Tables 8-11 present within-group item correlations while tables 12-17 present between-group item correlations. Spearman's rank-order correlation was used for analysis as the data set overall was relatively small (N = 48) and largely monotonic. Interpretation of correlation coefficients is based on Mukaka [34] with only statistically significant positive and negative correlations ≥ .500 included (Tables 4-7).

Descriptive Statistics and Within-Group Item Correlations

Comfort level

Descriptive statistics for this study and this sample found that school-based SLPs are moderately or extremely uncomfortable with CI procedures (68.7%, n = 33); moderately or extremely uncomfortable with CI brands (87.5%, n = 42); moderately or extremely uncomfortable regarding different types of hearing aids (50%, n=24); moderately or extremely uncomfortable with bone conductor hearing aids (60.4%, =29); moderately or extremely uncomfortable troubleshooting devices (66.7%, n=32); and moderately or extremely uncomfortable with mapping a CI (87.6%, n=42). School-based SLPs appear somewhat more comfortable regarding “how a CI works” and their skills “interpreting audiograms”. Respondents rated their comfort level regarding “how a CI works” as extremely, moderately, or slightly comfortable (43.7%, n=21) versus moderately or extremely uncomfortable (39.6%, n = 19). Respondents rated their comfort level interpreting audiograms as extremely, moderately, or slightly comfortable (52.1%, n=25) versus moderately or extremely uncomfortable (27.1%, n = 13) (Tables 4).

Table 4: Comfort Levels.

		N	%
CI Procedures	Extremely Comfortable	0	0.0%
	Moderately Comfortable	2	4.2%
	Slightly Comfortable	4	8.3%
	Neutral	3	6.3%
	Slightly Uncomfortable	6	12.5%
	Moderately Uncomfortable	10	20.8%
	Extremely Uncomfortable	23	47.9%
CI Brands	Extremely Comfortable	0	0.0%
	Moderately Comfortable	0	0.0%
	Slightly Comfortable	2	4.2%
	Neutral	2	4.2%
	Slightly Uncomfortable	2	4.2%
	Moderately Uncomfortable	10	20.8%
	Extremely Uncomfortable	32	66.7%
Different HA	Extremely Comfortable	0	0.0%
	Moderately Comfortable	4	8.3%
	Slightly Comfortable	5	10.4%
	Neutral	5	10.4%
	Slightly Uncomfortable	10	20.8%
	Moderately Uncomfortable	13	27.1%
	Extremely Uncomfortable	11	22.9%
Bone Conductor HA	Extremely Comfortable	1	2.1%
	Moderately Comfortable	1	2.1%
	Slightly Comfortable	3	6.3%
	Neutral	4	8.3%
	Slightly Uncomfortable	10	20.8%
	Moderately Uncomfortable	12	25.0%
	Extremely Uncomfortable	17	35.4%
Troubleshooting Devices	Extremely Comfortable	1	2.1%
	Moderately Comfortable	1	2.1%
	Slightly Comfortable	4	8.3%
	Neutral	0	0.0%
	Slightly Uncomfortable	10	20.8%
	Moderately Uncomfortable	11	22.9%
	Extremely Uncomfortable	21	43.8%
How CI Works	Extremely Comfortable	0	0.0%
	Moderately Comfortable	5	10.4%
	Slightly Comfortable	16	33.3%
	Neutral	6	12.5%
	Slightly Uncomfortable	2	4.2%
	Moderately Uncomfortable	8	16.7%
	Extremely Uncomfortable	11	22.9%
Interpreting Audiograms	Extremely Comfortable	7	14.6%
	Moderately Comfortable	7	14.6%
	Slightly Comfortable	11	22.9%
	Neutral	4	8.3%
	Slightly Uncomfortable	6	12.5%
	Moderately Uncomfortable	5	10.4%
	Extremely Uncomfortable	8	16.7%
Mapping CI	Extremely Comfortable	0	0.0%
	Moderately Comfortable	0	0.0%
	Slightly Comfortable	1	2.1%
	Neutral	0	0.0%
	Slightly Uncomfortable	5	10.4%
	Moderately Uncomfortable	9	18.8%
	Extremely Uncomfortable	33	68.8%

A Spearman's rank-order correlation was run to assess the association between school-based SLPs' comfort level and their management of selected hearing devices and procedures. There were statistically significant, moderate positive correlations between CI procedures and CI brands, $r_s(48) = .536$, $p < .001$; CI procedures and "how a CI works", $r_s(48) = .514$, $p < .001$; CI procedures and mapping a CI, $r_s(48) = .574$, $p < .001$; CI brands and mapping a CI, $r_s(48) = .584$, $p < .001$; bone conduction hearing aids and different types of hearing aids, $r_s(48) = .532$, $p < .001$; troubleshooting devices and different types of hearing aids, $r_s(48) = .586$, $p < .001$; interpreting audiograms and different types of hearing aids, $r_s(48) = .527$, $p < .001$; bone conduction hearing aids and troubleshooting devices, $r_s(48) = .524$, $p < .001$; interpreting audiograms and bone conduction hearing aids, $r_s(48) = .515$, $p < .001$; and troubleshooting devices and mapping a CI, $r_s(48) = .572$, $p < .001$. A statistically significant, high positive correlation was noted between bone conduction hearing aids and CI procedures, $r_s(48) = .737$, $p < .001$ (Table 5).

