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Editorial

New Format

With the JARA shifting to a completely online publication, the format of the journal has been updated and I hope that you like the new look. As before, the journal will continue to serve as a platform for sharing research, and clinical and educational information that promotes the mission of the Academy of Rehabilitative Audiology. That is, the JARA will continue to promote better understanding of hearing loss and its impact on individuals, families and society, as well as excellence in hearing healthcare and (re)habilitation.

This issue includes three articles that typify the mission of the academy. It includes a study that looked at the effectiveness of a service learning component within an adult aural rehabilitation course (Van Hyfte, Richards, & Krishnan), a hearing aid study looking at the impact of high frequency cut-off on speech perception in adults (Vasil Dilaj & Cienkowski), and an investigation of the aural rehabilitation services provided to adults fitted with cochlear implants and their met and unmet needs (Tucker, Compton, Mankoff, Labban, & Dudley). These articles should add to your knowledge in the field, and for many of you, inspire your current and future research, clinical activities and teaching efforts.

Sheila R. Pratt, Ph.D., Editor

Journal of the Academy of Rehabilitative Audiology

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Contents

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Research Article

Benefits of Service-Learning in Adult Aural Rehabilitation Course

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Abstract

Rationale

The purpose of this study was to determine whether students benefitted from a service-learning (SL) component incorporated into an aural rehabilitation course.

Methods

For three consecutive years, the students enrolled in the graduate-level Adult Aural Rehabilitation course at Purdue University spent the initial two-thirds of the course in the classroom and the final third at one of two assisted living facilities where they implemented course content while providing hearing screenings, aural rehabilitation sessions, and leading book discussions. Resident participants were asked to complete surveys to provide feedback to the students and students wrote daily reflections regarding their experiences.

Results

Specific themes emerged from the students' daily reflections, which included student awareness of building relationships, the opportunity to make a difference in the lives of others, and the educational advantages of hands-on learning. These qualitative data showed that the SL component added value to the students' education and learning in the course.

Introduction

Benefits of Service-Learning in Adult Aural Rehabilitation Course

Aural rehabilitation is defined as "intervention aimed at minimizing and alleviating the communication difficulties associated with hearing loss" (Tye-Murray, 2009, p. 671). The long-term goal of an aural rehabilitation course focused on elderly populations is to improve the lives of persons with hearing impairment and also benefit student clinicians who are provided the chance to interact with older adults (Lesner, 1992). This interaction affords students the opportunity to personally discover the challenges and rewards of working with older adults who have hearing loss. One way to provide this experience to students, while also meeting a community need for aural rehabilitation services, is through service-learning (SL). The overall goal of this study was to add a SL component to the graduate-level Adult Aural Rehabilitation course at Purdue University to determine whether and how it enhanced student learning.

Service-Learning

Grounded in Dewey's (1938) theory of experiential learning, SL has been defined as a "form of experiential education in which students engage in activities that address human and community needs together with structured opportunities intentionally designed to promote student learning and development" (Jacoby, 1996, p. 5) Service learning implies that there is benefit to both the individuals providing the service as well as the recipients of the service (Sigmon, 1997). Courses that include SL blend service activities and academic course material to address real community needs, and the result is often a rich learning environment that also instills civic responsibility (Bringle & Hatcher, 1996). Service learning sets itself apart from volunteering, where the focus is on the service; and internships, where the primary emphasis is on student learning. Rather, SL is a blend of student learning and recipient benefit, such that all parties have needs met (Furco, 1996). It has been shown that reflecting on their experiences can help students deconstruct preconceived notions relative to the group being served (Baldwin, Buchanan, & Rudisill, 2007).

Experiential learning theory provides additional support for the benefits of learning through peer and social interaction, rather than confining education to the classroom (Kolb, 1984). As shown in Figure 1, Kolb's experiential learning theory stated that "learning is the process whereby knowledge is created through the transformation of experience" (p. 38). He described a four-stage learning cycle that includes concrete experiences, reflective observation, abstract conceptualization, and active experimentation (McLeod, 2010). In order to enhance learning, activities should address each stage of the learning cycle and require students to go through the entire process. Additionally, having a direct experience, reflecting upon it, and making changes based upon these reflections rather than simply studying the material will enhance learning (Smith 2001, 2010).

For example, in learning to lead an adult aural rehabilitation seminar, the following might take place: (1) Concrete experience - Instructor guides students in how to provide a presentation and answer questions, (2) Active experimentation - Students use what they have learned via coursework and incorporate their interpersonal skills to deliver a presentation with their own style, which occurs in the assisted living environment in a community setting within this particular class, (3) Reflective observation - Students observe peers delivering presentations and answering questions (again in the assisted living environment), and (4) Abstract conceptualization - Students participate in classroom activities that include reading research that identifies various methods of aural rehabilitation.

Figure 1. Overview of the experiential learning cycle (Adapted from Kolb, 1984).

The literature on the use of SL models in audiology courses is very limited. Cokely and Thibodeau (2011) compared student outcomes from their auditory rehabilitation course before and after the implementation of a SL component. Although their data showed that the majority of student outcomes did not change with the addition of a SL component, they did report that written comments from students indicated that the majority of students believed the projects strengthened the learning of core concepts, and more than 50% of the students indicated that the SL project was their favorite component of the course. Additionally, several students in the course reported that they gained professional confidence, real-world problem-solving skills, and increased self-awareness.

Kaf, Barboa, Fisher and Snavely (2011) describe a SL experience that involved audiology and speech-language pathology students working in a nursing home with adults with dementia. They indicated that the experience resulted in students having more positive attitudes towards older adults in residential facilities. Including SL in a course on pediatric audiology also has been shown to result in increased interest in a career in pediatric audiology, and improved readiness to participate in pediatric hearing evaluations (Kaf & Strong, 2011). Finally, audiologists who provide aural rehabilitation services in assisted care living facilities have noted the benefit that this community service provided the older patient and that working in this setting required more than simply understanding hearing loss (Nemes, 2010).

In an effort to better understand the benefits of SL in aural rehabilitation instruction, the following study was conducted. The purpose of the study was to examine graduate students' experiences in and perspectives on the SL component of an adult aural rehabilitation course for use in consideration of future inclusion of SL in this course. Specifically, the following research questions guided this inquiry:

1. How do students describe their experiences working with older adults in a community-based aural rehabilitation setting?

2. What outcomes do students perceive from the SL experience?

3. How do the students' describe the connection between the SL experiences and the aural rehabilitation course?

Methods

Course Description

The Adult Aural Rehabilitation course at Purdue University is a graduate-level, 2 credit course taught over the summer session. For 3 consecutive years (2011 – 2013), the course included a SL component. The lecture portion of the course comprised the initial two-thirds of the class (approximately 23 hours of instruction) and the latter third of the class (approximately 13 hours) included SL to encourage students to apply what they had learned in class to staff and elderly persons in an assisted living facility. Course content included information related to hearing, hearing loss, amplification and assistive technology devices, auditory training, informational and emotional counseling, communication strategies, cerumen management, and presentation preparation. Additionally, classroom lecture time included discussions in which students were encouraged to practice answering common questions that arose from patients and caregivers. The instructor and peers provided feedback so that the respondent could reflect on the feedback and make modifications, if needed, prior to beginning the SL component.

Community Partners

Creating a SL educational experience required a community partner in need of service. Assisted living facilities were contacted 6 months prior to the start of each class. The needs of the facility and whether there was a need for aural rehabilitation services were discussed with the sites, as well as the time frame required to meet these needs. Over the 3 years, two different assisted living facilities in the Lafayette and West Lafayette, Indiana area partnered with Purdue University for this course. One facility, which will be referred to as "Serenity Retreat", was chosen for the first and third years, and the second facility, referred to as "Dublin Hills", was the community partner for the second year. In both assisted living facilities, residents lived in their own apartment-style living space but dined together in a dining hall. The ages of the residents ranged from 69-90 years and all were ambulatory.

Students

A total of 17 students participated in this course over the 3 year period (2011-2013). The course was for Clinical Doctor of Audiology (Au.D.) students beginning the third year of their 4-year training program. The group consisted of 17 females and who ranged in age from 22-26 years. All but one student were Caucasian. Approval was gained from the appropriate institutional review board prior to implementing the study.

Planning and Development of Program Activities

The students had an opportunity to tour their assigned facility and meet with the staff 1month prior to beginning the program in order to further define the goals of the SL project. Once an achievable short-term goal was defined, students reviewed relevant literature to determine best evidence-based practices for group aural rehabilitation, and made preparations to conduct the service program (compiling screening materials, presentation materials, etc.).

Two to 3 weeks prior to the start of the program sessions, a letter was distributed to residents detailing the mission of the program and the schedule of activities. This letter was posted on the activities board at the facility, placed in resident mailboxes, and included in the community newsletter. Pre-registration (signing-up) was encouraged so the students could better organize and plan for hearing screenings and have adequate handouts for presentations; however, pre-registration was not required for any activities and participation was optional.

The service program was free of charge to the residents and staff members, and program variations existed based on the needs of the individual facility, but ultimately the programs included hearing screenings, a series of group aural rehabilitation sessions, book club discussions, presentations to staff (first and third years), and a presentation to frequent communication partners (first year only). The hearing screenings were open to all residents and staff, and were supervised by the course instructor. Three aural rehabilitation sessions were offered, with each covering a different topic. The students worked in pairs to present the material in the these sessions. In addition to the presentations, the students answered questions and were given the chance before and after the presentations to interact with the participants.

Recent books selected for the book club included *A Quiet World* by David Myers (2000) and *Shouting Won't Help – Why I and 50 Million Other Americans Can't Hear You* by Katherine Bouton (2013). The books were provided for the residents interested in participating in the book club 2 weeks in advance of the sessions. The students prepared conversation starters and questions designed to elicit conversation, but were encouraged to allow residents to take the lead in asking questions and sharing thoughts regarding the readings. Students were assigned times when they would be the leader of these discussions. An example of a daily session follows:

- Set-up/Prep 8:30-9:00 A.M.
- Hearing Screenings 9:00-10:00 A.M.
- Book Discussion 10:00-11:00 A.M.
- Aural Rehabilitation Session 11:00-12:00 P.M.
- Wrap-Up/Discussion/Reflection 12:00-12:30 P.M.

Student Reflective Journals

To evaluate the impact of the SL experience, each student was required to keep a daily journal of their experiences and reflections. The students were free to write what they believed and perceived, but were encouraged to reflect on the following questions in order to assist in the reflective portion of this learning activity:

- What experience today was unique? Why? How did it impact you?
- Describe how you felt about your interactions with participants today.
- Discuss something you learned that will impact your future decision-making, counseling, and/or relationships with patients in the future.
- Was there anything you would like to keep, adjust, or change for future presentations based on your experiences today? Describe your experience and rationale.

The student journals were collected at the end of each semester and transcribed for analysis. As part of the transcription process, identifying information was removed to protect the identities of the students.

Resident Evaluations

The residents who attended sessions were asked to complete brief, one-page evaluation forms to provide feedback to the students. As shown in Appendix A, these evaluations included Likert-scale responses and open-ended questions. Completion of the surveys was optional and anonymous. The forms that were completed were transcribed to compare to the students' perceptions.

Data Analysis

Data gathered from the student reflections and resident/ staff evaluations were analyzed by a trained qualitative researcher (second author) with the assistance of NVivo 9 data analysis software package (QSR International, 2010).

The qualitative researcher was not involved in the acquisition of primary data, allowing for independence in his analysis. The NVivo 9 software provided structure for the themes and allowed analysis file sharing. The analytic framework consisted of a combination of analytic induction and the constant comparative method (Lincoln & Guba, 1985). In contrast to deductive analysis in which the researcher codes data into a priori themes, analytic induction involves a process through which the themes emerge from the data analysis process (Strauss & Corbin, 1998). In this way, a framework is developed for communicating the essence of the data through the analysis process itself.

The constant comparative method focuses on reducing data, identifying emerging themes, and extracting the essence of what is being communicated through the data (Patton, 2002). Themes are categories of data that have been grouped together because they are communicating a similar message and reflect a pattern in the data. Themes are identified by "bringing together components or fragments of ideas or experiences, which often are meaningless when viewed alone" (Leininger, 1985, p. 60). Through constant comparison, themes are created, recreated, consolidated, and expanded as the data analysis process unfolds. This allows for the continuous coding of new data into emerging themes while simultaneously making changes to the thematic structure. In this study the iterative process of constant comparison was implemented and continued until three themes and associated subthemes were derived that best explained the experiences of the students in the SL program. These themes were refined and defined, and exemplar quotations were selected for illustration. The rigor of qualitative research is enhanced through methodological decisions intended to enhance the research design (Lincoln & Guba, 1985; Patton, 2002).

In the current study, trustworthiness was enhanced through data triangulation, insider-outsider perspective, and peer debriefing. First, data triangulation was facilitated by drawing upon multiple data sources (student reflections and resident/staff evaluations) and by collecting reflections from multiple students over a three-year period. Second, although the qualitative researcher's involvement was independent of the primary data acquisition, he did discuss the analytic framework and resulting themes with the other two authors, who were audiology professionals and familiar with the course. This was critical to making sure that the themes were logical from an insider's perspective. Finally, an expert in qualitative research not associated with the project served as a peer de-briefer. This individual reviewed the emerging themes throughout the data analysis process, provided comments, and challenged the researchers' assertions.

Results

Hearing Screening

Residents of the assisted living facilities voluntarily completed a hearing screening prior to the first session. Table 1 shows the results of the hearing screenings over the three years of the program. Of the 81 individuals screened, only 8 passed the hearing screening.

Table 1. Hearing Screening Results

Screening Outcome	Year		
	2011	2012	2013
Completed	25	20	36
Passed	1	0	7

Assisted Living (AL) Participants by Activity

Some AL participants took part in all activities and others chose to participate in select programs. Table 2 summarizes the number of AL participants in each activity over the three years of the program. Overall, a total of approximately 60 AL participants took part in the aural rehabilitations sessions and 22 in the book club discussions. Only 5 staff members attended the presentations.

Questionnaire Returns

Those residents who participated in the aural rehabilitation sessions were asked to complete a survey. As shown in Table 2, of the 60 participants, only 19 surveys were completed in full and returned, a return rate of 32%. Residents were not required to complete a survey and many chose to take the survey with them and did not return it. Of the 19 questionnaires completed, all were from Serenity Retreat and 17 were from the most recent term, Summer of 2013. In 2012, residents took the surveys as they left each presentation, but none returned them, so in 2013 the residents were asked to complete the forms and turn them in immediately following the presentation rather than at a later date, which resulted in an increased return rate. Three participants completed questionnaires for the first aural rehabilitation session, 7 were completed for the second session, 5 for the third session, 2 for the staff presentations, and 2 from 2011 of the overall experience (no particular session was noted). Hearing screening and book discussion participants were not surveyed regarding their experiences.

Table 2. Number of Participants and Questionnaires across the Three Years

Activity	Year					
	2011		2012		2013	
	Participants	Questionnaires	Participants	Questionnaires	Participants	Questionnaires
AR Session 1	5	0	9	0	5	3
AR Session 2	5	0	11	0	9	7
AR Session 3	7	2*	2	0	7	5
Book Discussion	6	NA	13	NA	3	NA
Staff Presentation	(3)	0	0	0	(2)	(2)

Note. *Questionnaire from summary of the three session experience and not specific to AR Session 3,
AR = aural rehabilitation, NA = Sessions not evaluated, ( ) denotes non-residents.

Analysis of Daily Journals and Questionnaires

The results of the analyses of the student reflections across the 3 years revealed that the students who participated in the SL class generally enjoyed the experience. Comments such as "overall, I very much enjoyed the experience I had" (Ellen, 2013) (real names not used; year participated) and "I'm glad I was able to step out of my comfort zone off campus and try to help some individuals who need it" (Leah, 2012), are representative of the students' impressions of the experience. Some students, such as Amber (2013) went as far as to say that "this experience effectively justified and solidified my passion for this field," and Marla (2011) noted that "[this] may be one of my favorite classes so far. It was a positive experience that I hope every class has the opportunity to experience as well." More specifically, the data analyses resulted in the construction of three themes and associated subthemes related to the students' experiences during the SL program: building relationships, making a difference, and benefits of hands-on learning.

Building Relationships

The students who participated in the SL program during the three years of the study emphasized the importance of building relationships with the residents of the assisted living facilities. The theme of building relationships included the subthemes of getting to know people, building trust, and feeling valued.

Getting to Know People

Students recognized the importance of getting to know residents with whom they interacted while at Serenity Retreat (2011 and 2013) and Dublin Hills (2012). Getting to know people on a more personal level was both a precursor to being able to give effective treatment and benefit of the experience. Following the second day at Dublin Hills, Gwen (2012) noted that the "book club was a challenge for me, but I feel like we were still able to make a connection with a more reserved lady, and another resident who wore hearing aids had good insights." Ellen (2013) expressed excitement about how the SL experience allowed her to get to know residents on a more personal level: "I do not usually have much time to sit and chat with elderly adults, so it was nice to just sit and chat with one woman and just hear about her daily life." Dana (2012) expected it to be more difficult to build relationships with some of the residents, "but many were willing to talk and were motivated to start conversations…it put me at ease that they were so open to talking about things."

