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What do Rush Limbaugh, 8 members of the Artinian family (of Sound and Fury fame) and 35,000+ persons as young as 12 months and as old as 87 years from countries around the world, have in common? No, not conservative politics, a cochlear implant (or maybe even two). These people reside primarily in the United States, Australia, Japan and Western Europe where there is a rate of growth of 4,000 to 6,000 new CI recipients per year.

There are currently 3 manufacturers of implantable devices that are approved in the US, namely Cochlear Americas, Advanced Bionics and Med-EI. In the Technology column, Allison K. Pezzullo and Leigh Ann Monthey, audiologists at Cochlear Americas lead the issue off with a summary of the current state of cochlear implant candidacy criteria such as lower and upper ages for implantation, degree of hearing loss, age of onset of deafness, and the issue of bilateral implants. These professionals invite all SLPs and Audiologists with interest to become more knowledgeable about re/habilitation so that CI recipients will have resources for intervention close to home. If you need a refresher on the components of a CI and how it works, this article provides a sidebar on that topic.

The first invited article by John Christiansen, Ph.D., (faculty member in the Department of Sociology faculty at Gallaudet) and Irene Leigh, Ph.D., (a faculty member in the Department of Psychology there) reports on a project with which they both have been involved for several years. Namely, interviewing parents with children who have received CIs, as well as many of those children to get an up close and personal perspective on this new intervention option. Their research culminated in the publication in 2002, of their book, Cochlear Implants in Children: Ethics and Choices, Washington, D.C., Gallaudet University Press. (Dr. Christiansen has an additional special interest in the topic, as he is a recent recipient of a cochlear implant.)

Many of the traditional auditory-oral schools and programs in the US are on board with the CI trend as 30-70% of the children with severe and profound hearing loss enrolled in these programs are using a CI. Many of those children will make their way into mainstream educational environments. Carol Flexer and Denise Wray, who wrote about CIs in the HEARSAY technology issue 3 years ago, are back as authors of the second invited article for this theme, with their colleagues, Beth Robb and Ron Sommers. Their article explains the Auditory-Options Project, a new Ohio Resource for early intervention services and resources for children with hearing loss of all degrees, including those with CIs. The effort and family focus that is needed to insure that children with CIs have an opportunity to achieve in the mainstream is well illustrated in their article through 2 case studies of young CI recipients.

In keeping with our efforts to bring you cutting edge information, The Hearing Research Forum, a new column, features an article by Katherine Gordon and Robert V. Harrison of the University of Toronto on the nature of changes in the central auditory system as a result of early onset deafness. Gordon and Harrison highlight the challenges of measuring those changes in the human central auditory system. Our ability to understand CANS plasticity has profound implications for understanding how or if measurable changes can be modified with early use of hearing aids or CIs. The authors offer some intriguing insights on this question.

The CI theme is continued in the Hearing is Believing Columns authored by Renee Banakis and Laura Kelly. The first features an interview with Peter Artinian, the man who was at the center of the arguments in Sound and Fury, The Communication Wars of the Deaf, a documentary film produced in 2000 about CIs in families with both deaf and hearing members. Mr. Artinian reveals background about the filming, and about his attitudes which he felt were not accurately portrayed in the final version of the film. The companion article provides a review of literature on the wide variety of attitudes of adults who are deaf toward CIs, both from inside and outside of Deaf Culture. (As a sidebar, those of you who are familiar with the Sound and Fury film will wonder about the outcomes for the young nephew of Mr. Artinian who received a cochlear implant at the end of the film. Cochlear Americas, a CI manufacturer, has produced a film entitled TWINS, A Cochlear Implant Study which features the twin nephews of Mr. Artinian as well as a second set of twin girls. Each set has one twin who is deaf and received a CI and one who is normally hearing. This one is definitely worth a look)

The Research Forum includes two articles, the first on the measurement of personality types in SLP students at 3 universities with implications for identifying students who might be potential PhD candidates to become faculty in Communication Disorders programs. (Editor’s note: The foregoing summary deserves a comment about personalities of current CSD faculty, but I will not stoop to that level.) Colleagues from Minnesota, who explored the validity of using limited numbers of utterances from a large language sample to derive MLU for words score, authored the second article. This research utilized the CHILDES database provided on the web by Jon Miller.

The School Forum features an article by the educational audiologists from the Cincinnati Public Schools. They are clearly busy with conventional activities such as fitting assistive listening devices and helping to plan intervention for children who are deaf and hard of hearing but I believe readers will find the brief histories of the children in CPS with CIs to be very interesting. The diversity of school age students who may be members of the CI club is noteworthy.

This HEARSAY is not just about children, however. About half of persons who receive CIs these days are adults. Increasingly we are also encountering adolescents with long standing hearing loss who are receiving implants. In the Clinical Grand Rounds article authored by Lindsay Russell and Jane Prasse of University Hospitals Health System, Cleveland, two case studies of adolescents are provided. A reprint from Loud & Clear, a newsletter published by Advanced Bionics, and authored by Donna Wayner and Judy Abrahamson provides information on assisting adults with CIs. Although the latter is sub-titled An Audiologist Rehabilitation Guide, this article is equally useful for SLPs.

This is an information packed issue and we are confident that you will learn something of interest regarding who CI users are these days, and how as SLPs and Audiologists, we may be called on to help someone with a cochlear implant and their families make the most of this extraordinary new technology or to honor the decision of those who decide a CI is not right for them.

OSLHA will be offering ASHA CEUs to members for reading articles in this issue. Check the web site for details and also look for displays at the Convention in March with information on how to obtain these units.

Laura W. Kretschmer, Ed.D.
Managing Editor, HEARSAY
HEARSAY is a publication of the Ohio Speech–Language–Hearing Association for the benefit of its membership and other individuals committed to the highest quality of service to people with communication challenges.

The purpose of this journal is to expand the level of information, research, and clinical science in our professions. It is provided as a vehicle for reporting studies relevant to human communication and its disorders and to provide information on the activities and affairs of members and directors of the Ohio Speech–Language–Hearing Association. Each issue contains (1) invited articles on journal themes or other topics important to state and national issues, (2) peer reviewed research articles, and (3) forum columns or articles on topics of interest to audiologists and speech-language pathologists employed in a variety of settings, as well as pre-service students, whether undergraduate or graduate.

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Submissions to any of the HEARSAY forums or columns are encouraged. Material may be sent to the OSLHA Executive Director c/o the specific forum or column editor for consideration. Individuals interested in submitting material to the Research Forum should follow the guidelines outlined below. All submissions will be considered for publication. Articles submitted to Research Forum are carefully reviewed. Membership in the Ohio Speech–Language–Hearing Association is not a requirement for contributors. No manuscript or other material or content that has been published or is under consideration elsewhere should be submitted. Material should be submitted electronically, saved as a Word document. Images should be included separately electronically. All electronically images need to be provided at their actual size at 300 dpi and formatted as a jpeg, tiff or eps. A high quality hard copy may be provided to be scanned, either black and white or color.
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Reports. Most reports are data-based descriptive or experimental studies that pertain to clinical topics of limited scope. Reports describing new assessment or intervention programs will also be accepted for publication.

Articles. Articles may be scholarly papers related to communication and its disorders. Articles may be theoretical, integrative, practical, pedagogic, or empirical.

Case Studies. Case studies are reports that describe new or unusual findings, new insights, or new clinical approaches. Consideration will be given to the reliability of the data reported in case studies.

MANUSCRIPT REQUIREMENTS

All submissions are considered for publication. Membership in the Ohio Speech–Language–Hearing Association is not a requirement for contributors. No manuscript that has been published or is under consideration elsewhere should be submitted. Research manuscripts are reviewed by at least two consultants with relevant experience. Author identification is not available to reviewers. Manuscripts may be submitted in electronic form in Word, Rich Text Format or as.pdf files. Paper copies are not longer required.

Tables and Figures. Copies of tables and figures should be attached to each manuscript. Use arabic numerals for both tables and figures. Do not use suffix letters for complex tables; instead, simplify complex tables by making two or more separate tables. Table titles and figure captions should be concise but explanatory. The reader should not have to refer to the text to decipher the information. Glossy or otherwise camera-ready prints of figures or digital copies should be submitted with the manuscript.

Acknowledgments. Citation of grant or contract support of research should be given in an acknowledgments section at the end of the article. If any part of the research was supported by an institution not named in the title page, that institution should be acknowledged in this section. Individuals who assisted in the research or were helpful in the review process may be acknowledged.

References. All literature, as well as test and assessment tools and ANSI and ISO standards, that are cited in the text must be listed in this section. References should be listed alphabetically and then chronologically by author. Journal names should be spelled out and underscored or in italics. Pay particular attention to accuracy and APA style for references cited in the text and listed in the references. Double space these sections to facilitate editing and typesetting.

All manuscripts must be accompanied by a cover letter requesting that the manuscript be considered for publication and stating that it has not been published previously and is not currently submitted elsewhere. The contact author’s business address and phone number should be included.

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Cover Art

Hearsay expresses its thanks to Ohio Valley Voices for letting us have the opportunity to photograph their students for this year’s cover. See additional information below about their school.

Ohio Valley Voices is a nonprofit school for deaf and hearing-impaired children. Our mission is to teach our students to speak and to understand when others speak to them. We strive to meet the basic objectives of oral language development as soon as the child’s deafness is diagnosed, and to provide the tools necessary for family members to become their child’s advocate and coach. Students attending OVV mainstream to their local schools by the third grade.

Ohio Valley Voices • 9994 Zig Zag Rd. • Cincinnati, Ohio 45242 • 513-791-1458
If you’re a speech-language pathologist, or audiologist not currently working with cochlear implant recipients, you may think that these patients are outside your scope of practice. If you referred a long-time patient for a cochlear implant evaluation sometime in the past and never learned the result of that consultation, perhaps you assumed that they no longer required your services. If the last time you heard anything about cochlear implants was graduate school or a seminar, you may think that cochlear implant technology is only appropriate for profound hearing losses. Well, if you answered yes to any of the above, think again! It’s time for an update and you might be surprised by how much has changed. 1

There have been important advances in recent years, in candidacy criteria, outcomes, and technological refinements. Cochlear implants (CIs) are now better than ever before, making them an appropriate choice for greater numbers of adults and children with hearing loss. With three manufacturers all producing excellent products, the decision for CI candidates is often not so much whether to go forward as much as which product to select. (see web sites for Cochlear Americas, Englewood, CO, Advanced Bionics Corporation, Sylmar, CA, Med-El Corporation, Durham, NC) This article is intended to help speech-language pathologists and audiologists assist their patients in choosing technology that may be best suited to their individual needs.

Age no longer has much to do with candidacy or potential outcomes of using a CI. Children as young as twelve months of age, (Heher et al, 2002) and adults age 80 and older, routinely receive CIs. In 2002, most children with CIs attended school in mainstream settings using spoken language as their communication mode (Sorkin, 2002). As recently as a decade ago, a high proportion of deaf children were educated in segregated educational facilities, such as a school for the deaf (Sorkin, 2002). Now, with more children using spoken language for communicating, as well as greater efforts by public schools to address the needs of all deaf and hard of hearing children regardless of communication modality, parents increasingly opt for less restrictive environments for their deaf children.

CIs have been demonstrated to have a significant, positive impact on the health and general quality of life of seniors with significant hearing loss (Francis, et al, 2002; Kelsall, et al, 1995). For seniors living alone or for those with poor vision, the restoration of hearing provided by a cochlear implant is critical to their ability to live independently. The isolation that often accompanies significant hearing loss is mitigated or even eliminated as CI users once again enjoy social, cultural, and educational activities that may have become inaccessible to them as their hearing deteriorated. CIs often provide dramatic listening improvements for those who are using hearing aids and assistive listening devices, but still struggle to understand speech.

Expanded Candidacy Criteria

Recipients May Now Have More Residual Hearing.  Candidacy decision-making for cochlear implants has changed in important ways since the early 1990s. Adults and children who have more residual hearing and those who have had favorable outcomes with hearing aids may still be considered candidates for CIs. Specifically, the level of hearing loss for candidacy has been expanded from only profound deafness to include individuals with either severe or profound hearing loss, opening up the benefits of CIs to many more people. (Dowell et al, 2004; Shani et al, 2004) Speech understanding for adults can be as high as 50% (with a hearing aid) in the ear to be implanted, or 60% (with hearing aids) binaurally. Individuals with such listening scores would have been turned down for CIs in the past due to their level of residual hearing. This rejection frustrated not only the person seeking an implant, but also the health professional who may have referred them for the initial evaluation, as he or she watched their performance plateau or deteriorate with even the most advanced digital hearing aid technology. With today’s expanded candidacy criteria, many such individuals are considered appropriate candidates for CIs.

Adults with Prelingual Deafness Now Candidates. Another important change in candidacy decision-making in recent years is the inclusion of prelingually deafened adults (individuals who were either born deaf or lost their hearing prior to learning language) as appropriate candidates for CIs. Until recently, adults who had been deafened in early childhood were not considered good candidates for CIs. Recently, an increasing number of prelingually deafened adults have been considered for CIs. This is being done as their ability to understand speech is improved by CIs.

1 For a variety of up to date research reports on the issues of cochlear implants in children, including effects on speech and language development, bilateral implants, implants in children with significant residual hearing, the reader is referred to the Archives of Otolaryngology Head and Neck Surgery, May 2004, volume 30.
deafened adults who have used amplification, listening, and speech for an early and significant portion of their lives have received CIs with excellent results.

Some successful CI recipients who have had hearing loss since childhood communicate using sign language in conjunction with listening, while others rely entirely on spoken language. The key success factors for this group of adults include being “wired for sound” by having used the auditory channel with amplification for some period of their lives, and also being comfortable with spoken language. A number of such individuals who received CIs are now able to use a voice telephone when they had never done so before. Not all prelingually deafened individuals who receive CIs gain sufficient open set discrimination to use a voice telephone, but most appropriate candidates derive valuable listening improvements for spoken language and environmental sounds, as well as improved ability to monitor their own speech.

The decision whether to go forward with a CI is a personal one that should feel right for each individual, regardless of the results of their objective candidacy evaluation. At the same time, potential recipients should rest assured that if they are evaluated and determined to meet the candidacy criteria, they can expect the benefits gained via the CI to improve their hearing capabilities beyond what they derive from their hearing aids. It is unusual for such improvement not to occur. As an audiologist or speech-language pathologist working with the prospective recipient or their family, you are often the first, and most trusted, source of information. Educating yourself about the current options in cochlear implant technology provides a unique opportunity to steer your patient through a potentially overwhelming, and sometimes confusing process.

Younger Children = Better Outcomes. Another major change is the expanded use of cochlear implants for young children. Early identification of hearing loss has allowed children who are identified and receive appropriate intervention by six months of age to attain significantly better language skills than those whose losses are addressed after 6 months of age (Yoshinaga-Itano et al, 1998; Niparko, 2004; Geers, 2004). With so many children being identified in the first days of life, it is no longer unusual to fit babies as young as one month with hearing aids. Such early fitting gives these children a valuable jump on learning language and also provides the basis for the earliest possible evaluation of their candidacy for CIs.

Early identification, along with expanded trial criteria, the availability of family support and intervention services, have all made possible a dramatic lowering in the age of implantation of children. In the United States in 1997, a total of only 8 children, 18 months or younger, received CIs compared with 154 children in 2003. When the age criterion is increased to 2 years or younger, the number implanted in 2003 jumps to 255! As you can see, there is a trend toward earlier implantation in children, as well as more rapid growth in pediatric implants compared with use of the technology in adults.

The Food and Drug Administration (FDA) criteria now include children as young as 12 months of age as appropriate candidates when they a profound hearing loss and demonstrate lack of auditory progress with appropriate amplification. The FDA also includes children with severe to profound hearing loss at 2 years of age as candidates. We are now routinely implanting children at 12 months of age while less than a decade ago, a two-year-old was considered a very “young” candidate (Sorkin, 2002; data from Cochlear

![FIGURE 1](image_url)

Average scores for CUNY sentences in quiet (auditory only) for adults with at least 6 months experience using the most advanced Nucleus cochlear implant system available at the time.
Taking a cue from the hearing aid traditional (box-like) body-worn processors that perform as well as the manufacturers now offer ear level speech listening devices. All three CI manufacturers are now working with a range of assistive technology attractive, convenient, and appealing to adults who use cochlear implants. Recent advancements on CI technology have changed as research supported the benefits of binaural hearing aids. Those same benefits hold true for a CI recipient, whether through the use of binaural CIs (Litovsky et al, 2004) or, more commonly, by wearing a hearing aid in the un-implanted ear. Recent research demonstrating benefit when combining a hearing aid with a CI, as well as a trend toward bilateral implantation, are changing the way many audiologists think about candidacy. Comments from recipients describing more natural sound, better sound localization, and improved hearing in noise with the use of either two implants, or an implant and a hearing aid, are impacting the hearing industry and making the role of speech-language pathologists and audiologists even more significant.

Improved Outcomes with Cochlear Implants

Cochlear implant technology has advanced dramatically, improving outcomes for both adults and children. Indeed, a key reason for the expanded candidacy criteria described in the previous section, is the fact that results with CIs have improved so significantly. We know, for example, that someone who is currently able to understand 50% of words in sentences wearing appropriate amplification will likely enjoy much improved speech understanding with a CI.

There is now a considerable body of experience and data confirming performance levels for CI recipients of all ages. With each enhancement in device design, speech coding strategies, and/or mapping techniques used to program the devices, we have seen users’ speech recognition scores continue to improve. One benefit that these technological advances have had on adult performance with CIs are illustrated in Figure 1 (Cochlear Americas, Englewood, CO).

Recent Technological Advancements

CI manufacturers are now working on many refinements to make their technology attractive, convenient, and compatible with a range of assistive listening devices. All three CI manufacturers now offer ear level speech processors that perform as well as the traditional (box-like) body-worn devices. Some of these look much like a behind-the-ear hearing aid. Taking a cue from the hearing aid industry, CIs are now offered in a range of skin tones (i.e. beige, black, brown) and even sleek silver! Some companies offer removable battery covers in wide-ranging colors—purple, cobalt blue, pink, green, and yellow. Children, and even many adults, love the color options. Manufacturers also offer a variety of options for connecting to assistive listening technology such as televisions, radios, CD players, and of course, telephones. One manufacturer has added a built-in telecoil to their device, allowing direct linkage to telephones with the flick of a switch. Directional microphones, special settings for soft voices, and programs designed for noisy environments are other features that stretch CI users’ ability to hear in difficult listening situations.

Two Ears Are Better Than One, Right?

Remember when it was standard practice to recommend only one hearing aid, even for a patient who had bilateral hearing loss? That, of course, has changed as research supported the benefits of binaural hearing aids. Those same benefits hold true for a CI recipient, whether through the use of binaural CIs (Litovsky et al, 2004) or, more commonly, by wearing a hearing aid in the un-implanted ear. Recent research demonstrating benefit when combining a hearing aid with a CI, as well as a trend toward bilateral implantation, are changing the way many audiologists think about candidacy. Comments from recipients describing more natural sound, better sound localization, and improved hearing in noise with the use of either two implants, or an implant and a hearing aid, are impacting the hearing industry and making the role of speech-language pathologists and audiologists even more significant.

Some audiologists who specialize in CI mapping may not have enough that research supported the benefits of binaural hearing aids. Those same benefits hold true for a CI recipient, whether through the use of binaural CIs (Litovsky et al, 2004) or, more commonly, by wearing a hearing aid in the un-implanted ear. Recent research demonstrating benefit when combining a hearing aid with a CI, as well as a trend toward bilateral implantation, are changing the way many audiologists think about candidacy. Comments from recipients describing more natural sound, better sound localization, and improved hearing in noise with the use of either two implants, or an implant and a hearing aid, are impacting the hearing industry and making the role of speech-language pathologists and audiologists even more significant.

Some audiologists who specialize in CI mapping may not have enough experience with the current technology to keep up with the constant improvements in hearing aid technology. The audiologist with expertise in hearing aids may find few opportunities to work with CI recipients. By working together, these professionals are ensuring that CI recipients achieve improved outcomes through taking advantage of binaural hearing in their everyday lives.

Teamwork is Essential

The speech-language pathologist, educational audiologist, auditory-verbal therapist, or other re/habilitation provider should not be left out of the equation. Although it has been common for children to be enrolled in some type of post-implant therapy, more and more adult CI recipients are seeking the services of a rehabilitation specialist to improve their performance with the CI. This therapy relationship may be relatively short and self-directed by the recipient in the case of a pre-linguistically deafened adult, with the speech-language pathologist providing materials that the individual can practice at home. For a pre-linguistically deafened adult or child, the therapy relationship may be more traditional, with weekly appointments over a long period of time to work on specific listening/language learning goals. In either case, frequent communication between the CI audiologist and the therapy provider about progress and areas needing improvement is key to the recipient’s continued improvement.

So how do you partner with your CI colleagues to address the needs of this unique group? Your primary contact may be a CI center in your area. If you do not know of a center in your area, websites of each of the device manufacturers include listings of specialized centers that perform CI surgery and necessary follow-up. As more and more individuals receive CIs, the need for follow-up care increases. Many recipients prefer to have those services in their hometown or local area, so partnering with a CI center to provide follow-up services, particularly in rural areas, should be considered by speech-language pathologists and audiologists with an interest in this population. For the present, educate yourself and ask lots of questions. Information about CIs, candidacy, and outcomes can be found on device manufacturer’s websites (listings of which can be found in references below), in trade journals, research periodicals, and even on TV or in the newspaper! As CIs become more prevalent, there is a role for all of us on the team as we work together in the best interests of individual patients and their families. Together, imagine what we can accomplish!

Edited by: Tina Veale
How the Cochlear Implant Works

Hearing aids amplify sound. For most people with hearing loss, hearing aids are an appropriate and effective remedy. But even the most sophisticated hearing aids may not offer sufficient benefit to people with severe to profound hearing loss. In contrast to a hearing aid, a cochlear implant does not make sounds louder. Rather, a cochlear implant bypasses the damaged hair cells and directly stimulates the remaining nerve fibers in the ear. The implant provides useful hearing and improved communication ability to the implant user and is a safe, reliable treatment for appropriate candidates with severe to profound hearing loss. Multi-channel implants have been in use for over twenty years and are approved by the Food and Drug Administration (FDA) for adults and children.

A cochlear implant works in the following way:

1. Sounds are picked up by a microphone. In this case, the microphone is directional and located on a behind-the-ear headset.
2. Sound from the microphone is carried to the speech processor, which is a powerful miniaturized computer powered by batteries.
3. The speech processor filters, analyzes and digitizes the sounds into coded signals.
4. The coded signals are sent from the speech processor to the transmitting coil.
5. The transmitter sends the coded signals across the skin to the internal implant receptor under the skin.
6. The cochlear implant delivers the electrical energy to an electrode array in the cochlea, which was inserted during surgery.
7. The electrodes stimulate the remaining nerve fibers, which then send the sound information through the auditory system to the brain for interpretation.

REFERENCES and RESOURCES:


Cochlear Implant Manufacturers

Cochlear Americas, 400 Inverness Parkway, Suite 400, Englewood, CO 80112. www.cochlear.com

Advanced Bionics Corporation, 12740 San Fernando Road, Sylmar, CA 91342. www.advancedbionics.com

Med-El Corporation, 2222 East Highway 54, Beta Building, Suite 180, Durham, NC 27713. www.medel.com
There are a number of important ethical issues related to pediatric cochlear implants which parents, health care professionals, and others might consider before deciding whether an implant is appropriate. Our purposes in this paper are to describe some of these issues by focusing on the findings of two research projects examining general societal and deaf community perceptions of cochlear implants and deafness and to discuss some of the ethical dilemmas that supporters and opponents of pediatric implants have faced during the past 15 years since cochlear implants have become widely available.

The concerns and viewpoints of parents of deaf children are particularly important to consider since the majority are hearing people who generally have little, if any, contact with deaf people and know next to nothing about deafness. Whether they learn of their child’s deafness on their own, or whether their child’s deafness is diagnosed by an audiologist or pediatrician, many parents are shocked and devastated by the news, have few clues about what course of action to take and feel that they need to "do something."

Two Research Studies: Surveys and Interviews

A nationwide survey reported in 2003 was conducted by the Gallaudet University Research Institute (GRI). Data were obtained from 439 responses to a 12-page instrument, “Survey of Parents of Pediatric Cochlear Implantees.” Respondents to the GRI survey were invited to participate in follow-up interviews. We conducted 56 interviews with a total of 82 persons, including parents of children with cochlear implants, one parent who decided not to get an implant. We did not attempt to randomly select people to talk with, but we did interview people from different regions of the country in order to make the sample geographically representative. The majority of parents that we interviewed were strong supporters of the cochlear implant; therefore sample bias is evident in our survey and interviews.

The GRI and subsequent interviews focused on perceptions of a number of important issues. Parents were asked how they discovered their child was deaf and how they reacted to this (usually) unexpected news. We asked parents about their contacts with health professionals, implant centers, and members of the deaf community. Parents were asked to discuss some of the reasons why they decided to get an implant for their child, how much speech and listening therapy their child had, the modes of communication (signing, speaking, or both) that their child typically uses, and their child’s educational experiences.

Responses raised some important ethical issues. First, many parents had a very difficult time discovering that their child was deaf, and a number of parents shared experiences with insensitive pediatricians and other health professionals, including audiologists. Others portrayed their experiences with such professionals as very positive and helpful. Parents were often devastated by the unexpected news that their child was deaf, and if the diagnosis was delayed until the child was two years old, that compounded a difficult situation for the families. Many parents reported receiving conflicting advice, especially related to the question of whether or not they should use some variant of sign language with their child, and what type of pre- and post-implant speech and listening therapy their child should receive. Moreover, since professionals advising parents were often somewhat biased towards their own particular educational philosophy or communicational approaches, parents were left to sort through the information they were given and determine what was best for their child.

Readers interested in examining these issues in more detail than is presented here are invited to check our book, Cochlear Implants in Children: Ethics and Choices, Gallaudet University Press, 2002. The information, including quotations, which is taken from the book and reported here, is reprinted with the permission of Gallaudet University Press.

In addition to these sources of data, we interviewed several current or former Gallaudet students who are using, or have used, a cochlear implant. We conducted interviews with adolescent cochlear implant users with their parents. We distributed a four-page questionnaire dealing with cochlear implants to a sample of Gallaudet faculty, staff, students and alumni (see Christiansen and Leigh, 2002, Cochlear Implants in Children: Ethics and Choices, for more information).
cational modality, their advice was presented in a way that was difficult for parents to evaluate, given limited knowledge of deafness. Consequently, conscientious parents were often on their own in their effort to find unbiased, objective information about educational and communication options.