Confidence level

Descriptive statistics for this study and this sample found that school-based SLPs feel moderately or extremely inadequate with auditory training for individuals with CI (50%, n = 24); moderately or extremely inadequate with speech reading tasks for individuals with CI (58.4%, n = 28); and moderately or extremely inadequate with theory of mind tasks for individuals with CI (50%, n = 24). Respondents rated their confidence level as slightly, moderately, or extremely adequate with respect to articulation therapy for individuals with CI (70.8%, n = 27) versus moderately or extremely inadequate (20.8%, n = 10). Respondents rated their confidence levels as slightly, moderately, or extremely adequate with respect to treatment of executive functions individuals with CI (47.9%, n = 18) versus moderately or extremely inadequate (37.5%, n = 18). Respondents also reported feeling slightly, moderately, or extremely adequate with respect to treatment of phonological awareness in individuals with CI: (52.9%, n = 25) versus those that felt moderately or extremely inadequate (22.9%, n = 11) (Table 6).

A Spearman's rank-order correlation was run to assess the association between school-based SLPs' confidence level and their ability to carry out aural habilitative and rehabilitative treatment plans. There were statistically significant, moderate positive correlations between auditory training and articulation, $r_s(48) = .519$, $p < .001$; auditory training and phonological awareness, $r_s(48) = .629$, $p < .001$; speech reading and theory of mind, $r_s(48) = .612$, $p < .001$; speech reading and executive functions, $r_s(48) = .503$, $p < .001$; theory of mind and articulation, $r_s(48) = .653$, $p < .001$; theory of mind and executive functions, $r_s(48) = .661$, $p < .001$; and theory of mind and phonological awareness, $r_s(48) = .686$, $p < .001$. There were statistically significant, high positive correlations between auditory training and speech reading, $r_s(48) = .811$, $p < .001$; auditory training and theory of mind, $r_s(48) = .714$, $p < .001$; auditory training and executive functions, $r_s(48) = .705$, $p < .001$; articulation and executive functions, $r_s(48) = .747$, $p < .001$; articulation and phonological awareness, $r_s(48) = .826$, $p < .001$; and executive functions and phonological awareness, $r_s(48) = .763$, $p < .001$ (Table 7).

Knowledge of roles and responsibilities

Descriptive statistics for this study and this sample found that school-based SLPs feel moderately, very, or extremely knowledgeable regarding the roles and responsibilities of audiologists (87.5%, n = 42), teachers (68.7%, n = 33), speech-language pathologists (75.1%, n = 36), and parents (79.2%, n = 38) in the management of individuals with hearing loss. Approximately 48% (n = 23) of respondents reported feeling slightly knowledgeable or having no knowledge regarding the role of otologists in the management of individuals with hearing loss (Table 8).

A Spearman's rank-order correlation was run to assess the association between school-based SLPs' knowledge of cochlear implants and the roles and responsibilities of individuals associated with the management of hearing loss. There were statistically significant, moderate positive correlations between otologists and audiologists, $r_s(48) = .554$, $p < .001$; otologists and teachers, $r_s(48) = .550$, $p < .001$; otologists and speech-language pathologists, $r_s(48) = .527$, $p < .001$; and otologists and parents, $r_s(48) = .620$, $p < .001$. There were statistically significant, high positive correlations between audiologists and teachers, $r_s(48) = .794$, $p < .001$; audiologists and speech-language pathologists, $r_s(48) = .715$, $p < .001$; audiologists and parents, $r_s(48) = .824$, $p < .001$; teachers and speech-language pathologists, $r_s(48) = .782$, $p < .001$; teachers and parents, $r_s(48) = .789$, $p < .001$; and speech-language pathologists and parents, $r_s(48) = .731$, $p < .001$ (Table 9).

Preparedness/training

Descriptive statistics for this study and this sample found that the majority of school-based SLPs felt that neither their undergraduate education, graduate education, nor their practicum experiences sufficiently prepared them to work with children with cochlear

Table 5: Spearman's Rho Correlation Matrix (Comfort Levels) (N=48).

	CI Procedures	Brands	Different HA	Bone Conduct.	Troubleshoot	How CI Works	Audiogram	Mapping CI
CI Procedures	-							
CI Brands	.536*	-						
Different HA	.381	.389	-					
Bone Conduct.	.737**	.425	.532*	-				
Troubleshoot	.383	.496	.586*	.524*	-			
How CI Works	.514*	.319	.382	.445	.473	-		
Audiogram	.292	.320	.527*	.515*	.396	.381	-	
Mapping CI	.574*	.584*	.408	.471	.572*	.494	.363	-

*. Moderate Positive (Negative) Correlation is significant at p<.001 (2-tailed).
**. High Positive (Negative) Correlation is significant at p<.001 (2-tailed).