Several students made journal entries about specific interactions they had with residents while in the assisted living facilities. Writing about a woman she screened for hearing loss, Dana (2011) noted that she was an "amazing woman to start with before we even got to start the screening! She told me about her husband and how he worked at sea next to loud machinery…she joked that she blamed him for her hearing loss because he had the volume on the TV so high." Mindy's (2012) sense of concern for a resident helped compel that resident to seek further assessment: "It took me expressing outward concern, but she finally did begin to ask more questions…[and] asked for the phone number of the clinic." In communicating with a particularly emotional patient, Kim (2011) "found myself sharing with her that I want her to be able to continue to lead a full life. This was the most contact I have had with emotional topics in a clinical situation and it felt good to be able to offer some hope and be there to listen."

Building Trust

Related to the notion of getting to know people, several of the students noted the importance of building trust with the residents. Due to the stigma associated with hearing loss, there was a general feeling among the students that they could not do their job effectively without first establishing a trusting relationship. Tammy (2013) explained that "there was some hesitation by some of the residents, as I am sure they thought we were there trying to sell them something…once they saw we were there to help them they were willing to at least listen to what we were doing there." After her first day at the facility, Gwen (2012) recognized the importance of working to build trust: "I have a feeling that the residents will open up more and more as they get to know us and we build relationships with some of them. We just have to give it more time." Following her last day at Dublin Hills, Gwen believed that was able to accomplish this mission. She explained that "by establishing relationships and changing our plans to fit the needs of the residents, I think we were successful in trying to help some people."

Several of the students noted that one of the key things they took away from the SL experience was the need to build trust with patients. For many, these relationships began to develop after having spent some time in the assisted living facilities. Amber (2013) noted that she felt less like a stranger and "more like a welcomed guest" as the experience progressed. Ellen (2013) added that, on the second day, "our presence was much better accepted [sic] than last week. This reaffirms to me that going to visit the week before may be a way to show we are not there to sell something, but rather to learn and teach." The need to build trust in the clinician-client relationship was a major take away point for Mindy (2012):

> *"Despite the fact that we are here to provide a medical service, it is probably more important that we establish rapport with these individuals and let them know that we are not the "bad guys," as sometimes may be the feeling with other doctors and service providers. By taking interest in the individuals for who they are, rather than what disabilities they have, it seemed like they were more receptive to recommendations that we made."*

Feeling Valued

For several of the students, an outcome of the relationships developed with and services provided to the residents was that they believed that the residents valued their time and effort. Comments such as "everyone at [Serenity Retreat] was gracious, kind, and receptive to the information and services we had to offer" (Marla, 2011), and "all of the residents that I screened were jovial and appreciated the work we were doing" (Jada, 2013) were representative of the students' sentiments. Cindy (2013) was a little disappointed with the attendance at some of the events. However, she noted that, while only one individual attended book club on a particular day, "I think that the gentleman that did come appreciated the time that we spent with him…the screening on this day also dropped in attendance, but I do think those that came still enjoyed the experience."

Jada (2013) explained that the sense of appreciation she felt from the residents made her want to go back again in the future: "it was gratifying to see the appreciation of the residents after each session we held. I honestly can see a few of us visiting [Serenity Retreat] in the future." Several residents told the students that they were some of the most informative visitors that had ever visited the assisted living facilities. Kim (2011) was excited to report that "several of the attendees of our sessions stopped us to tell us that we were the best group of students to give these types of presentations and to thank us."

Specifically related to the aural rehabilitation presentations, several students thought that the residents appreciated the information that was presented. Ellen (2013) noted that "I think the session went very well today. Participants seemed to enjoy the demonstrations." Similarly, Kim (2011) explained that "The residents seemed to be really looking forward to the information [in the session] and I saw several taking notes." The students' feelings were affirmed by several resident comments on the evaluation forms. One resident wrote "enjoyed the presentation, thanks," while a second noted "thank you for giving your time and knowledge to the [Serenity Retreat] residents. Others indicated that they were "impressed with the professionalism and knowledge of the presenters," and "great presentation, great preparedness". The residents' overall evaluation of the sessions support the participants' perceptions. On a 4-point, Likert-type scale, the 17 residents who provided feedback rated their overall experience in the sessions as 3.82 (*SD* = .39).

Making a Difference

Important to the service component of the SL mission, students in this study found that volunteering audiology services at the assisted living facilities helped them feel as if they were making a difference in the lives of the residents with whom they interacted. The Making a Difference theme was divided into two subthemes that related to sharing information and impacting people's lives.

Sharing Information

In their reflections, students repeatedly described how they perceived that the information they shared with residents was valuable because it helped the residents improve their health and well-being. Mary (2011) wrote: "I think the presentation was well received by the residents and the questions that they had for us really showed that they all were able to get at least something useful out of all the information we had for them." Cara (2011) echoed this sentiment: "I was impressed by how much the residents had absorbed during the week! When we asked questions…they applied information that we had covered in earlier sessions." In reference to a presentation given to the staff at Serenity Retreat, Marla (2011) was encouraged that "the staff who attended obviously had some interest in the topic…ultimately, it is the residents who benefit from this because the staff is better equipped with the knowledge to help them."

Several of the students made comments specific to the sessions, which were the primary mode through which information was shared with the residents. Mindy (2012) noted that "I think the individuals who showed up [to the presentation] believed they had received good information, and it really meant a lot when they thanked us saying that we had made a big difference." Cindy (2013) added that "the session…went wonderfully! It was nice to see that the residents were interested and engaged in the session, and seemed to take away some useable knowledge."

Comments from residents on the evaluation forms affirmed the students' impressions that the sessions provided useful information. Several residents discussed learning about "new technologies" to assist individuals with hearing loss, and others provided more general comments such as indicating that they had "learned a ton of new ideas." Some residents provided more specific comments, such as "I now am more aware of many things that I can do to help myself hear better," and "[this] helped me learn different ways to help myself with my hearing problem…I was given the names of doctors that I could go to…I needed this [information] since I am new to this area." Residents' evaluations of the sessions similarly confirmed the students' impressions. On a four-point, Likert-type scale, the 17 residents who provided evaluations rated the relevance of the information as 3.88 (*SD* = .33).

Impacting People's Lives

Beyond providing useful information, several of the students believed that they were able to impact the lives of the residents in a positive manner. In the words of Kim (2011), "I made a lot of connections and empowered people today to advocate for themselves and their needs." Kim (2011) explained how she believed that book club discussions helped participants connect better with one another. In her words, "all of the people were very engaging and had lots of stories and advice to share. It was great to see that they were learning from each other's experience as well as from our comments." One particularly moving event discussed by several of the students occurred during book club in 2011. In this session, one resident opened up to another about how hearing loss prevented them from becoming closer friends. Dana (2011) captured this moment especially well in her reflection:

> *"I think the take-away moment from today for me was when the woman with very little to no hearing loss turned to the resident with really only one good ear and said that "I have wanted to come and visit with you so many times, but didn't because I thought that would make you frustrated because of your hearing loss." I think they will form a great friendship…I am glad that we were able to help facilitate this moment of communication for them."*

Several of the students discussed impacting the residents' lives in relation to self-advocacy skills. In reflecting on information she had provided a resident during a hearing screening, Mary (2011) "had the opportunity to counsel her… it was rewarding to see her light up with the knowledge that she can advocate for herself." In reference to a book club discussion, Violet (2012) thought "it helped to discuss the topic of hearing loss, communication strategies, and self-advocating. I believe this effort has at least kindled their minds to consider seeking professional support to manage hearing loss in the near future." During an individual consultation, Elise (2012) explained that she reminded an individual that he "needed to be an advocate for his hearing needs…I pointed out that we can ask our communication partner for assistance, such as writing something down and our partners will be more than willing to help us if we are polite and clear about our needs."

Benefits of Hands-on Learning

Another key element of SL is that students engage in activities that further their academic and civic development. Students who participated in this study articulated their sense of academic and civic learning through three interrelated subthemes: Breaking down pre-conceptions, applying what we have learned, and learning to work with patients.

Breaking Down Preconceptions

An important civic outcome of participating in the SL element of the course was that it challenged students' preconceptions of assisted living facilities and working with the elderly. Students who volunteered at both Dublin Hills and Serenity Retreat noted the luxurious nature of the facilities. In many cases, this challenged what they thought they knew about these types of facilities. Students referred to the facilities as "far from ordinary" (Amber, 2013) and others noted that the facilities were "grand and beautiful" (Kim, 2011). Several of the participants spoke more directly about how the facilities were drastically different from what they expected or had seen before. Marla (2011) explained that "growing up, my grandparents spent time in a nursing home and I've had bad connotations about nursing homes ever since. [Serenity Retreat] looked like a hotel…the atmosphere was friendly, warm, and inviting." Speaking about Dublin Hills, Mindy (2012) explained that she was "very impressed by how nice and clean the facility was. My grandfather was just released from a nursing home…it was grungy and had the stereotypical nursing home smell." Dana (2011) was impressed that Serenity Retreat seemed to have been designed with hearing loss in mind: "One thing I noticed was how great the general listening areas were. Almost 95% of the entire building was carpeted and many of the walls had some kind of wall hangings on them."

In addition to having their perceptions of nursing homes challenged, several of the participants also discussed how the experience helped them reevaluate their assumptions about the elderly. Kim (2011) explained that she thought that most elderly people lost hearing as they aged, but there were several people at Serenity Retreat who could hear very well. From her perspective, "It was great to see firsthand people who do not lose much hearing as they aged. They told me that they were not having any trouble hearing, but liked to have their hearing screened every year to check on it." Mary (2011) was similarly impressed with the residents' ability to critically discuss their hearing loss: "I was so impressed with their ability to relate difficulties they have with hearing to other difficulties, like walking. They were also able to see connections between why people do not seek help and the stigma that goes along with it." Mindy (2012) added that she was "impressed with how attentive the residents were during the presentation we gave today."

Applying What We Have Learned

Several of the students noted connections between what they were learning through their coursework and their experiences in the assisted living facilities. Such connections are important in helping students to translate theories and concepts learned in the classroom to their practice as clinicians. Many of the students indicated that things they experienced "sounded familiar from class" (Mindy, 2012) and others noted that the experience was a "good review of things we have learned" (Ellen, 2012). Marla (2011) believed that she was able to "function as an independent audiologist with the assistance of [the course instructor]. It was the perfect opportunity to integrate the information I've learned in real-life practice." Related to helping people cope with hearing loss, Cara (2011) noted the importance of experiencing what had been discussed in lecture: "even though we can read about these emotions in books and hear about them in lectures, it doesn't really sink in as well as when you actually see patients who are in the different stages of grief."

Kim (2011) described a situation in which she was able to apply what she had learned while conducting a hearing screening: "She [the resident] told me that at her last hearing test she did not have enough hearing loss for hearing aids, but based on my screening she appeared to be a great candidate for an open-fit hearing aid." The SL experience helped students such as Cara (2011) understand how far they had progressed in their education. She explained that "[working at Serenity Retreat] helped me to realize truly how much we have learned about hearing aids. It felt great to be able to explain everything and answer all of the questions."

Learning to Work with Patients

Beyond helping students to apply what they had learned in lecture, the SL experience resulted in hands-on experiences that taught them a great deal about working with elderly adults and in clinical settings. In this way, the experience both related to and extended previous learning. In her final reflection, Amber (2013) explained that, "all in all, I'm so extremely grateful for this experience, because it gave me a taste of what being a professional feels like." Similarly, Mary (2011) noted that one session in particular was "great for all of us because he [the resident] had very good questions that really made us think about how to respond to questions in an easily understood, appropriate manner." Violet (2012) learned that "it is important to allow the patient to process the facts before providing the next steps. This will prevent any harsh negative reactions toward the recommendations."

Several of the students discussed lessons they learned specifically related to communicating with the elderly. Dana (2011) explained that she noted that a woman sitting near her in a presentation was not participating in an activity and "when I asked her if she had any questions she informed me that she just couldn't see…she just needed my assistance." Gwen (2012) emphasized the importance of using communication strategies that were appropriate for the elderly: "I enjoyed sitting in our little circle [during a session] and preferred it to speaking in front of a larger group…If I were to visit a nursing home in a similar position again, I think I would try to recreate this environment by having smaller groups." Finally, Marla (2011) noted benefits related to the protracted nature of the experience: "it was especially helpful to get this type of hands-on experience working with elderly patients day after day for a week rather than a clinical experience for 3 hours once a week."

Discussion

Over the past three years of using this SL model, various benefits have been observed by students and resident participants. The themes derived from qualitative data analysis included building relationships (getting to know people, building trust, and feeling valued), making a difference (sharing information and impacting people's lives), and the benefits of hands-on learning (breakdown of preconceptions, applying what was learned in the classroom, and learning to work with patients). These data were consistent with previous work (Cokely & Thibodeau, 2011, Kaf et al., 2011) and add to the literature on SL in audiology coursework, providing further evidence of the benefits of SL, not only in academic learning, but also in interpersonal skill development and civic learning.

The SL model offered the opportunity for students to be engaged in the learning process and develop interpersonal and problem-solving skills while instilling the value of community service. Additionally, providing SL activities allowed community members (which included residents, staff, and others who were at the facility) to see the profession of audiology in a positive light. Assisted care living facilities were approached early in order to build rapport and aid in scheduling and this set the stage for professionalism. Working with two facilities created two new community partners for possible future engagement activities. These positive interactions provided residents and staff a glimpse into the audiology profession and the students gained perspective of one way to build positive relationships within a community.

Through the provision of presentations and book club discussions, students gained greater insight into the needs of the adult population and their caregivers, as well as the opportunities available and the need for volunteers at assisted living facilities. The idea and nature of "volunteerism" is one that can be beneficial to those served as well as personally rewarding and enriching for the profession as a whole. Those who give back to the community can find a mutual positive exchange (Ellis, 2005). The "spirit" of volunteering can begin in graduate school with opportunities within classes. In the past 3 years, at least one student asked about ongoing volunteer activities at the assisted care living facility that were unrelated to audiology, but would not have been realized without this experience. This type of experience may serve as a stepping stone to additional volunteerism efforts at the local, state, or national level and can benefit the profession as a whole by putting it in a positive light.

Simply stated, this course was functional in that students applied classroom knowledge in a meaningful way that engaged and benefited assisted living residents. While theories were taught and foundational knowledge was addressed, this course content was presented in a way that was practical and applicable, where students engaged in the process by directly applying classroom knowledge in the real-world setting. At the end of the class, students created a portfolio of handouts, presentations, and discussion questions and were prepared to apply what they learned when the opportunity would present itself in the future. Students were encouraged to "make it personal" and plan for the future by appropriately preparing for the presentations, embracing the time afforded to listen to the stories of residents, and taking responsibility for their own education. When students were well prepared and took ownership of their learning, the presentations went well, the answers to questions came easily, and clinical decision-making was sound. If preparation was not complete, the students learned from this and made revisions prior to the next day to ensure a more successful experience for participants. If students did not take the time to interact with staff and residents, attendance at the planned events suffered. Therefore, students learned that when they engaged in their environment they were rewarded with interested participants.

The one-on-one and group engagement activities provided opportunities for students to develop greater interpersonal communication skills. In addition, the variety of formats required creative thinking and facilitated self-confidence in interacting in a planned presentation, as well as an unscripted book club discussion. Students learned to apply classroom knowledge quickly and effectively and had to answer questions or guide a discussion in a patient-friendly manner. Questions that arose often were related to personal struggles encountered by an individual that required students to listen intently, ask necessary follow-up questions to better understand the problem, and offer potential solutions. These problem-solving opportunities were valuable clinical skills to develop and served as a first step in helping the students become successful clinicians.

Conclusion

Providing adult aural rehabilitation education using a SL delivery model has been beneficial to both students and community members. Students discovered a greater appreciation for the foundational concepts when given the opportunity to apply them in an assisted living facility. Additionally, residents, staff, and caregivers were able to view budding audiologists in a positive light. The overall conclusion of incorporating SL into the aural rehabilitation course was that the best classroom environment was the community facility itself and the best teachers were the residents, staff, and caregivers.

Limitations

Although this SL model was in place for several years, data were only been collected for the three years presented here. The number of students and participants were limited leading to a small data set. Continuing to expand this program to new assisted living facilities and collecting data for ongoing analysis and evaluation will provide additional insights into this learning model. In addition, consideration of a "control group" of students who do not participate in the SL portion of this course could provide additional insight into the value of the SL component.