In the final analysis, parents often dealt with conflicting recommendations by doing more than one thing. Above all, parents wanted to be able to communicate with their child, and they frequently used whatever worked in their family situation. As a consequence, many deaf children and their parents, both before and after implantation, used both sign and spoken language. Even though all but one of the parents we talked with eventually decided to get an implant for their child, for many the decision was made after a lot of soul searching. Interestingly enough, most of the parents we talked with said they did not feel pressure from the cochlear implant center to get the device; in fact, many wondered why the implant center was not more forceful in recommending an implant. Nor were parents generally adamant that their child continue to use the implant; many told us that, while they hoped their child would benefit from the device, it was the child’s choice, particularly when they turned 18, to decide whether to continue using the implant. Most parents simply wanted to provide more options for their child and make it easier for their child to acquire spoken language.

The attitudes of some of the parents we talked with frequently reflected general societal views of deafness and implantation, which can be summed up quite easily: Deafness is a physical disability, and, as such, a deaf person (or the parent of a deaf child) would do well to consider any prosthesis, from a hearing aid to a cochlear implant, that might restore at least part of what has been lost. Indeed, popular magazine and newspaper articles frequently describe implants as a medical breakthrough or a miracle cure that enables the recipient to escape from a "prison of silence," even though, at the present time, the implant does not restore normal hearing (see, for example, Foster, 2000, and Wheeler, 2002). Not all parents share these general societal views of deafness.

In contrast to a disability-oriented medical model which sees deaf people as disabled, many people in the deaf community oppose pediatric implants. When deafness is seen as a culture, deaf people do not see deafness as a disability and, consequently, see no need to “fix” something that is not broken. In this sociocultural model deafness is seen as a way of life and not a disability. By using American Sign Language (ASL) and sharing a vibrant culture, upwards of a half-million deaf people in the United States consider themselves to be part of the deaf community. Another reason for oppose implants is that parents should wait until their child is old enough to decide for himself or herself if implantation is desired. Many people in the deaf community do not oppose adult implantation since this represents a mature individual’s presumably informed choice.

Parents who reported contacts with deaf people told us that they encountered some criticism from the deaf community about their decision to get an implant for their child. Not surprisingly, many of these parents did not appreciate the criticisms they received, especially because parents typically see their implanted child as deaf, because many children continue to use sign language post-implant, and because many implanted children have non-implanted deaf friends. As a result, many parents of implanted children, as well as implanted children and adolescents themselves, are quite vocal in their desire to reach out to the signing deaf community.

The historical opposition to pediatric implantation has changed in recent years. For example, more and more signing deaf adults are deciding to get an implant, deaf adult children of deaf parents are beginning to get implants, and deaf parents are starting to get an implant for their deaf children, as witness the McBride family shown on TV in a Good Morning America segment. Some residential schools, including the Laurent Clerc National Deaf Education Center at Gallaudet University, now have programs for children with implants. While these programs typically combine signing and speech, they do represent a rather dramatic shift from outright rejection of pediatric implants a decade ago, especially in residential schools, to a more flexible position today.

In what is perhaps the clearest manifestation of this change, in 2000 the National Association of the Deaf (NAD) issued a position paper that recognized the right of parents to make informed choices that take into account that early implantation may promote the development of language and literacy. This is in contrast to a 1991 NAD position paper that was critical of the Food and Drug Administration (FDA) for approving pediatric implantation (children under age 17). We asked Gallaudet students, faculty, staff and alumni to comment on this shift. One representative respondent said: “I formerly did not support the cochlear implant as I felt it would destroy the deaf community. But now I respect individual choice and feel the cochlear implant is part of deaf culture, anyway. People’s perspectives on deaf culture are different now.”

**Ethical Dilemmas**

What do we mean when we talk about ethics? Ethics are moral principles adopted by an individual or group to provide rules for appropriate conduct. Behavior perceived as ethical within one community or culture may be perceived as unethical in another.

Ethical considerations have been raised by both supporters and opponents of pediatric cochlear implants. Should parents implant a child without the child’s consent, or should they wait until the child is old enough to decide? Does implanting a deaf child deny the child “the right to be deaf?” Is cochlear implantation of a deaf child tantamount to “child abuse” or “genocide” against the deaf community, as some allege?
Research involving human subjects is subject to a plethora of bioethical requirements. Bioethics “examines the ethical dimension of problems at both the heart and the cutting edge of technology, medicine, and biology in their application to life” (T. Shannon, 1997, p. 4). Bioethics deals with medical issues created by new technology, such as the cochlear implant. Medical decisions must take into account the extent to which expected benefits outweigh risks, and the extent to which new technology will contribute to accepted clinical procedure and not be primarily for the sake of research (Blume, 1994; Clark, Cowan, & Dowell, 1997).

Bioethical decisions are based on the principles of beneficence, nonmaleficence, and respect for autonomy (Jonsen, Siegler, & Winslade, 1998; T. Shannon, 1997). Beneficence means that the duty of physicians is to do good and avoid evil. This duty is closely tied to their ability to fulfill the goals of medicine in conjunction with the patients’ preferences about the goals of their lives. It involves judgment about the extent to which individuals believe the technology will be of benefit to them. Corollary to beneficence is the principle of nonmaleficence, which is the duty to refrain from causing harm in the interest of maintaining well-being. Surgical risks and technology failure need to be considered as well as psychosocial considerations related to medical procedures. In medical decision-making both beneficence and nonmaleficence are judgment calls of how degrees of benefit are weighed against degrees of harm. Respect for autonomy is based on the principle that individuals must be perceived as capable of deliberating courses of action and making decisions for themselves (T. Shannon, 1997). This process requires informed consent, which is defined as “the willing acceptance of a medical intervention by a patient after adequate disclosure by the physician of the nature of the intervention, its risks and benefits, as well as of alternatives with their risks and benefits” (Jonsen, Siegler, & Winslade, 1998, p. 55).

**Ethical Perspectives of Supporters of Pediatric Implantation**

**Beneficence:** Medical school training focuses on why people do not hear and the methods needed to conquer deafness (“The death of deafness?” 2000). Doctors, allied professionals such as audiologists, and the general public do not see hearing loss as a natural occurrence but as a pathology that adversely affects the individual’s quality of life. This easily leads to the social construction of hearing loss as an abnormal condition, handicap, or disability that needs to be corrected or cured in order to avoid the negative consequences of deafness (Cohen, 1995; Crouch, 1997; Tyler, 1993). Creating the ability to hear by providing the child with a cochlear implant is portrayed as an effort to minimize disability, or to “activate a God-given thing,” as John Niparko, a cochlear implant surgeon, puts it (Arana-Ward, 1997, p. 1). It is beneficial to provide communicative value, auditory enjoyment, and enhance safety. One is “doing good” for the child (Balkany, Hodges, and Goodman, 1996). The hope is that after implantation the profoundly deaf child, especially one implanted at a relatively early age, will benefit by mastering spoken language and interacting more often with hearing peers (Geers, Nicholas & Sedey, 2003; Moog & Geers, 2003; Spencer & Marschark, 2003). This will presumably lead to enhanced opportunities for education, employment, and personal relationships. Based on this perspective, the implanted child will have a chance for an “open future,” one that is not constrained by deafness or by limitations in spoken communication. This open future is generally defined as consisting of infinite possibilities over and above those available when one remains primarily within the deaf community. An ancillary concept is that of freedom of choice. With cochlear implants, the expectation is that children will eventually be able to choose where they want to be, whether among hearing people, part of the deaf community, or straddling both the deaf community and the surrounding hearing society.

A related consideration, repeatedly mentioned by the parents we talked with, as well as widely acknowledged in the literature, is that hearing parents would like their children to be “like them,” that is, part of the hearing mainstream (Crouch, 1997). On this basis, one can argue that enabling the profoundly deaf child to participate in the culture of the parents contributes to the principle of beneficence, or doing good for the child. The alternative possibility is that potential harm could ensue should the child be estranged from the family of origin, or if life possibilities are limited when the child enters the deaf culture/community. This is not to say that those who join the deaf community necessarily become estranged from their family of origin. However, parents do worry about this possibility.

**Nonmaleficence:** The medical community no longer considers the surgical procedure itself to be experimental. Medical complications occur in a minuscule percentage of patients (Cohen, 1995, 2000). The FDA approved pediatric implants as being medically safe following years of extensive testing (American Academy of Audiology, 1995), and children were implanted only after extensive work with deaf adults, as based on ethically accepted practices for research (Clark, Cowan, & Dowell, 1997). However, some of the parents we surveyed and interviewed reported a few surgical problems and technology failures. Most technology failures are amenable to correction by repeat surgery when the internal components fail. Even if minimal, not only the frequency but also the severity of technical failure needs to be considered in the harm versus benefit calculation.

Another factor that needs to be considered in this calculation is whether the cochlear implant sufficiently facilitates spoken language development and ease of interaction with hearing people to make the procedure a viable option for deaf children. The literature reveals numer-
uous articles that attest to successful outcomes of implantation in children with severe-to-profound hearing loss (e.g., Clark, Cowan, & Dowell, 1997; Geers, et.al., 2003; Niparko, 1998; Niparko, et.al., 2000; R. Shannon, 1998; Spencer, 2002; Waltzman & Shapiro, 1999). Success is sometimes somewhat narrowly defined as demonstrating improvement in speech perception and production more often than in language development or in social interaction within-in hearing environments. However, recent studies have noted improvement in expressive and receptive language skills following cochlear implantation, even with maturational changes factored out (e.g., Kelsay & Tyler, 1996; Niparko, 1998; Spencer, 2002; Waltzman & Shapiro, 1999).

For socialization, research tends to note some improvement in interactions with hearing peers (Bat-Chava & Deignan, 2001; Kluwin & Stewart, 2000; Nicholas & Geers, 2003). Respect for Autonomy: The patient (or parent) is accorded respect as a decision-maker and as an agent of self-determination. To empower consumers in making informed decisions, cochlear implant center staff must explain that cochlear implants do not restore normal hearing, outcomes are highly variable, and long-term commitment to rehabilitation is required. Professionals are responsible for presenting the information in ways that are easily comprehended by parents and patients.

As noted above, most of the parents we interviewed did not feel pressured by the cochlear implant center to decide in favor of the implant. Parents generally felt they were well-informed consumers who were actively involved in the decision-making process. Practically all of the parents we interviewed acknowledged being informed of the possibility that all their child could achieve might be awareness of environmental sounds.

Ethical Perspectives of Opponents of Pediatric Implants

For opponents of pediatric cochlear implants, the overriding perception is that benefits are not really all that beneficial and harm is being done to deaf children. The principle of autonomy is violated by the biased nature of information provided to parents by professionals with a vested interest in cochlear implants.

Beneficence and Nonmaleficence: In the deaf community, people do not see themselves as condemned to an inferior world of silence. From their perspective, opening the child up to deaf community membership will facilitate access to a signed language such as ASL. As some researchers have found, in spite of misperceptions to the contrary, ASL can provide a link to the written language of the hearing society (Erting, Thumann-Prezioso, & Benedict, 2000; Lane, Hoffmeister, & Bahan, 1996; Marschark, 1998). Consequently, ASL is seen as a form of beneficence. In this conceptualization, the medical construction of deafness as a disability to be overcome is jettisoned for a social construction of deafness as a characteristic way of life. Cochlear implantation means that the focus is on the disability and not on the child as a deaf person. The surgery forces the child away from a “natural” means of communication (i.e., ASL) into an artificial hearing status that will still not guarantee full acceptance by the hearing community. To opponents of pediatric implants, harm is done by depriving a deaf child of “natural” opportunities and by promoting implants as the prime avenue to accessing hearing society when there are options that do not require surgery.

In view of the wide variation in speech and language acquisition among implanted children, those who question the procedure emphasize that the ethical question of whether children benefit enough from the cochlear implant to make much difference in their lives demands careful scrutiny (Blume, 1994; Crouch, 1997). Their lives are already impacted by the fact that the path to oral language development is arduous, with no guarantee of fluency or ease of function in hearing society. The community validates that a deaf person is able to learn, work, and play. The right of the child to be free of “force” or “undue pressure” to perform in hearing society is stressed. Not being implanted lessens the ongoing struggle to be part of the hearing community.

Opponents of pediatric implantation feel justified in continuing to claim that the principle of nonmaleficence has not been upheld. The present potential harm is a serious consideration, taking into account the fact that deaf children without the implant can and do achieve psychological health, independence, and happiness in adulthood.

Respect for Autonomy: Respect for parental autonomy involves a parent’s right to decide based on unbiased information. Pediatric implant opponents wonder how alternatives to cochlear implants are presented to parents by cochlear implant teams (Carver, 1990). Deaf adults who can clarify the implications of all options are rarely represented on cochlear implant teams. The parents we interviewed generally acknowledged receiving information about deaf community viewpoints from implant centers, but rarely if at all were they exposed to deaf people who could present such viewpoints as part of the routine screening. Part of the reason for exclusion may be attributed to the perception that the deaf community is entrenched in irrational opposition to the implant. Opponents of pediatric implantation see informed consent procedures as being rendered suspect by the biases inherent in presenting implants as a means of minimizing the isolation of deafness. Parents therefore psychologically may not have freedom of choice, contrary to what proponents of cochlear implants believe.

3 One of the authors (Irene W. Leigh) served on a cochlear implant team in the early 1990’s.
The Principle of Justice

Of equally pressing concern is the fact that technology, especially cochlear implants, is not universally or equally available to low socioeconomic deaf children, including many deaf children of color. For example, even though minorities comprise over 40% of the Gallaudet annual survey of more than 40,000 deaf and hard-of-hearing children throughout the United States (Gallaudet Research Institute, 2003), in the GRI cochlear implant survey approximately 85% of the respondents were white. In our interview sample only one set of parents was from an ethnic minority group. Data from the Allen, Rawlings, and Remington (1993) report on preliminary findings in Texas indicated that 90% of their pediatric implantee sample was white. Geers and Brenner’s (2003) cochlear implant child sample was 162 white, five African American, five Hispanic, five Asian, and four “other.” The under-representation of racial and ethnic groups is a serious ethical concern.

The Issue of Choice

At what age are children sufficiently competent to participate in the decision-making process? How is the information packaged and presented to the child or adolescent? How vulnerable is the deaf child to pressure from parents and professionals, whether overt or subtle? How seriously is the child’s discomfort with the idea of surgery or of wearing the implant paraphernalia addressed? These are all ethical questions that require thoughtful consideration.

The role of children and adolescents in the decision-making process is a sensitive one, especially since the process requires that they undergo surgery and the intensive post-surgical rehabilitation required to effectively learn how to comprehend and use speech. Legally a child or adolescent need not play a role in decision-making or formally consent to treatment. Ethically, most professionals believe children should be allowed to express preferences, and their assent to treatment should be obtained whenever possible (Deaton, 1996). Children and adolescents, insofar as possible, should be afforded the principle of autonomy. They should be given the right to participate in the decision-making process with their parents. However, the extent to which young children can collaborate in such decisions is a complex issue.

We interviewed a number of young deaf adults in our research, and they have some interesting perspectives on choice. Thirteen of the young adults we talked with were not using the implant while 14 were using it. Three of the nonusers reported they were too young to understand much about the surgery, and another nonuser, implanted at age 7, reports that her mother did not ask her how she felt about the cochlear implant. A female implanted at age 13 reported that her parents did not ask her if she wanted the cochlear implant. She was taken to the hospital without explanations or any interpreting of what was going on. When she woke up, she had an implant. Another female who was implanted at age 13 said, “My parents asked me. It was my decision if I wanted this cochlear implant thing. I said yes, fine, but my main reason was to please my parents. They seemed to be so excited over this new thing that can help me hear…. I mean, I was 13 years old, and I had a hard time with the whole concept of not wanting to be shown that I’m deaf…A lot of conflicting feelings, but as time went on I was ready for it.”

The issue of choice includes not only the decision to start, but also the decision to stop using the implant. One female decided that after one year of use she had had enough and wanted to go back to “quiet time.” Other nonusers stopped using the cochlear implant during adolescence. It either did not work, it was too noisy, discriminating sound was too difficult, they got headaches, or there was no real change in communication. For them the benefits were not worth the effort to use the implant. Some of them mentioned identity issues, peer pressure, and the desire to be connected with Deaf Culture.

No young adult nonuser expressed intense anger at parents for having chosen an implant. Three appreciated having had the chance to use the implant and to know what hearing was like.

Of the 14 adolescent and young adult users six indicated they chose the implants for themselves. Their ages at the time of surgery ranged from 13 to 17. One 16-year-old reported that her mother asked her if she was really sure she wanted the implant because she did so well with hearing aids. One 18-year-old female initially expressed skepticism about the effectiveness of the implant over hearing aids. Additionally, she hated doctors, but decided to pursue implantation at the age of 15 after seeing her implanted friends surpass her in oral communication skills. Her parents were the reluctant ones!

The implanted young people we interviewed, both users and nonusers, do not take choice issues lightly. Nor do the respondents to the Gallaudet University survey of students, faculty, staff and alumni that we conducted, half of whom felt parents should not be permitted to choose the implant for children under the age of 5, even after careful research.

How strongly do deaf young adults agree with the decision their parents made to implant them when they were children? The interviews we conducted indicated variability in agreement, with a good number of users and nonusers expressing concern about very young children being implanted. Consequently, parents need to take their children’s opinions and feelings into account if possible. Whether the children participate or not, parents need to carefully weigh potential risks and benefits in terms of successive stages of development. This involves not only exploring the literature and talking to a wide spectrum of professionals, but also meeting members of the deaf community, both those who have grown up with implants and those who have not. When they have done all these things, their final decision to proceed or not will have been fully informed. This is especially pertinent considering that the FDA now approves specific cochlear implants for children as young as 12 months of age (e.g., FDA Releases Next Generation Cochlear Implant System, 2004). Parents owe that to their children, who live with the consequences of that decision.

Conclusions

We offer five general conclusions based on our research. First, a deaf
person with or without a cochlear implant can have good psychological health. Second, a cochlear implant does not inevitably separate young deaf children from the deaf community or deaf friends. Third, implantation does not mean that implantees will never sign or that they will not need support services. Fourth, pediatric implantation will in all likelihood facilitate the development of spoken language, particularly if implantation occurs at an early age and appropriate intervention follows. Fifth, deaf people can lead successful, rewarding and immensely satisfying lives using either signed or spoken languages. Ethical perspectives need to be carefully considered in the decision-making process when cochlear implants are being considered, particularly for children.

Edited by: Monica Gordon Pershey, Associate Editor of Hearsay

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Rationale for Early Implantation:
A Neurological Perspective

We hear with the brain -- the ears are just a way in. The problem with hearing loss is that it keeps sound from reaching the brain. The purpose of a cochlear implant (or a hearing aid) is to access, stimulate and grow auditory neural connections throughout the brain as the foundation for spoken language, reading and academics (Gordon et. al. 2004). Due to neural plasticity, age at implantation is critical - younger is better (Sharma et al, 2004). Because the CI is an auditory prosthesis, early and ongoing auditory therapy is absolutely essential (Robbins, et al, 2004).

Important neural deficits have been identified in the higher auditory centers of the brain due to deafness,
and further, the auditory cortex is directly involved in speech perception and language processing in humans (Kretzmer et al, 2004). In order for auditory pathways to mature, acoustic stimulation must occur early and often because normal maturation of central auditory pathways is a precondition for the normal development of speech and language skills in children (Quittner et al, 2004). Children receiving implants very early (around 1 year of age) may benefit more from the relatively greater plasticity of the auditory pathways than will children who are implanted later within the developmentally sensitive period (Sharma et al, 2004). Their results suggest that rapid changes in P1 latencies are not unique to electrical stimulation but rather reflect the response of a deprived sensory system to new stimulation. P1 latencies are a cortical auditory evoked potential generated by auditory thalamic and cortical sources that varies as a function of chronological age; P1 latencies reflect central auditory pathway maturation. Gordon et al (2003) concurred with Sharma and reported that activity in the auditory pathways to the level of the midbrain can be provoked by stimulation from a cochlear implant. Therefore, the hypothesis that early implantation appears to be promoted by changes in central auditory pathways was supported by evidence provided by Gordon and colleagues.

Emerging data1 from the Colorado Project are showing that about 90% of children born with a profound hearing loss, who obtain a CI before they are 18 months old, attain intelligible speech (Yoshinaga-Itano, 2004). Further, if the cochlear implant is obtained between 2 and 4 years of age, about 80% of the children born with a profound hearing loss will attain intelligible speech (Yoshinaga-Itano, 2004; Yoshinaga-Itano et al, 1998). This outcome is based on having the CI mapped/programmed appropriately and worn consistently.

Direct, repetitive auditory skills instruction as part of an effective family-based early intervention program, also is critical. That is, “extra” auditory stimulation is necessary. Contrastively, only about 20% of children born with a profound hearing loss who wear hearing aids (and not a cochlear implant), attain intelligible speech. Robbins, et al, (2004) found that skills mastered as close as possible to the time that a child is biologically intended to do so, results in development synchrony. That is, mastery of any developmental skill depends on cumulative practice; each practice opportunity builds on the last one. Therefore, the more delayed the age of acquisition of a skill, the farther behind children are in the amount of cumulative practice they have had to perfect that skill. The same concept holds true for cumulative auditory practice. Delayed auditory development leads to delayed language skills.

To summarize, current research confirms several facts for families who desire a spoken language outcome for their infant or toddler who experiences profound deafness. Families need to know that very early insertion of a cochlear implant (to access, stimulate, and grow auditory centers of the brain during times of critical neuroplasticity), followed by thoughtful, intense and ongoing auditory skill development activities (to take advantage of developmental synchrony and cumulative practice), offer a high probability of reaching their desired outcome. We live in a time of exciting new possibilities for children with hearing loss.

Issues in Early Intervention for Infants and Toddlers with Cochlear Implants: Challenges for the Family

When a baby/child is identified with a hearing loss, a multitude of issues immediately face the family and intervention team. Because of brain neuroplasticity, time is not on our side. Therefore, the following questions must be addressed as soon as possible after identification of the hearing loss:

1 See also Gordon and Harrison in this issue of HEARSAY for further information on this topic.
What is the role of the state’s Part C early intervention providers? (Part C of IDEA mandates that Federal funds be distributed to all states for the purpose of providing early intervention to children ages 0-3 with disabilities and their families. In Ohio, the Help me Grow program through the Ohio Department of Health (ODH), receives and channels Part C Federal funds. See the ODH website for more information: www.odh.ohio.gov)

What is the critical and essential role of caregivers in the intervention process?

How important is exposure to typical speech-language models/peers?

How can communication between multiple interventionists and the pediatric audiologist from the implant center be facilitated (in what often occurs as a fragmented service delivery system)?

How important is baselining the child’s meaningful auditory integration behaviors?

Who will conduct and document ongoing diagnostic therapy?

How can we transition goals and outcomes established by Ohio’s Regional Infant Hearing Program (RIHP) as detailed in the IFSP, to the school district’s IEP when the child turns 3 years old, and how can an appropriate preschool setting be found? (RIHP is funded by a portion of Ohio’s Part C funds that have been designated for children ages 0-3 with hearing loss and their families.)

In order to illustrate how families might meet these challenges on a personal level, two case studies will be presented. Both families were faced with the aforementioned questions. They resolved their dilemmas in ways that coincided with their vision for their child’s educational and communicative outcomes. Anonymity of the children has been retained by keeping identifying information confidential.

Case Study #1

Eleven-month old “Jacob” underwent audiometric screening right after his older sibling was identified as having a sensorineural hearing loss. Shortly thereafter, evoked auditory brainstem testing in combination with behavioral assessment confirmed a bilateral, profound, sensorineural hearing loss. He was amplified binaurally with powerful behind-the-ear (BTE) hearing aids at 12 months of age. The family initiated therapy employing an Auditory-Verbal philosophy as soon as hearing aids were fitted. Jacob attended Auditory-Verbal (A-V) therapy twice a week and the process for implant candidacy was immediately recommended by both the managing pediatric audiologist and the Certified Auditory-Verbal Therapist (AVT). The parents were comfortable with the family-based early intervention program promoted by A-V, and siblings, aunts, and uncles were included in intervention sessions and often in crucial decision making processes. In addition to A-V therapy, the family received intervention in the home once a week from a parent advisor from Ohio’s Regional Infant Hearing Program (RIHP).

The family had access to both a pediatric audiologist and a Certified Auditory-Verbal therapist (AVT) who had cochlear implant experience. The AVT began collaborating and consulting with the parent advisor from the RIHP to consolidate services. The family was steadfast in their desire to achieve spoken language outcomes for Jacob. They shared this vision with interventionists on their team who were not as familiar with facilitating auditory skill development and who were more comfortable with visual modes of communication. Focusing on audition was challenging because hearing aids appeared to benefit Jacob only minimally. At that time, CI protocol required that hearing aids had to be worn for a six-month trial period before implantation. The AVT was able to identify subtle indications that Jacob was responding to sound, and began laying the groundwork for post-implant intervention.

After contemplating their two available choices of cochlear implants, the family decided on the Clarion S Series implant manufactured by Advanced Bionics, a cochlear implant company. Jacob was subsequently implanted at 18 months of age. Surgery went well and detection to environmental and speech stimuli progressed at an expected rate. By nine months post-implant, he was detecting all six Ling Sounds (Ling, 2002) at 15’, verbalizing with communicative intent, using most vowels, and demonstrating comprehension of numerous routine directions and familiar phrases.

By two years post-implant, baseline data regarding use of auditory information and speech perception skills were obtained by administration of the Infant-Toddler Meaningful Auditory Integration Scale (Zimmerman-Phillips, Osberger & Robbins, 1998), numerous cochlear implant map/program checks (Koch, 1999a), and the Word Associations for Syllable Perception (WASP, 1999), Levels I and II. Also at that time, the family was faced with finding an appropriate educational setting for Jacob once he turned three years old. With his cochlear implant age (brain
obtain comparative data. Most notably, Jacob's distance hearing of the Ling 6 Sounds had deteriorated, and the total number of correct features exhibited on the WASP levels had significantly decreased. Both manner and placement feature distinctions were incorrect and final consonant deletion began to re-surface. An immediate appointment with the audiologist at the implant center revealed even more disturbing news. Jacob was losing the number of channels that the implant made available to him. An immediate consultation with Advanced Bionics, the cochlear implant company that manufactured the device worn by Jacob, culminated in a decision to surgically remove the original device and insert a new one because of faulty CI function. The family requested that re-implantation occur as soon as possible in order to allow Jacob's first mapping to take place a month prior to school resuming in the fall. The re-implantation and initial mappings progressed in a timely fashion, and Jacob was prepared to begin his second year of preschool with a new speech processor and internal device.