Table 6: Confidence Levels

		N	%
CI Auditory Training	Extremely Adequate	1	2.1%
	Moderately Adequate	5	10.4%
	Slightly Adequate	8	16.7%
	Neutral	5	10.4%
	Slightly Inadequate	5	10.4%
	Moderately Inadequate	12	25.0%
	Extremely Inadequate	12	25.0%
CI Speech Reading	Extremely Adequate	0	0.0%
	Moderately Adequate	5	10.4%
	Slightly Adequate	7	14.6%
	Neutral	5	10.4%
	Slightly Inadequate	3	6.3%
	Moderately Inadequate	13	27.1%
	Extremely Inadequate	15	31.3%
CI Articulation	Extremely Adequate	11	22.9%
	Moderately Adequate	16	33.3%
	Slightly Adequate	7	14.6%
	Neutral	1	2.1%
	Slightly Inadequate	3	6.3%
	Moderately Inadequate	5	10.4%
	Extremely Inadequate	5	10.4%
CI Theory of Mind	Extremely Adequate	4	8.3%
	Moderately Adequate	5	10.4%
	Slightly Adequate	2	4.2%
	Neutral	8	16.7%
	Slightly Inadequate	5	10.4%
	Moderately Inadequate	11	22.9%
	Extremely Inadequate	13	27.1%
CI Executive Functions	Extremely Adequate	4	8.3%
	Moderately Adequate	14	29.2%
	Slightly Adequate	5	10.4%
	Neutral	3	6.3%
	Slightly Inadequate	4	8.3%
	Moderately Inadequate	7	14.6%
	Extremely Inadequate	11	22.9%
CI Phonological Awareness	Extremely Adequate	7	14.6%
	Moderately Adequate	18	37.5%
	Slightly Adequate	5	10.4%
	Neutral	2	4.2%
	Slightly Inadequate	5	10.4%
	Moderately Inadequate	5	10.4%
	Extremely Inadequate	6	12.5%

Table 7: Spearman's Rho Correlation Matrix (Confidence Levels) (N=48).

	Aud. Train.	Sp. Read.	Artic.	Th. of Mind	Ex. Func.	Phono Awar.
Aud. Train.	-					
Sp. Read.	.811**	-				
Artic.	.519*	.428	-			
Th. of Mind	.714**	.612*	.653*	-		
Ex. Func.	.705**	.503*	.747**	.661*	-	
Phono Awar.	.629*	.474	.826**	.686*	.763**	-

*. Moderate Positive (Negative) Correlation is significant at $p < .001$ (2-tailed).
**. High Positive (Negative) Correlation is significant at $p < .001$ (2-tailed).

implants. In response to the prompt, "how well do you feel your undergraduate education prepared you to work with children with cochlear implants?", 68.8% (n = 33) reported "not well at all", 27.1% (n = 13) reported "slightly well", and 4.2% (n = 2) reported "moderately well". The same prompt was provided for "graduate education". Approximately 52% of respondents suggested that their graduate education did "not" prepare them "well at all" to work with cochlear implants while 35.4% described their training

Table 8: Knowledge of Roles and Responsibilities.

		N	%
Otologist	Extremely Knowledgeable	3	6.3%
	Very Knowledgeable	6	12.5%
	Moderately Knowledgeable	16	33.3%
	Slightly Knowledgeable	13	27.1%
	Not Knowledgeable	10	20.8%
Audiologist	Extremely Knowledgeable	5	10.4%
	Very Knowledgeable	18	37.5%
	Moderately Knowledgeable	19	39.6%
	Slightly Knowledgeable	4	8.3%
	Not Knowledgeable	2	4.2%
Teacher	Extremely Knowledgeable	5	10.4%
	Very Knowledgeable	12	25.0%
	Moderately Knowledgeable	16	33.3%
	Slightly Knowledgeable	11	22.9%
	Not Knowledgeable	4	8.3%
SLP	Extremely Knowledgeable	8	16.7%
	Very Knowledgeable	13	27.1%
	Moderately Knowledgeable	15	31.3%
	Slightly Knowledgeable	10	20.8%
	Not Knowledgeable	2	4.2%
Parent	Extremely Knowledgeable	4	8.3%
	Very Knowledgeable	15	31.3%
	Moderately Knowledgeable	19	39.6%
	Slightly Knowledgeable	8	16.7%
	Not Knowledgeable	2	4.2%

Table 9: Spearman's Rho Correlation Matrix (Knowledge of Roles/Responsibilities) (N=48).

	Otologist	Audiologist	Teacher	SLP	Parent
Otologist	-				
Audiologist	.554*	-			
Teacher	.550*	.794**	-		
SLP	.527*	.715**	.782**	-	
Parent	.620*	.824**	.789**	.731**	-

*. Moderate Positive (Negative) Correlation is significant at $p < .001$ (2-tailed).
**. High Positive (Negative) Correlation is significant at $p < .001$ (2-tailed).

as "slightly well". Six respondents (12.5%) reported their graduate training to be "moderately well" prepared. In terms of practicum placements, the majority (70.8%, n = 34) reported "not well at all" to the provided prompt followed by 16.7% (n = 8) as "slightly well", 6.3% (n = 3) as "moderately well", and 6.3% (n = 3) as very well (Table 10).

A Spearman's rank-order correlation was run to assess the association between school-based SLPs' educational training and their perception of preparedness to work with children with cochlear implants. A statistically significant, moderate positive correlation was identified between graduate education and practicum placements, $r_s(48) = .680$, $p < .001$ (Table 11).

Table 10: Preparedness/Training.