Future Research

The daily reflections that students provided related to their experiences and observations and offered qualitative insights into individual growth and advancing self-awareness; however, the qualitative data could be strengthened by incorporating a pre- and post-assessment survey (with a control group) to measure interpersonal skills such as the Groningen Reflective Ability Scale (GRAS: Aukes, Geertsma, Cohen-Schotanus, Zwierstra, & Slaets, 2007). An additional measure for a qualitative approach would be to utilize the Reflective Ability Rubric (O'Sullivan, Aronson, Chittenden, Niehaus & Learman, 2010). In addition to adding a survey or assessment related to growth of interpersonal skills, an assessment of self-awareness administered before and after the experience could offer additional insight into personal growth that may occur related to the SL experience.

Many students reported in individual reflections that this SL component strengthened their desire to continue to find opportunities for volunteerism. Utilizing a scale such as the Community Service Attitudes Scale (CSAS: Shiarella, McCarthy & Tucker, 2000) prior to and following the SL component of this course would provide quantitative evidence of growth in this area.

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Appendix A

Session 1 Survey: Understanding Hearing Loss and Hearing Aids

Please take a moment to rate our presentation. Thank you for giving us the opportunity to speak with you.

Evaluation Scale: (1) Poor, (2) Fair, (3) Good, (4) Excellent

Overall Experience	1	2	3	4
Information				
Relevance	1	2	3	4
Clarity	1	2	3	4

How new was this information to you?

What was most helpful?

What was least helpful?

What would you like to see in future presentations on this topic?

Other comments/suggestions:

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Research Article

The Impact of Increasing Hearing Aid High-Frequency Bandwidth

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Abstract

Rationale

The purpose of this study was to investigate the influence of high-frequency cut-off on speech perception in quiet and noise; specifically to determine if a significant benefit is observed on speech recognition testing in quiet and noise as high-frequency information is amplified with receiver-in-the canal (RIC) devices using a commonly used fitting rationale.

Methods

Eighteen adults with high-frequency hearing loss (HFHL) were fitted with bilateral RIC hearing aids programmed to NAL-NL1 targets in three high-frequency cut-off conditions: 4000, 5500, and 7500 Hz. Speech perception was assessed using Pascoe's High Frequency Word List and the Hearing in Noise Test (HINT).

Results

The results indicated that the participants in this study benefited from amplification through 4000 Hz. There was a tendency for performance to increase on Pascoe's High Frequency Word List as cut-off condition increased, but there was no effect of cut-off condition on performance on the HINT. Statistical analyses of the data indicated that increasing cut-off frequency past 4000 Hz had minimal impact on the scores for both test measures when using an NAL-NL1 target.

Introduction

High-frequency hearing loss (HFHL) is the most common configuration of hearing loss for adults, especially first-time hearing aid users (Hannulu, Bloigu, Majamaa, Sorri, & Maki-Torkko, 2011; Van Tasell, 1993). Individuals with this type of hearing loss have normal hearing to a mild hearing loss for low- to mid-frequency sounds sloping to poorer hearing (of varying severity) for high-frequencies such as 2000 or 4000 through 8000 Hz (Mueller, Bryant, Brown & Budinger, 1991; Tye-Murray, 2004). This type of loss is common among individuals with a history of presbycusis (Schuknect, 1955), ototoxicity (Ballantyne, 1973), and exposure to noise (Sataloff, Vassallo, & Menduke, 1967).

Adults with HFHL often are fitted with receiver-in-canal (RIC) hearing aids. The RIC devices offer the advantage of an open ear to minimize perceived occlusion (Kiessling, Brenner, Jesperson, Groth, & Jensen, 2005; Kiessling, Margolf-Hackl, Geller, & Olsen, 2003; Kuk & Keenan, 2006; Kuk, Keenan, & Lau, 2005; Vasil & Cienkowski, 2006) and, due to new receiver technology, potentially include extended bandwidth receivers (Kuk & Baekgaard, 2008). The popularity of these devices is growing rapidly. In 2009, it was reported that "mini-BTE" hearing aids were worn by 25.3% of individuals that participated in the MarketTrak survey (Kochkin, 2011). Recently, Kirkwood (2012) suggested that approximately 63% of BTE hearing aid sales for the first quarter in 2012 were RIC. This was compared to 2009 when 58% of BTEs purchased were conventional BTE devices (Kirkwood, 2012).

Although the benefits of RIC fittings have been argued; clinically, bandwidth effects have not been investigated specifically for RIC fittings or for traditional fitting algorithms. In early work, Fletcher (1953) noted that individuals with a loss between 2000 and 8000 Hz were at the most risk of missing auditory cues for consonant perception. Consonant understanding is highly dependent upon the perception of second and third formant frequencies of adjacent vowels (Boothroyd, 1978), and differentiate place of articulation

Delattre, Liberman, & Cooper, 1955; Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). The high-frequency speech energy beyond 4000 Hz has been shown to be important (Heinz & Stevens, 1961; Hughes & Halle, 1956; Sher & Owens, 1974), for perceiving final consonants such as /s/, especially when produced by female and child speakers (Stelmachowicz, Pittman, Hoover, & Lewis, 2001; 2002; Stelmachowicz, Pittman, Hoover, Lewis, & Moeller, 2004). In addition, auditory access to resonances between 3500-8000 Hz helped to differentiate voiced from voiceless fricatives (Heinz & Stevens, 1961; Hughes & Halle, 1956; Minifie, 1973). This suggests that audibility of high-frequency speech information is crucial to consonant perception.

Investigations of whether adults with HFHL can benefit from extended high-frequency amplification have produced conflicting results. Numerous studies have demonstrated improved speech recognition with increased high-frequency audibility (Beamer, Grant, & Walden 2000; Hornsby & Ricketts, 2003, 2006; Horwitz, Ahlstrom, & Dubno, 2008; Pascoe, 1975; Plyler & Fleck, 2006; Skinner, 1980; Sullivan, Allsman, Nielsen, & Mobley, 1992; Turner & Henry, 2002). In contrast, a number of investigators reported that speech recognition remains constant or deteriorates as amplification is provided at higher frequencies (Amos & Humes, 2007; Baer, Moore, & Kluk, 2002; Ching, Dillon, & Byrne, 1998; Hogan & Turner, 1998; Horwitz et al., 2008; Murray & Byrne, 1986; Rankovic, 1991; Skinner, 1980; Sullivan et al., 1992; Turner & Cummings, 1999; Vickers, Moore, & Baer, 2001). However, these results are not easily compared to clinically fitted RIC devices. Much of the bandwidth research has utilized digitized and spectrally-shaped speech signals presented through headphones or inserts (Sullivan et al., 1992; Turner & Henry, 2002; Vickers et al., 2001) or in monaural conditions (Hogan & Turner, 1998; Hornsby & Ricketts, 2003; 2006; Horwitz et al., 2008; Preminger & Wiley, 1985; Souza & Bishop, 2002). In all of these cases, the devices and headphones blocked the ear canal from being "open." During an "open" fitting, frequencies below 1500 Hz are attenuated (Lybarger, 1985). As a result, RIC hearing aids provide a unique acoustic situation in that there is minimal balance between the low- and high-frequency acoustic information. This is unlike conventional hearing aids with vents or when listening with headphones.

A second challenge for the application of these results to clinical fittings is a lack of a standardized fitting protocols among the research studies. Presently there are two prescriptive fitting methods that have been widely used across hearing aid manufacturers: National Acoustics Laboratory Nonlinear 1 (NAL-NL1; Byrne, Dillon, Ching, Katsch, & Keidser, 2001) and Desired Sensation Level (DSLv5.0; Scollie et al., 2005) (Ricketts & Mueller, 2009). For adult hearing aid users, the most common prescriptive fitting algorithm utilized is NAL-NL1 due to the substantial amount of evidence that supports patient preference and success with this type of fitting (Byrne et al., 2001; Keidser & Grant, 2001; Mueller, 2005; Ricketts & Muller, 2009). The rationale behind NAL-NL1 is to maximize speech intelligibility for specific loudness levels (Byrne et al., 2001). The result may be prescribed gain for high-frequencies that is less than optimal for audibility for individuals with sloping losses (Byrne et al., 2001). The question then remains as to whether the increased high-frequency cut-off is worthwhile and meaningful for individuals with sloping HFHL fitted with RIC hearing aids to a standard and commonly used prescriptive fitting algorithm.

The purpose of this study was to further investigate the influence of high-frequency cut-off on speech perception in quiet and noise. Specifically, we aimed to determine if a significant benefit is observed on speech recognition testing in quiet and noise as high-frequency information is amplified with RIC devices using a commonly used fitting rationale. If not, were there negative consequences that would lead to reduced performance with an RIC device?

Methods

Participants

An a priori power analyses indicated that for an repeated measures model, a sample size of 17 would result in power of .80. Four females and 14 males were recruited from the areas surrounding the University of Connecticut. The mean age of the participants was 62.94 years with a standard deviation (*SD*) of 5.22 years. Eleven participants were non-hearing aid users and 7 individuals were binaural hearing aid users, with the average years of use at 3.25 years (*SD* = 3.91 years). The mean hearing thresholds for the 18 participants are displayed in Figure 1. On average, the participants had normal hearing from 250 through 1000 Hz sloping to a moderate to moderately-severe sensorineural hearing loss in both ears. This research was approved by the University of Connecticut Institutional Review Board and informed consent was obtained from all participants. All participants were provided financial compensation following completion of the protocol.

Inclusion criteria were set such that participants with central deficits or dead regions were not included. This was determined by performance on the Dichotic Digits Test (Musiek, Gollegly, Kibbe, & Verkest-Lenz (1991) and Threshold in Equalizing Noise (HL) test (Moore, Glasberg, &

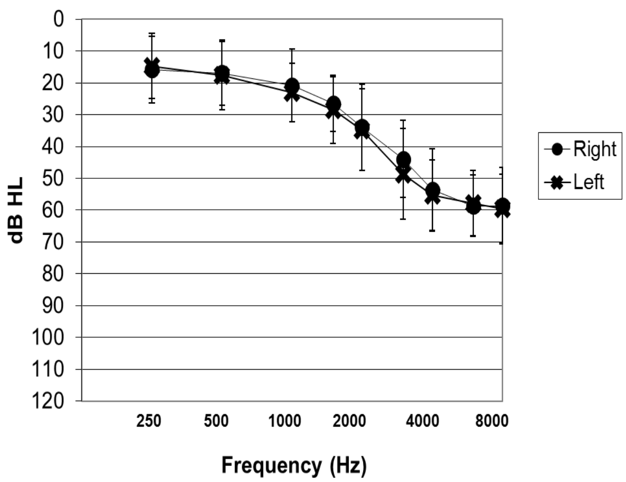

Figure 1. Mean audiometric thresholds for all participants. Error bars represent one standard deviation.

Stone, 2004) respectively. The Dichotic Digits Test was administered at 50 dB SL re: the threshold at 1000 Hz. Participants were instructed to repeat all four numbers they heard. Musiek and colleagues (1991) determined that use of standard criterion for individuals with HFHL yielded a high false positive rate. Based on their data of 30 individuals with hearing loss, they adjusted the criterion from 90% in each ear to 77% in the left ear and 85% in the right ear (Musiek et al., 1991). This adjusted criterion was used as the screening criterion for all participants. For the TEN (HL) test, participants were asked to detect pure tones in the presence of broadband noise presented at 10 dB SL re: the threshold at each frequency. The researchers calculated the difference between the intensity level of the detected pure tones and the intensity level of broadband noise. If a difference was greater than 14 dB, this indicated the presence of a dead region. The use of 14 dB is a conservative cut-off for screening for cochlear dead regions (Hornsby & Ricketts, 2006; Summers et al., 2003).

Hearing Aids

Commercially available RIC hearing aids with a bandwidth upper limit over 8000 Hz as defined by coupler measures according to ANSI S3.22 (1996) were utilized for this study. The hearing aid receivers were fitted according to manufacturer specifications for each participant as receiver length and receiver tip size varied based on individual pinnae sizes and canal circumferences. The hearing aids were fitted binaurally using individualized gain responses set to the NAL-NL1 target for comfort and audibility (Byrne et al., 2001). An individualized gain response was chosen because each individual's hearing loss is unique and should not be fitted with the same response. In addition, the use of individualized fitting responses has been shown to provide more significant, clinically relevant information, especially for speech intelligibility in noise studies (Horwitz et al., 2008).

Prior to programming for the high-frequency cut-off conditions, the low- and mid-frequency-band channels were fitted with gain according to the manufacturer NAL-NL1 targets and were not adjusted for the duration of the study. Noise reduction and directional microphone settings were disabled. All programs utilized the recommended general compression settings in the manufacturer software.

An initial starting point for bandwidth conditions was established using coupler measures. Following ANSI S3.22 (1996) standards for coupler measures, the input composite signal level was set to 60 dB SPL with the hearing aid at user settings. From this response curve, the high-frequency average (HFA; average intensity at 1000, 1600, and 2500 Hz) was calculated by the Fonix 7000 hearing aid analyzer. A line was drawn at the intensity level obtained by taking the HFA and subtracting 20. The intersection with the high-frequency portion of the response curve was considered the cut-off frequency for the upper limit of the hearing aid. Gain was reduced within channels in the manufacturer software to create the three upper frequency cut-offs programs with boundaries at 4000 Hz, 5500 Hz and 7500 Hz, as confirmed in the coupler. These bandwidth conditions were chosen based on the limitations of the hearing aid, use of similar bandwidth and cut-off conditions in the literature, and the limitations of the frequency responses of the verification equipment.

Audiometric information for each participant was entered into the Fonix 7000 real ear module and individualized NAL-NL1 target values were created for a 50 dB SPL signal. The real ear data was used to verify that the cut-off frequencies were correct, that the high-frequency roll-off was similar in all three programs, and that the output met NAL-NL1 targets. Real-ear aided responses (REARs) were obtained with a 50 dB SPL composite signal. The settings on the hearing aids were adjusted as needed through the manufacturer software to be within 5 dB SPL of the NAL-NL1 target as calculated using the Fonix Real Ear NOAH Module (Version 2.12). It should be noted that gain for channels from 2000 through 8000 Hz always was increased to meet NAL-NL1 target values on the Fonix 7000. For all participants, three programs were created: Program 1 was a full-bandwidth (7500 Hz) condition, Program 2 was a mid-bandwidth condition (5500 Hz), and Program 3 was a low-bandwidth condition

(4000 Hz). Figure 2 displays the average REARs for all three conditions in comparison to audiometric information and average target values.

The REARs were compared with each participant's loudness discomfort levels (LDLs) to ensure that hearing aid output did not exceed discomfort levels. Unaided LDLs were obtained using the Contour Test of Loudness Perception (Cox, Alexander, Taylor, & Gray, 1997). This test was chosen because it was designed specifically for hearing aid fittings.

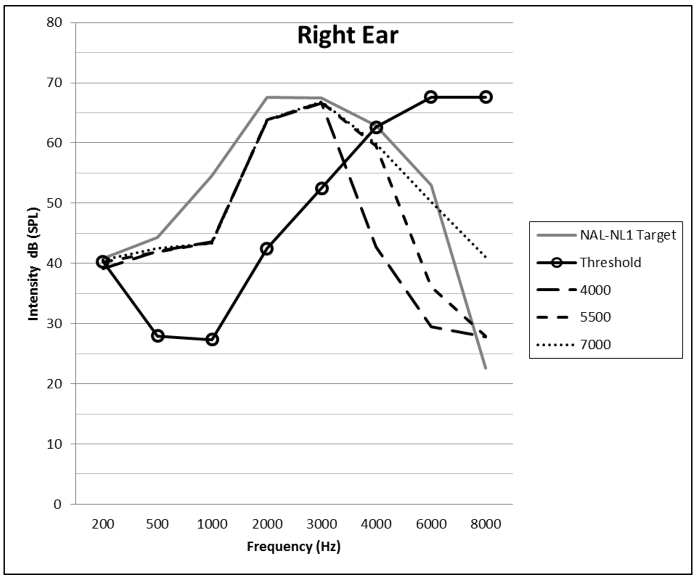

Figure 2. Mean REARs for all three bandwidth cut-off conditions for the right ear (top) and left ear (bottom). Mean NAL-NL1 target values and mean participant audiometric thresholds are also plotted.

Stimuli

Word Recognition in Quiet

Assessment of speech perception for individuals with hearing loss is most often completed through word recognition testing. It has been shown that individuals with HFHL can achieve scores of 90-100% on traditional word recognition tests in an unaided condition (Maroonroge & Diefendorf, 1984; Roup & Noe, 2009; Schwartz & Walden, 1983; Sher & Owens, 1974). Individuals with HFHL performed well on word tests that are not high-frequency weighted because they had access to the low-frequency vowel and mid-frequency consonant information. In addition, many of these tests use familiar words that are easy to decipher if a person does not hear all the information (Maroonroge & Diefendorf, 1984). Therefore commonly used word recognition materials may not be sensitive enough for individuals with sloping hearing losses. For this study, an intelligibility test with primarily high-frequency information was chosen in order to accurately assess speech perception ability and prevent ceiling effects.