Because Jacob was now 4 1/2 years old, the family and AVT deliberated over a new educational placement. The team recognized the increased need for Jacob to be surrounded by as many good speech-language models as possible, particularly in light of his recent experience with CI device failure. The intervention team was warned to expect some regression of speech-language behaviors which did, in fact occur. However, Jacob’s communication skills resumed “on track” at a surprisingly fast pace; within five months he appeared to have re-gained previous skill levels. At that time, the family was impressed with a local community preschool that one of Jacob’s older siblings had attended. After consultation with the community preschool staff, they decided that Jacob would be engaged in a full-day preschool program that would involve both attendance at the special-needs preschool half-day and attendance at the community preschool the other half. The parent and the AVT visited the local preschool and once again, she and the parent in-serviced the staff who proved to be very receptive to learning about Jacob and his cochlear implant.

The decision to enroll Jacob with all typical peers was an arduous one because after his second implant, Jacob’s behavior was often impetuous and off-task. However, the teacher appeared to be a strong-willed educator with a concise classroom rule system in place. The intervention team highly recommended that Jacob be treated as normally as possible. This combination of “regular” preschool placement tempered with “special needs” class placement proved extremely effective. While he received excellent speech-language services at the special preschool, and private Auditory-Verbal therapy one-on-one once per week, each school day he also was being exposed to typical peer communication models. His behavior at home and at school improved markedly once all educators communicated via visits, and reviewed his communication notebook that contained his weekly objectives.

Communication skills continued to show steady improvements, and standard scores on a variety of language tests (i.e., vocabulary, concepts, morphemes, and syntax) all fell within the low-average range of performance when compared to normal hearing peers. Subsequently, a third year in preschool was determined to be the best choice given the fact that Jacob had a summer birthday. The intervention team believed that an additional year in the combined preschools would offer Jacob extra time to strengthen his auditory neural foundation and enhance his lagging communication skills. Jacob’s classrooms always had classroom sound field systems, but beginning in kindergarten, a personal-worn FM system was coupled to his CI speech processor. Jacob continues to love the FM system, and uses it everyday in school with no resistance.
Currently, Jacob is completely mainstreamed in a general education second grade classroom, receiving speech-language services and tutoring for pre-and post-teaching twice per week. Initially, the tutoring (i.e., math and reading) services were offered four times per week. Because of his good progress, the frequency of tutoring was reduced. The school district also provided funding for outside consultation and training by Jacob’s AVT for the school’s SLP who had had no prior experience with cochlear implants. The school also provided summer speech-language services. Reading tutoring was discussed, but not deemed a high priority because Jacob’s standardized test results on reading comprehension and decoding have been in the high-average range since kindergarten. Most recently, Jacob’s scores on the school district’s standardized reading assessment obtained in the second grade fell in the above-average range. It should be noted that his A-V therapy included much work on phonemic and phonologic awareness as well as on vocabulary, background knowledge, and reading aloud (Robertson, 2000). Jacob now receives A’s and B’s on his second grade report card and is involved in various outside activities such as baseball, basketball, and cooking classes. He is a confident, inquisitive, and outgoing youngster who is fully integrated in general education.

Professionals and family members were faced with making numerous decisions about Jacob during the past six years. Their ability to work collaboratively, share ideas candidly and respectfully, and tap into the educational expertise of all involved have had far reaching positive effects for Jacob and his love of learning.

**Case Study #2**

The second child named “Matt” presents somewhat different background and intervention issues than Jacob. Audiometrically, Matt also was diagnosed with a severe-to-profound sensorineural hearing loss at approximately 10 months of age. Matt was adopted, and there was no known information regarding pre-natal history. He was subsequently amplified with two powerful behind-the-ear (BTE) hearing aids at 12 months. The parents shared a vision for Matt that included near age-appropriate speech-language skills, high level reading and writing achievement, and an opportunity to obtain a post-secondary education of some type. Unfortunately, there were no Certified Auditory-Verbal therapists (AVTs) in close proximity to their home. Ultimately, the family worked weekly with two different AVTs who were located quite a distance from their home. The family enjoyed receiving input from two AVTs sharing the same desired outcomes for Matt.

Initially the first two state-provided early interventionists (EI) strongly opposed using the A-V philosophy. They rigorously tried to convince the family to use a visually-based communication mode rather than an auditory one. It was not until the third state-provided EI arrived that the parent’s wish to follow an Auditory-Verbal philosophy was respected. This third EI was willing to learn more about Auditory-Verbal methodology by working with the parents and the two private AVTs.

Matt reportedly did not become a full-time hearing aid user until about 13 months of age, and even then, he would frequently remove his hearing aids if not occupied in play or closely supervised. He did not consistently detect any of the Ling 6 Sounds (Ling, 2002) except /s/, he detected an increasing array of environmental sounds and toys, enjoyed and clearly responded to music, demonstrated comprehension of about ten directives (in context), attempted to imitate duration and words/phrases when prompted with the hand cue, and had expanded his phonologic repertoire to include consonants /w, h, p, n/ and vowel variation in two-syllable approximations. Also at five months after his initial mapping, the implant audiologist reported that Matt responded to warble tone stimuli in sound field at 35 dB HL across the speech spectrum. The entire intervention team now believed that Matt’s auditory and speech-language learning curve was on the rise.

Matt’s attention span increased and standardized speech-language assessments could be obtained by 3 1/2 years of age. Initial tests involved single-word vocabulary and preposition- and adjectival concepts. Quite remarkably, twenty months post-
implant he was testing within the “low-average” range in comparison to his peers with normal hearing. It was at this time that school placement decisions had to be made. The family chose to send Matt to a private preschool with normal hearing peers and smaller class sizes. They also enrolled him in a music class for children and participated in library events because he loved having books read to him. He continued with one of his AVTs once a week and eventually every other week as school activities expanded and his spoken language skills strengthened. During both years of preschool with typical peers, Matt attended the private preschool 3 mornings per week, and the family also enrolled him in another local community school several afternoons per week. Audiologic testing in the sound field yielded responses to warble tones at 25 dB HL across the speech spectrum. Speech intelligibility increasingly improved to the point that phonology scores fell within the average range by kindergarten. Standard scores on the Preschool Language Scale-3 (Zimmerman, Steiner, & Pond, 1992) were well within the average range compared to peers with normal hearing, and the preschool teacher believed that Matt was well-prepared to attend kindergarten at age 5 1/2 in spite of the fact that he would be only 3 1/2 years post-implant.

By kindergarten, it was determined that he would continue with A-V therapy once per month and receive speech-language services at the school. Matt did not qualify for reading or math tutoring because of his high test scores. Phonemic awareness training, a consistent part of his auditory intervention program, had prepared Matt well for reading. Receptive and expressive language scores continued to improve to the point that his total language score (SS=106) fell within the high average range on the Clinical Evaluation of Language Fundamentals-3 (Semel, Wiig, & Secord, 1995). Only tests normed on typically hearing children were used to evaluate Matt because that is Matt’s peer group.

Currently, Matt is completely mainstreamed in a general education third grade classroom where he is receiving all A’s and B’s. He now uses a personal FM system in the classroom coupled to his body-worn speech processor. His outgoing and inquisitive nature finds him participating in enrichment math class, numerous sports, scouts, and he is learning a second spoken language. His parents drove many miles in the early days after Matt’s implant in order to receive the services they believed Matt required. They are a good example of how a family can live far from their service providers and still obtain appropriate services for their child. They continue to drive Matt everywhere, but the journey now is to extracurricular activities where he is fully integrated with his hearing friends. The family also had a powerful impact on the state-sponsored early interventionist with whom they worked many years ago. She now knows that children born with profound deafness can learn to listen and speak at high levels by developing their auditory neural centers that are accessed by cochlear implants.

**Summary of Case Studies.** Jacob and Matt are not isolated cases of “star performers”; they each had substantial obstacles to overcome. Rather, they are examples of what early identification, early amplification and implantation, early auditory brain stimulation and growth, and family commitment can yield. On the one hand, there were distinct differences in their management, but on the other, there were many similarities:

- Intense family-centered therapy leading to a decision to mainstream
- Early classroom placement with typical peers exhibiting typical speech-language models
- Continuing speech and language therapy immediately following amplification
- High expectations for achieving the family-specified desired outcomes of spoken communication, literacy development, and age-appropriate performance in general education classrooms

**Qualities of a ‘Qualified’ Service Provider**

The previous case studies illustrate several points about service provision that will now be discussed. When a communication system reliant on functional audition and spoken language is the desired outcome, several key elements must be in place and passionately adhered to, in order to reach the intended outcome. A critical factor that will inevitably affect the child’s communication outcome is the type and quality of professionals providing early intervention services to the family and child.

Somewhat conversely, a breadth of research and literature related to early intervention service delivery ascerts that *parents* play the strongest role in terms of impacting their child’s growth, development, and resultant outcomes. If the preceding statement is accurate, why the
insistence that only highly qualified professionals be incorporated into a family’s early intervention plan? Is it not contradictory to offer in one statement, that type and quality of early intervention service providers have a vital impact on a child’s progress and outcome, and then assert in a subsequent statement that parents have the strongest impact on a child’s intervention results? In fact, these statements are not at all oppositional when one considers the magnitude of effect that a qualified provider can impose on a child’s development by intervening through the parent or primary caregiver. An early intervention professional’s greatest potential to impact a child’s progress and development is not solely related to providing direct therapy; a most influential factor is how the interventionist can indirectly affect the parent’s interactions with the child. The goal is that parent/child interactions will be consistently meaningful and productive in accomplishing set targets, objectives and goals.

State-sponsored early intervention (EI) service providers remain pivotal in establishing these appropriate targets, objectives and goals. Moreover, they are essential in assessing progress and implementing diagnostic therapy and intervention sessions. Frequently, the EI service providers are the family’s primary link to, and referral source for, other necessary services and agencies. State of Ohio sponsored EI programs such as Help Me Grow and the Regional Infant Hearing Program (RIHP) play a significant multifaceted role in the lives of families of children with cochlear implants. These agencies provide services and interventions, direct families to other agencies and professionals who may provide additional intervention and services critical to a child’s obtaining a successful outcome, and are often responsible for the coordination of those services. Although a paradigm shift involving the potential role of EI service providers appears inevitable if not past due, it is evident that the need for, and crucial importance of EI service providers is not in question, nor at risk. In fact quite the contrary considering that today, families of children who are deaf or hard of hearing have many choices, options, services, and service providers available to them. Often, as a result, parents may be bombarded by a host of professionals, all available to provide various EI services for the child and the family unit. By the time a child reaches 3 years of age, a family may have had a myriad of professionals interacting with and impacting their child’s development and the family’s life routine. Consider this, a single family in Ohio with one child who has hearing loss may be receiving services from any or all of the following agencies and professionals: a RIHP outreach specialist, an Ohio Help Me Grow early intervention specialist, a pediatric audiologist, an Ear/ Nose/Throat specialist, and a private speech language pathologist or certified auditory-verbal therapist. Now, consider that a high prevalence of children who have hearing loss also present with co-occurring disorders and syndromes. One can now confidently apply a bevy of additional service providers to the list of professionals intervening in the family’s life; perhaps the services of an occupational therapist, physical therapist, or behavior specialist. Therefore, if only as a tool to narrow down the field of potential service providers, a parent must be informed about what to look for in a qualified provider.

Concomitantly, a professional should know what today’s savvy and assertive parents are looking for in a qualified provider, both in an effort to meet parental demand, and in order to suggest appropriate referrals to other agencies and professionals.

Any professional providing EI services to a family of a child with a cochlear implant should be knowledgeable about the impact that hearing loss has on audition, speech, language, cognition, and auditory brain development. Accordingly, these professionals should obtain current information regarding today’s CI technology. They should be aware of the expected and realistic potential for “sky is the limit” outcomes for speech, language, literacy and auditory brain development for this most recent generation of early implanted CI recipients. When implementing an auditory approach to managing hearing loss and developing a spoken language communication system, diagnostic and therapeutic interventions serve no purpose if the auditory centers of the brain are not being adequately accessed. Consequently, the providers should be comfortable carrying out basic listening, visual, and troubleshooting checks on the CI, hearing aids, and or FM systems. Generally, parents should look and are looking for, qualified professionals who are not only comfortable but encouraging when a parent decides to seek a second opinion. Parents should be assured that the professional(s) they choose will be willing to collaborate and communicate with any other professional who may be providing a service to the family.

Providers such as early childhood intervention specialists, speech-language pathologists, and certified auditory-verbal therapists should include parents and primary caregivers as active participants in intervention and therapy sessions. Parents who are actively involved in the child’s training have children who have the greatest gains in communication and literacy skills (Geers, 2002). Therapy goals and objectives and the rationale for their creation must be identified and explained to the parent. Minimally, parents should be able to observe the intervention and therapy activities, take notes, and ask questions before and after sessions (Flexer, 1999). Regardless of ideal or minimal practices, parents should be provided with home program goals, objectives, and activities. These home programs (see Appendix II) should serve to support and reinforce what has been tar-
targeted during the intervention session, and will promote carryover and generalization of learned skills into a multitude of listening and communication environments.

The components of the intervention lesson plan developed by a particular service provider can potentially offer valuable insight into that provider’s qualifications for facilitating a successful spoken language and listening outcome for a child who has a cochlear implant. Ideally, lesson plans should include goals and objectives that target audition, speech, language, cognition, and literacy development (see Appendixes I and II).

The expected outcome for the majority of children who receive CIs is that they will develop listening and spoken language abilities commensurate with those of typically hearing peers. Therefore, these children will be expected to perform and compete in mainstream learning and social environments within the hearing community. Thus, it is essential that a qualified service provider carry out diagnostic therapy and assess progress using tools that utilize normative data and criterion referenced measures based on expectations for typically hearing same-age peers.

Finally, it is important to reiterate that early intervention provided with the intention of facilitating a successful auditory and spoken language outcome for a child with a cochlear implant is futile in the absence of a qualified pediatric audiologist. We must be able to get adequate sounds and speech to the child’s brain if spoken language and the auditory centers of the brain are to develop to their fullest potential. Recognition and focus on active collaboration between the pediatric audiologist and/or cochlear implant mapping specialist, and the early intervention service provider(s) (i.e. state-sponsored early childhood intervention specialist, speech language pathologist, certified auditory-verbal therapist) is unquestionably one of the foremost qualities a parent should seek in a qualified professional.

Overview of the Ohio Auditory Options Project

The Emergence of the Auditory-Options Project to Support Auditory Outcomes for Infants/Toddlers with Hearing loss and Their Families

On July 1, 2003 a private foundation awarded a three-year grant to The University of Akron and the Family-Child Learning Center which is a jointly operated program of Children’s Hospital of Akron and Kent State University. The population targeted by the Auditory-Options Project (AOP) was children ages 0 -3 who were deaf or hard of hearing and their families. The intent was to educate and train families of these children in the development of auditory and spoken language skills. In the process of accomplishing this goal, in-service training programs were to be offered to professional personnel who provide and/or direct service programs for these children and their families. The AOP was designed to work within existing state-sponsored service programs as a resource and ally and not become an independent service agency. Within Ohio, key agencies and service providers of great importance to the AOP have consisted of The Ohio Department of Health’s Regional Infant Hearing Programs (RIHP) and the Help Me Grow Project. Liaison and interactions with audiologists and SLPs in hospitals, schools and other clinical settings such as cochlear implant centers also were of particular interest and importance. The AOP is expected to continue providing its programs of free services in Ohio until July 1, 2006 for families who desire audition and spoken language as an outcome for their child.

The Auditory-Options Project (AOP) and Issues of Early Intervention (www.auditoryoptions.org)

The AOP strives to address many early intervention issues by utilizing different tactics and strategies. All services and materials provided by the AOP are completely free-of-charge to agencies, organizations and families, and they are offered only upon request. A significant component of the AOP revolves around a myriad of educational activities conducted by members of the AOP staff. The vehicle to provide these educational activities takes different forms. In-service training opportunities are frequently provided for Educational and Clinical Audiologists, Speech-Language Pathologists, Early Childhood Intervention Specialists, and related personnel. These events vary in content based upon the prior knowledge of the audience and the duration of the allotted time for the presentations. The purpose of these in-service training programs is not to develop highly qualified providers of auditory-spoken language training. Rather, it is to inform and demonstrate fundamentals of Auditory-Verbal and Auditory-Oral training methodologies suitable for use with infants and toddlers in order to further support, promote and facilitate a successful auditory and spoken language outcome.

The issue of the roles and expectations of family involvement in the child’s first three years is addressed in a less-formalized training opportunity in which the AOP Consultant/Trainer demonstrates auditory-spoken language training concepts and techniques within the home setting. In some instances, the RIHP staff members and other professionals such as Help-Me-Grow EI specialists are also present. If requested by the family, services of an AOP Parent Mentor are provided and the AOP will arrange a home visitation with the family.

Parent Mentors are AOP service providers who offer unique services to the families who reside in many different regions of Ohio. Parent mentors either are currently rearing a child with hearing loss or have done so, thus, they are experienced in how to stimulate the development of auditory and spoken language skills. They are
able to share ideas about the nature of hearing loss, and family members’ feelings related to having a child with hearing loss. Parent mentors also are sources of information about services and assistance that families can seek to meet their special needs.

An important issue in early intervention for these infants, toddlers and family members concerns early auditory training/intervention. How much training and how frequently it is received appears to depend upon the child’s capacity to learn, the degree and skills of the family members who are actively involved in the child’s training, and the appropriateness of the CI or hearing aid and its maintenance. However, AOP staff generally believes that infants and toddlers in training with involved family members make the best progress if seen at least weekly by a qualified auditory/spoken language trainer. In most instances, one visitation and training session a month does not appear adequate to maximize the child’s acquisition of auditory/spoken language skills. In the case of the infant and toddler fitted with a CI, it has been reported that the intensity of training in the auditory-verbal or auditory-oral method of communication is considered to be one of the most critical variables associated with the successful use of CIs by children (Moog, 2002). The AOP staff members strongly agree with findings from published research showing that families who receive some training and who become actively involved are very important factors influencing the extent to which the young child using a CI achieves maximum gains in auditory-spoken language development (Beiter, Staller & Dowell, 1991; Geers, 2002).

A key issue in early intervention that demands attention and diminishes the chances for continued growth and progress of these infants and toddlers relates to the issue of continuity of service. With continued support, many children using CIs and/or hearing aids can be placed and be successful in general education public school classes. However, when the child reaches age 3.0, the IFSP is terminated and the IEP begins. Unfortunately, in many areas of Ohio and in the nation, families are confronted with little or no options for their child’s communication training from age 3 -5 and after entering the typical elementary school situation. Preschool teachers who serve children with various forms of disabilities frequently do not have training or experiences with deaf or hard of hearing children. Not uncommonly, and particularly in rural areas, school audiologists are not available and SLPs often have large caseloads and will admit to not having the background or skills to continue the training of the child’s auditory-spoken language communication system (Rowan, Wray & Sommers, 2002). To date, the Auditory-Options Project has witnessed the important need for continuous services for these children as they enter preschool and elementary school-ages. Although we have no solutions, we are continuing to promulgate the importance of this major educational shortfall.

Another issue of importance to all EI programs relates to accountability. How effective are the strategies and approaches to meeting the child’s and family’s goals and objectives? In the case of the AOP, the importance of gathering and summarizing critical information about the scope and effectiveness of the AOP has resulted in the development and implementation of a computerized data gathering system. The value of in-service training programs is evaluated by those in attendance each time an in-service is conducted. In addition, families served by AOP staff provide written feedback judging what they learned and how well it was presented. Likewise, any EI service provider attending a home visit with an AOP staff member also is invited and

strongly encouraged to provide written feedback about the AOP staff member regarding information presented and activities conducted during the visit. Family members also evaluate the services of AOP Parent Mentors. Clearly, accountability and efficacy are vital aspects of any state-sponsored or private EI and educational program. We are all accountable for providing quality services.

Summary

Early intervention and early use of cochlear implant technologies allow outcomes never before dreamed of for children with severe to profound deafness. The extensive auditory centers of the brain can be accessed and stimulated through cochlear implants. Spoken communication, literacy and academic outcomes within general education classrooms now can be a reality for most children with hearing loss. New technologies have indeed offered an exciting paradigm shift that focuses on auditory access with subsequent high expectations.

Cochlear implant technology is only the first step toward reaching parents’ auditory and spoken communication outcomes for infants and toddlers who are born severely-profoundly deaf. Family-centered intervention by a highly qualified provider is the critical next step. The Joint Position statement 2000 states that families must be given full information regarding possible outcomes for their child including what it takes to reach those outcomes. Because of the time-locked neuroplasticity of auditory neural pathways, decisions must be made quickly if spoken language is an outcome desired by the family. The Ohio Auditory-Options Project is designed to assist professionals, students, and families in their quest for the high expectations available in 2005.

Edited by: Monica Gordon Pershey, Associate Editor of Hearsay
Appendix I: Sample Lesson Plan for a Beginning CI Listener

Client: BR: Note: In addition to the core lesson plan content, a rationale and brief explanation of the goals, objectives, and activities will appear in italicized text.

A. Long Term Auditory Goal:
to integrate hearing and listening in a meaningful way into BR’s life; to assess and develop BR’s auditory skills through continued evaluation and management of his sensorineural hearing loss and his auditory perception skills. Meaningful auditory activities will stimulate and develop BR’s brain, thus providing BR with skills to communicate effectively in formal and informal hearing and listening in a meaningful way into BR’s life; to assess and develop BR’s auditory skills through continued evaluation and management of his sensorineural hearing loss and his auditory perception skills. Meaningful auditory activities will stimulate and develop BR’s brain, thus providing BR with skills to communicate effectively in formal and informal environments.

1. To check functioning of BR’s cochlear implant (Without proper implant function, therapy activities are of no value.)

Procedure: With the caregiver’s participation, the therapist will complete a partial map/program check (troubleshooting checklist) and verify that all dials are set appropriately on BR’s cochlear implant. (Each cochlear implant company provides guides for troubleshooting their equipment. Contact the implant company for the necessary troubleshooting equipment and written material – See Appendix III.)

2. BR will detect all Ling 6 sounds (oo, ah, ee, sh, s, m) at distances of 3, 9, 12, and 20 feet (Ling, 2002). (Distance hearing is critical for incidental listening and learning; the greater the distance hearing, the better the access to background knowledge and conversations that occur in the environment. A well-programmed CI should allow detection of all speech sounds to at least 20 feet in a quiet environment. A chief value of a cochlear implant is that it allows far greater distance hearing than does a hearing aid; a hearing aid may allow sounds to be available for only a few feet for a child who has a severe-profound hearing loss. In fact, reduction of distance hearing is often the first signal of a faulty CI map. The Ling sounds should be administered using an acoustic screen – no visual cues and spoken at the loudness level and duration that the phonemes would occur in a sentence. Beware of speaking each sound too loud, and prolonging the sound unnaturally long. To do so will over-estimate the child’s casual access to spoken language. Once you know BR’s distance hearing in a given environment, you need administer the Ling Sounds only once at that distance – which should be at least 20 feet. There is no need to spend time determining if he can hear at closer distances once you know that his detection is at 20 feet.)

Procedure: Therapist will administer Ling 6 Sound Test (Ling, 2002) at distances of approximately 3, 9, 12, and 20 feet (or only once at his distance hearing limit, once that is known). BR will hold a small plastic bear up to his ear, listen for the Ling 6 sounds, and then drop the bear into bucket of water once he hears the sound to indicate detection of each Ling 6 sound. (Of course, BR first must be conditioned for this “listen and drop task”; such conditioning is a priority. Until he is conditioned, one can observe behavioral changes to the sounds.)

3. BR will demonstrate recognition of when a speech signal begins and ends, when a continuous vowel or fricative is presented. (see Biedenstein, Davidson, & Moog, 1995, the SPICE Curriculum: Detection Goal B1)

Procedure: Therapist will demonstrate the activity by producing a continuous sound such as “eeeee” or “shhhh” while moving a toy car on the table. Therapist starts the movement when the speech sound starts, and stops the movement when the speech sound ends.

B. Long Term Language Goal:
BR will use appropriate language in order to express his wants and needs in his environment. (The initial goals of therapy focus on auditory stimulation, not on vocal production. Meaningful sounds/words cannot be produced until the brain has had sufficient stimulation and growth to provide the auditory infrastructure that can support spoken language production. If BR is not yet spontaneously producing meaningful sounds, don’t force it. Use the following activities as auditory stimulation activities – input – and not as required spoken output activities.)

Short Term Language Objectives:

1. BR will engage in finger play activity to enhance language.

Procedure: BR will engage in finger plays such as “Wheels on the Bus,” “Five Little Monkeys,” and “Itsy Bitsy Spider.” Therapist will begin the verse and BR will join in with the corresponding finger play and spontaneous imitative sounds as his brain develops. (These activities are the beginning stages of specific phonologic awareness training that will follow in later lesson plans as preparation for literacy development.)

2. BR will demonstrate comprehension of 3 different verb phrases, 4 articles of clothing, and 4 body parts by following one-step verbal directions, two-thirds of the time. (Once again, this is an auditory stimulation activity, not a verbal output activity.) Visual cues can be added as needed following the initial presentation of the verbal direction. If visual cues, such as pointing, are added, be sure to then revert to an auditory-only presentation.

Procedure: BR will respond to the following types of instructions for 3/5 trials:

• “put on _________”
• “take off ________”
• “show me Mr. Potato Head’s ________”
• etc.

(Mr. Potato Head and items including hat, shoes, eyes, mouth, ears, nose, glasses, etc. will be used as props).

3. BR will demonstrate book handling skills that involve attending to the pictures, turning the pages, and focusing auditorially for the length of the story. The story to be read is, Where's Spot? (Hill, 1994).

4. BRs caregivers will begin the creation of an experience book. Examples of experience books will be displayed. Part of the home program will be to collect photos of BR with family members to start his first experience book. The home program also will emphasize reading to BR on a daily basis.

C. Long Term Speech Goal: BR will spontaneously produce and imitate developmentally appropriate vowels and consonants within meaningful contexts.

Short Term Language Objectives:

1. BR will imitate the following speech sounds within the context of Learning to Listen Sounds: /w/, /h/, /p/, and /m/. (Until BR’s brain has developed sufficiently for him to spontaneously imitate, the following activities should focus on meaningful auditory stimulation. Don’t force the verbal output until he is ready.)