		N	%
Undergraduate Degree	Extremely Well	0	0.0%
	Very Well	0	0.0%
	Moderately Well	2	4.2%
	Slightly Well	13	27.1%
	Not Well At All	33	68.8%
Graduate Degree	Extremely Well	0	0.0%
	Very Well	0	0.0%
	Moderately Well	6	12.5%
	Slightly Well	17	35.4%
	Not Well At All	25	52.1%
Practicum Placements	Extremely Well	0	0.0%
	Very Well	3	6.3%
	Moderately Well	3	6.3%
	Slightly Well	8	16.7%
	Not Well At All	34	70.8%

Between-Group Item Correlations

Comfort and confidence levels

A Spearman's rank-order correlation was run to assess the association between school-based SLPs' comfort level and their management of selected hearing devices and procedures and their degree of confidence regarding their ability to carry out aural habilitative and rehabilitative treatment plans. There were statistically significant, moderate positive correlations between CI procedures and auditory training, $r_s(48) = .529$, $p < .001$; different types of hearing aids and auditory training, $r_s(48) = .595$, $p < .001$; bone conduction hearing aids and auditory training, $r_s(48) = .540$, $p < .001$; different types of hearing aids and speech reading, $r_s(48) =$

Table 11: Spearman's Rho Correlation Matrix (Preparedness/Training) (N=48).

	Undergrad	Graduate	Practicum
Undergrad	-		
Graduate	.476	-	
Practicum	.386	.680*	-
*. Moderate Positive (Negative) Correlation is significant at p < .001 (2-tailed). **. High Positive (Negative) Correlation is significant at p < .001 (2-tailed).			

Table 12: Spearman's Rho Correlation Matrix (Comfort and Confidence Levels) (N=48).

	Aud. Train.	Sp. Read.	Artic.	Th. of Mind.	Ex. Func.	Phono. Awar.	Overall Conf.
CI Procedures	.529*	.335	.195	.300	.291	.245	.662*
CI Brands	.267	.316	.033	.146	.008	.077	.510*
Different HA	.595*	.557*	.337	.450	.405	.354	.573*
Bone Conduct.	.540*	.380	.096	.317	.222	.182	.657*
Troubleshoot	.434	.586*	.183	.318	.162	.182	.566*
How CI Works	.458	.369	.334	.526*	.299	.331	.612*
Audiogram	.456	.401	.196	.378	.267	.382	.482
Mapping CI	.438	.444	.197	.303	.187	.149	.515*
*. Moderate Positive (Negative) Correlation is significant at p < .001 (2-tailed). **. High Positive (Negative) Correlation is significant at p < .001 (2-tailed).							

.557, p < .001; troubleshooting devices and speech reading, $r_s(48) = .586$, p < .001; "how a CI works" and theory of mind, $r_s(48) = .526$, p < .001; CI procedures and overall confidence, $r_s(48) = .662$, p < .001; CI brands and overall confidence, $r_s(48) = .510$, p < .001; different types of hearing aids and overall confidence, $r_s(48) = .573$, p < .001; bone conduction hearing aids and overall confidence, $r_s(48) = .657$, p < .001; troubleshooting devices and overall confidence, $r_s(48) = .566$, p < .001; "how a CI works" and overall confidence, $r_s(48) = .612$, p < .001; and mapping a CI and overall confidence, $r_s(48) = .515$, p < .001 (Table 12).

Comfort level and knowledge of roles and responsibilities

A Spearman's rank-order correlation was run to assess the association between school-based SLPs' comfort level managing selected hearing devices and procedures and their knowledge of cochlear implants and the roles and responsibilities of individuals associated with the management of hearing loss. There were statistically significant, moderate positive correlations between "how a CI works" and parents, $r_s(48) = .521$, p < .001 and mapping a CI and parents, $r_s(48) = .541$, p < .001 (Table 13).

Comfort level and preparedness/training

A Spearman's rank-order correlation was run to assess the association between school-based SLPs' educational training and their perception of preparedness to work with children with cochlear implants and their comfort level managing selected hearing devices and procedures. There were statistically significant, moderate positive correlations between interpreting audiograms and graduate education, $r_s(48) = .508$, p < .001 and mapping a CI and graduate education, $r_s(48) = .587$, p < .001 (Table 14).

Confidence level and knowledge of the roles and responsibilities

A Spearman's rank-order correlation was run to assess the association between school-based SLPs' confidence level regarding their ability to carry out aural habilitative and rehabilitative treatment plans and their knowledge of the roles and responsibilities of individuals associated with the management of hearing loss. There were statistically significant, moderate positive correlations between theory of mind and teachers, $r_s(48) = .516$, p < .001; theory of mind and speech-language pathologists, $r_s(48) = .501$, p < .001; theory of mind and parents, $r_s(48) = .544$, p < .001; phonological awareness and speech-language pathologists, $r_s(48) = .508$, p < .001; auditory training and parents, $r_s(48) = .535$, p < .001; and overall confidence and parents, $r_s(48) = .517$, p < .001 (Table 15).

Table 13: Spearman's Rho Correlation Matrix (Comfort Level and Knowledge of Roles and Responsibilities) (N=48).