To evaluate the effect of bandwidth on speech intelligibility in quiet, the Pascoe High-Frequency Word List (Pascoe, 1975) was used. Pascoe's High Frequency Word List contains 50 monosyllabic words with primarily high-frequency consonant information. The list contains consonants, over 60% of which are voiceless fricatives and plosives, combined with three vocalic nuclei /ɪ/, /ɑɪ/, and /oʊ/. These consonant sounds contain high-frequency energy that would be difficult for individuals with HFHL without amplification to perceive at normal conversational levels. The remaining consonants contain primarily low-frequency energy as nasals, laterals, and voiced plosives (Pascoe, 1975; Skinner & Miller, 1983). This high-frequency word list is unique because every word was chosen so that there were at least six other words that were similar in the list (Pascoe, 1975). The list contains groups of easily-confused words which allowed for easy and various randomizations of list presentation and prevented against learning effects. It has been used previously in bandwidth literature (Pascoe, 1975; Skinner, 1980; Skinner & Miller, 1983) and allowed for direct comparison with previous reported results.

A standardized commercially recorded version of Pascoe's word list has not been produced; therefore, recordings were developed for this study. The words were produced by a female speaker in her 20s, as female and child voices are more likely to produce high-frequency response errors (Gardner, 1984; Stelmachowicz et al., 2001; 2004). This speaker was chosen out of a pool of female speakers because she was a native English speaker that had a high fundamental frequency (above 200 Hz), clear speech without roughness (as subjectively rated by two listeners), and fricative and plosive energy above 6000 Hz. The speech stimuli were recorded in a sound-treated room and the female speaker monitored the level of her voice using a sound level meter. A Shure BG 1.1 microphone was connected to a Dell Latitude D620 laptop computer and the words were recorded using Cool Edit Pro 2.0 digital audio software. Each word was presented in the middle of a carrier phrase, "Write________, please" followed by a pause. The words were recorded at a sampling rate of 44,100 Hz in stereo with 16-bit resolution. Anti-aliasing was not necessary because the sampling rate was greater than twice the widest bandwidth condition. Steady-state background noise, a product of the recording microphone, and background noise, a product of the recording microphone, and pops were removed from recordings using the noise reduction and pop elimination tools within Cool Edit Pro 2.0.

An acoustical analysis of the Pascoe stimuli was performed to ensure adequate high-frequency information and consistency in the frequency components of the consonant sounds. The acoustic analysis was conducted using Adobe Audition 3. Frequency information was analyzed using Fast Fourier Transform (FFT) with a Hanning Window set to 1024 Hz. The FFT produced a spectrum for the specific sound that was being analyzed. The FFT analysis was conducted for each initial and final consonant sound as well as all vowel sounds. The window at which the FFT was performed was chosen by the researcher by looking at the spectrogram for each word. For each sound, a 10 ms time window was analyzed. For fricatives, a window at which frication noise was present on the spectrogram was chosen for the analysis. For stops, the burst segment was chosen for analysis and for the nasals, the point at which murmur was present was chosen for FFT analysis. The FFT analysis provided peak frequency values for each window. The peak frequency information was recorded and compared to normative values previously reported in the literature (Minifie, 1973).

DirectRT software for psychology experiments was used to randomize and present all words in each condition. The software was loaded on a Dell Otiplex GX620 computer. The computer audio output was directed to the audio inputs of a GSI 10 audiometer. The stimuli were presented at 55 dB SPL, a level encountered in everyday life for soft conversational speech. This level was also chosen from a preliminary study which suggested that the presentation level of Pascoe's High Frequency Word List needed to be at least 55 dB SPL in order for normal hearing individuals to score over 90%. The level was calibrated in the sound field using the substitution method. Participants were seated at 0 degrees azimuth at a distance of 3 feet from a GSI sound-field speaker within a sound-treated booth (ANSI S3.1-1999).

Following the procedures used in three similar studies, participants were instructed to listen to each stimulus and write their response (Pascoe, 1975; Skinner, 1980; Skinner & Miller, 1983). The participants were provided sufficient time to write their response following each presentation because the pause time was controlled by the researchers. Written responses were chosen to prevent auditor bias. Words were scored phonetically such that the words did not need to be spelled correctly in order to be considered correct.

Sentence Recognition in Noise

One of the most common complaints of individuals with a HFHL is that they have difficulty hearing in noisy environments (Roup & Noe, 2009). Studies have demonstrated that more significant differences in speech perception ability are observed in the presence of background noise (Horwitz et al., 2008; Pascoe, 1975; Schwartz, Surr, Montgomery, Prosek, & Walden, 1979). Since individuals with HFHL rely on their low-frequency hearing for speech perception, the addition of low-frequency background noise, if loud enough, may mask low-frequency information that would usually be available to individuals with sloping hearing losses (Horwitz et al., 2008).

A standardized recorded version of the Hearing in Noise Test (HINT: Nilsson, Soli, & Sullivan, 1994) was used as the sentence test in noise. Use of the recorded HINT allowed for computerized scoring procedures and randomization of lists. The HINT was chosen because it is an adaptive procedure that yields a signal-to-noise ratio (SNR) that reflects 50% correct identification. As a result, the HINT was not subject to floor or ceiling effects when utilizing this test.

The HINT was presented through one sound-field speaker at 0 degrees azimuth in order to simulate the most difficult listening environment where speech and noise are coming from the same direction. The broadband noise was presented at a fixed level of 50 dB SPL. This level was chosen to be consistent with the presentation of Pascoe's High Frequency Word List at a low-level and to prevent output from reaching levels of discomfort for the participants. Twenty sentences were presented in each bandwidth condition and participants were asked to repeat the sentence they heard. If they repeated the entire sentence correctly, the researcher would press "yes" and if they repeated the sentence incorrectly, the researcher would press "no". The level of the sentence was adjusted after each response. If the participant's response was correct, the level of sentence was decreased; if the participant's response was incorrect, the level of sentence was increased. Following the presentation of all sentences, a SNR threshold was calculated for each bandwidth condition that reflected 50% correct identification.

Procedures

All testing was completed within 1 to 2 sessions lasting approximately 2 to 3 hours total. All screening and unaided testing was performed first and the hearing aid fitting and testing was conducted in the later part of the session or in the subsequent session. Cut-off frequency conditions were randomized such that the effect of condition order could be analyzed as a between-subjects variable. During testing, programs were changed by the researcher using the program button on the hearing aid. Participants were blinded to each condition. In addition, order of HINT vs. Pascoe list tests were randomized among all subjects.

Results

Word Recognition in Quiet

A repeated measures analysis of variance (R-ANOVA) was completed to investigate if changes to hearing aid high-frequency cut-off resulted in statistically significant differences in scores on Pascoe's High Frequency Word List. According to the results from the Huynh-Feldt test of within-subject effects, there was a significant main effect of condition, $F(3, 45) = 52.292$, $p < .001$, $\eta^2_p = .777$ indicating that the results on Pascoe's High Frequency Word List were condition dependent. Results for the interaction between condition and randomization indicated that there was no effect, $F(6, 45) = .712$, $p = .617$, $\eta^2_p = .087$. Group means and standard deviations per condition are displayed in Figure 3. Review of mean data suggested that there was a difference between the unaided condition and the three aided cut-off conditions and a tendency for scores to improve as cut-off frequency was increased. However, the differences between the three aided conditions were slight. The difference between the 4000 Hz and 7500 Hz conditions was approximately 6%. The standard deviations overlap considerably when data were collapsed, supporting minimal differences between the three conditions. To further analyze the main effect of condition found in the R-ANOVA, paired *t*-test comparisons were performed for the Pascoe's High Frequency Word List scores in all conditions. The results are displayed in Table 1. The paired *t* -tests demonstrated scores for the unaided condition were significantly lower in comparison to all aided conditions, $p < .001$. Among the aided conditions, the 4000 Hz and 7500 Hz conditions were significantly different after Bonferonni correction ($p < .02$), however, the 5500 Hz condition was not significantly different from either the low or high cut-off frequency conditions.

Table 1. Paired *t*-test results comparing the results on Pascoe's High Frequency Word List between conditions.

Conditions	*t*	*df*	*p*-value
Unaided vs. 4000 Hz	-6.93	17	.00*
Unaided vs. 5500 Hz	-9.24	17	.00*
Unaided vs. 7500 Hz	-9.23	17	.00*
4000 Hz vs. 5500 Hz	-2.29	17	.04
4000 Hz vs. 7500 Hz	-3.16	17	.01*
5500 Hz vs. 7500 Hz	-0.82	17	.42

*Significant at the Bonferroni specified level $p < .02$.

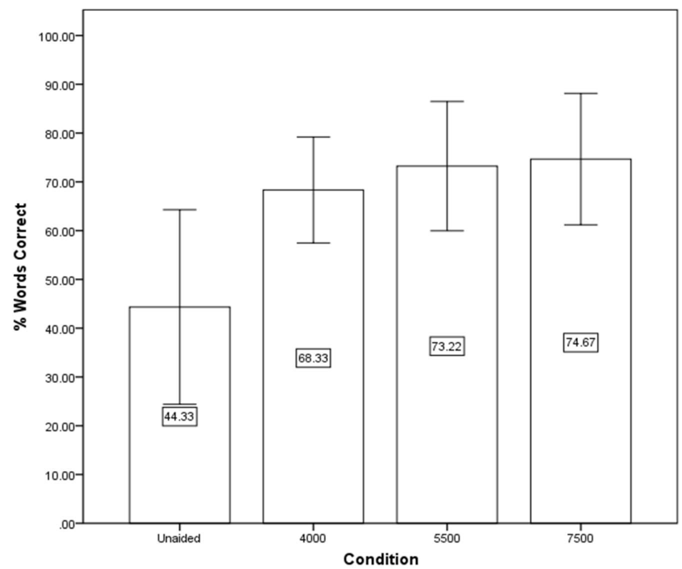

Figure 3. Mean percent correct score for Pascoe's High Frequency Word List in the four conditions. Error bars indicate one standard deviation.

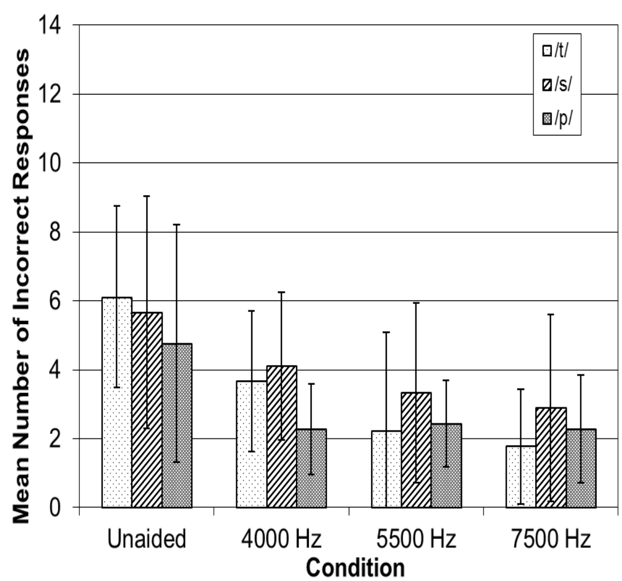

Figure 4. Mean number of phoneme errors for /t/, /s/, and /p/ on Pascoe's High Frequency Word List in the four conditions. Error bars indicate one standard deviation.

Results from Pascoe's High Frequency Word List also were analyzed according to number of phoneme errors for three of the most commonly occurring sounds: /t/, /p/, and /s/. The results are displayed in Figure 4. Overall, there was a trend for the number of errors to decrease as cut-off frequency increased. An R-ANOVA was conducted to determine if there was an interaction between bandwidth condition and phonemic errors. The Huynh-Feldt test of within-subject effects revealed a significant interaction between these two factors $F(6, 96) = 2.766$, $p = .028$. In reviewing the mean data, it was apparent that number of errors for each phoneme differed with increasing high-frequency bandwidth. Paired *t*-tests were conducted for each consonant. The results revealed that errors for /t/ and /s/ were significantly different among the three conditions such that errors were reduced as cut-off frequency increased $p < .02$. Number of errors for /p/ did not change between the three cut-off conditions.

Pearson correlation coefficients were obtained for Pascoe's High Frequency Word List, average thresholds from 1500 to 8000 Hz and average loudness discomfort levels. As displayed in Table 2, the scores in all three aided conditions were significantly negatively correlated with hearing thresholds. The results suggested that as the thresholds increased, scores decreased. Interestingly, the strongest correlation for the 4000 Hz condition was with the 3000 Hz threshold and the strongest correlation for the largest bandwidth condition was with the 2000 Hz threshold. Loudness discomfort levels were not significantly correlated to the scores on Pascoe's High Frequency Word List.

Table 2. Correlations between scores on Pascoe's High Frequency Word List and hearing thresholds. Thresholds were averaged for right and left ears.

Condition	Threshold Test Frequency (Hz)				
	2000	3000	4000	6000	8000
4000 Hz	-.55	-.74**	-.67**	-.51	-.36
5500 Hz	-.78**	-.54**	-.50	-.51	-.41
7500 Hz	-.73**	-.59**	-.53	-.57*	-.54

Note. $*p < .01$, $**p < .00$

Sentence Recognition in Noise

Mean reception thresholds for sentences (RTSs) in comparison to reported norms are displayed in Figure 5. It should be noted that the lower the RTS, the better the ability to hear in noise. A review of mean data suggested there was a change from the unaided to the aided conditions. Participants performed better in the aided conditions overall. The 50th percentile scores for normal hearing American-English speakers has been shown to be -2.6 dB SNR with a standard deviation of 1.0 dB (Soli & Wong, 2008; Vermiglio, 2008). In comparison to the normative data, the participants performed more poorly such that they needed the SNR to be 1 to 1.5 dB higher to achieve a 50% score.

An R-ANOVA was completed to determine if changes to hearing aid cut-off frequency resulted in statistically significant differences in the scores on the HINT. The results of the Huynh-Feldt test of within-subject effects indicated that there was a significant effect of condition, $F(3, 45) = 14.147$, $p < .001$, $\eta^2_p = .485$. This implied that the HINT scores changed as a result of increasing and decreasing access to high-frequency information. There was no interaction between condition and randomization, $F(6, 45) = .736$, $p = .624$, $\eta^2_p = .089$.

A review of Figure 5 suggested a tendency for improvement as cut-off frequency was increased. Interestingly, as bandwidth condition was increased, variability in scores decreased. However, the most noticeable difference was between the unaided condition and the three frequency cut-off conditions. Paired *t*-tests were conducted

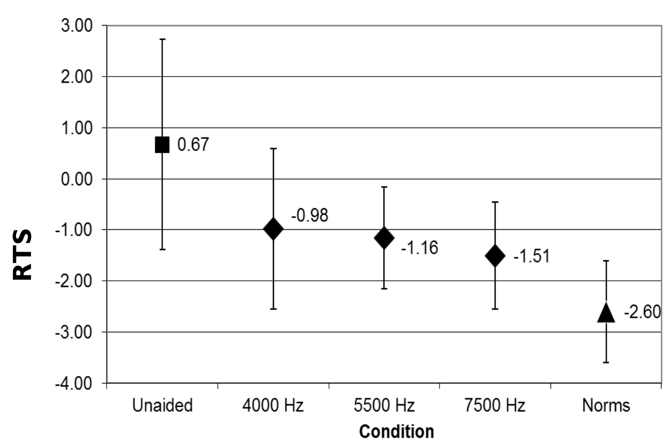

Figure 5. Mean HINT SRTN for each cut-off frequency condition and norms (Soli & Wong, 2008; Vermiglio, 2008) with error bars indicating one standard deviation.

for RTS in each of the three conditions. The results were not significant for any of the three conditions suggesting that cut-off frequency did not influence RTS results for the participants. The significant difference observed in the R-ANOVA likely was the result of the difference in RTS from the unaided condition and the three aided conditions or under-powering of the test. The R-ANOVA was repeated for the three aided conditions alone. The results supported that aiding individuals with HFHL improves the ability to hear in steady-state background noise, but that increasing the cut-off frequency from 4000 Hz does not significantly improve performance for this test.

Pearson correlations were conducted for the HINT scores in each aided condition, average thresholds from 250 through 8000 Hz and loudness discomfort levels. Scores on the HINT were not significantly correlated with thresholds or discomfort levels.

Discussion

Word Recognition in Quiet

The results of this investigation indicated that performance increased in quiet from the unaided to aided conditions. The statistical analyses suggested a main effect of condition, primarily the result of the large difference between the unaided and three aided conditions. The results supported a small but statistically significant difference between the lowest cut-off frequency (4000 Hz) and highest cut-off frequency (7500 Hz) conditions, supporting best performance at the most extended bandwidth. The mid cut-off condition (5500 Hz) was not significantly different from either of the other two aided conditions.