Procedure: Therapist will present the “Learning to Listen Sounds” before BR is presented with the corresponding object. (That is, the sound of the object precedes the visual presentation – “hearing first”. The objects can be hidden under a colorful blanket or in interesting and mysterious containers). BR will imitate the sound, or demonstrate a listening attitude in the beginning stages of therapy, and then be given the object to play with. Examples include:

- slide = up, up, up, wheee
- bunny = hop, hop, hop
- boat = puh, puh, puh, puh
- food items = mmmmmmmm

2. BR will imitate syllables through syllable play. (If BR’s CI has just been mapped and he is not yet producing many sounds, clapping, marching, and dancing are appropriate output measures.)

Procedure: Therapist will use a drum, streamers, and clapping to demonstrate repetitive syllables such as aah-aah, eee-eee-eee, shhh-hhhh-shh, and mmmm-mmmm. Syllables are first presented verbally, with addition of drum, streamers, and clapping, with secondary presentation as needed.

Appendix II: SAMPLE THEMATIC LESSON PLAN with HOME PROGRAM FOR A MORE ADVANCED CI LISTENER

Client: GL

Theme: Easter

AUDITION:

Goal: 1. To check functioning of GL’s cochlear implant

Procedure: Therapist will complete a partial map/program check (troubleshooting checklist) and verify that all dials are set appropriately on GL’s cochlear implant. (see previous lesson plan for details. Once again, GL’s mother/caregiver is an active part of this session).

Goal: 2. GL will detect and produce all Ling 6 sounds (Ling, 2002) at a distance of 3, 9, and 20 feet.

Procedure: Therapist will administer Ling 6 Sound Test at distances of approximately 3, 9, and 20 feet or just once at GL’s maximum distance hearing capabilities (see previous lesson plan for explanation). GL will hold a plastic Easter egg up to his ear, listen for the Ling 6 sound, and repeat the Ling 6 sound that he heard.

Goal: 3. GL will demonstrate the ability to recognize negatives in sentences; 4/5 trials.

Procedure: Using carrots and bunnies, Therapist will first model for GL the linguistic concepts. “The carrot is FAR away from the bunny.” or “There is 1 carrot before the bunny, there are 2 carrots after the bunny.” Therapist will then have GL listen and place the carrots in the correct location based on the sentence and linguistic concept presented by the therapist.

Goal: 2. GL will demonstrate understanding of linguistic concepts: under, behind, and on top; 3/5 trials.

Procedure: Therapist and Parent will hide plastic eggs, bunnies and carrots around the therapy room. Therapist and Parent will take turns describing to GL where an object is hidden. Example: “The egg is UNDER the table.” GL will listen and then try to find the object in the described hiding place.

SPEECH:

Goal: 1. GL will correctly produce the initial /k/ sound at the single word level; 4/5 trials.

Procedure: Therapist will scatter plastic eggs and paper bunny rabbits throughout the facility halls. Pictures of words containing the
initial /k/ sound will be inside the eggs and under the paper bunnies. GL will go on a scavenger hunt collecting these items and saying the initial /k/ words depicted in the pictures. Therapist and parent will provide verbal, visual, and tactile cues/models as needed.

**COGNITION:**

**Goal:** 1. GL will sequence events from a story; 3/5 trials.

**Procedure:** GL will listen to the story of “Peter Rabbit.” Therapist will provide pictures of events from the story. GL will sequence the pictures according to the events in the story.

**HOME PROGRAM:** Continue to expand on GL’s understanding and use of spatial concepts and prepositions. Example targets: in, on, under, behind, next to, on top of, and beside.

**Activity 1:** Have GL help prepare a snack. Relocate common items to unusual places within the house or kitchen. He must listen for parent to tell him where the ingredients for the snack are located and bring them to you. Example: “The bread is UNDER the table.” or “The peanut butter is BEHIND the couch.”

**Activity 2:** Make getting dressed a little more interesting and challenging. Place pieces of GL’s clothing outfit in different places around the house. Go on a hunt for the items with GL. When an item is found, ask GL, “Where did you find your ________ (shoes, hat, shirt, socks, etc.)?” GL can then verbally answer, “IN the bathtub” or “BESIDE the TV.”

*Note these activities will also help build GL’s vocabulary for furniture, household items, and clothing. Try to think of different variations of these activities using other household and family routines. We will help GL discuss what his favorites were next week!*

**Activity 3:** Read to GL daily. Books that emphasize rhyming schemes to reinforce phonemic awareness activities are recommended.

**Activity 4:** Add a page to GL’s experience book. Perhaps take or draw a picture of GL finding his socks in the bathtub. Paste or draw the picture in the experience book with a three sentence written description of what happened.

**Appendix III: Sample of Resources and Intervention Materials**


**Some Additional Websites for Therapy Resources and Training Textbooks:**

2. http://clercenter2.gallaudet.edu/KidsWorldDeafNet/e-docs/CI/
3. 3. http://www.nciohio.com/
5. 5. http://www.johntracyclinic.org
6. 6. www.oraldeafed.org
7. 7. www.auditoryoptions.org

**Sample of Resources for Purchase (there are many more not listed due to space):**


**Koch, M. E.** (1999). *Bringing sound to life: Principles and practices of cochlear implant rehabilitation.* MD:York Press. (This is a video set that includes detailed information on the WASP). (List Price: $207.50 at www.yorkpress.com).


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The sound of that mythical tree falling in the forest is a series of pressure waves that must be processed by at least one person or animal’s central auditory pathways in order for the sound to be heard. In humans, the ability to hear speech sounds that are carried in everyday conversations is essential for the normal development of the central auditory system as well as for normal speech and language acquisition. Children with severe to profound sensorineural hearing loss do not have access to this important auditory input during potentially sensitive periods in development. In this article, we will review some important findings regarding normal auditory development and impacts of deafness experienced in childhood. We will also discuss how stimulation from a cochlear implant can promote both normal and abnormal central auditory development in children.

Normal Development of the Ear and Central Auditory Pathways

The formation of the ear, the auditory nerves and the connections between different relay points in the central auditory system allow the fetus to hear once the cochlea begins to function in the early part of the third trimester. Fetal reactions to sound in the third trimester of gestation have been reported (Ruben, 1992) which demonstrates that the normal system is functional at this stage. Because the fetus lives in a fluid-filled environment, its access to environmental sounds is probably limited to loud low frequencies. For the most part, the most prevalent sounds in utero stem from the mother’s physiology including her heartbeat, her breathing, her voice and her digestion.

Normal development of the ear and the nerves that will transmit auditory information to the brain begins in the early weeks of gestation. The ear stems from the same embryonic layer as the central nervous system. This layer, the ectoderm, gives rise to the neural tube and neural crest as well as the otic placode. Within the first few weeks of gestation, the placode forms a depression that will become the otocyst, the precursor of the ear, and a budding that will become the acoustic ganglia. The ability of ectodermal cells to differentiate and grow into their mature forms is mediated genetically with the help of chemicals described as growth factors (Abe, Wataya, Amano, & Kondo, 1991; Bernd & Represa, 1989; Marzella & Clark, 1999). Neuronal growth is guided in part by the release of these chemicals from target cells while non-targets might send repellent molecules to restrict the neuron from growing in the wrong direction (Friauf & Lohmann, 1999).

The spiral ganglion cells are present before the Organ of Corti in the developing embryo. Interestingly, the Organ of Corti develops from base to apex while the hair cells mature from apex to base. The spiral ganglion forms dendritic processes to innervate the immature cochlea beginning at the base. The connections, or synapses formed between auditory neurons and hair cells allow hair cell depolarization to be translated into neuronal activation. Huttenlocher and Dabholkar (1997) have reported that the creation of new synapses (synaptogenesis) in the human auditory cortex begins in utero with synaptic proliferation occurring until the third postnatal month. These new connections form at the same time that the neurons grow longer axons and show increased dendritic sprouting.

As we age, our auditory pathways undergo many changes that refine the system, enabling more efficient processing of sounds. This might, for example, allow us to develop improved speech perception that is necessary for speech and language learning. The abundance of synapses found in the auditory cortex by 3 months of age are pruned over the next 12 years of life (Huttenlocher & Dabholkar, 1997). It is possible that activity in the system mediates the elimination of specific connections and not others. This concept was originally proposed by Donald Hebb (in 1949 who suggested that synapses which are consistently active and work successfully become strengthened over time whereas those synapses which remain inactive or do not successfully allow transfer of activity from one nerve to another will die. It has been proposed that synaptic strengthening accounts for decreases in auditory brainstem response latencies over the first year of life (Ponton, Moore, & Eggermont, 1996).

The first 12 years of life are also important for innervation of the six cortical layers in the temporal lobe that respond to auditory input. Moore and colleagues (Moore & Guan, 2001) have reported that only cortical layers 3, 4, 5, and 6 contain axonal staining before 5 years of age. At approximately 5 years of age, the superficial layers of the auditory cortex (layers 1, 2) show axonal innervation which increases in density over the next 7 years. The neurons in the superficial layers of the cortex connect with neurons from other cortical areas (such as speech and language or vision areas of the brain) or with the opposite cortical hemisphere and are therefore likely to be important for more complex processing of auditory information including speech (Eggermont & Ponton, 2003; Moore & Guan, 2001). The role of activity in
the developmental innervation of the cortex is unclear, however, Ponton and Eggermont suggest that normal superficial layer innervation can only occur if auditory input is provided before a critical age in development (Ponton & Eggermont, 2001).

**Effects of Auditory Deprivation on the Developing Auditory Pathways**

It is clear that, before the onset of hearing, auditory development occurs by intrinsic mechanisms. After the onset of hearing, developmental changes could be orchestrated by intrinsic and/or extrinsic (activity-dependent) processes. The roles of “nature” (intrinsic mechanisms) and “nurture” (experience or input directed changes) in auditory development require further definition. The importance of activity on the development and the maintenance of the central auditory system can be explored by examining the effects of auditory deprivation experienced by subjects with deafness.

In animal models, deafness can be experimentally induced through such means as injection of ototoxic drugs, exposure to noise, removal of the cochlea(e), or plugging of the middle or external ear. Studies using these techniques have shown that there may be consequences of deafness that are most severe when occurring in early stages of life. For example, high frequency hearing loss in neonatal kittens resulted in reorganization of frequency maps in the inferior colliculus (Harrison, Ibrahim, & Mount, 1998) and cortex (Harrison, Nagasawa, Smith, Stanton, & Mount, 1991). The same configuration of hearing loss induced in adult cats resulted in no changes to the normal organization of frequencies in these areas (Harrison, 2001). Similarly, the removal of one cochlea in ferrets or rats, resulted in abnormal brainstem connections but only if the removal occurred during a particular period in the early stages of life (Moore, 1990; Russell & Moore, 1995). These studies suggest that auditory input is important during sensitive periods in development and has a role in shaping the developing auditory system.

The effects of partial deafening or unilateral deafening might be different than the effects of more extensive auditory deprivation as experienced by subjects with bilateral profound hearing loss. In congenitally deaf white cats, alterations occur in the endbulbs of Held of primary auditory nerves (Ryugo, Pongstaporn, Huchton, & Niparko, 1997). These endbulbs normally allow for very effective transfer of activity in the auditory nerve to neurons in the central nucleus that will ultimately be important for accurate sound localization. Morphologic variations can interfere with normal synaptic functions and these cats also show deficits in cortical activation (Kral, Hartmann, Tillein, Heid, & Klinke, 2000). On the other hand, Kral and colleagues have shown that the central auditory pathways are present in deaf white cats and are able to transmit information between the primary auditory nerve and the auditory cortex despite the fact that the cats never had access to auditory input (Hartmann, Shepherd, Heid, & Klinke, 1997; Heid, Jahn-Siebert, Klinke, Hartmann, & Langner, 1997). Interestingly, the pathways retain tonotopic arrangement (Hartmann et al., 1997; Heid et al., 1997). Retention of tonotopic organization in the central auditory pathways has also been shown in animals which were bilaterally deafened using ototoxic drugs although extensive loss of primary auditory neurons occurs in these cases (Leake, Hradek, & Snyder, 1999; Shepherd, Baxi, & Hardie, 1999).

**Evidence from Children with Cochlear Implants**

Based on the evidence from animal models, children with early onset severe to profound sensorineural hearing loss might have differences in their central auditory pathways compared with normally hearing children which could compromise their ability to hear once auditory input can be introduced. One way to test for these differences is to examine how the naïve auditory pathways in children who are deaf are able to respond to input.

For children with severe to profound deafness, access to a wide range of frequencies can only be provided through a cochlear implant. The implant consists of an array of electrodes which are surgically placed into the scala tympani of the cochlea. Each electrode delivers electrical pulses directed to the spiral ganglion which are housed in the modiolus. Electrical stimulation is used to depolarize primary auditory neurons, a function normally performed by cochlear hair cells. It is hoped that the central auditory pathways are capable of carrying the information provided by the auditory nerve with sufficient accuracy and efficiency to reach the auditory cortex for the perception and recognition of sound.

We have analyzed how the central auditory system first reacts to electrical stimulation from a Nucleus cochlear implant in 50 children with early onset severe to profound sensorineural hearing loss. Most of these children had pre-lingual onset of hearing loss (n=46) and the others had peri-lingual onset (n=4). They ranged in age at the time of implantation from 12 months to 17 years (5.4 ± 4.0 years).

At the time of initial device activation, we presented monopolar electrical pulses at 11 Hz from a basal implant electrode. The nerves stimulated by this electrode normally respond to frequencies above 8 kHz and were therefore unlikely to have received stimulation even from high-powered hearing aids (which do not provide output beyond 3-4 kHz). Evoked potential results showed clear evoked potential responses from the auditory nerve and auditory brainstem in almost all of the children tested. Using the Neural Response Telemetry system, 90% of children had clear electrically evoked compound action potentials of the auditory nerve (ECAPs) and 94% had clear electrically evoked auditory brainstem responses (EABRs). This suggested that, despite auditory deprivation in early childhood, the auditory nerve and brainstem pathways were able to respond in an organized and recognizable way to electrical stimulation. Sharma and colleagues
(Sharma, Dorman, & Spahr, 2002) have reported electrically evoked cortical evoked potential responses in 5 children collected within the first 8 days of implant use. In their group of children at the initial stage of implant use, all 5 showed clear P1 cortical responses evoked by electrical stimulation from the cochlear implant. Studies using Positron Emission Tomography (PET) to image cortical activity in pre- and post-lingually deafened adults, show that electrical stimulation results in activity of the primary auditory cortex (Naito et al., 1997; Okazawa et al., 1996). Together, the results suggest that there are pathways from the auditory nerve to the cortex which form in the absence of significant auditory input. Ponton and Eggermont (2001) agree that the consistent presence of cortical responses in implant users indicates a resiliency of the reticular-activating system pathway. It is likely then that the many connections made along the pathways from the auditory nerve to the auditory cortex in humans develop via intrinsic mechanisms without the need for input.

We further asked if extended periods of deprivation cause changes along the central auditory pathways. To answer this, we assessed the relationship between the age at implantation, which represented the duration of deafness in our cohort of children, and the ECAP and EABR wave latencies and amplitudes. We found that there was no significant relationship; at initial device activation, older children had similar latency and amplitude values as their younger peers (Gordon, Papsin, & Harrison, 2003). Thus, the electrically evoked responses of the auditory nerve and brainstem were not affected by extended periods of auditory deprivation. By the same token, there was no advantage of longer periods of hearing aid use. This means that the formation of the human auditory nerve and brainstem pathways does not require auditory input. The lack of change in responses with long periods of auditory deprivation could be explained in a number of ways. It could be that no changes occur during the period of auditory deprivation or that the changes are too small to be recorded using electrically evoked potentials. Alternately, changes including decreases in neuronal survival could be masked by an increase in neural synchrony known to result from electrical pulse stimulation (Shepherd & Javel, 1997).

**Responses from Thalamo-Cortical Pathways in Children with Cochlear Implants**

We also recorded the electrically evoked middle latency response (EMLR), reflecting activity in the thalamo-cortical pathways, in the same cohort of children while they were awake and watching a video. Unlike the responses from the auditory nerve and brainstem, thalamo-cortical responses were detected in only very few children (35%) (Gordon, Papsin, & Harrison, 2004). This was in sharp contrast to the expectation that normal hearing children, if tested during wakefulness, have clear middle latency activity at any age (Kraus, McGee, & Comperatore, 1989). Poor response detectability in children using cochlear implants suggests that there are insufficient numbers of neurons responding in synchrony in the auditory deprived thalamo-cortical pathways. The significant effects of auditory deprivation found in the thalamo-cortex was in contrast to the lack of effect that we found in initial responses from the more peripheral areas of the auditory nerve and brainstem (Gordon et al., 2003) and the presence of cortical P1 responses at early stages of device use (Sharma, Dorman, & Spahr, 2002).

It may be that the cortical negative peak (N1), like the thalamo-cortical middle latency response, is not detectable in children using cochlear implants (Eggermont & Ponton, 2003; Ponton & Eggermont, 2001). Ponton and Eggermont suggest that the N1 response is normally generated in the superficial layers of the cortex. Because these layers are last to be innervated in normal development (Moore & Guan, 2001) and show deficits in electrically evoked activity in congenitally deaf white cats (Kral et al., 2000), development of the superficial layers of the auditory cortex might be limited by a critical period in development. The superficial cortical layers provide connections with other cortical areas; it is therefore likely that auditory association areas would be negatively affected by limited activity in superficial layers of the auditory cortex. This is supported by studies that use Positron Emission Tomography (PET) to record cortical activity in adults with pre or post-lingual deafness. Although electrical stimulation evokes activity in primary auditory cortex, there are often limitations in activations of association areas (Giraud, Price, Graham, Truy, & Frackowiak, 2001; Nishimura et al., 2000) perhaps due to cross-modal plasticity (Lee et al., 2001).

Further analyses of EMLRs indicated that the electrically evoked thalamo-cortical response was better detected in children implanted at older ages. Detectability in children 5 years of age or older was 47% while EMLR detectability in children implanted under 5 years of age was only 22% (Gordon, Papsin, & Harrison, 2004). This unexpected finding suggested that the thalamo-cortical pathways mature with age even in the absence of auditory input. It is possible that this maturation occurs via intrinsic mechanisms unrelated to input or is directed by non-auditory input. Kraus and McGee suggest that there are two distinct thalamo-cortical pathways, the primary and non-primary, which mature with separate time courses (Kraus & McGee, 1993; Kraus, Smith, & McGee, 1988; McGee & Kraus, 1996). This group has shown that the auditory system at the level of the thalamus receives input from attentional and arousal systems specifically in the non-primary portion of the pathway (McGee, Kraus, Comperatore, & Nicol, 1991). Currently, it is not clear how auditory deprivation impacts the normal relationship between primary, non-primary, attentional, and arousal systems in children with early onset deafness.
Auditory Plasticity after Implantation

Although responses can be evoked in the naïve auditory pathways at the level of the auditory nerve, brainstem and cortex, there is still a question as to what extent the pathways can incorporate and change in response to the input. Moreover, given the poor ability of the thalamo-cortical pathways to respond with initial stimulation, we asked whether it would be possible for the pathways to mature with ongoing cochlear implant use. A number of studies suggest that all levels of the pathway appear to change with consistent implant use with the possible exception of the superficial layers of the auditory cortex (Gordon et al., 2003; Gordon et al., 2004; Ponton et al., 1996; Ponton, Moore, & Eggermont, 1999; Sharma, Dorman, & Spahr, 2002).

In our cohort of 50 children, ECAP and EABR latencies and interwave latencies decreased and amplitudes increased over the first six months to one year of implant use suggesting an increase in neural synchrony (Gordon et al., 2003). We also recorded EABRs and EMLRs in a group of 31 children with pre-lingual onset of severe to profound hearing loss who had used their implants for at least one year (mean of 5.3±2.9 years) and in 11 adult cochlear implant users. This allowed us to assess the time course of the changes in electrically evoked responses. Improvements in neural conduction time in the peripheral portion of the brainstem with duration of cochlear implant use were smaller than the changes which occur during the first 1 to 2 years of life in normal hearing children (Gordon, Papsin, & Harrison, 2004). On the other hand, neural conduction time in the more central portion of the brainstem, appeared to decrease with a similar magnitude and over a similar time course as that occurring in normally hearing children (Gordon, Papsin et al., 2004). These similarities suggest that many normal developmental changes in the central portion of the brainstem require activity; the changes were arrested during the period of auditory deprivation in children who were deaf but were promoted by cochlear implant use. Of course, in children with cochlear implants, these changes took place later in life than in normally hearing children. No significant relationships between the rates of change in interpeak latencies and amplitudes and the age at which children were implanted could be found (Gordon et al., 2003). Thus, the changes in electrically evoked responses of the auditory nerve and brainstem were not clearly affected by a critical period during childhood.

Changes in thalamo-cortical activity were shown by increasing EMLR

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**FIGURE 1**

Acoustically Evoked Potentials in Normal Hearing Adults

- **Cortex**
  - P1
  - N1
  - P2
  - Latency: 60 ms
  - Amplitude: 2.0 uV

- **Thalamus**
  - Na
  - Nb
  - Latency: 10 ms
  - Amplitude: 1.7 V

- **Midbrain Brainstem Auditory Nerve**
  - I
  - II
  - III
  - IV
  - V
  - Latency: 1.8 ms
  - Amplitude: +0.3

**Legend**

- Late Latency Potential [Auditory Cortex]
- Middle Latency Response (MLR) [Auditory Thalamo-cortex]
- Auditory Brainstem Response (ABR) [Auditory Nerve to Midbrain]

*Figure 1-* Typical acoustically evoked potential waveforms from normal hearing adults, each shown in parallel with the level of the auditory system generating the response.
detectability with increased duration of implant use (Gordon, Papsin et al., 2004; Gordon et al., 2004). EMLRs were clearly recorded in 100% of 31 children who had greater than 1 year of implant experience (mean(sd) = 5.3(2.9) years). An improvement in neural synchrony was supported by findings of decreasing latencies and increased amplitudes with increased duration of implant use. Cortical potentials also showed decreasing latencies with implant use (Ponton et al., 1996; Sharma, Dorman, & Spahr, 2002). Interestingly, the initial decrease in the cortical P1 response is similar to the changes occurring in normally hearing children albeit delayed by the period of deprivation. Again this suggests that development of the central auditory system is arrested without significant auditory input but that changes at the level of the auditory cortex can be promoted with implant use. After longer periods of implant use, however, the latency changes of the P1 wave appear more limited (Ponton et al., 1999). This limitation might be linked to the absence of a separate N1 response which normally begins to appear in cortical responses of children aged 9-12 years (Ponton, Eggermont, Khosla, Kwong, & Don, 2002). The N1 response has been recorded in post-lingually deafened adults who use cochlear implants and might be generated in the superficial layers of the auditory cortex (Ponton & Eggermont, 2001). The absence of the N1 in children using cochlear implants remains to be substantiated; however, without this response, the P1 latency might appear not to change after longer durations of implant use (Ponton & Eggermont, 2001; Ponton et al., 1999).

Figure 2 - Typical electrically evoked potentials recorded from children who use cochlear implants. In theory, the electrically evoked responses are generated at similar levels to their acoustically evoked counterparts.
Evoked potential responses of the thalamo-cortical pathways support the later latency response findings. In our studies, there was a rapid increase in EMLR detectability over the first 6 months of implant use in children implanted below the age of 8 years whereas a reduced rate of change was found in children implanted between 8 and 17 years of age (Gordon, Papsin, & Harrison, 2004). It is therefore possible that plasticity in the thalamo-cortical areas is limited by increasing age at implantation and/or duration of deafness.

Defining the specific age at which cochlear implant use promotes limited changes depends on the outcome measured (El-Hakim, Abdolell, Mount, Papsin, & Harrison, 2002). With respect to evoked potential measures, Sharma has suggested that changes in cortical potentials are limited in children implanted at 7 years or older (Sharma, Dorman, Mf, & Spahr, 2002) and Ponton and Eggermont (2003) argue that activity in superficial layers of the cortex may be compromised (as suggested by the absence of the N1 response) even in children who experience as little as 3 years of auditory deprivation before 6 years of age. Indeed, behavioral results suggest that children implanted at 2 years of age or younger achieve better speech perception skills than their older peers and that children implanted at 1 year of age outperform those implanted at 2 years (Mount, Gordon, Papsin, & Harrison, 2004).

Given the evidence regarding central auditory activation and development after cochlear implantation, the behavioral findings of poorer speech perception skills with advancing age at implantation are likely the functional implication of depressed activity in the thalamo-cortical pathways and association areas of the auditory cortex. There appears to be a relationship between these areas in normally hearing children (Moller & Rollins, 2002) but this remains to be clearly defined in both normally hearing adults and children and those who hear through cochlear implants.

New approaches to the study of auditory processing in hearing and deaf individuals include techniques such as positron emission tomography (PET), functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG). When combined with multi-channel electrophysiological techniques, such as those described in this paper, better spatial and temporal resolution of brain activity can be achieved. Studies of normal auditory development and brain plasticity in response to deprivation and stimulation will be enhanced by converging evidence from these various approaches. Future research will continue to elucidate the functional connectivity and interactions between brain regions involved in the processing of rapidly changing stimuli such as speech, and thus guide rehabilitative strategies designed to restore hearing through cochlear implantation and electrical stimulation of the auditory pathways.

Appendix A

Evoked potential recordings of auditory activity allow examination of discrete areas of the auditory system and can be recorded in all children regardless of age. These responses are measured by recording electrodes typically placed at specific locations on the head and are recorded as amplitude peaks occurring at specific times after the onset of stimulation (latency). Acoustically evoked responses have been instrumental tools in assessing normal developmental changes along the human auditory system. The Auditory Brainstem evoked potential Response (ABR), in particular, has been used effectively in the clinic to assess neural conduction along the brainstem and to determine hearing sensitivity in neonates, infants and older children in whom behavioral measures are of questionable reliability. A summary of acoustically evoked potentials and the level of the system at which they are generated is shown in Figure 1. Electrically evoked potential measures may also be important measures of the deaf auditory system. These measures, summarized in Figure 2 in parallel with their theoretical generators, have been successfully recorded in animal models of cochlear implantation and in human cochlear implant recipients.