	Otologist	Audiologist	Teacher	SLP	Parent
CI Procedures	.331	.237	.272	.231	.403
CI Brands	.016	.089	.057	.092	.212
Different HA	.054	.279	.259	.398	.349
Bone Conduct.	.255	.213	.258	.163	.294
Troubleshoot	-.086	.199	.261	.204	.269
How CI Works	.266	.409	.485	.286	.521*
Audiogram	.241	.436	.465	.435	.416
Mapping CI	.168	.401	.403	.284	.541*
*. Moderate Positive (Negative) Correlation is significant at p < .001 (2-tailed). **. High Positive (Negative) Correlation is significant at p < .001 (2-tailed).					

Table 14: Spearman's Rho Correlation Matrix (Comfort Level and Preparedness/Training) (N=48).

	Undergrad	Graduate	Practicum
CI Procedures	.026	.294	.283
CI Brands	.154	.291	.298
Different HA	.230	.397	.389
Bone Conduct.	.139	.362	.367
Troubleshoot	.161	.331	.175
How CI Works	.004	.415	.244
Audiogram	.290	.508*	.372
Mapping CI	.196	.587*	.394
*. Moderate Positive (Negative) Correlation is significant at p < .001 (2-tailed). **. High Positive (Negative) Correlation is significant at p < .001 (2-tailed).			

Confidence level and preparedness/training

A Spearman's rank-order correlation was run to assess the association between school-based SLPs' confidence level regarding their ability to carry out aural habilitative and rehabilitative treatment plans and their educational training and perception of preparedness to work with children with cochlear implants. While statistical significance was achieved for many items, none of the Spearman's rank-order correlations were ≥ .500 (Table 16).

Table 15: Spearman's Rho Correlation Matrix (Confidence Level and Knowledge of Roles and Responsibilities) (N=48).

	Otologist	Audiologist	Teacher	SLP	Parent
Aud. Train.	.334	.444	.453	.440	.535*
Sp. Read.	.240	.421	.428	.418	.499
Artic.	.310	.373	.360	.403	.314
Th. of Mind	.336	.469	.516*	.502*	.544*
Ex. Func.	.222	.303	.325	.318	.290
Phono Awar.	.340	.423	.451	.508*	.404
Overall Conf.	.251	.366	.393	.309	.517*

*. Moderate Positive (Negative) Correlation is significant at $p < .001$ (2-tailed).
**. High Positive (Negative) Correlation is significant at $p < .001$ (2-tailed).

Table 16: Spearman's Rho Correlation Matrix (Confidence Level and Preparedness/Training) (N=48).

	Undergrad	Graduate	Practicum
Aud. Train.	.341	.442	.434
Sp. Read.	.452	.497	.452
Artic.	.208	.180	.218
Th. of Mind	.191	.375	.434
Ex. Func.	.206	.195	.258
Phono Awar.	.263	.171	.171
Overall Conf.	.143	.337	.302

*. Moderate Positive (Negative) Correlation is significant at $p < .001$ (2-tailed).
**. High Positive (Negative) Correlation is significant at $p < .001$ (2-tailed).

Knowledge of roles and responsibilities and preparedness/training

A Spearman's rank-order correlation was run to assess the association between school-based SLPs' educational training and perception of preparedness to work with children with cochlear implants and their knowledge of the roles and responsibilities of individuals associated with the management of hearing loss. A statistically significant, moderate positive correlation was identified between teachers and graduate education, $r_s(48) = .557$, $p < .001$ (Table 17).

Table 17: Spearman's Rho Correlation Matrix (Knowledge of Roles/Responsibilities and Preparedness/Training) (N=48).

	Undergrad	Graduate	Practicum
Otologist	.128	.320	.246
Audiologist	.157	.436	.328
Teacher	.324	.557*	.375
SLP	.257	.473	.313
Parent	.204	.485	.351

*. Moderate Positive (Negative) Correlation is significant at $p < .001$ (2-tailed).
**. High Positive (Negative) Correlation is significant at $p < .001$ (2-tailed).

Summary

The intent of this study sought to investigate the comfort, confidence, knowledge of professionals' roles, and perception of preparedness of Kentucky's school-based speech-language pathologists working with children with hearing loss, specifically those with cochlear implants. The results in ranked order found that SLPs appear most uncomfortable discussing how CIs are mapped, the different CI brands, CI procedures from surgery to activation, troubleshooting devices (i.e., hearing aids) including bone conductor hearing aids, and their knowledge of the many different types of hearing aids on the market. SLPs, per this sample, appeared more comfortable interpreting audiograms and explaining the general process of how a CI works. Moreover, the greatest high positive correlation per this sample was noted between an SLP's comfort level with bone conduction hearing aids and CI procedures in general.

Kentucky school-based SLPs (per this sample) appear to lack the greatest amount of confidence in their abilities managing aural habilitative and rehabilitative treatment plans that involve speech reading, auditory training, and theory of mind tasks. They appear much more confident with executive functions, phonological awareness, and articulation. Again, the aforementioned areas are rank-ordered from low confidence to high confidence. The greatest high positive correlation per this sample was noted between SLP's confidence level in carrying out habilitative/rehabilitative treatment plans involving articulation and phonological awareness targets.

With respect to identification of the roles and responsibilities of individuals associated with the management of hearing loss, Kentucky school-based SLPs appear most knowledgeable per the duties of the team's audiologist. This is followed by the roles and responsibilities of the parent, speech-language pathologist, and the classroom teacher. Per this sample, SLPs reported lower knowledge regarding the roles and responsibilities of the otologist. The greatest high positive correlation per this sample was noted with respect to SLP's knowledge of the roles and responsibilities of the audiologist and the parent.