In the literature, performance on Pascoe's High Frequency Word List has been shown to be optimal when amplification was provided through 6300 Hz in comparison to other hearing aid frequency responses, including an extension out to 8000 Hz (Pascoe, 1975; Skinner & Miller, 1983). Additional research focusing on the effects of bandwidth on speech perception in quiet found no change in performance with increasing bandwidth beyond 4500 Hz (Hogan & Turner, 1998; Horwitz et al., 2008; Schwartz et al., 1979; Sullivan et al., 1992). The results from this study also demonstrated that providing amplification through 4000 Hz using an NAL-NL1 target resulted in a significant difference in performance on a high-frequency word recognition list and that extension beyond 4000 Hz provided slight improvement with no adverse impact on performance.

The use of Pascoe's High Frequency Word List in the current study and those by Skinner and colleagues (1980; 1983) and Pascoe (1975) suggested that this list of stimuli may be useful in assessing benefit with high-frequency amplification for individuals with HFHL. When consonants with high-frequency emphasis, such as /s/ and /t/, were analyzed separately, differences in conditions were clearly observed. Individuals, on average, had the least amount of errors for /s/ and /t/ when they had access to the highest cut-off condition. This is understandable because the peak energy for /t/ was located at 5300 Hz and the peak energy for /s/ was above 6000 Hz. Because peak energy for /p/ was between 1500-3000 Hz, individuals reached maximum performance once they had access to the lowest cut-off condition.

In reviewing the results of the phonetic analysis for the sounds /s/, /t/ and /p/, it was apparent that no participant missed all of the high-frequency phonemes in the unaided condition. This may be the result of access to cues from the formant transitions. Consonants are not perceived in isolation; they appear next to and are part of adjacent vowels. Research has demonstrated that the second formant vocalic transitions differentiate stop consonants (Cooper, Delattre, Liberman, Borst & Gerstman, 1952; Delattre et al., 1955). It is possible that participants were able to use the frequencies from formant transitions to determine the correct phoneme. For example, if the rise or fall of the transition was audible to the participant, he/she may have been able to deduce the correct phoneme from the second formant transition alone. As a result, the acoustic analysis of vowels in addition to consonants needs to be taken into account when considering audibility of speech information and performance scores since there may have been coarticulation effects which impacted scores.

In the current study, audiometric thresholds were highly correlated with scores for the three cut-off conditions. This is consistent with the results from Skinner (1980) in which she demonstrated audibility as a significant factor in the increased scores on Pascoe's High Frequency Word List. It has been reported in the literature that hearing loss can account for 65-90% of the variance in speech perception scores for older adults (Festen & Plomp, 1983; Humes, 1991; 1996; 2002; Humes & Christopherson, 1991; Humes & Roberts, 1990). In analyzing individual thresholds, 2000 and 3000 Hz had the strongest significant relationship with speech perception score. It is understandable that there would be a strong correlation between 2000 Hz and the scores because Pascoe's High Frequency Word List included consonants and vowels with energy at 2000 Hz.

Sentence Recognition in Noise

The HINT was used to determine if speech perception in noise was influenced by increases in cut-off frequency. A significant effect was found for amplification through 4000 Hz.

Once again, this supported that there were significant differences between the unaided and aided conditions. However, the ANOVA and paired comparison results did not support a difference among cut-off conditions for RTSs. As a result, increasing the cut-off frequency did not result in increased performance in background noise for all of the participants.

Although other studies have indicated differences in performance in noise, the results have not been remarkable. Hornsby and Ricketts (2006) tested individuals with HFHL using the Connected Speech Test (CST; Cox, Alexander & Gilmore, 1987) presented at a +6 dB SNR. They compared 12 filter conditions with the two highest cut-off frequency low -pass conditions at 3150 and 7069 Hz. Although they had indicated that there was a difference in increasing the cut-off frequency, this difference was 6% on average between these two conditions. This can be considered a slight difference and similar to the current results of the HINT. Plyler and Fleck (2006) also reported significant differences on the CST in noise between two bandwidth conditions, the maximum (6000 Hz) and minimum (3000 Hz) audibility conditions. These differences were small, but significant. They also used the HINT and observed significant differences between the two conditions. The minimum audibility condition (3000 Hz) yielded average scores around 1 dB SNR for the individuals with moderate HFHL and 2.5 dB SNR for individuals with moderately-severe to severe HFHL. These scores were similar to the unaided scores that were obtained by all participants in the current study. The maximum audibility (6000 Hz) condition yielded average RTS thresholds around -1 dB for the moderate HFHL group and around 0 dB for the more severe HFHL group. Again, these results are similar to the results of the current study in that aided HINT RTSs were between -0.5 dB and -1.5 dB. The statistically significant results of that study also may have been the result of a difference in procedures used by Plyler and Fleck (2006). The researchers kept the speech signal constant at 65 dB SPL and adjusted the level of background noise. In the current study, the HINT background noise was set to 50 dB SPL and the sentence levels were adjusted to obtain RTS.

Sullivan and colleagues (1992) demonstrated that cut-off frequency influenced scores on a nonsense syllable test when presented in background noise. However, the cut-off frequencies were over four octaves apart. The middle response was at 1700 Hz and the high-frequency cut-off was 6000 Hz. As a result, the effects that were observed could have been the result of amplifying 2000 or 4000 Hz, instead of extending from 4000 to 6000 Hz. Turner and Henry (2002) found that when nonsense syllables were severely limited by background noise, providing amplification to make speech audible showed positive benefit in all cases, even with additional high-frequency information. However, differences between conditions and performance scores were not provided and it is unclear how much benefit was received from adding additional high-frequency information. They argued that there was no detriment to providing high-frequency audibility, even if benefit was not significant (Turner & Henry, 2002). Similarly, the results from the current study showed that increasing the high-frequency cut-off for individuals with HFHL did not influence speech perception in noise as assessed by the HINT. Therefore, like Turner and Henry (2002), providing amplification improved performance and additional high-frequency information did not degrade performance.

NAL-NL1

Overall, the results from this study did not demonstrate consistent measureable improvement in individuals with HFHL as a function of more access to high-frequency information. Horwitz and colleagues (2008) suggested that a lack of significant differences in their study may be the result of narrow high-frequency ranges being added and low audibility for high-frequency speech information due to elevated thresholds and the NAL-NL1 target (Horwitz et al., 2008). The minimal improvement from the 4000 to 7500 Hz condition is likely the result of a lack of audibility in the high frequencies considering many of the speech cues in the high-frequency region are of low intensity. An NAL-NL1 fitting algorithm does not attempt to produce high levels of amplification for frequencies with the greatest losses in a sloping hearing loss. In fact, the NAL-NL1 fitting algorithm recommends gain in the high frequencies should be equal to or less than the gain at 2500 Hz (Byrne et al., 2001). As displayed in Figure 2, the NAL-NL1 target values were below thresholds at 6000 and 8000 Hz and audibility at these frequencies was not reached for individuals with thresholds over 55 to 60 dB HL. It has been suggested that NAL-NL1 is most appropriate for a mild and moderate, flat and gently sloping symmetrical loss (Schum, 2009). An NAL-NL1 target may be a fine starting point for fitting sloping losses, however, the fitting may need to be modified to achieve maximum benefit or audibility from extended bandwidth. Therefore, although RIC hearing aids are marketed as having extended bandwidth receivers, clinicians should be aware that fitting to an NAL-NL1 target will result in minimal audibility above 6000 Hz.

There have been two concerns noted with regard to amplifying the high frequencies. One concern for individuals with HFHL was that full high-frequency audibility can lead to comfort and sound quality issues (Schum, 2009; Skinner, 1980).

In addition, depending on the extent of damage to the cochlea, audibility does not necessarily guarantee usable hearing, especially when amplifying high-frequency information (Schum, 2009). A second concern was a lack of balance between low-/mid- and high-frequency information. Skinner and Miller (1983) compared the results of bandwidth on word identification. They found that high-frequency amplification needed to be in appropriate balance with low-frequency energy around 500 Hz in order for sound quality to be acceptable and speech intelligibility to be maximized. Amplification was not adjusted below 2000 Hz and the low-frequency cut-off was not adjusted in the current protocol. Skinner (1980) indicated that spectral configuration of the speech energy was an important factor in the scores on Pascoe's High Frequency Word List. She recommended that hearing aids should be set so that the lower band differs approximately 15 dB from the higher band (above 2000 Hz). This balance was not maintained for this research study and may have been a factor in the results. It has been suggested that to optimize fittings for individuals with sloping losses, gain should be reduced in the high frequencies and audibility should be targeted to the mid-frequency transition region (Schum, 2009). As supported in this study, amplifying up to 4000 Hz provides significant benefit for high-frequency consonants and for listening in background noise. However, the benefits of "extended bandwidth" would not be available if audibility was not prescribed in these frequencies.

Finally, it should be noted that minimal differences may have also been seen due to the small effect size and low statistical power. While estimated power was high for the four conditions, the comparison of the three aided conditions yielded an effect size and power estimate that were low. In order to increase the statistical power, the sample size would need to be doubled.

Conclusion

Theoretically, providing additional high-frequency audibility should be beneficial to individuals with HFHL. The purpose of this study was to determine whether extended high-frequency cut-offs in RIC hearing aids programmed using NAL-NL1 targets benefit patients with HFHL on measures of speech recognition in quiet and noise. The results of this study indicated that individuals with HFHL benefit from amplification through 4000 Hz as there were significant differences between unaided and aided conditions for both test measures. While the results were similar to those previously reported, it should be noted that the linguistic and acoustic composition of the stimuli used in this study may have also had an impact on the results. There was a tendency for performance to increase on Pascoe's High Frequency Word List presented in quiet as cut-off frequency increased. However, the difference in performance between the lowest cut-off and highest cut-off was minimal. This is likely due to reduced audibility in the high frequencies, the result of using NAL-NL1 targets. On the HINT, there was no influence of cut-off frequency on performance between the three aided conditions. Therefore, extending high-frequency cut-offs past 4000 Hz may not have a positive or negative impact on RTSs for individuals with sloping HFHL when hearing aids are programmed to an NAL-NL1 target.

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Research Article

Self-Perceived Biopsychosocial Needs of Late-Deafened Adults with Cochlear Implants: Implications for Aural Rehabilitation

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Abstract

Rationale

This study was conducted to document the self-perceived biopsychosocial needs and listening expectations of late-deafened adults with cochlear implants.

Methods

Twenty-one adults completed a 40-item online survey that included structured and open-ended questions that targeted pre- and post-surgical listening expectations, listening satisfaction listening challenges, quality of life (QofL), self-efficacy, and use of post-surgical aural rehabilitative support services.

Results

Overall, the respondents were pleased with the sound quality of their cochlear implants. However, quantitative and qualitative data obtained from the survey revealed the following: 1) The respondents' ease of listening skills did not significantly improve after surgery and remained lower than expected after implantation, specifically regarding telephone and television; 2) The ability to listen to music through the CI remained a challenge; 3) Self-perception of QofL and self-efficacy (social life and independence) did not significantly improve after implantation. Only 12% of respondents reported receiving face-to-face group aural rehabilitative therapy to address ongoing listening, QofL, and self-efficacy challenges.

Introduction

The correlation between age and hearing loss in adults is extremely high, with hearing loss being one of the most common handicapping conditions in adults over the age of 65 years. The causes and onset of hearing loss vary across the population, but late-acquired deafness creates complex aural rehabilitation (AR) challenges in that it dramatically impairs independence, communication, quality of life (QofL), self-efficacy, and emotional well-being (Kricos, Erdman, Bratt, & Williams, 2007). One form of medical intervention for late-deafened adults is cochlear implantation – a surgically implanted device that electrically stimulates the peripheral auditory nerve and auditory cortical centers of the brain, thus providing late-deafened adults with the means to physiologically regain some of their ability to hear. During the process of obtaining and being fitted for a cochlear implant (CI), it is critical for both the CI user and hearing health care providers to recognize the connection between the CI and the brain and the ongoing psychological, social, and emotional needs of the adult patients with late deafness.

Current theoretical perspectives from social cognition are evident in the biopsychosocial approach to AR (Erdman, 2009; Gagne & Jennings, 2010). Two constructs that reflect biopsychosocial factors are self-efficacy and QofL. Self-efficacy has been defined by psychologist Albert Bandura (Bandura, 1997) as the confidence one has in their ability to successfully accomplish a task. When applied to the process of cochlear implantation in adults, self-efficacy relates to how CI users perceive their ability to control their own hearing health and communication goals. Quality of Life is defined as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns" (World Health Organization, 1993). This definition incorporates an individual's social well-being and social relationships. However, implantation of a biomedical device alone does not address QofL and self-efficacy issues faced by the adult population with late deafness.

Although researchers have investigated self-efficacy and QofL in CI recipients, medical practitioners and audiologists continue to focus exclusively on speech perception tests and annual mapping of the external speech processor as outcome measures for determining implant success. These traditional speech perception measures fail to document how late-deafened adults function psychologically and socially after surgery (Zaidman-Zait, 2010). Moreover, little is known about how pre-surgical implantation expectations and post-surgical performance with the CI contribute to the QofL and self-efficacy of late-deafened adults.

The public health impact of late deafness is extreme. Late-deafened adults report communication deprivation and a restricted sense of self-efficacy coupled with interference with everyday communication in-home, work, and social environments (Kerr & Cowie, 1997; Knutson, Johnson, & Murray, 2006). For late-deafened adults, the loss of hearing can be extremely traumatic, especially for those who suffer sudden hearing loss due to illness, medication, or trauma. Cheng and Niparko (1999) conducted a meta-analysis and found that profound hearing loss in adults resulted in a significant loss in adjusted costs of QofL years. Kerr and Cowie (1997) likened acquired hearing loss to the experience of chronic pain, in that the physical disorder of losing one's hearing is only a minor portion of the limiting effects caused by the physical loss of the ability to hear. Hallam, Ashton, Sherbourne, and Gailey (2006) summarized interview reflections of late-deafened adults who indicated that their loss of hearing had catastrophic, alienating and disorienting effects on their lives and personal relationships. Moreover, late-deafened adults encounter pervasive identity challenges in that their self-worth and their social-role relationships are altered by their inability to hear as they once did (Barlow, Turner, Hammond, & Gailey, 2007; Rutman & Boisseau, 1995). Late deafness also is associated with psychological distress, such as elevated feelings of anger, isolation, and anxiety (Knutson et al., 2006). Similarly, Aguayo and Coady (2001) interviewed 25 late-deafened adults in Canada and reported three emergent themes concerning the psychological and social effects of late deafness: 1) emotional trauma in becoming deaf (all respondents reported intense feelings of grief, mourning, and anxiety; 2) oppression, exclusion, and isolation within their families; and 3) general oppression, exclusion, and social isolation. The late-deafened adults in this study further mentioned that no medical health professionals were ever involved in prescribed treatment for these social and emotional challenges. They also reported dissatisfaction with their rehabilitation services, which were primarily medically oriented. In sum, late-deafened adults reported that their psychosocial needs were often overlooked and neglected. Decreased self-confidence and loss of expectations and hope for the future constitute additional effects of late deafness on adults' perception of themselves as viable social beings (Kent & La Grow, 2007; Rutman & Boisseau, 1995). Thus, late deafness can result in restricted participation in daily social activities and interpersonal isolation that cause feelings of stress, anxiety and abandonment as well as loss of identity.

Hallberg and Ringdahl (2004) described the benefits and challenges of using a CI as "a rehabilitative device." They reported that the learning process with CIs takes time, from months to years, and that to obtain optimal benefits the CI patient requires long-term training. Given the lengthy learning process, it is vital for CI users and hearing healthcare providers to recognize the connection between the biomedical device and the whole person, rather than exclusively focusing on the connection between the biomedical device and the inner ear. In learning to use this biomedical device, patients must "retrain their brains" to process auditory information differently than they did before they experienced hearing loss. Unfortunately, much of the clinical focus of CI programming to date relates to threshold and loudness data (more peripheral functions), and does not evaluate the patient's higher-level auditory processing skills, such as listening in noise, auditory memory, auditory closure, and sequencing.

Despite the benefits associated with CIs, there are many aftercare (post-implantation) challenges for late-deafened adults. Many patients hold unrealistically high expectations—believing that the implant will immediately result in restoration of their lost hearing and repair their traumatized social identity (Aguayo & Coady, 2001). Some patients also experience frustration with adjustments they must make in their listening abilities as the implant is initially mapped and as they cope with the external components of the device (Hallberg, Ringdahl, Holmes, & Carver, 2005). Additionally most physicians and audiologists do not routinely offer group or individual AR beyond mappings to program the CI's external speech processor, due to inconsistencies in reimbursement policies for AR services by insurance companies (Laplante-Levesque, Hickson, & Worrall, 2010). Although current research reveals that implantation with follow-up with auditory perceptual training helps late-deafened adults recognize and discriminate specific segmental aspects of speech more readily (Chan et al., 2007; Dunn et al., 2010; Fu & Galvin, 2008), late-deafened adults with CIs often continue to experience psychological challenges. After implantation, many late-deafened adults struggle to adjust to their altered auditory perception and attitudes toward an unfamiliar way of listening. For example, Knutson et al. (2006) followed a large sample of late-deafened adults with CIs over an eighteen-year period and found that these late-deafened adults experienced high levels of loneliness, anxiousness, depression, suspiciousness, and social introversion. Clinically significant levels of depression, suspiciousness, and social isolation were present in 10%-16% of the late-deafened adults, along with high expectations of success with their implants. These findings suggest that improvement in hearing acuity from a CI does not necessarily yield correspondingly better psychological status. Thus, current implementation of individual and group AR with late-deafened adults with CIs does not routinely address social and psychological factors that could adversely impact the communication abilities of late-deafened adults with CIs.