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Renee Banakis  
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Laura J. Kelly  
Miami University

Author’s Note: The impetus for this article resulted from audience responses to a presentation by Peter Artinian at Miami University in the Spring of 2004. Following his talk, individuals in the audience were heard to make comments like, “After seeing the film I was prepared not to like him, but he is a really nice guy.” We hope that by describing his experiences during and after making the documentary others will also gain a more balanced perspective of the film and of Peter. LK

Introduction

“If you could make a deaf child hear, would you?” (Weisberg, 2000)? The catch-phrase of the PBS documentary Sound and Fury only hints at the complex issues inherent in the cochlear implant debate. The film attempts to provide insight into the decision making process associated with cochlear implantation. Director Josh Aronson recruited Peter and Chris Artinian, brothers with a long history of family-deafness. Peter is prelinguually deaf, and married to a deaf woman named Nita. They have two deaf children, Heather and Tim, and a hard-of-hearing son, C.J. Their family communicates in American Sign Language and the Deaf Culture is an important part of their lives. Peter’s brother Chris has normal hearing, and is married a hearing woman named Mari, whose parents are both deaf and rely on ASL for interpersonal communication. Mari was a competent ASL user. At the time when the film was made, Chris and Mari had a hearing daughter, Emily, and infant twin sons, Christopher and Peter. Baby Chris was born with normal hearing and baby Peter was born deaf. Chris’ and Peter’s parents, Marianne and Peter (senior), are both hearing. The controversy and the film begin when Chris and Mari decide to have baby Peter (the twin) undergo cochlear implant surgery. (Weisberg, 2000)

The surgery raises questions among the family members. Five-year-old Heather Artinian develops a curiosity about the cochlear implant, and the family divides over the decision concerning Heather’s future. Her hearing grandparents, Marianne and Peter (senior), encourage her implantation. Her parents Peter and Nita find themselves in the middle of cultural controversy and a crucial decision – do they implant their daughter and rely on the hearing world to assist in her upbringing, or do they raise her in the familiar Deaf Culture to share in its unique artistic traditions and beautiful language? During the film, Heather is often caught between the wishes of her hearing grandparents and her deaf parents. Arguments become heated as each side fights for what they believe will be best for Heather’s future. By the end of the film Heather’s family decides to move to a large Deaf community in Maryland where their daughter can be raised within the Deaf Culture with the best educational and social opportunities. The young Peter is implanted, and the end of the film features his initial stimulation with the implant and his growing awareness of sound. (Weisberg, 2000)

Editorial Decisions

Many individuals expect that a documentary will provide an unbiased view of a specific issue. According to recent research, the majority of individuals who viewed the film believed it provided an equal representation of both sides of the debate between Deaf Culture and the medical community (Kelly & Banakis, 2004). However, when editing any work, written, audio or video, decisions must be made regarding what will be included in the final version. In the case of Sound and Fury, 188 hours of video footage from a year-and-a-half of filming was edited down to 80 minutes. In addition, scenes were re-shot under Weisberg’s direction. Peter Artinian provides one example. He revealed that one crucial scene had to be filmed in several takes because the camera missed the dialogue, and during the retakes, the director reminded Heather to tell her mother that not getting the implant was her parents’ decision (P. Artinian, personal communication, June 8, 2004). In discussions with students who have watched the film, they often cite that specific scene as proof that the young Heather was coerced into her decision about the implant. (Kelly & Banakis, 2004) It was incidents such as this during filming that added to Peter’s sense of disappointment with the final product. He entered the project hoping to be able to share his family’s experiences as members of the Deaf community. In his opinion, the film featured the hearing perspective on the cochlear implant debate and did not accurately represent Deaf Culture (personal communications, March 18, 2004 and June 8, 2004).

Initially the documentary was intended to focus on a variety of individuals with hearing loss, with different identity choices and varying experiences with their deafness. As the film evolved, the documentary began to focus exclusively on the Artinians (Aronson, 2002). Peter felt that in the editing of the film, important opinions and role models were left out of the final version. Terrylene Sacchetti and Rory Osbrink are two
Deaf individuals who were videotaped for Sound and Fury. Their insightful perspectives added information on the cochlear implant debate and a further understanding of Deaf Culture. The two interviews were cut from the film and can only be found as additional footage on the DVD release. (Weisberg, 2000) Also cut from the movie were interviews with Peter’s boss, who discussed Peter’s performance in the work environment and his ability to communicate with hearing coworkers. (personal communication, June 8, 2004)

Contrasting sharply with the interview with his boss are scenes that were left in the film which seem to suggest communication difficulties between co-workers. It is interesting to note that despite his own admission that he might not be able to go “much further up the corporate ladder” (Weisberg, 2000), Peter recently received a promotion. He cited the wide spread availability of sign video relay systems, and other communication technology as mechanisms for supporting effective communication in the work place (personal communications, September 16, 2004).

Impact on the Family

An unexpected product of the film was the impact created by the public’s response. Some reactions were supportive; individuals shared with Peter and his family that the movie was wonderful and that they appreciated the family’s openness to share their lives. Other reactions were less supportive and even derogatory. To this day some people continue to be rude and insult Peter by calling him selfish because of his opinions regarding cochlear implantation. The stress on family relationships and pressure from the public kept the deaf and hearing members of the Artinian family at odds for an extended period of time. After three years, the families and parents have worked out their differences and have become close again. (P. Artinian, personal communications, June 8, 2004)

Despite proposals to make a follow-up documentary, all members of the extended family declined the offer because of the family issues that arose and invasion of their private lives (P. Artinian, personal communications, March 18, 2004).

Changes Since the Film

Since the release of the film in 2001, much has changed in the Artinian family. Peter’s family has moved back to New York from Maryland. The commute and the distance from extended family weighed heavily on their relationships, and Peter and his wife made the decision to return. Before the film, the extended Artinian family was composed of nine hearing members, two hard-of-hearing members, ten deaf members, and one individual with a cochlear implant. As of March 2002, the family composition had changed to nine hearing, two hard-of-hearing, three deaf, and eight individuals with cochlear implants. Included in the number of individuals with implants are Peter’s son Tim, who has two implants, his wife Nita, and his daughter Heather, whose implantation had been the center of family debate in Sound and Fury (Artinian, 2004). Heather was implanted at the age of nine and she has been very successful with it; she is able to communicate over the telephone and has recently begun writing poetry. Tim, implanted at seven-and-a-half, has experienced some degree of linguistic challenges, but his father explains that this is due to a language delay previous to implantation (Artinian 2004; personal communication, September 16 and 28, 2004). Nita’s experience with the implant has been varied; she struggles to understand speech, is not able to use the telephone and relies heavily on ASL to communicate (P. Artinian, 2004).

Peter has opted not to have the surgery for himself, preferring to keep his strong ties to Deaf Culture and his beloved language.

After his dissatisfaction with Sound and Fury, Peter was reluctant to participate in additional interviews; however, on April 20, 2003, Peter and his family were interviewed for the ABC news program Good Morning, America. He decided to take part in the interview because his mother had agreed to do so, and he felt obligated to represent the cultural position (personal communication, October 1, 2004). The segment featured Heather, Nita and their new cochlear implant. Peter hoped that by participating he and his family would have the chance to represent their culture, but he was again disappointed by the media (personal communication, September 16, 2004). Diane Sawyer focused her questions for Peter on implantation issues, which did not allow him to share his cultural perspective. He was especially let down when he was asked if he would accept corrective surgery if he was blind. In Peter’s opinion, asking him this question demonstrated a lack of understanding about Deaf Culture and lack of sensitivity to the feelings of individuals within the Deaf community (personal communication, October 1, 2004). The remainder of the segment featured the implant and Heather’s success without acknowledging the importance of her strong linguistic skills established in American Sign Language before implantation.

What was Peter’s reaction to the decisions of his family members to receive implants? From his portrayal in the film, one might be predisposed to expect an outburst of anger and emotion. When his daughter approached him several years ago with the intention of asking for a cochlear implant, Peter’s reaction was not what might be expected of the angry man in the film, but rather was what could be expected from a loving father. He supported her decision and has encouraged her along the way to take the steps that she knows to be right for herself. According to Peter, the decision was never his to make. Heather, his wife, and his son made their own decisions for what they thought was right. They are human beings with the right to make that decision for them, and it was never his intention to stand in the way of those decisions. He only wanted to wait until his children were old enough to understand the weight of their decisions.

In recent interviews Peter has expressed mostly sadness about the changing dynamics of the Deaf Culture. It is not and never was his campaign to stand in the way of the
progress of the cochlear implant. He respects the many advances in communication technology and has benefited from them himself. The film Sound and Fury portrayed Peter as a stubborn, close-minded, and angry man, but no picture could be less accurate. Peter shows concern about the decreasing appreciation for Deaf Culture and its linguistic and artistic traditions. He looks forward to the future of the Deaf Culture with a bleak optimism; he believes that the Deaf Culture could be integrated in the education of children with implants, but he has a realistic understanding of the potential impacts of the implant on the preservation of Deaf Culture. In his opinion, the Deaf Culture is something valuable that should be cherished by deaf and hearing individuals alike (P. Artinian, 2004)

The question of whether or not to implant a deaf child is not answered by any single family; the issue is far from the polarized pro-implant/pro-culture debate that the film portrays. The sad truth that Peter expresses is the potential deterioration of a culture that should be valued in our society. The answers to questions concerning implantation are not simple, but professionals must appreciate a deaf child’s cultural roots and work to find methods of providing both the best linguistic and cultural opportunities for every child and family that find themselves in the middle of this complex and emotional debate.

Acknowledgements

The conversations with Peter Artinian were conducted over several sessions in person, by relay, videophone and e-mail. We would like to thank Peter Artinian for the generous gift of his time and willingness to speak openly with us about his experiences during and after the making of Sound and Fury. We would also like to recognize his dedication to his family and Deaf Culture.

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Cochlear Implantation and the Deaf Community

On June 27, 1990, the Food and Drug Administration (FDA) approved the Nucleus 22-channel cochlear implant for use with children as young as two years old (NAD, 1991). The National Association of the Deaf (NAD) reacted strongly to the decision and responded with a position statement that reflected concerns shared by many within the Deaf community. “The NAD deplores the decision of the Food and Drug Administration which was unsound scientifically, procedurally, and ethically” (NAD, 1991). However, as cochlear implant technology has continued to improve the NAD has revisited their position. In October 2000, the NAD Board revised and moderated their statement on implants, focusing on the diversity within the Deaf community and the importance of psychological health of implanted individuals (NAD, 2000). Despite the changes in perspective, many individuals in the hearing world expect members of the Deaf community to react to discussions of implantation with unyielding opposition (Moore, 2003). It is not uncommon for professionals in communication disorders to comment that if individuals who are deaf truly understood what it was like to hear or if they had more information about cochlear implantation they would seek it out for themselves and for their children. In reality, the Deaf community is comprised of individuals with opinions concerning cochlear implants which cover a continuum from civil disagreement to adamant support. The following discussion is an attempt to summarize some of the varied opinions regarding cochlear implantation. The discussion takes the form of a series of individual profiles which present each person’s perspective on cochlear implantation. The examples presented here represent educated informed individuals with a variety of perspectives. By providing a forum for the expression of different opinions it is hoped speech-language pathologists (SLPs) and audiologists will gain a better understanding of and appreciation for the diversity within the Deaf community.

SLPs and audiologists are probably most familiar with the perspective of Deafness as Culture as opposed to disability. The choice to embrace Deafness as part of personal identity is exemplified by two individuals, Mathew Moore and Janice Springford. Matthew Moore, editor of Deaf Life Magazine, acts as a spokesperson for some members of the Deaf Culture in Anita Manning’s “The changing deaf culture” and For Hearing People Only. Moore cites the linguistic and artist creations of the Deaf as unique contributions that transform a disability to a Culture. (Manning, 2002) He has no personal desire to get a cochlear implant, enjoys using the language of sign as his natural language, and does not feel limited by his deafness or use of ASL. (Hewitt, Gose, & Birbeck, 2000).

His perspective is shared by Janice Springford. Janice became deaf at the age of eight. At the age of 15, she was sent by her parents to the House Ear Institute in Los Angeles to investigate cochlear implant technology for herself. She ultimately declined the implant, and has no regrets about the decision. She has since obtained a degree in psychology and teaches at a school for the deaf in Ontario. Springford states, “What is between the ears is a lot more important than what goes into the ears” (Swanson, 1997, p.1).

A number of individuals are opposed to implantation because of personal experience; they have been implanted and have chosen to permanently turn their implants off. Rory Osbrink was a student at Gallaudet in 2002. Although implanted at the age of four, Osbrink had not used the device in five years. He did not believe that his communication skills were improving and relies primarily on American Sign Language. (Manning, 2002). Kristen Shodden received an implant in 1990 at the age of 15. After implantation, she began to meet other deaf individuals and discovered Deaf Culture. Four years after implantation, Shodden stopped using the device. “I accept my differences now that I am aware of the Deaf Culture. My self-esteem has really increased”. (Swanson, 1997, p. 933)

Another faction of the Deaf community supports the exploration of cochlear implants as an assistive technology by adults, but is wary about its use with children for cultural, medical, or linguistic reasons. Donald Moores, editor for American Annals of the Deaf, has expressed reservation about implantation in children, especially those younger than two years of age. He questions the invasive procedure in such young patients in order to correct a condition that is not life threatening. With the recent research suggesting some connection between meningitis and implantation, Moores feels an even greater degree of caution concerning the use of the device with young children. In a personal discussion with one surgeon, Moores was accused of being “one of those educators who are opposed to the development of oral skills in deaf children” (Moores, 2002, p. 3). He explained to the surgeon that he supports the development of all channels of communication, but does not feel the risk of implantation provides
the only means to this end

In For Hearing People Only, Matthew Moore describes a meeting with a deaf woman at a conference in Chicago. She is deaf—but not late-deafened—and at the time when she met Moore, she had recently been implanted. A fluent signer and supporter of Deaf Culture as well as implantation, she seemed like a walking controversy. However, she was opposed to the implantation of children. She expressed her belief that implants should be a choice made by a fully-informed individual, and views the benefits of the cochlear implant in moderation. (Moore & Levitan, 2003)

Carol Padden, a linguist who is deaf, remarks on her concern for implanted children and trends in education. She worries that parents and the hearing world often place high expectations on the implanted deaf child rather than the implant itself. If the child does not experience success with the implant, parents and experts believe the child is not taking full advantage of the technology. For this reason, many implanted deaf children are prohibited from signing and isolated from other deaf children. Padden believes that technologies should add to the quality of lives, not detract from them (Padden, 2001).

Dr. Hartley Bressler is a physician who is deaf, expresses concern for the implantation of children. He is wary of the ability of young children to provide feedback about the device and fears that individuals implanted during infancy may come to regret the decisions of their parents on their behalf. Bressler is also deeply concerned about the self-esteem of deaf children who are implanted. “Deafness is not something that you should make a child feel defective or incomplete...I wonder about the future self-esteem of a child who is aware that she or he has undergone major surgery for a prosthetic device, not to save life but to please parents” (Swanson, 1997, p. 932).

Yet another faction of the Deaf community includes individuals who are implanted and supportive of the use of cochlear implants. They used—and some still continue to use—American Sign Language for communications. Many still feel a connection with the Deaf Culture and consider themselves to be “Deaf.” Joseph Gill became completely deaf at the age of five and believes that his signing abilities have helped him tremendously throughout his life. While he is grateful for his implant, which has allowed him to talk to his mother using a cell phone and to sing, Gill also recognizes the importance of his interpreters in his success and maintains an optimistic outlook for his future. (Farley, 2002).

Svetlana Kouznetsova is a Russian-American woman who became deaf at the age of two as a result of meningitis. She learned to speak and to lip-read both English and Russian to communicate with her family and other hearing individuals and uses sign language to communicate with other deaf individuals. She graduated from Rochester Institute of Technology (RIT) in 2000 and is appreciative of the opportunities provided by interpreters in school as well as in other group situations. Kouznetsova saw the implant as a chance to enrich her life and underwent the surgery in 1998. The implant has allowed her to use the phone and provided her with a greater understanding of the hearing world, but she also recognizes the limitations of the device and realizes that success of the device can depend on a variety of factors. (Farley, 2002).

Halfway through high school, Sharine Rawlinson lost her hearing after surviving spinal meningitis and an extremely high fever. She attended National Technical Institute of the Deaf (NTID), learned American Sign Language, and was able to take full advantage of interpreters and note-takers. In 1997, Rawlinson underwent cochlear implant surgery, wary of the potential complications but eager for the opportunity to once again hear music. She is thrilled with her implant, but realizes that she is still deaf and will continue to use sign language. Despite pressures from individuals desiring an identity label, Rawlinson chooses not to identify herself as “Deaf,” “hard-of-hearing” or “hearing,” but rather avoids conventional labels and relies on self-definition. (Farley, 2002)

Many other individuals who have profound hearing loss do not necessarily consider themselves members of the Deaf Culture and support the use of implants. Bonnie Poitras Tucker works at Arizona State University as a professor of law, and she has written an autobiographical book about her experience with deafness entitled The Feel of Silence (Tucker, 1995). She denies association with the Deaf Culture and views deafness as fitting the definition of a handicap. Individuals who reject the implant for themselves or their children because they do not wish to define themselves as “disabled”, in her opinion, should not expect or demand costly accommodations that are available through the Americans with Disabilities Act. (Tucker, 1997, 1998). Tucker, who is congenitally deaf and was never a hearing aid user, obtained a cochlear implant in her early 50’s. While she would be considered by many professionals to have limited success with the implant, she considers herself successful (Tucker, 1998).

Not every individual born with a hearing loss is able to feel a connection with or find an identity for themselves in the Deaf Culture. Jane Van Ingen was born with a progressive bilateral hearing loss. Although initially wary of the cochlear implant technology, a desire to continue independent life prompted her to investigate the cochlear implant surgery. Van Ingen recognizes the cultural position of many members of the Deaf community, but feels her own happiness is of greater importance. (Van Ingen, 2000)

Judge Richard Brown received his implant in his right ear in 1980; he was only the 69th individual to undergo the surgery. The judge abandoned his implant shortly afterwards. He had completely lost his hearing in his right ear after a bout with measles. His left ear had also been affected, but not to such an extent that he was unable to rely on it for speech discrimination. The loss in Judge Brown’s left ear became progressively worse, and in
1983, he underwent surgery to remove an acoustic neuroma, leaving him completely deaf. After that surgery, Judge Brown returned to his discarded implant, and in 1989 underwent another implant surgery to upgrade from the single-channel implant to the 22-channel model. He is most disappointed by the division within the Deaf community over the cochlear implant. “It seems that if you are deaf, you must either be in the hearing community or in the deaf community. You are either for us or against us”. (Brown & Holmes, 1991, p.16)

Suzanne Robitaille has hoped to find a way to more effectively deal with her deafness since she lost her hearing in childhood as a result of meningitis. She received her implant in 2002 and after an initial adjustment period, Robitaille has experienced improvement in speech abilities and enjoys listening to sounds she had never heard. She can hear more general sounds than before, but still has trouble discriminating speech without relying on lip-reading. Her boss has noted improvements in her enunciation skills within a short period after her surgery. Robitaille recommends implantation for deaf and hard-of-hearing individuals who feel left out because of their hearing loss. (Robitaille, 2002)

A variety of perspectives exist within the Deaf community surrounding the cochlear implant debate; the same variation exists within the larger hearing community. Angela and Edward Peters are hearing parents with six children, the fifth who was born deaf in 1995. Edward retained some signing skills from a class he had taken in college and began signing with his daughter, Margaret, once doctors confirmed her hearing loss. Margaret took to sign and began responding in sign within a matter of days. Although Edward and Angela wish that their daughter could hear, they view the invasive surgery as unnecessary since they do not view her as sick or in need of a cure. The Peters are not opposed to implantation and would support Margaret if she opts for the surgery later in life. Most important for this family is accepting their daughter the way she is; the decision over whether or not to implant will belong to their daughter. (Peters, 2000)

The cochlear implant debate is a complex one—often more multifaceted than the media portrays. The variation of opinion present in this debate is evidence of the importance of approaching individuals with a degree of tolerance and acceptance. It is unfair to assume that participation in a community or identification with a culture automatically implies a specific perspective. Although some deaf individuals are still adamantly opposed to cochlear implantation, many other opinions exist. Professionals must approach deaf individuals with an open mind and a respect for their particular opinion regarding implantation technology. In addition, it is important for SLPs and audiologists to educate themselves regarding all of the education and communication options available to children and adults who are deaf. Professionals should be careful to provide complete information to families and facilitate access to information from a variety of different sources. Finally, they should be open and honest about their own bias both with themselves and with families to ensure decision makers do not misconstrue a personal opinion for a professional recommendation.

**Edited by: Laura W. Kretschmer**

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**REFERENCES:**


RESEARCH FORUM – 
Personality Types At 3 Universities

Michael Fraas, Ph.D. 
University of New Hampshire

Ann M. McConn, MA 
University of Cincinnati

Robert A. Hull, Ph.D. 
Valdosta State University

Ernest M. Weiler, Ph.D. 
David E. Sandman, B.A. 
University of Cincinnati, 
Louise Van Vliet, Ph.D. 
Miami University

ABSTRACT

The authors had a joint interest in the question as to whether different universities shared common Personality Types among Speech-Language Pathology students. To investigate this question, personality profiles from undergraduate and graduate SLP students at three universities were compared. For the 4 pole Jungian system used by both the Myers-Briggs, and Keirsey instruments, Universities 1 & 3 (medium-sized commuter schools) showed ESFJ to be the most common, while University 2 (medium-sized residential) showed ISFJ to be the most common. Except for this difference, it was concluded that many SLP personality types were similar among the universities compared. Because the Introvertive (I) type is more common than Extrovertive (E) among university professors, and because there is reportedly a shortfall in SLP faculty, we recommend there be further studies to investigate whether the I personality type is common in persons who enter PhD programs with intent to become college teachers.

INTRODUCTION

There are several studies on personality data for the Myers-Briggs Type Indicator (MBTI), and the Keirsey Temperament Sorter (KTS), for speech-language pathologists (SLPs). Apparently, extrovertive sensory personalities are more common in this professional group (Briggs & Myers, 1997; Keirsey & Bates, 1984; Keirsey, 1987; Myers & Myers, 1995). The authors of the present study wondered whether the influence of particular university environments might have been overlooked so that the large-scale reports of average personality types for SLP students might have obscured differences in the frequency of types found at different universities. On the other hand, one of our authors (Hull, 1998) had asserted that SLP types were similar from school to school. He suggested that the similarities might mean there was a need to increase diversity, and also to recruit specific personality types who might become Communication Sciences and Disorders (CSD) college instructors. If we expected most SLPs to be extroverted, then this would contrast with the typical college instructor. For instance, the MBTI (Myers & Myers, 1995) has generally found that the majority of college teachers were introvertive, which might mean there is a need to focus on encouraging introvertive students to consider a Ph.D. degree within the SLP environment. The need to search for graduate students whether with an introvertive personality or not, should not be taken lightly. Between 1998 and 2000 the number of unsuccessful searches for CSD Ph.D. faculty doubled (Scott, 2002). Shortages of Ph.D. faculty increased from 2.8% to 5.4% during the same time period (Oller, 2001). A large proportion of existing CSD faculty are over 55 years old, and will need to be replaced with viable doctoral level graduates from the aforementioned shrinking pool in the next decade.

The primary purpose of the present study was to investigate whether prevailing personality types will be similar or different among CSD programs at three universities. The further purpose was to discuss the implications of the results for assuring a desirable diversity of personality types choosing SLP careers, including some whose personality types are not thought to be typical of SLPs.

Review of the Literature

Two widely used instruments for personality typing and occupation choice are the Myers-Briggs Type Indicator (MBTI) by Briggs & Myers (1997); and Keirsey Temperament Sorter (KTS) by Keirsey & Bates (1984). The MBTI is a forced-choice, self-report inventory developed to measure four underlying bi-polar constructs developed by Jung (1923). These constructs include the four Jungian dimensions: 1) extroversion/introversion (E/I); 2) sensing/intuiting (S/I); 3) thinking/feeling (T/F); and 4) judging/perceiving (J/P). The MBTI has been intensively studied (Myers & Myers, 1995), and this research has established that the MBTI is a valid and reliable tool for identifying an individual’s personality type.

Another inventory of personality comparable to that of the MBTI is the Keirsey Temperament Sorter (KTS) (Keirsey & Bates, 1984). The KTS is also based on Jung’s four bi-polar constructs, although users are encouraged to consider additional sub-divisions of the four types (Keirsey & Bates, 1984). Briggs-Myers and McCaulley (1989) gave reliability figures for a number of groups. Student teachers seemed to be the most similar to SLP college students. They indicate reliability figures ranging from Phi = 0.67 to 0.78 and Tetrachoric r Coefficients ranging from 0.83 to 0.92. Notice that the Tetrachoric r-values are consistently higher than Phi. Hull (1998) found that 84% of his group either agreed on the 4-pole personality profile or differed by only 1 pole. This would be comparable to an overall Pearson
Feeling and Judging/Perceiving of Extroversion/Introversion (E/I), revealed significant differences across field of study. Chi-square analyses existed between the students in each finite differences in personality profiles therapy. They determined that defini-
cian’s assistant, and occupational pharmacy, physical therapy, physi-
types among students enrolled in the MBTI to examine personality
jects (Bowles, Ursin, & Picano, 2000). Reduced levels of stress among sub-
occupation results in significantly match between personality type and
version” together significantly pre-
dimensions of “sensing” and “extro-
reliability limits of the two tests which then limits the maximum cross -correlation.
ment was 90 at the junior/senior level, the MBTI. There was one significant differ-
ences in personality profiles of undergraduate and graduate students in SLP programs from two markedly diverse Southwestern Ohio universities and one university in Georgia. The three studies were not planned together, but took place independently during a time when the authors were sharing their common interests.
METHODS
The participants were selected from three state supported university pro-
gress in CSD. All schools had two-
career in CSD. All schools had two-
ments related to career devel-
personality test related to career development, the Berufsbilder-Test, along
slightly different instruments were measuring similar concepts. From these studies, it appeared that the primary limit on the cross-correlations comes from the reliability limits of the two tests which then limits the maximum cross-covariance.

It seems appropriate to mention some studies supporting consideration of personality types relation to occupational choice. Christiansen, Backman, Little & Nguyen (1999) found that the MBTI was helpful at identifying significant attributes for meaningful occupations. The MBTI dimensions of “sensing” and “extroversion” together significantly predicted self-reports of well being (satisfaction). In a study to determine stress levels in airline pilots, investigators determined that an appropriate match between personality type and occupation results in significantly reduced levels of stress among subjects (Bowles, Ursin, & Picano, 2000).

Hardigan and Cohen (1998) used the MBTI to examine personality types among students enrolled in programs of osteopathic medicine, pharmacy, physical therapy, physician’s assistant, and occupational therapy. They determined that definite differences in personality profiles existed between the students in each field of study. Chi-square analyses revealed significant differences across the four Jungian bi-polar dimensions of Extroversion/Introversion (E/I), Sensing/Intuition (S/N), Thinking/Feeling and Judging/Perceiving (J/P). For example, those planning to work in osteopathic medicine, or as physician’s assistants, typically showed ESTJ (Extrovertive, Sensing, Thinking and Judging) profiles. Physical and occupational therapists had a typical ESFJ (Extrovertive, Sensing, Feeling and Judging) profile, while Pharmacists exhibited the ISTJ (Introvertive, Sensing, Thinking and Judging) profile.