Lastly, school-based SLPs overwhelmingly reported that neither their undergraduate education, graduate education, nor their practicum experiences sufficiently prepared them to work with children with cochlear implants. Per this sample, respondents rated their graduate education as only slightly improved over their undergraduate education experiences. Practicum placements were rated the lowest overall. The greatest moderate positive correlation per this sample was between graduate education and practicum placements.

Discussion

Early hearing detection and intervention (EDHI) laws have increased opportunities for children with hearing loss by requiring newborn hearing screenings and early intervention services by six months of age [35]. As the number of children diagnosed continues to increase, school based SLPs will likely have hearing-impaired students on their caseloads as 90% of children with hearing loss are educated in the public school system with 61% served in a mainstream classroom [24,36]. The goal is for direct speech, language, and auditory training services to decrease during the elementary and middle school years after quality intervention [26]. It is vital that SLPs who work with this population are proficient in their ability to provide treatment as student's progress with speech perception, speech production, and oral language requires quality and collaborative intervention [24,37]. In this study, forty-eight Kentucky schools based SLPs were surveyed on their comfort, confidence, knowledge, and preparation in providing appropriate intervention services for hearing impaired students.

Comfort

From a comfort perspective, the majority of this sample size rated their comfort levels with cochlear implant (CI) procedures, brands, troubleshooting and mapping as extremely uncomfortable. In a similar study conducted in New Hampshire, results demonstrated a lack of knowledge about cochlear implant candidacy as 100% of respondents answered they felt minimally competent (Babeu, 2016). Per this sample context, 81.2% of SLPs surveyed ranked themselves as uncomfortable with CI procedures from candidacy to activation. The ASHA [28], Knowledge and Skills for the Practice of Audiologic/Aural Rehabilitation outlines that SLPs who provide aural rehabilitation demonstrate the ability to describe candidacy criteria for amplification and sensory prosthetic devices. Understanding the candidacy criteria and preimplant factors that affect outcomes, will assist SLPs in their decisions, make the correct referrals, and provide support to families [26]. SLPs also assist in the candidacy process by providing the CI team with the child's expressive and receptive language skills, speech production, auditory behaviors, speech perception ability, attention, and other cognitive abilities to determine eligibility [11]. SLPs also contribute to the CI process before activation by conditioning the child to be aware of the presence of a stimulus using various cues [11]. A strong positive correlation was found in this sample between the comfort levels with CI procedures and their overall confidence levels in creating treatment goals with a .662 correlation. Understanding the CI process in combination with the child's pre-implantation speech and language skills will aid SLPs in developing appropriate expectations of the child [11].

Previous research has shown that SLPs demonstrated lower confidence scores when it came to determine the functional status of a hearing aid and even lower confidence troubleshooting [38]. Results from a Mississippi study indicated that 73% percent of the SLPs surveyed felt uncomfortable with troubleshooting procedures [31]. A similar study conducted in the Midwest also yielded similar results with SLPs indicating they had minimal to no knowledge on troubleshooting a malfunctioning implant [25]. Richburg and Knickelbein [39] yielded results of a two hundred and nine SLP sample throughout the United States that 60.6% rated their ability to assist students with malfunctioning hearing aids or FM systems as low and 57.6% rated their ability to assist students with malfunctioning cochlear implants as low. Results from Richburg & Knickelbein [39] study also suggested that although monitoring hearing aids is listed in the ASHA Guidelines, SLPs are not conducting listening checks to determine device function level adequately or appropriately. Per this sample of Kentucky school based SLPs, 87% felt slightly-extremely uncomfortable with troubleshooting devices. Consistent use of a well-functioning hearing device is critical to a child's success as auditory learning only occurs when integrity is maintained [11,37]. While malfunctioning devices subject an audiology referral, many school systems do not have educational audiologists readily available [40].ASHA's Knowledge and Skills for the Practice of Audiologic/Aural Rehabilitation [28] outlines that SLPs are able to "perform routine visual inspection and listening checks of clients' hearing devices and sensory aids to troubleshoot common causes of malfunctioning (para. 7). Common causes include cord dysfunction or battery status [11]. In addition to monitoring changes in a student's abilities that may indicate device malfunction, SLPs should also coach parents in checking the integrity of devices at home to ensure accurate access to sound [37,40]. For the cases where an audiologist is not readily available, most companies offer manuals to assist SLPs in troubleshooting [27].