Rutman and Boisseau (1995) found several emergent themes associated with late deafness: threat to identity and perceived competence; loss issues and communication strain; and interpersonal concerns. These researchers reported that the single most devastating consequence of losing hearing later in life is the negative impact on self-identity, which includes beliefs about capacities, needs, and personal skills (self-efficacy). Rutman and Boisseau (1995) reviewed fourteen qualitative studies of late deafness and found that late-deafened adults reported suffering with feelings of anger, embarrassment, and inadequacy as a result of hearing loss. Other researchers have documented similar significant psychosocial challenges late-deafened adults encounter after cochlear implantation. Through open-ended interviews with 17 late-deafened adults with CIs, Hallberg and Ringdahl (2004) identified several emergent themes, including "coming back to life, preventing disappointment, and retraining the brain" (p. 118). The CI patients in their study had a difficult time balancing feelings of hope and despair. Although feeling hopeful about the future, they had low expectations about the benefits they might experience when using their CIs.

Traditional AR service delivery approaches emphasize top-down, clinician-determined treatment models in which the clinician designates and delivers the "best" treatment and provides the patient with short-term CI orientation. This traditional approach is limited with regard to patient psychosocial needs. Although CI manufacturers provide adult CI users with individual listening training programs via online services, the materials do not address the social and emotional aspects of life with the device. Given the psychosocial and auditory processing challenges encountered by late-deafened adults with CIs, holistic approaches to AR are warranted. Building upon Bandura's humanization of healthcare (Bandura & Locke, 2003), many current holistic models of AR incorporate the biopsychosocial theories of human development (Engel, 1977) and interaction cited in the works of (Boothroyd, 2007; Erdman, 2009; Gagne & Jennings, 2010). They highlight the interactive, facilitative relationship between the clinician and patient with the patient becoming empowered in the treatment process.

Although researchers have begun to document the need for holistic AR approaches for late-deafened adults with CIs, few studies specifically investigated the pre- and post-surgery expectations of CI patients for listening and communicating via their implants. Moreover, they have not looked at improvement in QofL and the effect of the CI on self-efficacy. Additional research is needed to document these aspects of the cochlear implant process with late-deafened adults. Thus, we posited that documentation of the needs of adult CI users must be obtained in order to provide empirical support for appropriate AR for this growing patient population. The purpose of this study was to report the results of an online survey to document the biopsychosocial needs and expectations of late-deafened adults with CIs.

Methods

At the University of North Carolina at Greensboro (UNCG), we have established a multi-disciplinary AR program called Cochlear Implant Connections (CIC) that provides group and individual AR with late-deafened adults with CIs. For the current study, the CIC faculty research team at UNCG designed the UNCG Needs of Adult CI Users Online Survey. This survey consisted of a total of 40 items in the following categories: patient demographics, hearing loss profile, pre-surgery expectations, post-implantation rehabilitation support services, and pre- and post-surgery QofL. The format of the questions consisted of Likert scales, multiple-choice, and open-ended questions (see Appendix). Biopsychosocial items included questions on QofL, satisfaction, and self-efficacy. Items addressing issues of self-efficacy were modeled after validated questions found in the Self-Efficacy Scale (Fleming et al., 2003), which uses a 5-point scale. The purpose of the open-ended, qualitative biopsychosocial items in the survey was to document the respondents' perceptions of their QofL, self-efficacy, and expectations before and after CI surgery. The open-ended questions were adapted from questions developed from the Nijmegen Cochlear Implant Questionnaire (Hinderink, Krabbe, & Van Den Broek, 2000) and the Glasgow Benefit Inventory Questionnaire (Robinson, Gatehouse, & Browning, 1996).

The study design, procedures, informed consent document, and survey instrument were submitted to the

UNCG Institutional Review Board (IRB) for review. Approval was obtained prior to launching the survey online via an online survey platform supported by Qualtrics, LLC – a platform that allows researchers to build, distribute and analyze survey responses. Recruitment information regarding the UNCG Needs of Adult CI Online Survey was distributed regionally (East Coast) to participating audiologists at the University of South Florida, Duke University Medical Center, and the Center for Hearing and Communication in New York. These audiologists were recruited by the authors from contacts made at an international AR meeting. The participating audiologists shared recruitment information and online instructions for accessing the survey with their adult CI patients. Information about the survey also was distributed to adult CI patients seen at the UNCG Speech and Hearing Center.

The participants' responses to the survey were anonymous. There were no restrictions on how many questions the respondents were required to answer. Also, for open-ended questions, there were no restrictions on the number of items to which the respondents needed to address or the length of their responses. The survey was made available online for six months, from January to July 2011.

Data Analysis

The results from the survey were downloaded from the Qualtrics platform into an SPSS (version 19, IBM 2010) spreadsheet for quantitative and qualitative analyses. Wilcoxon signed ranks tests were used to test the Likert-type scaled data as to whether perceptions of pre-surgery and post -surgery status were significantly different. This nonparametric test was used, rather than traditional parametric tests, because the ordinal nature of the data.

Responses to open-ended questions about QofL, expectations, and suggestions for hearing professional were analyzed with inductive qualitative content analysis procedures delineated by Richards (2009). Additionally, topical coding (Miles & Huberman, 1994) was used for qualitative analysis. Knudsen et al. (2012) and Laplante-Levesque et al. (2012) point out that content analysis methods could be successfully applied to document perspectives of individuals with hearing loss concerning their rehabilitation and their psychosocial factors related to their rehabilitation. Thus, content analysis was used to categorize the information gathered from the responses to the open-ended questions from the online survey. These questions targeted patient expectations prior to, and following implantation, as well as perceived QofL after implantation and suggestions for professionals working with pre-surgery implant candidates. The statistical analyses report median scores of survey responses in order to best describe interval data obtained from the survey. Therefore, figures were constructed group percentages.

Results

Demographics

A total of 21 late-deafened adults with CIs accessed the online needs assessment survey instrument (5 males, 16 females). However, only 17 respondents completed the entire survey (completion rate of 80%). The respondents ranged in age between 26 to 81 years (M = 57 years) and were from 4 eastern states in the USA, with 13 respondents (62%) from North Carolina and the remaining 8 respondents (38%) from New Jersey, New York, and Florida.

Pre-surgery Hearing Profile

The survey results indicated that the length of time the respondents had experienced severe to profound hearing loss ranged from 8 months to 60 years (M = 29.3 years, SD = 20.1 years). Eighty percent reported experiencing chronic tinnitus with their hearing loss. A majority of the respondents (70%) described the onset of their hearing loss as gradual (over 1 year of more), whereas 30% indicated that their hearing loss occurred suddenly (from 1 day to 1 week). The causes of the respondents' hearing loss included Meniere's disease (15%), head injury (5%), ototoxic medications (5%), and meningitis (10%). One-fifth of the respondents (20%) did not know the cause of their hearing loss, and 45% indicated "other" causes than those indicated above. All of the respondents who reported having hearing loss due to Meniere's Disease or ototoxic medications reported a gradual onset, but all of the respondents who reported having a head injury or meningitis as the cause of the hearing loss reported a sudden onset. Of the respondents who did not know the cause of their hearing losses or had a non-listed cause, 24% reported a sudden onset and 76% reported a gradual onset. Over a quarter (27%) of the respondents also reported having some usable hearing in the non-implanted ear.

Cochlear Implant and Hearing Aid Information

Forty percent of the adult respondents reported that they had been implanted for 1 year or less, whereas 60% had been implanted more than 1 year. The type of CI varied across the respondents. Thirty-percent (n=6) wore Cochlear Corporation devices, 45% wore Advanced Bionics Corporation devices (n=9), and 25% wore MED-EL devices (n=5). The split between unilateral to bilateral fittings was 75% to 25% respectively. The wear time for CI devices ranged from 7 to 18 hours per day (M = 13.38 hours). Sixty-seven percent of the respondents reported using a hearing aid in the non-implanted ear, of which 27% described the hearing aid as providing usable hearing or benefit.

Satisfaction and Expectations

Question #15 on the survey asked the respondents about the their pre-surgery expectations for hearing with their CI in seven listening situations: environmental sounds, television, telephone, music, conversions in public meetings, conversations with family and friends, and location of sounds. Question #26 asked a related post-surgery question about listening situations. The respondents were asked to report how well they heard currently with their implants in those same listening situations (see Figure 1). Responses to both questions were on a Likert scale that corresponded to descriptors for listening ease. Before surgery, the respondents had the highest expectations (ease of listening) for environmental sounds (58%) and television (42%). The respondents had low expectations (between 21-32%) for all of the other listening situations (telephone, localization of sounds, conversations in public meetings, conversations with family and friends, and music). The lowest pre-surgical expectation for hearing easily with the CI was for the telephone (21%). Following surgery, performance exceeded expectations in 4 of the 7 listening situation categories (telephone, conversation with family and friends, music, and environmental sounds); however, performance in only 2 of the listening situations exceeded 50% in terms of ease of listening (environmental sounds and conversations with family and friends; see Figure 1). Overall, post-surgical ease of listening performance with the CI continued to be low and did not exceed pre-surgical expectations for 3 categories: location of sounds (23%), conversation in public meetings (23%), and television (29%). The respondents reported the greatest ease of listening with environmental sounds (65%). After surgery, ease of listening to music with the CI was reported at 47%; whereas approximately one-third reported great difficulty in hearing music with their CIs. The most difficult listening situations with the CI were telephone (29%), television (29%) and conversation in public meetings (23%). Of note is that all three measures did not exceed 30% for ease of listening with the implant.

The Wilcoxon signed ranks tests showed that pre-post comparisons failed to reach statistical significance for all listening conditions: environmental sounds ($Z = -1.56$, $p = .118$), location of sounds ($Z = -0.27$, $p = .785$), music ($Z = -0.84$, $p = .401$), telephone ($Z = -0.66$, $p = .512$), television ($Z = -0.321$, $p = .748$), speech conversation with family members and friends ($Z = -1.41$, $p = .159$), and speech conversations in public meetings ($Z = -0.71$, $p = .475$).

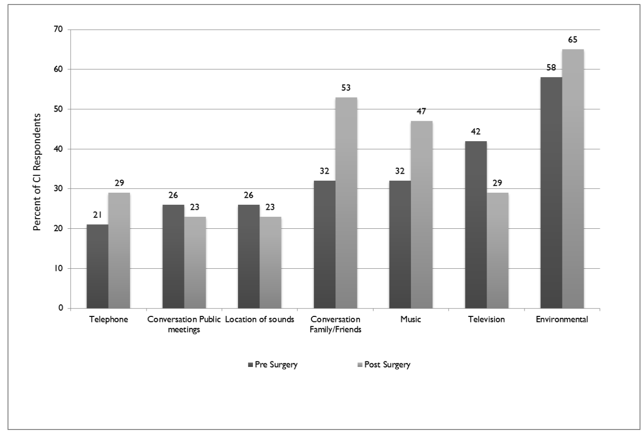

Figure 1. Comparison of respondents' self-reported pre-and post-surgery perceptions of their listening ease in seven listening situations.

The open-ended responses about pre-surgery expectations for improvement in hearing and QofL were elicited with survey question #17, which asked: "Overall, what were your expectations on how the implant would help you?" Analytical coding (Richards, 2009) was used to categorize the open-ended responses and 17 phrases were identified for coding (Table 1). Descriptive coding was applied to yield only one category, all positive expectations. Topical coding (Miles & Huberman, 1994) then revealed the following two subcategories: Hearing expectations (better speech perception, better music perception, improved use of phone), QofL expectations (lead a normal life, to not have to struggle for all communication needs), and regain employment. Hearing expectations related to listening on the phone, listening to music, and less reliance on lipreading. The responses reflected that all adult CI users expected the cochlear implant to help them. However, the level of pre-surgery expectation ranged from simply to hear better and discriminate what people were saying in conversations to high expectations of hoping the implant would allow the individual to lead a normal life, hold a job, and "to rejoin the human race and not be isolated anymore." What became most apparent about the QofL expectations expressed by the respondents was the variability among the range of expectations from their hoping for anything to hoping for everything. An example of a hearing expectation was "I thought that I would be able to have discrimination of what people were saying, better hearing in different environments, being able to listen to music again, and carry on normal conversations. I hoped I would have better hearing for safety factors." One powerful QofL comment from a respondent was that they wanted, "To rejoin the human race and not be isolated any more."

Table 1. Pre-surgery hearing and quality of life expectations. Summary of coding of respondents' pre-surgery hearing and quality of life expectations.

HEARING EXPECTATIONS
• I was hoping that it would help me to hear better than I was. • I had moderate expectations. (I) was hoping to hear anything! • I thought that I would be able to have discrimination of what people were saying, better hearing in different environments, being able to listen to music again, and carry on normal conversations. I hoped that I would have better hearing for safety factors. • That it would help improve the accuracy with which I heard and understood conversations and voices. • That I would hear…perhaps not as well as before but I could hear nothing so any improvement would help. • I hoped I would be able to hear with it and it would make me less dependent on lipreading. I hoped I could hear on the phone with it. • I was hoping it would restore at least some hearing in my deaf ear. • To use regular phone, not TTY. • She is doing better than she thought she would with the cochlear implant.
QUALITY OF LIFE EXPECTATIONS
• Expected to feel better about life. • I was hoping it would let me lead a normal life to the extent that could hold a job and have conversations with others even in crowded places. • I was looking for any help at all - anything that was better than the non-functionality I was experiencing with almost no hearing left. • To rejoin the human race and not be isolated any more. • Not to have to struggle for all communication needs. • I expected great success. • You thought things would be better immediately. • Very hopeful.

Table 2. Post-implant listening challenges. Summary of coding of respondents' auditory processing and interpersonal listening challenges.

AUDITORY PROCESSING	
Category	**CI Patient Responses**
Auditory Discrimination (Speech, Word Discrimination)	• I can hear speech, but sometimes it is hard to understand the individual words. • Speech discrimination. • I still have great trouble with word discrimination • Distinguishing sounds from one another.
Listening in Noise and Public Environments	• Hearing conversation in noisy environments. • Trying to hear people in a crowded restaurant. • Public environments/church. • Trouble hearing in a large auditorium. • Performances like plays and shows. • Listening in poor acoustical environments such as gyms and pools.
Localization and Hyperacusis	• Getting used to sound seeming so loud. • With only one implant, and no hearing aid, I have trouble with localization.
INTERPERSONAL LISTENING	
Category	**CI Patient Responses**
Interpersonal Group Communication	• To hear. To communicate with people. • People think I can hear better than I do, so they talk away from me or too fast. • Frustration in participation in conversation. • Trouble in distinguishing what is said when multiple people respond. • Large gatherings, example parties.
Listening to Music	• I miss music. • Hearing music. • I still am not able to hear the things I want to hear like music.

Post-Implantation Listening Challenges

Survey question #30, prompted respondents to list the top three challenges they continued to face in using their CIs. Descriptive coding yielded two categories: auditory processing and interpersonal listening. Topical coding of the Auditory Processing category revealed three sub-categories: auditory discrimination, listening in noise and public environments, and localization and hyperacusis (oversensitivity to sound) (Table 2). For example, one respondent expressed "I can hear speech, but sometimes it is hard to understand the individual words." Another respondent expressed difficulty in that "sound seeming so loud." Topical coding of the Interpersonal Listening category revealed two subcategories: interpersonal group communication and listening to music. Within this category, respondents described the challenges they had in communicating in group situations and in listening to music. For example, in describing challenges of interpersonal communication, one respondent said, "People think I can hear better than I do, so they talk away from me or too fast." Another respondent described their ongoing concerns that "I still am not able to hear the things I want to hear like music."

Quality of Life

Figure 2 displays a comparison of the respondents' self-reported pre- and post-surgical perceptions (survey questions #16 and #27) of how the cochlear implant affects three aspects of their QofL: self-confidence, social life, and independence. Prior to surgery, the respondents had moderately high expectations (62-84%) that the CI would improve their QofL in all three areas. The respondents expected the implant to have the most positive effect on their social lives (84%). However, following implantation, only self-confidence exceeded the respondents' pre-surgical expectations of how the implant would affect their QofL. Wilcoxon signed ranks tests were conducted to test whether the respondents' self-confidence, social life, and independence self-perceptions changed significantly from pre- to post-surgery. The analyses showed that pre-post-implantation differences were not significant for self-confidence ($Z = -0.82$, $p = .414$) and independence ($Z = -1.34$, $p = .180$). Interestingly, the respondents' perceptions of how the CI impacted their social lives were significantly reduced post-surgery compared with pre-surgical expectations ($Z = -2.12$, $p = .034$).