Studies of Personality and SLPs
Although studies of personality typing in speech-language pathology are limited in number, some studies have identified similar characteristics among individuals establishing themselves in the profession. Pierart, Leclercq, and Vandeveldt (1994) evaluated the psychological profile of 11 SLPs, using a personality test related to career development, the Berufsbilder-Test, along with other measurements. They concluded that a “willingness to rehabilitate”, a “need to be expressive”, and a “rejection of aggressive factors” were common trends between these SLP’s.

MacDaid, McCaulley, and Kainz (1986) used the MBTI to assess common personality trends among SLPs. They found E (extrovertive) and S (sensing) personality types most often. They described SLPs as tending to be sociable, popular and interested in the things that directly affect the lives of others.

These studies have given some insight into trends in personality profiles among working SLPs. However, research has not compared students from individual colleges or universities with regard to possible differences in the personalities of those preparing for a career in CSD.

Craig and Sleight (1989) compared both speech-language pathology students and audiology students on the MBTI. There was one significant difference noted. Almost all undergraduate students who went on to study Audiology in graduate school were classified as introverted, intuitive, perceiving and thinking, according to the classification systems of the MBTI. Those undergraduates who became graduate speech-language pathology majors more often fell with-
in the extroverted, intuitive, feeling, and judgmental type on the Myers-Briggs, but many showed other personality types, including those found in many Audiology students.

The present research compares previously unpublished data on personality profiles of undergraduate and graduate students in SLP programs from two markedly diverse Southwestern Ohio universities and one university in Georgia. The three studies were not planned together, but took place independently during a time when the authors were sharing their common interests.

University 1 Participants
Two groups of students at this University took part in the study. The first group included 22 female undergraduates majoring in CSD, ages 19 -34, with a mean of 22 years. The second group was comprised of 24 masters level CSD students (21 females, 3 males) ages 21-36 with a mean age of 23 years. Both groups were assessed using the Keirsey Temperament Sorter (KTS). (see McConn, 1998).

University 2 Participants
The subjects for this study included 116 undergraduate CSD students (113
female, 3 male) ages 19-37 with a mean age of 20 years. All of these were administered the Myers-Briggs Type Indicator (MBTI). (See Van Vliet, 1999).

University 3 Participants
This study included 60 female masters level graduate students in CSD (Hull, 1998) ages 21-47 with a mean age of 26 years. All completed both the KTS and MBTI.

Materials
As indicated previously, both the Keirsey Temperament Sorter (KTS) and the Myers-Briggs Type Indicator (MBTI) were used to assess personality types. Previous studies of reliability and validity made it seem reasonable to assume they were equivalent. At the time the present paper was conceived, the data at Universities 2 and 3 had already been gathered in a spirit of mutual cooperation. The KTS is easier to obtain (either from the published text or over the internet) and does not require the expense associated with the MBTI (Quinn, Lewis, & Fischer, 1992; Hull, 1998).

Procedures

Keirsey Temperament Sorter (KTS):
The KTS consists of 70 open-ended statements, potentially about the respondent, to which participants must select one of two choices (agree or disagree) for competition. Participants were given verbal instructions to insure that they knew how to complete the KTS. Personality profiles were extracted from the subject’s responses in accordance with the scoring procedure outlined by Keirsey and Bates (1984). If the data led to a tie between two poles (such as Introvert vs. Extrovert), then the poles were alternately assigned to successive subjects showing such a tie.

Myers-Briggs Type Indicator (MBTI):
Administration of the MBTI is similar to that of the KTS. Participants were given verbal instruction as to how to complete the instrument. They answered 126 questions by selecting the response that represents the way they often feel or act in each situation. Upon completion, responses were scored and the results were used to determine a specific personality type (Briggs & Myers, 1997).

RESULTS

University 1-Undergraduate vs. graduate student results
Undergraduates
The undergraduate student population showed 8 of the 16 possible personality types on the KTS. The two most frequent types, ESFJ (Extrovert, Sensing, Feeling, and Judging) and the ENFJ (Extrovert, Intuitive, Feeling, and Judging), represented 46% of the undergraduates participating. ENFP (Extrovert, Intuitive, Feeling and Perceiving) was the third most common type and represented 18%.

### TABLE 1

<table>
<thead>
<tr>
<th>POLE</th>
<th>COUNT UG/G*</th>
<th>% UG/G</th>
<th>CHI-SQUARE</th>
<th>p VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extrovert</td>
<td>16/19</td>
<td>73/79</td>
<td>0.262</td>
<td>&gt;.05 ns</td>
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<tr>
<td>Sensing</td>
<td>11/13</td>
<td>50/54</td>
<td>0.801</td>
<td>&gt;.05 ns</td>
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<td>Feeling</td>
<td>19/1</td>
<td>86/75</td>
<td>0.941</td>
<td>&gt;.05 ns</td>
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<tr>
<td>Judging</td>
<td>18/19</td>
<td>82/79</td>
<td>0.051</td>
<td>&gt;.05 ns</td>
</tr>
</tbody>
</table>

*UG= Undergraduate students at University 1
G= Graduate students at University 1

### TABLE 2

<table>
<thead>
<tr>
<th>POLE</th>
<th>COUNT U1/U3</th>
<th>% U1/U3</th>
<th>CHI-SQUARE</th>
<th>p VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extrovert</td>
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<td>79/68</td>
<td>0.98</td>
<td>&gt;.05 ns</td>
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<tr>
<td>Sensing</td>
<td>13/33</td>
<td>54/55</td>
<td>0.005</td>
<td>&gt;.05 ns</td>
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<tr>
<td>Feeling</td>
<td>18/48</td>
<td>75/80</td>
<td>0.258</td>
<td>&gt;.05 ns</td>
</tr>
<tr>
<td>Judging</td>
<td>19/47</td>
<td>79/78</td>
<td>0.011</td>
<td>&gt;.05 ns</td>
</tr>
</tbody>
</table>

*1= Graduate students at University 1
2 = Graduate students at University 3
Graduates

The graduate students exhibited 9 of the 16 profiles. As with the undergraduate students, the two most frequently represented profiles were ESFJ (Extrovert, Sensing, Feeling, and Judging) and the ENFJ (Extrovert, Intuitive, Feeling, and Judging) that represented 42% of the graduate students. Similarly, ENFP (Extrovert, Intuitive, Feeling and Perceiving) was the third most common type, among graduate students, representing 17%. Chi Square analyses found no statistically differences between response of the undergraduate and graduate students on any of the four bi-polar dimensions: E/I, S/N, F/T, or J/P.

University 1 vs. University 3;
Comparisons between graduate students

The graduate students at University 3 (Hull, 1998) exhibited 14 of the 16 personality profiles. As with graduate and undergraduate students at the University 1, the most common profiles were ESFJ (Extrovert, Sensing, Feeling, and Judging) and the ENFJ (Extrovert, Intuitive, Feeling, and Judging) that represented 46.65% of the graduate students at University 3. Similarly, ENFP (Extrovert, Intuitive, Feeling and Perceiving) was the third most common, and represented 10%. Chi Square analyses revealed no significant differences in the frequency of personality types at the University 1 and 3.

University 1 vs. University 2;
Comparisons between undergraduate students

Using the MBTI, 15 of the 16 personality profiles were represented by the undergraduates at University 2. The three most common types were ISFJ (Introvertive, Sensing, Feeling and Judging) at 21%, followed by ESFJ (Extrovertive, Sensing, Feeling, and Judging) at 13%, and ENFP (Extrovertive, Intuitive, Feeling, and Perceiving) at 9%. This appears to differ in style from University 1 and 3 where ESFJ (Extrovert, Sensing, Feeling, and Judging) was most frequent, the ENFJ (Extrovert, Intuitive, Feeling, and Judging) was next, and third most frequent was ENFP (Extrovertive, Intuitive, Feeling, and Perceiving). Chi Square comparisons of the four bi-polar personality dimensions revealed Judging vs. Perceiving (Insert Table 3) as the only significant difference (Chi Square = 4.250, df = 1, p < .05) between the undergraduates at University 1 and University 2. University 1 had 82% Judging (18% Perceiving), while University 2 was nearer to equal with 59% Judging (41% Perceiving). For future studies with larger samples, one might wish to consider certain non-significant trends. For instance, University 1 had a greater preponderance of Extrovertive respondents with 73% vs. 54% for University 2, also in the Midwest. Furthermore, another trend can be seen with Sensing vs. Intuitive, where University 1 had 50% Sensing (50% Intuitive) and University 2 had 66% Sensing (34% Intuitive). A larger sample might reveal whether University 1 (commuter school) attracts different personalities than University 2 (traditional and residential).

Discussion

At Universities 1 & 3, in Ohio and Georgia, for both undergraduates and graduate students, the two most frequent profiles were ESFJ (Extrovert, Sensing, Feeling, and Judging) and ENFJ (Extrovert, Intuitive, Feeling, and Judging). The ENFP (Extrovert, Intuitive, Feeling and Perceiving) was the third most common type. Thus the 4 pole profiles were consistent across these two schools, and agreed with previous literature. For University 2, the three most common types were ISFJ (Introvertive, Sensing, Feeling and Judging), followed by ESFJ (Extrovertive, Sensing, Feeling, and Judging), and ENFP (Extrovertive, Intuitive, Feeling, and Perceiving). The most common profile differed from Universities 1 and 3, but the next most common (ESFJ (Extrovert, Sensing, Feeling, and Judging)) was the same as the most frequent types at Universities 1 & 2. For single poles, University 2 had significantly fewer “Judging” types than University 1. This significant difference between undergraduates at University 1 and 2 (and the two suggestive disparities in Extroversion, and Sensing/Intuitive), and the difference in the most frequent 4-pole profile, might offer some basis in the differences between the two schools. University 2 is primarily a traditional Liberal Arts school with most students residing on campus; while University 1 (and for that matter the similar University 3) is a non-residential commuter school with a large proportion of students living in their home communities. It can be argued that the relatively small number of University 1 under-

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**TABLE 3**

<table>
<thead>
<tr>
<th>POLE</th>
<th>COUNT U1/U2*</th>
<th>% U1/U2</th>
<th>CHI-SQUARE</th>
<th>p Value</th>
</tr>
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<td>73/54</td>
<td>2.550</td>
<td>&gt;0.05 ns</td>
</tr>
<tr>
<td>Sensing</td>
<td>11/77</td>
<td>50/66</td>
<td>2.140</td>
<td>&gt;0.05 ns</td>
</tr>
<tr>
<td>Feeling</td>
<td>19/101</td>
<td>86/87</td>
<td>0.008</td>
<td>&gt;0.05 ns</td>
</tr>
<tr>
<td>Judging</td>
<td>18/68</td>
<td>82/59</td>
<td>4.250</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

1= undergraduates at University 1
2= undergraduates at University 2
graduates available as compared to University 2 (22 vs. 116) may have obscured some significant differences. Further research with larger numbers would improve the accuracy of the single pole comparisons between universities, and make it more feasible to test the significance of the most common of the 4 pole patterns.

Implications for CSD and future research
We conclude that it would be of value to give the MBTI (Myers-Briggs) or KTS (Keirsey) to undergraduate and graduate students in CSD to aid in recruiting and advising. It was found that the majority of SLP students, both graduate and undergraduate, were Extroverted, as previous research had suggested. Even though the ISFJ profile was the most common type at University 2, 54% of the individual students rated themselves as Extroverts. This is in contrast to the majority of Introverts reported among college professors. Assuming that the disparity of Extroverts and Introverts can be verified for CSD, future investigations might consider making the area of college teaching more attractive to Introverts. Investigations could consider whether the Clinical Faculty is more similar to the typical students, and the Academic Faculty less so.

REFERENCES:


List of Tables

Table 1 – Chi-Square results comparing undergraduates (UG) and graduates (G) at University 1
Table 2 – Chi-Square results between Graduate students at University 1 and University 3.
Table 3 – Chi-Square results for graduate students at University 1 and University 2.
RESEARCH FORUM –
Effect of Language Sample Size on MLUw

Kent Brorson
University of Minnesota-Duluth
Corinna Dewey
Munson Medical Center

Abstract
Mean length utterance (MLU) is a widely used measure of a child’s developing language. Although 50 to 100 utterances have traditionally been used to calculate MLU, the literature does not provide consistent support for using 50 to 100 utterances to calculate this measure. The purpose of this study is to determine if differences exist between MLU scores calculated from different sample sizes. This study concluded that MLU scores could be calculated from as few as 10 utterances from the middle of a complete language sample obtained with typically developing children ages 24 to 48 months. Implications of this finding are discussed in terms of current child language screening/assessment and research practices.

Language Development
During the early twentieth century, research on child language development sought to identify and describe predictable developmental patterns and regularities in the language of typically developing child. As early as the 1920s, Nice (1925) pointed out that assessment of sentence structure and data on the emergence of complex and compound sentences, as well as negation and other aspects of speech would “enable us to know many things as to his progress in this distinctly human achievement” (p. 370). In order to describe the process of speech development, Nice proposed dividing “the child’s linguistic journey” (p. 370) into four stages: (1) single words, (2) early sentences, (3) the short sentence and (4) the complete sentence. The average number of words a child used in each sentence described each stage. This measure was called “mean length of response” (MLR).

Since the introduction of MLR, various measures of utterance length have been identified. MLR measured utterance length by counting the number of words per utterance. This measure is also referred to as “mean length of utterance in words” (MLUw). Other measures of utterance length exist as well. Mean length of utterance in morphemes (MLUm) is calculated by counting the number morphemes per utterance. These measures are all used to show increased utterance length that occurs as a child’s language develops.

When Nice (1925) first introduced MLR, she provided guidelines for calculating this score. Nice recommended using 30 to 100 utterances, depending on the purpose of the collection. She did not provide any explanation for this recommendation, other than to say that this range of utterances “ought to show clearly a child’s stage of speech development…” (p. 378). McCarthy (1930) used 50 utterances to calculate MLR scores because “it would give a fairly representative sample of the child’s stage of linguistic development in a relatively short period of time” (p. 32). Since the early years of our profession, the recommendation of researchers such as Nice and McCarthy to use 30 to 100 utterances to calculate MLR became the standard practice. This practice continued with the emergence of the use of MLU. The available literature that examined the number of utterances needed to calculate MLU has also been limited and somewhat dated. Although the literature is dated, most researchers and professionals have continued to recommend using between 50 and 100 utterances to calculate MLU (Brown, 1973; Nice, 1925; Miller, 1981; Miller & Chapman, 1981; McCarthy, 1930; Templin, 1957; Paul, 2001; Retherford, 2000). Most researchers and scholars refer to a best practice perspective for recommending 50 to 100 utterances, but there is little empirical evidence to support this practice. Studies (Casby, 1984; Darly & Moll, 1960; Minifie, Darley & Sherman, 1963; and Riordan, 1982) that questioned whether MLUm/w measures could be calculated from fewer utterances have conflicting results.

Language Assessment Using Language Sample Analysis
The goals of a language assessment, whether a speech - language pathologist (SLP) is attempting to arrive at a diagnosis or evaluate treatment progress, are to identify and describe the unique and complex patterns of communication behaviors exhibited by a child (Owens, 2004). Language can be assessed using formal measures such as standardized tests. However, standardized tests leave a gap in understanding the child’s comprehensive linguistic system as it is put to use in communicative interaction (Kemp & Klee, 1997). Descriptive approaches to language assessment are used to fill this gap, because they highlight the individualistic nature of the child’s communication functioning. Many researchers agree that language assessment is not complete until some type of descriptive approach is employed (Hux, Morris-Frieh & Sanger, 1993; Klee, 1992; Lund & Duchan, 1993). The descriptive approach to language assessment is usually based on a language sample collected while the child is communicating in natural or quasi-natural circumstances (Klee,
Language samples can reveal information about the content (semantics), function (pragmatics) and form (syntax, morphology, phonology) of a child’s language as it is used in various naturalistic circumstances. Many researchers describe the collection and analysis of a language sample as one of the best, and most standard, means of gathering informative and ecologically valid data on these aspects of a child’s language (Dollaghan, Campbell, & Tomlin, 1990; Kramer, James & Saxman, 1979; Paul, 2001).

### Uses of Language Sample Analyses

Language samples are collected and analyzed for both clinical and research purposes. Clinicians use language samples to aid in the diagnostic process, to help select appropriate treatment goals, and to evaluate a child’s progress during and after treatment. Kemp and Klee (1997) surveyed 253 speech language pathologists in the United States about their clinical language sampling practices. The results found that 85% of the clinicians surveyed collected an average of 25 language samples per year as part of the diagnostic, intervention and post intervention processes. Hux, Morris-Friehe & Sanger (1993) reported that of 239 school based SLP’s, 80% used language samples to supplement standardized procedures, 77% used language samples to assist in program planning, 62% used language samples to document treatment effectiveness and 54% used language samples to evaluate program effectiveness. The collection and analysis of a language sample is a valuable tool used by clinicians to understand a child’s language development during both assessment and intervention.

Language samples are also used for research purposes. Currently, researchers collect language samples to study five aspects of language: phonology, morphology, syntax, semantics, and pragmatics. Klee (1992) observed that the collection and analysis of a conversational language sample “is a descriptive tool that arguably has had the greatest single impact on the study of children’s language acquisition of any data-gathering technique” (p. 315).

One measure of language ability frequently employed in the analysis of a language sample is MLU. The MLU score obtained in the analysis of a child’s language is one piece of a much larger puzzle that provides information about a child’s current level of language functioning. The measure of MLU, whether it is in words or morphemes, must also be suited for the individual needs of the child being evaluated. The same individual decision making process is used for MLUm or MLUw when developing and conducting research that involves some level of analysis in syntactic complexity.

### The Relationship Between MLU in Words and MLU in Morphemes.

After the language sample has been collected and transcribed, the clinician must decide what type of analysis to conduct. One quantitative measure that is well suited and traditionally used for the purpose of language analysis is mean length of utterance in morphemes (MLUm). From a historical perspective, researchers such as Nice (1920), McCarthy (1930) and Templin (1957) described utterance length in terms of the MLUw – the average number of words per utterance. MLU can also be calculated in terms of the average number of morphemes per utterance (MLUm). Brown (1973) was one of the first researchers to advocate the calculation of MLU to show changes in a child’s grammatical development.

The MLUm is currently the accepted measure of utterance length in children under the age of 48 months, as opposed to the mean length of utterance in word (MLUw). Researchers have suggested that MLUm is one measure which can help the clinician or researcher quantify the entire language sample, providing a broad view of the child’s performance and aiding in the identification of specific aspects of language that require subsequent detailed analysis (Miller, 1981; Miller & Chapman, 1981). In fact, a survey conducted in 1993 identified MLU as the most common piece of information speech-language pathologists initially gathered from language sample analysis (Hux, Morris-Friehe & Sanger, 1993).

The first step in calculating MLU is to decide whether utterances will be measured in word units or morpheme units. Several studies have been conducted to better understand the relationship between MLUw and MLUm. These studies were conducted to determine if any statistical difference could be found between children’s MLUw scores when calculated based on the counting of words per utterance versus morphemes per utterance. Several researchers (Aguado, 1988; Hickey, 1981; Malakoff, 1999; Thordardottir, Weismer & Ellis, 1998) were able to show a strong relationship between MLUw and MLUm in children between the ages of 24 and 48 months. Malakoff (1999) compared MLUw and MLUm scores of 24-month-old African American children with low socioeconomic status. She found a high correlation (.97) between the two measures of utterance length. Studies of correlation between MLUw and MLUm of children speaking non-English languages also report similar results (Aguado, 1988; Hickey, 1981; Thordardottir, Weismer & Ellis, 1998). Strong correlations between the two measures were found for 15-36 month old Icelandic children (Thordardottir, Weismer & Ellis, 1998). A correlation of .99 was found between the two measures for Irish-speaking children ages 23-36 months (Hickey, 1981) and for Spanish speaking children 30 months of age (Aguado, 1988). The high correlation between MLUm and MLUw has been found in many languages, including English. Based on these research findings, the diverse cultural makeup of the research, and
an attempt to decrease the number of confounding variables in the analysis of utterance length, the current researchers chose to calculate MLUw as opposed to MLUm.

**Language Sample Size**

Owens (2004) observed that good language samples do not just occur; they are a result of careful planning and execution. A variety of variables such as setting, conversational partners, activities, and the length of the language sample must be carefully considered and planned by the clinician or researcher.

Many researchers have concluded that there is no ideal length for a language sample; the length of a language sample depends on the purpose of collection (Bloom & Lahey, 1978; Lee, 1974; Owens, 2001; Owens, 2004). Miller (1981) identified two options for determining the length of the language sample. The first option is to specify a number of utterances to be collected (such as 50, 100 or 200). The second option, preferred by Miller because of its flexibility, is to record the interaction for a specific amount of time. Miller suggested using a 30-minute session, during which an average of 100 utterances can be collected for a 24 month old child. Children less than 24 months of age will typically produce 30 to 60 utterances in a 30-minute period. Cole, Mills, and Dale (1989) found that an analysis of 50 utterances contained 73% to 83% of the lexical information found in a language sample containing a total of 100 utterances. They concluded that transcribing 50 to 100 utterances would provide an adequate representativeness, providing there is a variety of settings, partners, and tasks, and that at least 2 samples are taken. In general, the literature recommends collecting and transcribing a language sample of 50 to 100 utterances (Lahey, 1988; Miller, 1981; Miller & Chapman, 2000; Nelson, 1991; Paul, 2001; Retherford, 2000). All researchers’ recommendations for number of utterances collected for analysis are based on the assumption that the language transcripts are analyzed for all or most aspects of language (morphology, phonology, syntax, semantics, and pragmatics). This investigation is looking exclusively at the calculation of MLUw. The evidence suggests that a comprehensive and representative language sample must be gathered to ensure successful analysis of all aspects of language. However, the question still remains, “Can less than 50, 100, or more utterances be used in the calculation of MLUw/w?”

**MLU, Age, and Grammatical Complexity**

Mean length of utterance has also been closely scrutinized during the past several decades in terms of its relationship to age and grammatical complexity. The literature (Davis, 1937; Klee, Schaffer, May, Membrino and Mougey, 1989; McCarthy, 1930; Miller & Chapman, 1981; Nice, 1925; Rondal, Ghiotto, Bredart &Bachelet, 1987; Templin, 1957) provides strong, consistent support for the existence of a relationship between increases in age and increases in MLU. Research shows that increases in MLU scores are correlated with increases in age until the age of approximately 48 months and with overall grammatical use until the child reaches an MLU score of 3.5-4.5. However, researchers have indicated that because this correlating data does not come from a large sample of children, or a sample representative of the population of typically developing children, caution should be used when interpreting MLU by correlating it to age (Miller & Chapman, 1981; Lahey, 1994). The ability of MLU to predict grammatical complexity generally decreases as the child develops linguistically because the child obtains more grammatical forms that may only be elicited in certain situations. Therefore, the most valuable information on MLU/w, age, and grammatical complexity is in children with an MLU below 4.5 with a corresponding age score of approximately 48 months (Brown, 1973). Based on these assumptions, the data reviewed in this investigation focused

<table>
<thead>
<tr>
<th>TABLE 1</th>
</tr>
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<tbody>
<tr>
<td><strong>The Three Components of CHILDES</strong></td>
</tr>
<tr>
<td><strong>3 Components</strong></td>
</tr>
<tr>
<td><strong>The Database</strong></td>
</tr>
<tr>
<td><strong>CHAT − Codes for Human Analysis of Transcripts</strong></td>
</tr>
<tr>
<td><strong>CLAN − Computerized Language</strong></td>
</tr>
</tbody>
</table>
on children between the ages of 24 and 48 months to determine how many utterances in a language sample need to be used to accurately calculate an MLU score.

The purpose of the present study was to examine a large quantity of language samples collected from typical children, divided into four age groups, to answer the question: Do MLUw scores vary as a function of the number of utterances analyzed? If so, then the number of utterances used to calculate MLUw does affect the MLUw score, and significant statistical differences will exist between MLUw scores calculated from varying numbers of utterances.

**Methods**

Use of an internet database system known as the The Child Language Data Exchange System (CHILDES) (MacWhinney, 2000) facilitated the collection and analysis of the 402 language transcripts included in this study. The CHILDES is made up of three components; (1) the database of language transcripts, (2) Codes for Human Analysis of Transcripts (CHAT) and (3) Computerized Language Analysis (CLAN). The first component, the database, contains a large collection of language transcripts. These transcripts are available for public inspection, and researchers are free to contribute new language samples to this database at any time, providing they have followed some

<table>
<thead>
<tr>
<th>Researcher</th>
<th>Number of transcripts included in study</th>
<th>Number of different children included in study</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. Brown</td>
<td>112</td>
<td>3</td>
</tr>
<tr>
<td>P. Suppes</td>
<td>48</td>
<td>1</td>
</tr>
<tr>
<td>E. Clark</td>
<td>46</td>
<td>1</td>
</tr>
<tr>
<td>Valian</td>
<td>34</td>
<td>20</td>
</tr>
<tr>
<td>J. Gleason</td>
<td>28</td>
<td>13</td>
</tr>
<tr>
<td>C. Snow</td>
<td>26</td>
<td>1</td>
</tr>
<tr>
<td>M. Demetras</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>Sachs</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Fletcher</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>L. Bloom</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>VanKleeck</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>Higginson</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>S. Kuczaj</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Snow, C. &amp; Pan, B.</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Warren-Leubacker</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Haggerty</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>402</strong></td>
<td><strong>69</strong></td>
</tr>
</tbody>
</table>

1 Note. This table shows the number of transcripts selected from various researchers, and the number of different children from which the transcripts were taken. Studies conducted by these researchers are cited in the bibliography, in accordance with CHILDES protocol.
guidelines. The second component of CHILDES is the CHAT. Researchers are asked to transcribe their language samples according to a specific protocol. The language sample analysis program (CLAN) is the third component of CHILDES. This program is designed to enable the researcher to analyze any language sample transcribed in CHAT format. Table 1 provides a brief description of each component, and the goal that each component was developed to facilitate.

The CHILDES database contains hundreds of language samples collected from many different children and adults donated from over 40 different groups of researchers. Currently, the database includes transcripts from children with normal and disordered language, adults with language disorders, and bilingual or non-English transcripts.