A moderate positive (negative) correlation was evident in this survey between comfort level of troubleshooting and comfort level of both brands and hearing aids. The different hearing aid choices available and different brands directly impacts troubleshooting as each device works differently. SLPs should be familiar with each child's specific device and how it functions [11].Proficiency in device function and how a CI works assists in mapping procedures. When the SLP knows how the hearing device is set, they can observe the child's reactions to various sounds and environments to provide feedback to the audiologist to adjust settings for performance [37]. Previous research into SLPs proficiency with CI function noted a variance amongst SLPs however a majority responded that they did not feel confident in their abilities [25,30, 31,33]. SLPs in this survey also varied in their responses to their comfort level with how a CI works. It is important that SLPs understand the CI components to complete troubleshooting, connecting to FM systems, and completing daily listening checks [31]. In order to ensure quality intervention services and allow students to reach their full potential with their speech and language skills, SLPs must be knowledgeable about the mechanism of the device and effective management techniques [25]. SLPs should also understand and recognize signs that the device needs troubleshooting or adjustment to the mapping including changes in responses, vocal quality, speech production, or discomfort [11]. Unfamiliarity with the mapping procedures may be due to the fact that audiologists handle this rather than the SLP, however there is benefit to understanding mapping. Speech mapping is beneficial to SLP as it ensures that the patient can hear the necessary frequencies of the speech spectrum [7]. Being comfortable with the location of speech sounds plotted on an audiogram aids in determining whether the student is receiving appropriate benefit from their device and reveals deficits that prompt an adjustment to the mapping of the device [7].

Confidence

The SLP's primary responsibility is to develop and deliver an appropriate program with speech, language and listening goals to improve both social interactive and instructional communication [25,40]. ASHA [28] guidelines for aural rehabilitation state that SLPs should provide intervention that includes voice quality, resonance, phonologic processes, oral motor skills, articulation, prosody, semantics, and pragmatics. In this study, SLPs ranked their confidence levels in creating goals in auditory training, speech reading, articulation, theory of mind, executive function, and phonological awareness. SLPs' confidence levels were increased in establishing goals for articulation, executive function, and phonological awareness when compared to auditory training, speech reading, and theory of mind. Excluding theory of mind, the categories with decreased confidence levels were specific to hearing loss whereas the other categories are prevalent among other diagnoses. SLPs need to assess a student's speech and language skills in comparison to age matched peers and understand typical delays related to hearing loss [37]. Low confidence levels may be associated with lack of exposure and experience with this population. Watson and Martin's [25] data indicated that direct experience was associated with increased confidence levels to treat this population. Per this sample, the majority of SLPs had 0-5 kids on their caseload with hearing aids or cochlear implants. As implantations increase, school based SLPs will begin to see more students with hearing loss on their caseloads and it is vital that they possess the confidence to provide quality care.

Auditory training was a category found in previous research that SLPs had decreased confidence levels and minimal preparation in [25,33]. Babeu [30] however, found SLPs in the sample to be moderately competent in developing listening skills. In comparison to these studies, 60% of this sample of Kentucky school based SLPs, rated their confidence levels in developing auditory training goals as slightly-extremely inadequate. Additionally, Watson and Martin [25] found that SLPs did not feel that auditory training was their responsibility. Section VII. of the Knowledge and Skills Required for the Practice of Aural Rehabilitation states that SLPs should possess the skill to identify how hearing loss affects listening skills [28]. Auditory training is the process of teaching a child to interpret speech signals with four levels including sound awareness, sound discrimination identification, and eventual comprehension of auditory information [7,11]. SLPs who work with hearing impaired students must be aware of this auditory hierarchy and the effect it has on language, articulation and auditory development [27]. Integration of speech production with auditory training will allow for translation of both skills into daily activities and opportunity to acquire spoken language [11]. Understanding the candidacy criteria of CI procedures, directly impacts auditory training outcomes as knowledge of the child's preexposure to sound assists in determining the goals and needs of auditory skill development per each child [11].

Speech reading was another category where the majority of this sample, (64.7%) indicated their confidence levels in creating speech reading goals were inadequate. Due to advances in hearing technology, speech reading popularity has decreased [7] which may have contributed to the low confidence levels. It is important to note that in Watson and Martin's study [25] that 74% if survey respondents indicated that speech reading was the responsibility of the SLP, however they reported their knowledge in improving speech reading skills as minimal to slightly knowledgeable. While popularity of speech reading has decreased, it is still beneficial to receive training as it maximizes auditory learning by providing visual cues [26]. SLPs should possess the ability to use speechreading in their session to accurately follow the guidelines listed by ASHA in the practice of aural rehabilitation [28].

Theory of mind (ToM) has become a topic of interest with the hearing-impaired population as there has previously been a historical delay in development of it by deaf children [41]. Studies conducted about ToM development have yielded mixed results. A study conducted in the Netherlands, suggested that CI children were able to master initial theory of mind concepts but struggled with more advanced concepts [42]. In contrast, Remmel and Peters [43] found that CI children were not delayed when compared to their normal hearing peers however there was an atypical sequence in understanding ToM concepts. Other research conducted suggested that the age of implantation affected ToM development concluding that earlier implantation reflects normal acquisition of ToM concepts [44]. The studies previously referenced surrounding SLPs preparation and knowledge in treating students with hearing loss, did not specifically investigate ToM concepts. When addressing ToM concepts, 60% of respondents' confidence levels were slightly-extremely inadequate. As the primary goal for students with hearing loss is oral language, a child may be discharged from treatment before deficits in ToM occur or their ToM skills may be over looked. Post implant rehabilitation should encourage use of mental state language and focus on social cognition to supplement speech and language outcomes [43]. Support during classroom activities can assist children with deficits in ToM or other psychosocial outcomes as the classroom is where interactions expose the child to appropriate social, academic and communication behaviors that occur during daily routines and the consequences of inappropriate behavior [40].