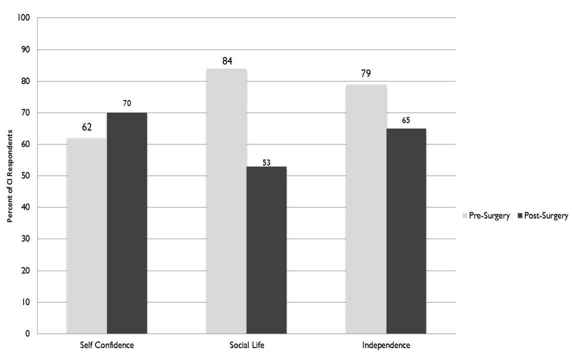

Figure 2. Comparison of the respondents' self-reported pre- and post-surgery perceptions of how their implant affects three aspects of Quality of Life: Self-confidence, social life and independence.

Analytical coding was used to categorize the data from question #34, which addressed QofL following implantation. Descriptive coding yielded three categories adapted from the subdomains of the Nijmegen Cochlear Implant Questionnaire (Hinderink et al., 2000): Sound Perception (physical functioning), Self-Esteem (psychological functioning), and Social Functioning. Within each of these categories, the respondents' responses were coded as either positive or negative. Participants with positive responses in sound perception reported the ability to hear music, speech, and outdoor sounds. For example, "I can hear outside noises. I can hear the birds. I can hear noises from another room and hear somewhat better in noise environments even though it is still a struggle." Negative responses indicated continued difficulty listening to TV, phone, radio, and music. One respondent shared "Music of any kind still hopeless, for which I am very sorry."

In the category of Self-esteem (psychological functioning), positive responses reflected that late-deafened adult CI users were more confident, independent, less anxious, and more optimistic of the future. One respondent shared, "It has totally changed my life. I am not afraid anymore." There were no negative responses reported for Self-Esteem. The category of Social Functioning was divided into two sub-categories: Activity and social interaction. Within those two sub-categories, responses were categorized as being positive or negative. In the activity sub-category, respondents commented on an increased willingness to go places and participate in activities that improved their QofL. The only negative type of response was that post-implantation social interactions were not as good as the respondents had expected prior to the surgery. In the sub-category of Social Interaction, there were more positive than negative responses. Among the positive responses, one example was, "I feel connected with life, family, and friends." An example of a negative social interaction response was, "Some difficulty face to face with strangers, so I still occasionally try to avoid such situations…"

Self-efficacy

Respondents were asked to rate on a five-point Likert scale their perceptions of five aspects of Self-efficacy before and after receiving their implants (Survey questions 18 & 32; see Figure 3). These aspects of Self-efficacy included self-reliance, feelings of insecurity, goal setting, ability to handle problems, and persistence in completing new tasks. Comparisons from pre-surgery to post-surgery were again tested using a Wilcoxon signed ranks tests. The respondents acknowledged positive aspects of self-efficacy had improved

Table 3. Summary of coding of themes concerning quality of life open-ended responses to survey question #34, "Briefly describe the quality of your life after getting your cochlear implant." Three major themes adapted from the subdomains of the Nijmegen Cochlear Implant Questionnaire (Hinderink et al., 2000).

Sound Perception (Physical Functioning)
Positive Responses: • I can hear. Wow! It's great! • I can listen to music. • [I can listen to] the sounds of music again. • As a late-deafened adult, I was able to pick up speech quickly after my implant. • Obviously better. Without it [CI] I am deaf. • I can hear one on one conversation a lot better. • The CI has improved my hearing and being able to use the phone. • The ability to use the phone and listen to the radio I hadn't been able to do for years. • I can hear outside noises. I can hear the birds. I can hear noises from another room and hear somewhat better in noisy environments even though it is still a struggle. **Negative Responses:** • I have trouble understanding most people when they talk. • I wish I could use the phone more easily. • Still cannot use TV, phone, radio, hear a speaker. • Disillusioned about the results of the implant. • Music of any kind still hopeless—for which I am very sorry. • I can now understand more of what I hear, but it is still difficult. • It's taken a very long time to get where I am with my hearing.
Self-Esteem (Psychological Functioning)
Positive Responses: • It [CI] seems to make life much easier. • More confident. • Increased my independence. • It has totally changed my life. I am not afraid anymore. • Like night and day--It gave me back my life. • Less anxiety about groups. • Personality changed to a confident person. • Feeling better about the future in general. **Negative Responses:** • No negative responses on self-esteem.

Table 3 cont.

Social Functioning	
Activity	**Social Interaction**
Positive Responses: • More willing to go places. • I can watch TV. • I can listen to the radio. • Being a successful bilateral CI user has Improved my enjoyment of many activities and my quality of life. **Negative Responses:** • It has not been as good to communicate in order to do things I did before in everyday life.	**Positive responses:** • [Hearing conversations better] allows more substantive contributions. • [Before getting the implant] I missed out on just trying to "pass" for years on my job and social life. • I'm more social, gregarious, initiate conversations, more effective on a business level. • I can hold conversations with others without having to ask them to repeat themselves all the time. • I hear conversations better. • More sociable. • I feel connected with life, family, and friends. **Negative responses:** • I have trouble understanding most people when they talk. • I still read lips. • Some difficulty face to face with strangers, so I still occasionally try to avoid such situations.

in all categories after getting the CI, but all five aspects of Self-efficacy failed to achieve statistical significance (self-reliance, $Z = -1.36$, $p = .174$; feelings of insecurity, $Z = -0.81$, $p = .417$; goal setting, $Z = -1.16$, $p = .248$; ability to handle problems, $Z = -1.51$, $p = .132$; persistence with new task or trying something new, $Z = -1.08$, $p = .281$). The respondents showed a significant reduction in reported overall anxiety level after implantation ($Z = -2.14$, $p = .032$).

After Surgery AR Support Services

Figure 4 depicts the percentage of late-deafened adults with CIs who reported receiving specific post-surgical AR support services (survey question #22). The most frequently received support service after surgery was external processor mappings performed by their audiologists (94%). Approximately 71% of the respondents reported receiving printed materials from the CI manufacturer concerning AR. Over half (59%) of the respondents reported using generic online individual resources provided by their CI device manufacturers. Just less than half of respondents reported receiving individual AR (47%), and only 12% of late-deafened adults with CIs reported receiving group AR. Moreover, only 12% of respondents reported attending informational CI workshops or using video materials supplied by the CI device manufacturers. Survey question #25 asked respondents to describe their experience with support services after implantation. Of the 16 responses obtained for this question, 6 respondents — specifically reported receiving either individual or group AR, and that AR was beneficial to them. One respondent specifically mentioned participating in both a face-to-face and online support group for individuals who had received CIs. Other respondents reported not being able to access individual or group AR. One respondent said, "Other than two assessments, the practice was essentially on my own."

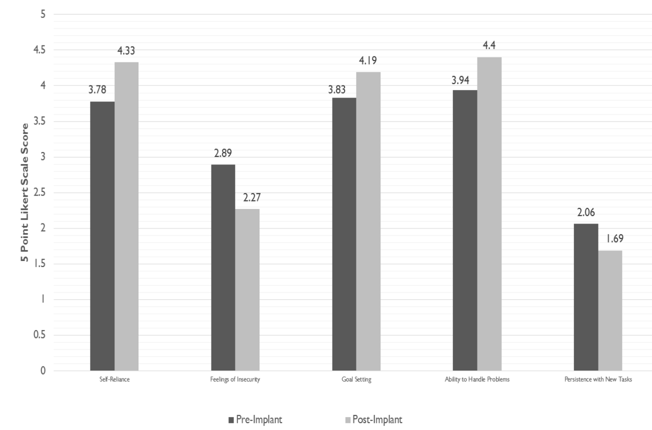

Figure 3. Comparison of respondents' self-reported pre- and post-surgical perceptions of five aspects of self-efficacy.

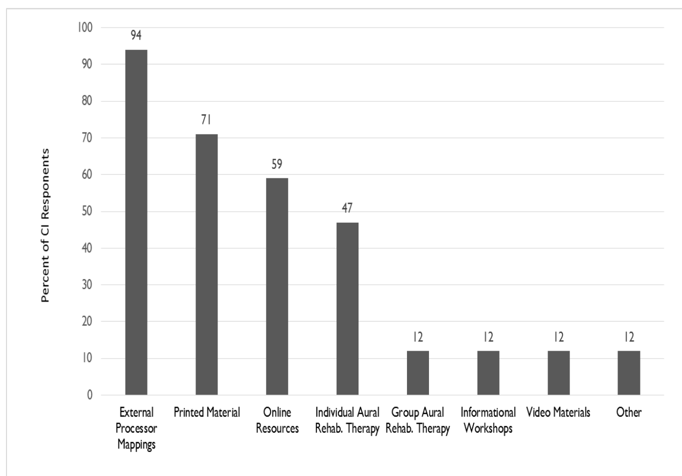

Figure 4. Percentage of respondents who reported receiving eight specific post-surgery AR support services.

Looking Back

Three final questions on the survey (questions #35, 36, and 37) were open-ended items asking respondents to share information about what they wished they had known prior to receiving their CI, as well as advice for hearing professionals and individuals contemplating getting a CI. Descriptive topical coding was applied across the three questions and yielded six categories: time, expectations and effort, information and personal research, CI technology, support, and need for AR services, all positive expectations. The respondents' comments to these four questions are shown in Table 4. With respect to time, respondents reported that the CI process takes time and that it is important to be patient as one learns to use it efficiently. In regards to expectations and effort, respondents cautioned new users "not to expect miracles" and for hearing professionals to prepare prospective CI users with appropriate expectations about the CI process. Moreover, the respondents noted that hearing professionals need to address related psychosocial challenges as the CI user learns to listen again. The respondents noted the importance of receiving ample information prior to surgery. With CI technology, the respondents reported wanting more information about ALDs and comparisons between the three CI manufacturers. For support, the respondents recommended talking with other CI users prior to surgery and "read all you can online!" Finally, the respondents indicated a need for AR services. One respondent's advice for hearing professionals was that they need to realize "that it [AR] takes the rehabilitation to help the hearing process to improve."

Table 4. Summary of reflections and recommendations from adult CI patients on the CI journey. Identified emergent themes included time, expectations and effort, information and personal research, CI technology, need for support, and need for Aural Rehabilitation

Identified Emergent Themes	Question #35: Info Before Getting Implant	Question #36: Advice to Doctors and Audiologists	#37 Advice to Prospective CI Users
Time	• I expected it to be better quicker. • I didn't think it would take as long for the hearing to come in where I could hear in a normal range of speech. • How long it would take to hear something. • Maybe I expected instant adaptation, and it was three months or so before I felt my CI and my brain were in sync.	• Tell patients it will be awhile before it is as helpful as they want it to be.	• To be patient. The hearing process will get better. • For them to know it will take a while to relearn hearing most sounds. • It will sound electronic at first but over time you will get use to it and thing will start to sound normal again. • It takes awhile before things will work. • It will sound better in time.
Expectations and Effort	• I had great expectations of hearing normal. • Not to expect miracles. • How well the CI could help you in your silent world. • How bad the stress would be being completely deaf. • How difficult functioning and hearing with an implant would be.	• Tell the patient what to expect and how you may get very depressed at this time. • They need to have proper expectations. They need to understand that they will be expected to push themselves—that no one can do it for them. • Make sure the patients understand that learning to hear again won't be an easy process.	• Be aware that it will be a hard process. • Don't think you're going to hear things perfectly right away. • Don't worry. • Keep your expectations low at time of activation. • Don't expect 20/20 hearing the way you can expect 20/20 vision with eyeglasses. Be realistic. • Don't be afraid of the surgery.
Information and Personal Research	• I did lots of research and felt I had the proper expectations. • I felt well-informed via my audiologist and my own research. • Would have researched other brands, even though I am satisfied with [one I have]. • I had been researching CIs since the 1970s, so I pretty much knew all about them when I got my first one back in 1997. • I didn't know the kind of questions to ask.		

Table 4 cont.

	• I received a lot of good information before I decided to get an implant.		
Identified Emergent Themes	**Question #35: Info Before Getting Implant**	**Question #36: Advice to Doctors and Audiologists**	**#37 Advice to Prospective CI Users**
CI Technology		• About the appearance of the implant. I thought it would be more under the skin and not where I could feel it. • Disappointed my hair didn't grow back. • A bit more technical advice about the CI and what it does. • More comparison between the three brands. • MUCH more help with ALDs.	• Use the resources from the manufacturer of your implant. • Check out all three brands.
Support		• Put them in touch with patient that had similar losses that got implants, with good and bad results. • They need a good solid family support system. • Talk to implantees, including those with different brands. • Put CI candidates in touch with HLAA and its local chapters so that they can meet people who have actually gotten them. • Have them read first person accounts, book about personal experiences, so that they can understand the perspective of other people with hearing loss in a way that a hearing person would never be able to convey.	• Get one-on-one help if needed. • Talk with others who have been through the experience. • Talk to implantees. • Read accounts of other CI users and books from other CI users. • Network with them [CI users] so you will have an idea of what to expect. • Read all you can online and people's books/ memoirs of their experiences.
Need for AR	• Why I would not get any help learning to hear with the implant? • More on AR.	• That it takes the rehabilitation to help the hearing process to improve. • Suggest Aural Rehab.	

Discussion

The purpose of this study was to document the self-described biopsychosocial and AR expectations and needs of late-deafened adult CI users before and after cochlear implantation.

Hearing Loss and Ease of Listening

In terms of respondent demographics, this study found that most late-deafened adults with CIs had a gradual onset of hearing loss rather than sudden hearing loss, and a majority of these patients experienced some form of chronic tinnitus. The online survey results revealed that a majority of the respondents wore a hearing aid in the non-implanted ear. This finding agreed with the listening technology profiles of the patients in the UNCG CIC clinic. This tendency also is in agreement with the findings of Hua, Johansson, Jonsson, and Magnusson (2012), who reported that adult patients with CIs performed better on the Hearing in Noise Test (HINT) when wearing a hearing aid on the non-implanted ear. The benefits of binaural hearing have long been recognized, and late-deafened adult patients using both CIs and hearing aids may require specific AR instruction and support services to learn how to successfully use these two very different types of biomedical devices together in listening and communication settings.

The results of the online survey revealed that most late-deafened adults with CIs were pleased or very pleased with the sound production of their implants and expressed many positive experiences and statements about the benefits. Prior to implantation, most expected to hear environmental noise and television with their CIs, very few expected to easily hear speech through the telephone, and over half anticipated not being able to hear music. Following implantation, ease of listening performance in 4 of the 7 listening conditions (using the telephone, location of sounds, listening to conversation in public settings, and listening to television) remained below low (less than 30%). The ease of listening on the telephone only reached 29% after surgery. The results of the survey were lower than those cited by Anderson et al. (2006) who reported 71% of CI users being able to receive benefit with landline phones and 54% with cell phones after surgery. These researchers also reported that only 14% of their adult CI users indicated that they could use a landline telephone with no difficulty. Results from the online survey indicated that many late-deafened adults with CIs, although pleased with the sound production of their CIs, continued to experience difficulty in many life listening situations. These findings were congruent with observations from the UNCG CIC clinic in that late-deafened adults with CIs reported frustration in listening with their CIs and that many continued to use additional assistive listening devices such as the CAP-Tel (captioned telephone).

Music

The survey respondents identified listening to music, both before and after surgery as a listening challenge. Leal et al. (2003) reported that only 38% of their 29 adult patients with CIs found enjoyment in listening to music. The results of the current survey were consistent with this finding in that less than half (47%) of the survey respondents reported an ease of listening to music with their implants.

Several comments from the survey indicated that respondents missed music and that they desired to listen to music again. Certainly, music contributes to many people's QofL, and the CI industry has been responding to this need with advancements in internal electrode and the external speech processor's ability to code music. However, technological advancements alone cannot meet this need for better music perception. Gfeller, (2009) and Plant, Plant, and Reynolds, (2011) reported on the benefits of structured music training in adult CI users. Plant et al. (2011) found positive outcomes when incorporating music listening exercises within individual and a group AR programs for late-deafened adults with CIs. Given the importance of music on QofL, the results of the present study affirm that listening to music and experiences (such as live performances) should be included as integral components of a biopsychosocial AR program.