**Description of Language Transcripts Included in this Investigation**

Language transcripts used in this study were acquired from the normal language “English Corpora” of the CHILDES database. A total of 402 language transcripts of normal developing 24-48 month old children collected from 69 children, by 16 different researchers, are included in this study. The number of transcripts contributed and the number of children used to collect language samples from each researcher are listed in Table 2. As can be seen, the number of transcripts contributed from each researcher ranged from 112 (Roger Brown) to 1 (Haggerty). Valian’s transcripts were taken from the largest number of children (20) and other researchers submitted multiple transcripts taken from one child. For example, Sachs submitted 20 transcripts collected from one child.

Children (49% female, 51% male) who transcripts were used ranges in age from 24 to 48 months, with a mean of 33.3 months. Language transcripts were collected from children in 7 geographic locations in the United States and the United Kingdom. Of

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### Table 1: Demographic Characteristics of Language Samples

<table>
<thead>
<tr>
<th>Socioeconomic Status</th>
<th>Ethnicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle-Upper Class</td>
<td>African-American 11%</td>
</tr>
<tr>
<td>Middle Class</td>
<td>Caucasian 11%</td>
</tr>
<tr>
<td></td>
<td>Unknown 78%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Geographic Location of Language Sample Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>California 34%</td>
</tr>
<tr>
<td>New York 11%</td>
</tr>
<tr>
<td>Massachusetts 43%</td>
</tr>
<tr>
<td>United Kingdom 4%</td>
</tr>
<tr>
<td>Texas 3%</td>
</tr>
<tr>
<td>Other* 2%</td>
</tr>
</tbody>
</table>

Note: * Other geographic location includes Georgia and Indiana.
these, the majority came from Massachusetts and California. Thirty four percent of the transcripts used had no report of the geographic location in which they were taken. Fifty one percent of the transcripts did not provide information regarding the socioeconomic status of the children. The remaining 49% of the transcripts were taken from children described as middle to middle-upper class. Eleven percent of the transcripts were taken from African American children, 11% from Caucasian children and 78% from children whose ethnicity was not identified. Figure 1 summarizes the demographic data available for the 402 language transcripts included in this study. The diversity of the language samples further supports the validity of using these data to calculate MLUw.

Each transcript in this study contains a minimum of 200 utterances, with an average total of 478 utterances (sd=346). Language samples were taken in the child’s home (46%), in a clinic (16%), and at school or daycare (4%). Thirty four percent of the transcripts in this study did not report the location where the language sample was collected. The activities used to elicit language samples were specifically stated in only 37% of the transcripts. These activities included free play, retelling of stories, looking at books, meals and activities of daily living. Participants included mothers, fathers, siblings, other children, other adults and the investigator in various combinations. Each transcript was collected with an average of 2.4 participants (sd=1.4), not including the child. Figure 2 summarizes the activities, setting and participants during the language samples that were analyzed in this study.

**Limitations of the Language Sample Transcripts**

Despite the large number of language transcripts included in this investigation, several limitations of the language sample pool should be taken into consideration. First, the
The vast majority of these language samples were gathered from children in the 1970s. Since that time, significant changes in the demographic, cultural, and communication topics have occurred in the United States. These changes are not represented in this investigation. Second, the data failed to identify over 50% of the children’s socioeconomic status and over 75% of the children’s ethnicity. Given the impact that socioeconomic status can have on the development of language skills in children (Hart & Risley, 1995), and the language differences that exist from one ethnic group to another, generalizations about the results from these language samples should be viewed with caution.

**Experimental Design and Statistical Analysis**

This study had a complex, quasi-experimental, 4X(7 XS) repeated measures factorial design consisting of four age groups between subjects and 7 measures of MLUw within subjects. The primary independent variable was the number of utterances used to calculate MLUw for each transcript. Seven different MLUw scores were calculated from 7 different utterance sizes: 10 utterances, 25 utterances, 50 utterances, 100 utterances, 150 utterances, 200 utterances, and the total number of utterances within each transcript. Utterances were selected from the middle of the sample because this is the point when the child has “warmed up” to the investigator, but has not yet fatigued from interaction. The middle of the sample was found using this equation: \( m = (n/2) \pm (k/2) \), where \( m \) = middle utterances in the sample, \( n \) = total sample size, and \( k \) = the number of utterances to be analyzed. For example, to find the middle 50 utterances in a sample of 200 total utterances, the equation \((200/2) \pm (50/2)\) would be used. The solution to this equation shows that the middle 50 utterances of a 200-utterance sample are utterances 75 – 125. Since each language transcript contained a different total number of utterances the middle utterances had to be calculated individually.

After the specified number of utterances was identified within the transcript, the MLUw was calculated using the Computerized Language Analysis (CLAN) software (MacWhinney, 2000). CLAN was used to calculate 7 MLUw scores of different sizes (10, 25, 50, 100, 150, 200 and total number of utterances) for each of the 402 language samples. The MLUw score was calculated from the “main line” of each child’s transcript. The specific code used to calculate MLUw is found in

<table>
<thead>
<tr>
<th>Code</th>
<th>Meaning of Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mlu +t*chi transcript.cha</td>
<td>This code tells CLAN to find the child’s MLU for the entire transcript.</td>
</tr>
<tr>
<td>Mlu +t*chi +z#u-#u transcript.cha</td>
<td>This code tells CLAN to find the child’s mlu for a specified range of utterances within a transcript.</td>
</tr>
</tbody>
</table>

Note: The # signs are replaced with a specific range of utterances. For example, to find the MLU for utterances 150-200, the # signs are replaced with the numbers 150 and 200. The code would appear: mlu +t’chi +z150u-200u transcript.cha.

### FIGURE 3

**Percent of Transcripts in Each Age Group**

- **24-29 mo**: 30%
- **30-35 mo**: 30%
- **36-41 mo**: 27%
- **42-48 mo**: 13%
Table 3. Seven MLUw scores (calculated from the different numbers of utterances reported above) were individually calculated for each of the 402 transcripts. The data were stored in Microsoft Excel. When all data were collected, they were transferred to the Statistical Package for the Social Sciences (SSPSx) computer analysis program for statistical analysis.

The age groups were formed by dividing the transcripts into 4 six month interval age groups: (1) 24-29 month olds (mean age = 24.75 months), (2) 30-35 month olds (mean age=32.4 months), (3) 36-41 month olds (mean age = 38.08 months) and (4) 42-48 month olds (mean age=45.13 months). Figure 3 shows the percent of transcripts contained in each of the 4 age groups. These age groups were formed based on balancing the need for a large number of transcripts in each group while maintaining a small age range within each group.

A multivariate analysis of variance (MANOVA) was used to determine whether or not there was statistical differences between utterance sizes within each age group. An alpha of .05 was used. A MANOVA design was selected over an ANOVA design for two reasons. First, because the 7 utterance sample sizes are selected from the middle of a transcript, they are not completely independent of each other. A sample of 50 utterances contains some of the same utterances that a sample of 200 utterances does, because both were selected from the middle of each transcript. Because the 7 levels of the independent variable “number of utterances analyzed” are not independent of each other, the assumption of independence needed to use an ANOVA is violated. Secondly, MANOVA designs do not require homogeneity of variance of different scores (Myer, 1979). The MANOVA procedure was also used for the between group comparisons. Analysis was performed using SPSSx.

Results

As seen in Table 4, the MANOVA results show (1) a non-significant (F(6, 2388)= .41, p = .874) effect for the number of utterances; (2) a significant (F=(3, 398)= 22.94, p = .001) effect for age and (3) a non-significant effect (F(3, 2388) = .47, p = .971) for the interaction between age and number of utterances.

There was a non-significant effect for number of utterances used to calculate MLUw within each age group. The two youngest age groups (24 to 29 months and 30 to 35 months) showed the most change in MLUw scores calculated at each utterance size. However, these changes were not statistically significant. The 36-41 month old group and the 42 to 48 month old group showed no change in MLUw scores within each group. This was verified statistically, as no significant differences within MLUw scores calculated for each age group existed.

There was a significant effect for age. Table 4 shows that MLUw scores increased as age increased. This finding is consistent with the findings of other researchers (Brown, 1973; Miller & Chapman, 1981; Nice, 1925).

Finally, a non-significant effect was found for the interaction of age and number of utterances. This finding indicates that MLUw scores do not significantly change as a function of number of utterances in any of the four age groups included in this study.

The results of this study indicate no significant differences between MLUw scores calculated from 7 different numbers of utterances (10, 25, 50, 100, 150, 200 or the total sample). These results are consistent in each of the four age groups (24-29 month olds; 30-35 month olds; 36-41 month olds; 42-48 month olds) of what we assumed were typically developing, English speaking children included in this study.

Discussion

Studies have been conducted to determine whether 50-100 utterances are adequate to calculate MLUw, and whether or not more or less then this number can be used. The results of this study found no significant differences in MLUw scores calculated from 10, 25, 50, 100, 150, or 200 utterances selected from the middle of larger language transcripts or the total number of utterances. Differences in MLUw scores were non-significant in any of the four age groups included in this study: 24-29 months, 30-35 months, 36-42 months and 43-48 months.

The results of previous studies addressing this question report a variety of conclusions. Some researchers have concluded that MLU should be calculated from more than 50 utterances (Minifie et al. 1963), and ideally from 175 utterances (Gavin & Giles, 1996). Other researchers report that a MLU score calculated from 50 utterances is adequate (Darley & Moll, 1960), or that as few as 10-20 utterances can be used (Casby, 1984; Riordan, 1982). The results of this study support the conclusions drawn from Casby (1984) and Riordan (1982) that as few as 10 utterances are adequate to calculate MLU.

It is interesting to consider why previous studies have reported such diverse conclusions. Reasons include differences in methods, language sample environments, geographies, age ranges, and homogeneity of groups. For example, the differences between the methods of each study may account for the differences in the results reported. When the methods of these studies are reviewed, it becomes apparent that the language sampling practices and geographic locations are often different. Another reason might be that the conditions of the language sampling situations (the activities, participant and settings which language samples occurred) vary between studies. For example, some studies collected the language...
sample in the home (Minifie et al. 1963), while others were collected in a clinic (Darley & Moll, 1960; Riordan, 1982). Thus, it becomes difficult to say whether studies concluded differing results because of the influences of the setting, or because of the effect of the independent variable (length) on the dependent variable (MLU).

A third reason for the disparity in research may be the different geographic origin of the children. For example, Darley & Moll (1960) and Minifie et al. (1963) gathered language samples from children from Iowa. Riordan’s (1982) results represent children from a midwestern urban location. Other researchers did not report the geographic location represented by their language samples.

It was also noted that the age ranges of the children varied between studies. Interestingly, the studies that utilized similar age ranges reported conflicting results. Some studies included 8 year olds (Minifie et al. 1963), or 5.5 year olds (Darley & Moll (1960). Although the age groups in these studies were similar, the results reported by each group of researchers were contradictory. Other researchers using children 36-47 month olds (Riordan, 1982), and 31-46 month olds (Gavin & Giles, 1996) reported conflicting results as well.

Another possible reason for conflicting findings is the subject pools. Within each study, the subject pool was carefully controlled. Subjects were homogenous with respect to age, language sampling conditions and geographic location. However, between studies, the ages, language sampling conditions and geographic locations varied greatly which makes comparison of results more difficult.

Even if these studies all reached the same conclusion, generalization of these conclusions to a clinical situation would be difficult for two reasons. First, the number of language samples in each study is generally quite small. Second, studies that did include larger numbers of language samples (such as the 288 collected by Minifie et al, 1963) represent only a fraction of the types of language sample elicitation activities, settings and combination of conversational partners a clinician can choose from when collecting a language sample.

In order to accomplish its goals, the present study required a large sample size. Therefore, it utilized the CHILDES database and the computer analysis software CLAN. Inclusion of a large number of language samples made it possible to represent more children of a greater age range, socioeconomic status and geographic location than previous studies. The large sample size also allowed for the representation of many different language sample elicitation techniques (such as free play, conversation,

### TABLE 4

<table>
<thead>
<tr>
<th>Age In Months</th>
<th>Number of Utterances Analyzed for MLU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td>24 - 29</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>(.98)</td>
</tr>
<tr>
<td>30 - 35</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>(1.15)</td>
</tr>
<tr>
<td>36 - 41</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td>(1.21)</td>
</tr>
<tr>
<td>42 - 48</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>(1.32)</td>
</tr>
</tbody>
</table>
retelling of stories, and activities of daily living) in a variety of settings (home, school, and clinic), with multiple combinations of people interacting with the child. However, as previously mentioned there are concerns about homogeneity of groups, geographic origin of children, language sampling situations, diversity in ethnicity and socioeconomic status in the samples used in this study which are all potential confounding variables that could influence the ability to generalize the findings of this investigation.

**Application of Results**

The results of this study indicate that MLU_{w} can be calculated using as few as 10 utterances selected from the middle of a larger language transcript. Therefore it is only applicable to the extent that a person gathers a complete language sample. The implication that the selection of 10 utterances from a larger language sample can be used to calculate MLU_{w} will be of interest to many busy clinicians because one of the major drawbacks of a language sample analysis is the time it takes to transcribe and analyze the sample. A survey by Wilson, Blackmon, Hall & Elcholtz (1991) reported that over half of 266 speech-language pathologists disagreed with the statement “I have enough time to assess each child” (p. 240). Speech-language pathologists reported that, because of a lack of time, they do not use language sample at all, or to the extent they would like to, despite the fact that they view the process as an important component of language assessment (Baker, 1988; Hux, Morris-Friehe & Sanger, 1993; Kemp & Klee, 1997). The results of this study could have important implications for clinicians who want to incorporate an aspect of language sample screening and analysis into their assessment of children 24 to 48 months of age.

MLU_{m}/w can be used for various purposes in the clinical situation, including screening and diagnostic evaluations. During both of these processes, it is important to use several measures of language development (both standardized and descriptive). In screening for language development, clinicians can save time by using only 10, rather than 50 utterances to calculate MLU_{w} and still obtain a statistically equivalent score, allowing the clinician to focus on identifying and using other measures to describe and understand a child’s language. Clinicians will still need to obtain (transcribe) a language sample of at least 50 utterances in order to utilize this technique.

**Conclusions**

Beyond the clinical implications of this investigation, it should be noted that the use of MLU_{w} as an independent variable in research should be discouraged because of its insensitivity to the causes of different utterance lengthening techniques used by different children. The results of this study have the greatest implication for the clinician because all seven of the sample lengths produced equivalent MLU_{w} scores. The clinician can choose which length is most appropriate depending on the purpose for calculating the MLU_{m}/w.

While the clinician can use several tools to screen the child, the use of MLU_{w} calculated from 10 utterances can be an indicator of the need for further assessment. In the diagnostic setting, calculation of MLU_{w} from 10 utterances may help guide the clinician in choosing further types of language sample analysis.

The results and conclusion of this study are based on the analysis of MLU_{w} rather than MLU_{m} as literature suggests the measures are equivalent. In our view, the use of MLU_{w} may be more appropriate when evaluating culturally diverse participants in a variety of settings or when language sample sizes vary greatly. Despite the notion that MLU_{w} appears as accurate as MLU_{m} with younger children (below the age of four years), future research is needed to investigate possible differences between MLU_{w} and MLU_{m} to confirm this impression.

The practice of calculating MLU_{m}/w within the profession of speech-language pathology is prevalent. It is a measure that is relied upon for screening and some times diagnostic purposes. Because of the prevalence of reporting MLU_{m}/w, it is important that investigations into the methods for gathering language samples, the procedures for calculation, the analysis of raw data, and the calculating and reporting of normative information continue to be explored.

**Author Bios**

**Kent Brorson, Ph.D., CCC-SLP**

Kent Brorson is an Assistant Professor at the University of Minnesota Duluth in the Department of Communication Sciences and Disorders. His academic responsibilities include instruction of undergraduate and graduate courses in language development and disorders.

**Corinna Dewey, M.A., CCC-SLP**

Corinna Dewey is a speech-language pathologist practicing at Munson Medical Center in Traverse City, Michigan. Her primary area of practice is pediatric speech and language evaluation and treatment.
REFERENCES


Davis, F. (1937). The development of linguistic skill in twins, singletons with siblings and only children from five to ten years. Minneapolis: University of Minnesota Press.


The progress made over the last decade in cochlear implants, surgical techniques, and speech processing strategies has been truly phenomenal. There has been a steady improvement in functional outcomes from cochlear implantation from the early single channel devices, which provided basic speech awareness and improved speechreading ability, to the current state of technology, where open-set speech recognition no longer amazes the clinician. With this improved technology, some may assume that the adult cochlear implant user is no longer in need of audio logic rehabilitation.

Is it appropriate to omit this component of the implantation process because the patient is “doing pretty well” without training? Is “good enough” adequate, when additional rehabilitative procedures could insure that the patient is performing at his or her optimal level? In addition to the cochlear implant and other hearing instruments and alerting devices, effective treatment must consider the effect of the hearing impairment upon the individual and the people with whom he/she interacts.

The information presented here is taken from our book entitled: “Learning to Hear Again with a Cochlear Implant: An Audiologist Rehabilitation Guide” published by Hear Again in 1998. We prepared the book on the following assumptions:

“Pretty Good” Is Not Good Enough
A rehabilitation program may contribute to cochlear implant users reaching their full potential. The nature and content of this rehabilitation program will vary with each individual, but even those with excellent performance after initial stimulation may benefit from a rehabilitation program designed for their needs.

Hearing Loss Often Cannot Be (Re)habilitated By Cochlear Implants Alone
In many cases, additional counseling, education, training in perceptual skills, and the dynamics of communication facilitate the individual’s independent management of their hearing impairment to improve communication skills.

Information And Support Is Important To The Important Patient
Implantation results in dramatic changes in communication function, interpersonal communication and relationships and environmental awareness. Information, guidance and support during the period of adjustment to the implant will facilitate the individual’s transition from being “deaf” to being “hard of hearing”.

Family Involvement In The Rehabilitation Process Is Not Only Desirable, But Important For Optimal Benefit From The Cochlear Implant
The sudden change in hearing status which results from implantation affects not only the individual but also his/her family, friends and coworkers. The rehabilitation process is quickened and the chances of success are improved if these individuals are involved. Information can enhance the patient’s and the communication partners’ understanding of the benefits and limitations of the cochlear implant and the recognized factors in listening environments that can have predictable effects on performance.

Sample Activities From The Guide
The guide has been prepared by practicing audiologists and a cochlear implant user and includes a variety of materials and activities which will assist the clinician in providing customized rehabilitative programs designed for the implant user and family members. It has a section related to cochlear implant orientation and adjustment which provides information for a patient’s use. There are additional lesson plans and workbooks in communication strategies, coping techniques and speechreading. These sections are designed to be used either with groups of cochlear implant users only, or with mixed groups of cochlear implant and aid users. Family members are encouraged to participate. Additional activities and exercises are included to allow the clinician to select materials appropriate for specific individual needs when a more standard program is not appropriate. A reference section includes resources to aid the clinician in providing quality rehabilitative services for the individuals they serve. Camera-ready handout material may be copied from the guide or bound copies of the workbooks prepared for patients entitled Better Communication and Cochlear Implants, A Personal Journal and A User’s Guide may be purchased sepa-
rately form Hear Again. (512) 451-6633 Sample material related to Telephone Use, Communication Strategies, Speechreading and Auditory Training are included to whet your appetite for the rewarding process of helping cochlear implant patients optimize their use of the cochlear implant.

I. Telephone Use

Phone use is a special challenge for anyone with hearing loss and this is especially true of cochlear implant users. Some may begin using the phone for the first time; others may begin again after not being able to for a length of time. Practice can make using the phone easier for most implant users.

Talk face-to-face with friends, co-workers and family members about using the phone, and teach them the best way to speak to you. If they understand what the cochlear implant can and can’t do, they will be more likely to remember to speak the way you need them to. Ask them to help you with some of the practice exercises in the guide. This may help them understand your new hearing status.

Strangers who call can be more of a challenge. If you have difficulty understanding, inform them that you have hearing loss. Tell them what you need, since callers probably will not figure this out themselves. Sales calls can be a special problem since sales people speak very quickly (and you really don’t want to listen to them anyway).
**Telephone Hints:**
Develop the skill of making specific suggestions to callers, rather than simply saying “Sorry, I didn’t hear that!” If you find yourself in a bind, try some of these examples:

- “I can’t listen as fast as you can talk. Will you slow down for me?”
- “I think I could understand you better if you would talk a little softer.”
- “Did you just say that (for example) the meeting is next Sunday at 7:00?”
- “I’m not good at recognizing voices. Who is calling, please?”
- “Please let me turn off the TV. I think I’ll hear you better without that noise.”
- “That is perfect volume (or speed) for me to understand. Thank you.”
- “Let me repeat that back to you to make sure I heard you right.”

**Telephone Hardware:**

- Telephone adapter for your speech processor – Follow the manufacturer’s instructions and practice using the adapter. Install it on the phone you want to use most regularly. Take it with you when you travel.
- Regular phone use – Follow the manufacturer’s instructions.
- Amplified Phones – Telephones with built-in amplifiers may be of help. Some amplify all pitches, others have tone controls, which allow some adjustment. Check with your audiologist for more information.
- Speaker Phones – For many, speaker phones provide the best signal.
- Pay Phones – When using pay phones choose one in a quiet location, if possible. Look for pay phone with an amplified handset. When traveling, carry your phone adapter (use one with a suction cup since the direct connect phone adapters will not work away from home or office).

**Things to think about when preparing to master telephone use:**

**Voice Recognition:**
Some cochlear implant users notice that they can’t recognize a person’s voice over the phone; everyone sounds the same. If this is so, tell the people you speak with regularly that you need them to begin each phone call by stating their name.

**Volume:**
Voices that are too loud or too soft may be difficult for the cochlear implant to process. Teach the people who call regularly how loud you need them to talk over the phone. Let them know when their voice is just right.

**Rate of Speech:**
Speaking slowly and clearly is helpful over the phone, but many people, especially sales people, talk very fast. Ask people to slow down, and remind them when they forget and go back to their faster rate. Let them know when their rate is just right.

**Background Noise:**
Keep in mind that background noise that is louder than the person’s voice will interfere with understanding. The speech processor will choose the loudest signal to send to your ear. You may need to turn down noise near the phone, or ask the caller to do the same before you can understand.

**Double-check details:**
It is very important to confirm your understanding of important details over the phone. Dates, times, names, addresses, etc., require accurate understanding. Get into the habit of double-checking details of conversations so you and person you are speaking with will know that these details have been successfully communicated.

**II. Communication Strategies**

Communication will be a challenge in the first days and months following initial stimulation for both the implant user and persons interacting with him or her. Sound will be different and it may take time of rate implant user to adjust to old and new sounds.

**Ways in which family members can assist:**

- Speak in normal tone of voice.
- Face the person.
- Help identify sounds that are new and perhaps confusing.
- Assist with “homework” assignments.
- Get the listener’s attention: If you wait until he/she is ready to listen before you begin talking, you may not have to repeat yourself.
- Do not shout: Talking louder usually makes matters worse because it creates distortion.
- Slow down: Talking a little slower than usual often makes your voice easier to understand.
- Get close: It is best to move close to the listener before talking. It saves you from shouting and makes you easier to understand.
- Speak clearly: don’t exaggerate your pronunciation, but do not try to finish speaking all the sounds of one word before you begin the next.
- Rephrase: If repeating one time does not help, it is better to use different words to express the same idea.
- State the topic: Tell the listener what topic you are about to discuss. Tell him/her when the topic changes.
### Sounds To Look For When Speechreading

The chart below outlines the visibility of different consonant sounds.

<table>
<thead>
<tr>
<th>Most Visible Sounds</th>
<th>Less Visible Sounds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SOUNDS</strong></td>
<td><strong>LIPS MOVEMENT</strong></td>
</tr>
<tr>
<td>P</td>
<td>Lips pressed together</td>
</tr>
<tr>
<td>B</td>
<td>Lips are rounded with small opening in center</td>
</tr>
<tr>
<td>M</td>
<td></td>
</tr>
<tr>
<td>WH</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Upper teeth touch lower lip</td>
</tr>
<tr>
<td>V</td>
<td></td>
</tr>
<tr>
<td>SH</td>
<td>Lips are slightly rounded and pushed outward</td>
</tr>
<tr>
<td>CH</td>
<td></td>
</tr>
<tr>
<td>TH</td>
<td>Tongue is visible between the teeth</td>
</tr>
</tbody>
</table>

- Use gestures: these can help with understanding.
- Confirm details: Politely double check that key details of a message have been understood accurately.
- Notice background noise: Turns the noise down or move to a quieter place, if possible. Be extra careful talking in a noisy place since it interferes with understanding.

### Tips For Improving Communication

There are many things that individuals can do in order to take the best advantage of state-of-the-art cochlear implant or hearing aids. Certain techniques go a long way in reducing the communication and the interpersonal challenges that can go along with hearing loss.

The Listener with an implant can:
- Pay attention: Concentration is very important.
- Develop good listening skills: Concentrate on what is said.
- Observe the talker: What you see can supplement what you hear.
- Plan ahead: Think about possible challenges to good understanding. Plan what to do if they occur.
- Take breaks if needed: Listening with a hearing loss can be tiring. You can concentrate better if you are fresh.
- Make specific suggestions about how to talk to you: For example, it is better to ask a person to rephrase or slow down rather than just say “What?”
- Provide feedback: If you tell your partner what you heard, both of you will know right away if you understood correctly.
- Double check details: Repeating what you understood someone to say can prevent confusion later on, especially date and times.
• Do not bluff! Pretending you understand when you don’t is a “no-win” situation.
• Set realistic expectations: Some situations are just too noisy to expect to understand clearly even with the best hearing aids.

III. Speech Reading
Activities for improving speech reading skills are included in the guide, as speechreading cues do augment comprehension of what is heard. (Please see chart Sounds To Look For When Speechreading)

Everyone speechreads or lipreads some. Practicing this skill will help you to take full advantage of visual clues.

IV. Auditory Training
Raymond Carhart described auditory training as the “process of teaching the child or adult who is hard of hearing to take full advantage of sound cues which are still available to him/her” (Chermack, p 146). Combining auditory and visual cues may optimize communication. Auditory training will assist the person with hearing loss to use his residual hearing to the fullest.

Sound may be heard, but it must have meaningful association to be understood. It must be related to people, objects, events and ideas. Auditory training should involve the use of meaningful dialogue representative of the messages an individual will encounter in his academic, work, home and social environment. Programs must emphasize practice in those daily situations in which the participants’ auditory comprehension is challenged. Such training should include listening, decision making and responding to representative speech messages.

Levels of auditory include:
• Awareness of sounds (presence/absence)
• Identification of sound (labeling)
• Discrimination of speech sounds (recognizing syllabic content)
• Comprehension of speech discourse (understanding)

Lessons Should Include:
• Explanation and tainting or auditory memory. (eg, remembering names, association practice, attentiveness)
• Practice activities related to rhythm, inflection, intonation and accent.
• Exercises in using contextual cues.
• Training in vowel recognition since they are the strongest voiced elements or speech.