Knowledge

From a knowledge perspective, Kentucky school based SLPs were surveyed on their knowledge of the roles and responsibilities of the otologist, audiologist, teacher, SLP, and parents. SLPs per this sample, felt knowledgeable with the roles and responsibilities of the audiologist, but decreased knowledge with the otologist, SLP, teacher, and parent. Erler [11] attributes this decreased knowledge to the trans disciplinary team on the student's case, stating that service provision roles often overlap. There are also various degrees of accessibility to an educational audiologist, making the SLP the easiest access for teachers or parents [38]. Lack of communication and access between different members will also cause blurred lines between roles [25,33]. Previous research investigated the access SLPs had to an audiologist. Watson and Martin [25] discovered that 13% of their respondents had an educational audiologist on staff and only 51% had access to an audiologist. Similar results were produced by Ward, Grubbs, and Biswas [31] reporting that 40% of participants reported that they were never in contact with an audiologist. In the North Carolina survey, 33.3% respondents stated that they had no contact [33]. However, the study completed by authors in North Carolina demonstrated that 87.5% of SLPs that participated had access to an educational audiologist. Watson and Martin [25] also investigated respondent's knowledge of the responsibilities of each role and the results varied. While access to an audiologist or other professional team members was not specifically researched in this study, respondents were asked about their knowledge of each role. Respondents from this sample size also indicated variation as the results were widespread between extremely knowledgeable to not knowledgeable. Respondents demonstrated a lack of knowledge of the roles and the responsibilities of the otologist which may be due to decrease in need for collaboration with one after implantation. Although there was some variation, the majority of respondents moderately-extremely knowledgeable in the roles and responsibilities of the audiologist, SLP, teacher, and parent. Interprofessional collaboration between members of the CI team allows members to have complete information on the child, effectively maximize their potential, and eliminate conflicting info [37]. Understanding each part of the multi-disciplinary team is crucial to ensure that SLPs are not practicing outside their scope of practice. Due to the lack of audiologists in schools, SLPs are often called upon to handle some of these responsibilities, however, SLPs must understand and perform only what is outlined in their scope of practice to eliminate ethical issues [39]. Positive outcomes for the student are achieved by the members of the interdisciplinary team working together on the goals and objectives to ensure generalization across all disciplines. Better education aimed at improving awareness and knowledge of each disciplines roles and responsibilities would increase collaborative effort [39].

Preparedness

Consistent with previous studies conducted [25,30,33], this survey supported previous research indicating that there is a need for more expertise and training with hearing impaired children. More specifically, this sample of Kentucky school based SLPs did not feel as if their undergraduate, graduate, or practicum placements adequately prepared them to treat and manage patients with hearing loss. Increasing education and preparation will raise SLPs comfort, confidence, and knowledge by providing more experience with this increasing population. While undergraduate, graduate, and practicum placements vary by state, school, and SLP, results suggest that universities can improve on their training and class curriculum to address the needs to this population. 66.8% of respondents felt their undergraduate preparation did not prepare them, 52% felt their graduate coursework did not prepare them, and 70.8% felt their practicum experience was not sufficient in preparing them to treat those with hearing loss. Specifics to the amount of lectures or hands on experience was not questioned in this survey however, previous surveys have investigated this. Babeu [30] discovered that only 19% of respondents in the study had received formal education on CIs through a graduate course. The UNCG survey results showed that only 3.9% of SLPs surveyed had practicum experience with Cis [33]. Certification for knowledge and skills needed for hearing loss can be met with few supervised hearing screening hours and one academic course [45]. With many other existing areas of speech language pathology, it is difficult to learn every disorder in the SLP scope of practice in two years, however this skill gap in hearing loss may be compensated through in-service training and multidisciplinary support [40]. Participants in another study completed, indicated that their level of competency came from workshops or professional development [30].As the caseloads of SLPs expands to include a higher incidence of auditory impairment, SLPs knowledge and skills need to expand as well [39]. Both undergraduate and graduate schools should address this skill gap, evaluate the curriculum, and provide clinical experience to better prepare SLPs to treat this population.

With insufficient training before working independently with this population, SLPs in this study indicated that they would receive the most benefit from continuing education courses, conferences, and online internet-based information. Previous research into the lack of expertise with treating students with hearing loss suggested that there is a need for accessible cochlear implant resources and seminars held by audiologists would be beneficial [31].

Further Research

As research and technology surrounding pediatric hearing loss improves, it is imperative that professionals who work with this population are prepared to treat this population. The sample size of this study was relatively small and results represented only a portion of school based SLPs in Kentucky. A larger sample size would be beneficial for future studies to achieve a more accurate representation. Future research investigating the access to other professionals such as audiologists or otologists in different places around the state may assist SLPs in receiving the support they need to effectively treat this population. The amount of preparation may depend on the undergraduate/graduate schools the SLPs have attended, therefore research into specific courses and electives offered in aural rehabilitation may reveal where programs are lacking. Further research may also look into recent graduates vs. longer practicing therapists for a more accurate description of the course work especially as technology for this population improves.

Through this research, the possible decreased levels comfort, confidence, knowledge, and preparation of Kentucky SLPs when working with students with hearing loss, were revealed. SLPs in this sample size suggested a need for more experience and continuing education resources to improve intervention for the hearing-impaired population. Discovering and acknowledging these shortfalls will assist in creating ways to close the gap and contribute to the success of children with hearing loss in the classroom.

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