Auditory Processing

The process of learning to listen again with a cochlear implant involves more than learning to efficiently process the signals presented to the auditory nerve at the level of the cochlea. In reality, all of the central auditory nervous system must adapt and learn how to use the electrical stimuli provided by the CI. This auditory learning affects the neural pathways in the brainstem, thalamus, as well as the auditory cortex, so that the brain is "retrained" in listening to sound. The respondents in the current study were asked to list their continuing listening challenges with the CI. These ongoing challenges reflected facets of higher level auditory processing, such as listening in noise (figure ground), hyperacusis (sound sensitivity issues), localization, auditory discrimination, and organization. Thus, group AR listening activities should incorporate tasks dependent on higher auditory processing skills such as listening in noise, auditory memory, and sequencing.

Quality of Life

The results of this study compared the respondents' pre-surgery expectations to their post-implantation outcomes on three QofL measures. The results revealed that for the respondents in this study, social lives and independence actually declined after cochlear implantation, with the quality of the perceived social life being significantly lower than the pre-surgery expectations. Qualitative responses were both positive and negative with the negative responses reflecting persistent listening challenges post-surgery. Only the respondents' perceptions of their self-confidence exceeded their pre-surgery expectations. These findings support the contention of Heydebrand, Mauze, Tye-Murray, Binzer, and Skinner (2005) that natural and automatic adjustments in social behavior over time cannot be assumed as a consequence of receiving a CI. Thus, we assert that group AR services provide late-deafened adults with CIs the means to discuss shared QofL challenges and to share support as they move along the cochlear implant journey.

The results of the survey were in contrast with several prior investigations that reported an increase in overall QofL after implantation. For example, Zhao, Bai, and Stephens (2008) documented positive changes in QofL (i.e., self-confidence, feelings of isolation, and the ability to communicate) in 24 profoundly deafened adults 4+ years post-implantation. Correlational analyses of their data found that the key determinants for QofL improvement in CI users were improvements in communication abilities, lessened feelings of isolation, increased feelings of self-confidence, and improvement of listening abilities in daily life, such as watching television or listening to music. However, Zhao et al. (2008) did find that after CI surgery, 10 out of the 24 subjects (41%) reported that their hearing abilities, even with the CI, continued to have a negative effect on their social lives. It is interesting to note that this study assessed participants four years after surgery and not during the first year post-implantation. Likewise, Vermeire et al. (2005) examined the hearing ability and QofL in 89 late-deafened adults with CIs across three adult age groups. They found no differences in QofL over time due to age, and that QofL improved after surgery. However, their results indicated that QofL in their CI recipients reached a plateau three months after surgery and that their QofL did not significantly improve over time. In a recent meta-analysis by Gaylor et al. (2013), the results suggested that QofL improved in adult patients using one CI, but the QofL benefits in patients with two CIs was variable. The findings of the current survey and the results of investigations by Heydebrand et al. (2005) and Vermeire et al. (2005) suggested that a plateau or decrease in QofL after surgery may indicate a lack of meaningful support services and structured AR services provided to late-deafened adult CI patients after implantation.

Self-Efficacy

Despite reporting post-implant improvement in self-reliance, goal setting, ability to handle problems, and ability to persist in completing new tasks, the participants did not demonstrate significant improvement in self-efficacy after receiving their implants. The analyses did, however, show that they reported being less anxious after receiving the implant. It is important to note that responses to self-efficacy questions, such as those posed in the current survey are not typically employed by hearing healthcare professionals during post-implantation follow-up care. Yet these areas of biopsychosocial functioning are critical components of a holistic AR approach that adult AR groups should address as advocated by Erdman (2009).

After Surgery AR Support Services

Findings from the current study revealed that adult CI users received excellent follow-up care in the mapping of the external speech processor. Additionally, many of the respondents received printed and video materials online by audiologists and CI manufacturers. However, less than half of the respondents reported receiving any individual AR, and only 12% reported receiving group AR services. This typical standard of clinical care for adult CI users stands in stark contrast to the standard of care for children with CIs, who routinely receive both individual and group aural habilitation therapy following implantation (Ertmer, 2005; Estabrooks, 1998, 2006). This difference may be due to an assumption that late-deafened adults with CIs do not need AR to adapt to their new biomedical device because they have prior hearing experience. The current investigation demonstrated that late-deafened adults' adaptation to their CIs extends far beyond periodic mappings and their speech discrimination scores. Moreover, results of the current study highlighted that losing hearing in adulthood and then learning to hear again with a CI presents a host of QofL challenges that can best be addressed and supported in a group AR setting with other adult CI users experiencing the same process. Thus, the adaptations of late-deafened adults to cochlear implantation (a biomedical device) can be likened to a patient undergoing a hip replacement (another biomedical device). When adult patients receive hip replacements, they are automatically enrolled in physical therapy. Yet, as the findings of the current study revealed, adult CI users are rarely enrolled in group AR services following surgery. Clinical observations of patients with late deafness who attended the UNCG CIC Clinic support participation in a group AR – that it helps to "normalize" the CI process for adult CI users and specifically assists them during their first year of adapting to the new biomedical device. In such group AR settings, members share common experiences and acquire self-advocacy strategies from each other (Gagne & Jennings, 2010; Jennings, 2009; Preminger, 2007). We therefore strongly advocate that adult CI users be afforded the same individual and group AR services as children with CIs receive (Tucker & Compton, 2012).

A theme that emerged regarding what the respondents wished they had known prior to receiving the implant was the time involved in learning to adapt to the CI. This theme about time also surfaced in their advice to hearing healthcare professionals and prospective CI users. Given the complexity of adapting to a CI by the human auditory system, more research is needed to determine expected benchmarks of progress in learning to listen with the implant. It can be posited that these benchmarks may extend well beyond the first year after surgery. For example, one of UNCG CIC referring audiologists reported to us "something magic happens at six months after the speech processor is turned on." We have also observed that our CI patients begin to experience marked improvements in speech perception approximately six months after implantation. Thus, during this six-month time frame after surgery, late-deafened adults with CIs will continue to need instruction, listening practice, and biopsychosocial support in managing their expectations and in learning to use this new biomedical device. Group AR provides a means where more experienced CI users can assist new CI users as they go through this adaptive process. Additionally, we recommend that in assessing hearing function of late-deafened adults with CIs, an assessment of central auditory skills should be conducted. The results of the responses to the current survey emphasized that a holistic biopsychosocial AR program should incorporate listening exercises that target central auditory processing skills such as listening in noise and localization as well as opportunities for CI users to engage in reflections of shared experiences and challenges in the CI process.

One limitation of the current study was that the sample size was relatively small and the respondents were from the Eastern portion of the USA. Future investigations need to include a larger and more diverse sample from across the country. Another limitation was that only CI users with access to a computer completed the survey. Accommodations for a paper survey option would help capture the perceptions CI users with less computer access.

Summary and Conclusions

This study employed an online survey format to document the pre- and post-surgical biopsychosocial needs and expectations as well as listening and AR needs of late-deafened adults with cochlear implants. Major findings of the survey revealed that: 1) ease of listening remains low after implantation, especially in the areas of telephone and television use, listening in public settings, localization of sound, and listening in noise; 2) listening to music remains a challenge for a majority of CI users; and 3) two areas of QofL (social life and independence) are not necessarily improved after implantation. Although respondents did comment that they believed themselves to be well-informed before receiving their implant, several mentioned that they wished they had better understood the amount of time it would take to effectively use their new CIs, how difficult listening with the implant would be, and why they would not receive any assistance on learning to hear with the implant. These respondents believed the process would be quick and relatively easy. The results of the survey found that only 12% of late-deafened adults with CIs responding to the survey had received group AR. In conjunction with the previous findings of AR researchers (e.g., Erdman, 2009; Gagne & Jennings, 2010; Heydebrand et al., 2005; Jennings, 2009; Preminger, 2007), the results of the present study suggested that group AR for late-deafened adults with CIs can provide a safe place for patients to engage with other CI users, who, like themselves, encounter challenges in the process of learning to listen with a biomedical device. In such interactive and patient-centered settings, hearing professionals can provide needed instruction and biopsychosocial support to help patients understand what to expect during the first year after implantation.

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UNCG COCHLEAR IMPLANT SURVEY

CONSENT

1. ____Yes, I agree to take the survey. ____No, I do not wish to take the survey.

(If Respondent selected yes, then they would immediately be allowed access to the survey.)

DEMOGRAPHICS

2. What is your gender? ___Male ___Female

3. What is your age (in years)? ___

4. Where do you live?

___Eastern NC (between Raleigh and the coast);

___Central NC (between Winston Salem and Raleigh, including Raleigh);

___Western NC (between Asheville and Winston Salem, including WS);

___Other (please enter your current state of residence).

HEARING LOSS AND IMPLANTATION

5. How long have you had your hearing loss? (in years) ___

6. How long ago were you implanted?

___Less than 6 months

___6 months to 1 year

___1 to 2 years

___More than 2 years

7. What is the brand (manufacturer of your implant(s)?

___Cochlear Corporation

___Advanced Bionics (ABC)

___MED-EL

8. What was the cause of your loss of hearing?

___Age

___Noise Exposure

___Meniere's Disease

___Head Injury; Meningitis

___Medications (like chemotherapy)

___Don't Know

___None of the Above

9. How did you lose your hearing over time?

___Suddenly (with one day to one week)

___Gradually over several months; Gradually over a year or more

10. Did you experience tinnitus (ringing in the ears) with your hearing loss before surgery?

___Yes

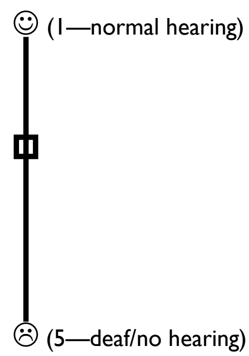
___No

11. How many hours a day do you wear your implant(s)?
___ Hours

12. How many implants do you have? ___One ___Two

13. Do you wear a hearing aid in the ear that was not implanted? ___Yes ___No

14. How much hearing do you have in the ear that was not implanted? Please move the slider on the scale to indicate how much hearing you have in the non-implanted ear. Top (smile) means normal hearing and bottom (frown) means deaf/ no hearing. (1 to 5 sliding scale)



PRE-SURGERY EXPECTATIONS

15. Before you got your cochlear implant, to what extent did you expect to hear:

Environmental sounds

Not at	With	With some	Easily	Very
○	○	○	○	○

Television

Not at	With	With some	Easily	Very
○	○	○	○	○

Telephone

Not at	With	With some	Easily	Very
○	○	○	○	○

Music

Not at	With	With some	Easily	Very
○	○	○	○	○

Conversations in public meetings

Not at	With	With some	Easily	Very
○	○	○	○	○

Conversations with family and friends

Not at	With	With some	Easily	Very
○	○	○	○	○

Location of sounds

Not at	With	With some	Easily	Very
○	○	○	○	○

16. Before your cochlear implant surgery, how did you expect a cochlear implant would affect your:

Self-confidence

Worse	About the	Better
○	○	○

Social life

Worse	About the	Better
○	○	○

Independence

Worse	About the	Better
○	○	○

17. Overall, what were your expectations on how the cochlear implant would help you?

18. Before you got your implant:

Did you see yourself as a self-reliant person?

Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
○	○	○	○	○

Did you set important goals for yourself?

Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
○	○	○	○	○

Did you see yourself as capable of handling problems?

Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
○	○	○	○	○

Did you give up if you are not successful when trying something new?

Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
○	○	○	○	○

19. Before you received your implant, rate your anxiety level.

___Very bad

___Bad

___Poor

___Neither good nor bad

___Fair

___Good

___Very Good

POST-SURGERY EXPERIENCE AND SELF PERCEPTIONS

20. During the first year after receiving your implant, how many times did you meet with your audiologist?

___Never

___More than 5 times

___3 to 4 times

___1 to 2 times

___Once

21. How often do you meet with your audiologist NOW? (times per year) ___

22. What kind of support services did your audiologist/ physician provide for you once your received your cochlear implant? Check all that apply:

___External processor mappings;

___Individual aural rehabilitation therapy;

___Group aural rehabilitation therapy;

___Informational workshops;

___Printed materials;

___Online resources;

___Online resources;

___Video materials;

___Other.

23. How often have you used the following materials/ resources to help you practice listening with your cochlear implant?

Online resources

Not at all	Several	Monthly	Weekly	Daily
○	○	○	○	○

Video resources

Not at all	Several	Monthly	Weekly	Daily
○	○	○	○	○

Audiotape resources

Not at all	Several	Monthly	Weekly	Daily
○	○	○	○	○

Printed resources

Not at all	Several	Monthly	Weekly	Daily
○	○	○	○	○

Friend or family member reading out loud to you

Not at all	Several	Monthly	Weekly	Daily
○	○	○	○	○

Individual aural rehabilitation therapy

Not at all	Several	Monthly	Weekly	Daily
○	○	○	○	○

Group aural rehabilitation therapy

Not at all	Several	Monthly	Weekly	Daily
○	○	○	○	○

24. Rate how effective the following materials/resources have been in your practice in learning to listen with your cochlear implant.

Online resources

Very ineffective	Ineffective	Somewhat ineffective	Neither effective or ineffec-	Somewhat effective	Effective	Very effective
○	○	○	○	○	○	○

Video resources

Very ineffective	Ineffective	Somewhat ineffective	Neither effective or ineffec-	Somewhat effective	Effective	Very effective
○	○	○	○	○	○	○

Audiotape resources

Very ineffective	Ineffective	Somewhat ineffective	Neither effective or ineffec-	Somewhat effective	Effective	Very effective
○	○	○	○	○	○	○

Printed resources

Very ineffective	Ineffective	Somewhat ineffective	Neither effective or ineffec-	Somewhat effective	Effective	Very effective
○	○	○	○	○	○	○

Friend or family member reading out loud to you

Very ineffective	Ineffective	Somewhat ineffective	Neither effective or ineffec-	Somewhat effective	Effective	Very effective
○	○	○	○	○	○	○

Individual aural rehabilitation therapy

Very ineffective	Ineffective	Somewhat ineffective	Neither effective or ineffec-	Somewhat effective	Effective	Very effective
○	○	○	○	○	○	○

Group aural rehabilitation therapy

Very ineffective	Ineffective	Somewhat ineffective	Neither effective or ineffec-	Somewhat effective	Effective	Very effective
○	○	○	○	○	○	○

25. Briefly describe your experiences with support services and resources after your cochlear implant surgery.

26. After you got your cochlear implant, to what extent can you hear:

Environmental sounds

Not at	With	With some	Easily	Very
○	○	○	○	○

Television

Not at	With	With some	Easily	Very
○	○	○	○	○

Telephone

Not at	With	With some	Easily	Very
○	○	○	○	○

Music

Not at	With	With some	Easily	Very
○	○	○	○	○

Conversations in public meetings

Not at	With	With some	Easily	Very
○	○	○	○	○

Conversations with family and friends

Not at	With	With some	Easily	Very
○	○	○	○	○

Location of sounds

Not at	With	With some	Easily	Very
○	○	○	○	○

27. After your cochlear implant surgery, how does your cochlear implant affect: your

Self-confidence

Worse	About the	Better
○	○	○

Social life

Worse	About the	Better
○	○	○

Independence

Worse	About the	Better
○	○	○

28. How pleased are you with sound from your implant?

___Very Displeased;

___Displeased;

___Neutral;

___Pleased;

___Very Pleased.

29. Rate your overall satisfaction with your cochlear implant.

___Dislike Extremely;

___Dislike Very Much;

___Neither Like nor Dislike;

___Like Very Much;

___Like Extremely.

30. List the top three challenges you face if using your cochlear implant. (Qualitative, open-ended written response.)

31. To what extent has the cochlear implant affected your

Self-confidence

Much	Worse	Somewhat	About the	Somewhat	Better	Much
○	○	○	○	○	○	○

Enjoyment in life

Much	Worse	Somewhat	About the	Somewhat	Better	Much
○	○	○	○	○	○	○

Independence

Much	Worse	Somewhat	About the	Somewhat	Better	Much
○	○	○	○	○	○	○

View of the future (hopefulness)

Much	Worse	Somewhat	About the	Somewhat	Better	Much
○	○	○	○	○	○	○

Self-worth (the way you feel about yourself)

Much	Worse	Somewhat	About the	Somewhat	Better	Much
○	○	○	○	○	○	○

32. Since getting your implant:

Do you see yourself as a self-reliant person?

Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
○	○	○	○	○

Do you feel insecure in your ability to do things?

Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
○	○	○	○	○

Do you set important goals for yourself?

Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
○	○	○	○	○

Do you see yourself as capable of handling problems?

Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
○	○	○	○	○

Do you five up if you are not successful when trying something new?

Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
○	○	○	○	○

33. Since getting your implant, rate your anxiety level.

___Very Bad

___Bad

___Poor

___Neither Good nor Bad

___Fair

___Good

___Very Good

34. Briefly describe the quality of your life after getting your cochlear implant.

35. What information do you wish you had known before getting your cochlear implant?

36. What advice would you give audiologists and doctors working with adults who are considering cochlear implantation? (Qualitative, open-ended written response.)

37. What advice would you give a person who is thinking about getting a cochlear implant?

38. Are there any other experiences or perceptions with the cochlear implant that you would like to share?