You have seen a few samples of the many practical materials included in our book for cochlear implant users. We hope these inspire you to guide your patients to get the most out of their implant technology. With work, time, practice, and patience, each user of a cochlear implant can gain improved communication function. Even those individuals who have worn their speech processors for long periods can and will realize improvement in communication effectiveness by following some of the guidelines in our book. Learning to take full advantage of the potential of the device is a continuing process. Encourage your patients to recognize this.

Suggest that your patient and significant others work together to become better communicators by following some of the practice tips listed. Recommend that they work on their own using books on tape. If you observe that they could benefit from one-on-one audilogic rehabilitation or they express the need, provide it if you can, or have a list of community resources readily available for them to contact. Make it a point to regularly distribute detailed information about the local chapters of national support groups including:
1. The Cochlear Implant Association, Inc.,
2. Self Help for Hard of Hearing People, Inc. and
3. The Association of Late Deafened Adults.

Should you want your patients to purchase their own workbooks, sections from the “Learning to Hear Again with a Cochlear Implant: An Audilogic Rehabilitation Guide” are available in two short workbooks. You or your patients may access ordering information by visiting our website: www.hearagainpublishing.com or by calling (512) 451-6633. Titles are listed in References and Resources.

Good luck in this exciting adventure of facilitating improved communication for your patients who use cochlear implants, their families and friends. It is a privilege to act as a facilitator in this endeavor. We welcome your comments and suggestions via e-mail at: hearagain@jump.net. •

Edited by:
Amy McConkey Robbins
REFERENCES and RESOURCES:

1. Support Groups
Cochlear Implant Club International (CICI)
5335 Wisconsin Avenue, Suite 440
Washington, DC 20015-2034
(202) 895-2781

Self Help for Hard Hearing People, Inc. (SHHH)
7901 Woodman Avenue, suite 1200
Bethesda, MD 20914
(301) 657-2248 (Voice)
(301) 657-2249 (TTY)

Association of Late Deafened Adults (ALDA)
2600 W. Peterson Avenue., Suite 202
Chicago, IL 60659

2. Recommended Reading
Toronto, Ontario, Canada.


Dungan, Marica (1997). Keys to living with hearing loss, Bethesda,
MD: SHHH Publications.

Romoff, A. (2000). Hear Again, N.Y.: Legague for Hard of
Hearing Publication.

Wayner, Donna S. (1998). Hear what you’ve been missing: How to
cope with hearing loss, Minneapolis, MN: John Wiley Publishing.

Again with a cochlear Implant; Clinician Manual; A Personal
Journal; User’s Guide, Hear Again, Austin, TX.

3. Publication Sources
A.G. Bell Association for the Deaf
3417 Volta Place, NW
Washington, DC 20007-2778
(202) 337-5220 (Voice/TTY)

SHHH Publications
7910 Woodmont
Bethesda, MD 20814
(301) 657-2248 (Voice)
(301) 657-2249 (TTY)

Learing to Hear Again
1200 Madison Avenue
Austin, TX 78757
(512) 451-6633

Life After Deafness
6773 Starboard Way
Sacramento, CA 95831-2413
(916) 392-5750 (Fax)

NIDCD Information Clearinghouse
National Institute on Deafness & Other
Communication Disorders
National Institute of Health
1 Communication Avenue
Bethesda, MD 20892-3456
(800) 241-1044 (Voice)
(800) 241-1055 (TTY)

4. Audio Books
Books on Tape, Inc.
(offers unabridged books on tape for rent)
(800) 252-6996

Educational Records Center
(offers a six cassette tape set, The Definitive
Encyclopedia of Sounds Effects, for sale)
(800) 438-1637

Micro Sound Product
(offers a four CD set, Sound Effects, for sale)
(707) 347-7662

5. Internet Sites and E-mail addresses
http://www.Cochlear Implant Forum
http://www.CI@YORKU.CA
NIDCD Information Clearinghouse
http://www.nih.gov/nided
nidcd@aerie.com (E-mail)
http://www.hearagainpublishing.com
hearagain@jump.net (E-Mail)

For up to date information on the
Ohio Speech-Language-Hearing Association,
go to www.ohioslha.org
Sensory hearing loss is a chronic condition that affects over 22 million Americans. Of these individuals, an estimated 464,000 to 738,000 are severely to profoundly deaf (Blanchfield, Feldman, Dunbar, & Gardner, 2001). For many people with severe to profound hearing loss, hearing aids and assistive listening devices are not sufficient to interpret environmental sounds or to understand conversational speech (Larky, 2000). One option for many people who do not optimally benefit from these devices is a cochlear implant.

Assessment
Cochlear implant candidacy is determined usually by an audiologist and an otorhinolaryngologist, but the input of other professionals, such as speech-language pathologists, psychologists, and educators, is often sought. The Food and Drug Administration’s (FDA’s) guidelines regarding cochlear implant candidacy state that a candidate must have bilateral severe to profound hearing loss, demonstrate limited benefit from hearing aids, and be at least two years of age, although one-year-olds may receive cochlear implants if they are profoundly deaf (Zwolan, 2000). Once these criteria are met, the next step is a hearing evaluation, most often performed by an audiologist.

Hearing evaluations help better determine level of hearing loss, etiology of hearing loss, benefit of hearing aids, and/or if contraindications for a cochlear implant exist. An absent or significantly malformed cochlea, lack of a viable cochlear nerve, radical mastoidectomy cavity, co-existing conditions such as a Central Nervous System disease that would prevent benefit, active otitis media (ear infection), and poor medical health are all conditions that may limit effectiveness and preclude an individual from implantation of the device (Kelsall, 2004).

Surgery
Cochlear implantation involves a two to three hour surgical procedure (Hirsh, 2001). A surgeon typically makes an incision behind the pinna of the ear to be implanted (Miyamoto, Robbins, Iler, Kirk, & Wagner-Escobar, 1997). A well is created in the skull where the internal components of the cochlear implant device will be placed and secured with bone-anchored, tie-down sutures (Balkany, Cohen, & Gantz, 1999). A mastoidectomy (removal of the cells of the mastoid) (Martin, 1997) is performed. The mastoidectomy allows access to the facial recess, an area between the external auditory meatus (ear canal) and the facial nerve. The facial recess is opened to visualize the round window, which separates the middle and inner ear regions (Pappas, 1998). A cochleostomy, or obliteration of the cochlea, is performed anterior and inferior to the round window membrane (Miyamoto et al., 1996). A small opening is created in the round window and the electrode array of the cochlear implant is inserted through the round window. The electrodes enter and curl around the cochlea (Balkany et al., 1999). Approximately 4 to 6 weeks after surgery, the external portion of the cochlear implant, the speech processor, is programmed (Shapiro, 2000).

Treatment after Implantation
After a person receives a cochlear implant, work is needed in order to learn to listen with the new device. A cochlear implant is not an instant cure for deafness and, as a result, requires a period of adjustment, habilitation, or rehabilitation. Cochlear implant users continue to progress over time, but often need input from a trained therapist to reach higher level goals. Therapists can provide aural rehabilitation, or training of auditory skills, for implant users of all ages, from babies to the geriatric population.

In addition to auditory skill training, therapy after implantation can focus on development of spoken speech and language. Articulation practice allows improved precision of speech sounds and increased overall intelligibility. Language therapy can target difficult-to-hear morphemes such as plural and possessive endings, and improve receptive-expressive semantic development and word order.

Teenagers: A Unique Population
One population of cochlear implant recipients is teenagers. Teenagers who get implants for the first time and teenagers who have had implants since early childhood can both benefit from auditory skills training. Shramm, Seguin, and Fitzpatrick (2002) found that 5 of 6 pre-lingually deafened participants implanted as adolescents were able to understand open-set sentence information a year after implantation. The challenge with this population is to engage them through activities that hold their interest while targeting valuable auditory skill development. This can be done by letting the youth participate in some aspects of goal setting and designing therapy activities that target goals but are fun to do.

Bosco, D’Agosta, and Ballantyne
Outcomes for Adolescents

Though all people with an implant perform differently, certain traits have been identified as being predictors of optimal outcome. Outcome is defined differently for each patient, with some outcome goals being the desire to hear environmental sounds, to be able to talk on the telephone, to order in a restaurant, or to be functionally independently in an oral environment. One difference is between people who were prelingually deafened (lost their hearing prior to learning to speak) and those who were postlingually deafened (who lost their hearing after learning to speak). Studies show that people who lose their hearing postlingually have better outcomes due to a greater auditory memory for environmental and speech sounds (Kelsall, 2004). As a result, one would expect that a teenager with a progressive hearing loss who lost his or her hearing after learning to speak would have a better prognosis than a person implanted as a teenager who lost his or her hearing prelingually.

Another aspect that can affect outcome is the duration of deafness, the length of time a person has been deaf. A shorter duration usually correlates with better outcomes, but it is important that duration has been long enough to allow for possibly recovery, allow the patient to accept deafness, and to determine if a person can receive appropriate benefit with a hearing aid (Kelsall, 2004). Children implanted as adolescents have been shown to develop greater open-set recognition and sentence scores than people implanted at an older age (Fitzpatrick, Seguin, & Schramm, 2004). One hypothesis for this would be the shorter duration of deafness for adolescents compared to adults.

Age at implantation has been identified as another factor that is important when determining candidacy for a cochlear implant. Before a child with or without hearing loss learns to speak, a child listens and gathers information regarding pitch, intonation, loudness, speech sounds, words and sentences (Rose, McAnally, & Quigley, 2004). A child with a severe to profound hearing loss may not benefit from auditory input, which in turn can cause the child to develop spoken language differently and in a different amount of time than typically developing children. Children who receive a cochlear implant earlier have earlier access to auditory input, which may allow better learning of spoken language (Kelsall, 2004). Children may be at a language learning disadvantage if not implanted until adolescence. Though adolescents do make gains with open-set tasks (Fitzpatrick, Seguin, & Schramm, 2004) one may expect an adolescent’s optimal outcome prognosis to be lower than that of a younger child.

Zwolan (2000) suggested that implanting young children presents additional challenges, as pre-implant assessment of speech and language skills is more difficult and, post-operatively, very young children have difficulty providing the conditioned responses needed to appropriately program, or “map,” the device. With the advent of neural response telemetry available through some cochlear implant devices, which allows an audiologist to confirm the integrity of the device and confirm physiological responsiveness in children and adults unable to independently report how they are hearing, maps can be created without conditioned responses. Unlike young children, teenagers often are reliable reporters of how they are hearing. Once a teenager can reliably detect sound, he or she can play an active role in programming the device, increasing the likelihood of an optimal program.

The following case studies examine therapy activities used for teenagers with cochlear implants at our facility.

Case Study #1

“Kathleen” is a 15 year old female who was identified as having a hearing loss at eight months of age. She received hearing aids by 12 months. Her family opted to learn how to use Cued Speech and used this mode of communication with Kathleen both at home and at school. According to the National Cued Speech Association, Cued Speech “is a sound-based visual communication system which, in English, uses eight handshapes in four different locations (“cues”) in combination with the natural mouth movements of speech, to make all the sounds of spoken language look different.” Cueing provides information supplementary to speech-reading information that helps a person with a hearing loss to distinguish among sounds that look the same on the lips.

Kathleen is currently mainstreamed in a local public high school. Her transliterator attends classes with her. Kathleen and her family decided to pursue a cochlear implant around her 15th birthday, with goals of improving speech intelligibility and allowing Kathleen to hear more in her environment. After a full team assessment, involving the surgeon, audiologist, speech-language pathologist, and learning specialist, Kathleen received a cochlear implant. Prior to her implant, Kathleen engaged easily in verbal communication, though she was reliant on lip-reading and utilized her transliterator at school. She was able to detect and discriminate long and short vocal duration and discriminate words of varying syllables presented auditory only in closed set choices of two. When a closed set was expanded, or if she was asked to identify two words having the same number of syllables, Kathleen’s accuracy was not consistent.

Kathleen began speech-language
therapy post implantation. From the initial session, Kathleen was encouraged to contribute to her own therapy by learning to identify difficult listening situations. In therapy she discussed situations at school that were difficult to listen in and was able to predict situations that would be hard for her, for example, dinner at a restaurant on prom night. With adolescents it is important to discuss listening strategies to help the teen manage the environment in a way that enhances his or her listening experiences. This allows the youth to become a better self-advocate as he or she is approaching adulthood.

Though drill exercises have value in a therapy session, modifying age-appropriate games to promote auditory development allows a more natural and engaging avenue to practice varying skill levels. Common games can be modified to target auditory goals. Kathleen initially showed success with “Guess Who,” a game in which each player asks yes/no questions in order to determine the other player’s “mystery person.” Kathleen originally was presented with one or two words auditory only, such as “red hair” or “glasses.” To assist in hearing these words, words were presented independently, at varying rates, or with emphasis on a phoneme in the word. Kathleen listened for phonemes and indicated which sounds she heard in a word or phrase, even when she was unable to identify the word or phrase. She quickly was able to identify the carrier phrase “does your person have/wear” when it was presented in an auditory modality with no visual cues and subsequently interpreted the whole phrase “does your person have a big nose.” If an adolescent’s auditory skills are not yet at the level of open-set recognition, this game can be modified to a closed set task. For example, the child could be informed that he or she will hear either “hat” or “blue eyes.”

After mastering “Guess Who,” Kathleen progressed to “Guess Where,” a game in which she had to learn to listen for and identify two key pieces of information, a person and a location, within a question presented without visual cues. At first Kathleen needed the sentence broken down for her. Instead of providing “Is the mother in the family room,” Kathleen needed to first listen for “Is the mother.” After she heard “Is the mother,” she would then listen for “Is the mother in the family room.” With practice and increased auditory skills, Kathleen became able to listen for the key words presented as a full unit. This game is a closed set task, as the client listens for only a limited number of people and room names.

After success with the closed set tasks, Kathleen began working on “Taboo,” a game which is an open set task. In this game, a player must describe a word so that the other player can guess the word, however, each card provides three words the describer can not use to explain the word. Kathleen was first presented with an auditory only description of the word she was to guess. The description increased in length as her auditory skills increased. If Kathleen could not interpret the description after the first or second repetition, the description was first broken down to the phrase level and ultimately to the word level if needed. When the description was simplified, the rate of presentation was varied. Kathleen focused on acknowledging any sounds or words within the phrase that she could identify. This practice ultimately helped her in real life situations as she learned strategies for listening. For example, her ability to pick out key vocabulary may aid in her comprehension of a conversation, in which she misses a few words. At this time, Kathleen requires multiple repetitions of key phrases within a sentence, and occasional repetition of individual words, but is usually able to identify the beginning of the sentence (for example, “it is an animal,” “you wear it,” “it has a” “you eat this with”) without repetition.

Kathleen is currently almost six months post initial stimulation of her cochlear implant. She has attended speech therapy services targeting auditory skills training once a week as well as 45 minutes of speech therapy at school per week. Kathleen has made great gains with her cochlear implant and continues to show improvement weekly. When provided a category such as “things that are hot,” Kathleen is able to identify single words presented auditory only with approximately 80% accuracy. When presented with three single words from a closed set of 12 and asked to repeat back the words in the order she heard them (auditory memory), Kathleen is accurate on 75% of trials.

Three months post initial stimulation, Kathleen demonstrated increased ability to identify sounds in a sentence or phrase presented auditory only, even when she could not identify the actual word she was hearing. For example, she might not have been able to consistently identify “cheese” but was able to identify that she heard an /i/ and /z/ sound.

Kathleen continues to demonstrate increased auditory skills. A teacher at school noted she asked the class a question and Kathleen responded while looking down, having not read the teacher’s lips. Kathleen enjoys her ability to follow along in a paragraph that the teacher is reading out loud. She also is beginning to explore music, something she has never been able to appreciate in the past. Kathleen is a teenager who was successful academically with use of hearing aids and Cued Speech. In addition, she and her family chose to pursue a cochlear implant and is she demonstrating gains with the device. She plays an active role in determining her therapy goals by identifying difficult listening situations. She also has been able to enjoy therapy while maximizing her auditory potential.

Case Study #2

“Ken” is a 16 year old who returned for auditory skills training though he had not received speech therapy services since childhood. Ken lost his hearing pre-lingually and received his cochlear implant at the age of 2. He attended speech therapy for years and was eventually discharged due to his successful ability to listen and communicate orally. At a mapping, his audiologist recommended meeting with a speech-language pathologist to confirm that Ken was optimizing his
potential with his cochlear implant. Upon evaluation, it was noted that Ken had reduced auditory memory skills as well as difficulties with telephone use. Practice conversations on the phone during the evaluation revealed that reduced auditory memory was playing a role in communication failure on the telephone. For example, Ken could easily arrange an outing to the movies during a mock phone conversation, but had moderate difficulty when the caller presented him with a list of items to pick up from the grocery store.

Ken and his mother were not interested in pursuing traditional speech-language therapy at the time of the evaluation. They did show interest in targeting further development of auditory skills. Similarly to Kathleen, Ken was given a role in guiding his personal therapy by allowing him to describe situations that were difficult for him as well as learning to identify what made a particular situation difficult. Therapy consisted of developing communication strategies to help Ken create ideal listening environments independently. Some strategies included positioning during conversations to best see a speaker’s face, proximity to a speaker, and turning off sources of background noise such as the television.

Ken’s greatest interest was in developing better phone skills. He lacked confidence in his ability to hear on the phone and as a result avoided answering the phone. Auditory memory tasks were performed first in an auditory drill approach. After he showed improved success with auditory memory in a drill, auditory memory tasks were incorporated into his telephone listening therapy. Telephone listening therapy was conducted with two real phones in close proximity to each other. Conversations were conducted on the phone, sometimes with a declared topic and other times with no previously discussed topic, as would occur in a real telephone situation. After each conversation, communicative breakdowns were discussed. The goal was to identify what made the listening situation difficult and to identify solutions to use should this situation occur again. For example, it was quickly noted that Ken replied “what” any time he did not understand something. Though asking for repetition is a good and appropriate way to get clarification, Ken found he did not always understand it on the second presentation either. Problems identified by Ken were that the speaker was too quiet, or that the speaker spoke too quickly. Ken was then instructed to direct the speaker on how to communicate to make the situation easiest for him. For example, instead of just saying “what,” Ken would say “could you say that again slower?” By teaching communication strategies, Ken learned to be a better advocate for himself in listening situations. He developed the confidence to use the phone because he learned a set of tools to make phone calls seem less threatening.

**Conclusion**

Therapy is needed for teenagers with cochlear implants. It is important to give teenagers a role in determining the course of their therapy. An emphasis on communicative strategies is one way to allow youth to take an active role in promoting better listening and communication. Using modified games or targeting an interest such as telephone use helps engage teens in therapy while continuing to focus on their communicative strengths and weaknesses. Whether a teenager has had a cochlear implant since early childhood or has recently acquired one, auditory training can be a beneficial tool to promote increased communicative success and self-advocacy into adulthood...

Edited by: Monica Gordon Pershey and Laura W. Kretschmer

**REFERENCES:**


The Evolution of Services

At the Cincinnati Public Schools, Audiology Services are an integral part of the Department of Student Services. The three audiologists serve with all of the public schools, non-public special placement schools, auxiliary schools (primarily parochial schools), preschool diagnostic teams, and itinerant preschool teams. Although everyone reading this journal understands that hearing aids do not “fix” hearing loss, our greatest challenge is showing teachers how hearing impairment adversely impacts a child’s ability to fully participate in the curriculum and social development. Table 1 shows the growth of audiology services in terms of “the numbers.”

We provide services within the guidelines of the Ohio Department of Education’s Operating Standards (Section 3301-51-01). These standards require that audiology include six distinct service components. Our diagnostic assessments include using Otoacoustic Emissions and behavioral testing to assess hearing sensitivity. Speech discrimination ability, acoustic immittance and otoscopy are used to assess middle ear health; observation (both structured and overview) to assess instructional impact, D.I.B.E.L.S. (Dynamic Indicators of Basic Early Literacy Skills)1 benchmark assessment; and acoustic analysis of classrooms.

Our speech-language pathologists are our major support in each building for identification of students who are suspected of having educationally significant hearing problems. They conduct screenings on each student receiving their services and as requested by their building intervention teams. The audiologists review screening results for more than 2,000 students and follow-up with families to help guide treatment and medical follow-up. Our speech-language pathologists also provide direct service for the habilitative activities that are identified through the educational audiology evaluation.

Amplification, Assistive Listening Devices, and Classroom Instruction

We offer a broad variety of assistive listening and amplification devices. Each assistive listening device (ALD) uses a teacher transmitter, commonly referred to as teacher microphones. Receiver/transducers come in a wide variety of configurations. Whole classroom ALDs have either receivers that are separate from the sound-field speaker (transducer) or receivers enclosed in the same casing as the speaker. While most of our classroom ALDs use FM transmission, we have recently started using systems with infrared transmission. Whole classroom ALDs are generally used when there is need to overcome difficulty related to noise and distance from the speaker. Desktop assistive listening devices are used in classrooms to overcome problems related to noise, distance from the speaker, and reverberation for a single listener or small group of listeners. Individual amplification and assistive listening devices come in a variety of forms but are all used to provide a direct auditory signal from the teacher to a specific student. These include receivers with headphones, ear-level amplification with FM receivers, and ear-level FM receivers.

Channel changeability of these personal devices provides audiologists with the ability to use FM signal reception without changing devices as multiple students move throughout the same and proximal spaces within a school. The advent of programmable and now digital technology allows

<table>
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<tr>
<th>School Year</th>
<th>Number of Schools Served</th>
<th>Number of Students Served</th>
<th>Number of Students Evaluated</th>
<th>Number of Screenings Reviewed</th>
<th>Number of Audiology FTE’s</th>
<th>CPS Average Daily Attendance</th>
<th>Percentage of Students with Disabilities</th>
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</thead>
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<td>38173</td>
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<tr>
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</table>

us to use a relatively small number of hearing aid systems with FM receivers that are flexible to fit a broad range of hearing losses for use at school. It would be ideal if all of our students needing personal amplification had properly functioning hearing aids that reliably fit acoustically and mechanically. If this were the case, educational audiologists could focus on providing an acoustical setting for the best possible use of the students’ amplification and on the habilitation of effects of hearing impairment. Unfortunately this is not the case, as many of our students who have been fitted with personal hearing aids do not maintain them long enough to rely on their use on a consistent, long-term basis at school, when personal hearing aids are not available, we provide school amplification that matches the recommended personal hearing aid fitting targets.

As educational audiologists, we work directly with parents, deaf education certified teachers and speech language pathologists in developing goals, objectives, and services needed to guide each student toward achieving age-appropriate curriculum standards. We look at obstacles that limit deaf and hard-of-hearing students from accessing instruction and implement accommodations to remove barriers, whether in the school environment, in teaching strategies, and/or in instructional aids and materials. In working with our students we help them understand their hearing limitations and strengths, to grow in responsibility of caring for their own assistive devices, to become self-advocates, and to become knowledgeable in technology and about laws designed to provide equal access for them.

**Use of Cochlear Implants at School**

Like most public school programs we also have students who have received CIs. As a result, we continue to review the variety of methods we use to provide the recommended +20 dB level of instructional volume over background noise; a signal to noise relationship that is particularly critical for successful CI use in the classroom. To help students with CIs, we first evaluate the acoustic environment for reverberation and noise sources not dependent on the occupants of the space. Then we examine the physical set-up of the classroom and the teacher’s management strategies and teaching style. Only after these aspects are considered can we focus on assistive listening devices (ALDs) that meet the need to provide the +20 dB signal advantage and yet are appropriate for a student’s ability, degree of mobility, and compatibility with their CI speech processor. All of our students using cochlear implants now have ear-level speech processors. We use both sound field (desktop) ALDs and direct audio input FM receivers. The most recent advancements in direct audio input FM receivers allow us to check the FM reception and eliminate noise associated with termination of the FM transmission. Fitting a direct-input receiver requires a high level of commitment and cooperation on the part of the teachers. The balance between the environmental and FM signals in the speech processor must be considered in determining the effectiveness of a direct FM device. While we do not currently map speech processors, our students have highly proficient clinical audiologists who conduct the programming. This allows us to consider the direct audio input FM option. Training of teachers and being flexible in our services are keys to successfully serving these students.

Currently, we serve eight students who have received cochlear implants. There are few common threads among these students other than each of them has had CI surgery. Each student has an individualized education plan which includes speech-language services, a deaf education intervention specialist’s services, audiology services, and accommodations. Age of implantation varies from 2 years to 16 years of age.

**Descriptions of the CI Students**

One seven-year-old female student had a failed implant secondary to the effects of meningitis prior to moving into our district at age 4. Her mother preferred that she not be re-implanted or undergo another surgical procedure to have the implant removed. She vocalizes when expressing strong feelings or to gain the attention of a hearing person but uses manual communication proficiently and is in a total communication program with inclusion for some academic instruction. One 14-year-old male student was implanted at the age of five. He had a body-style speech processor until this school year. He brought the body-style processor to school less than 50% of the time. He was excited to get the ear-level his speech processor at the beginning of the year but now removes it when not in class. Because of the model and age of the internal component, he cannot use the most current processing strategies. This student is tri-lingual and is a proficient speechreader. He is fully included with hearing students for all instruction and has a sign language interpreter and support from a deaf education teacher to continue his success in the general education classroom.

Two female students with CIs transferred into our district this school year. One, in the first grade, is 8 years old and an auditory-oral communicator, has binaural implants, and is fully included in general education with support services. The other, in the second grade, uses total communication and prefers simultaneous speech and sign language expressive language. Her family also uses total communication and she receives reading, science, and math instruction in the general education classroom with a sign language interpreter.

Two male teenagers were recently implanted. Both are prelingually hearing impaired. The 16-year-old student has binaural implants, and is fully included in general education with support services. The other, in the second grade, uses total communication and his speech is intelligible for social communication to familiar listeners. His emotional stability appears to be a factor in the amount of time he wears his speech processor. At school, he wears the speech processor for up to one hour. The 13 year old has an
asymmetrical hearing loss with a severe-moderate upward sloping sensorineural hearing loss in his better hearing ear. He also uses total communication but uses only speech with peers and adults who do not sign. This student wears his speech processor when it is working but has had an above average number of problems with cord malfunction. When wearing the implant, his voice quality is more natural and his speech is intelligible to unfamiliar listeners for all but new vocabulary. Both of these teens are continuing with “fine tuning” their speech processors at their implant center.

Our most successful implant user is an eighth grade female student who was post-lingually deafened. She has other learning/memory weaknesses and was in a self-contained auditory-oral classroom 50% of her school day in elementary school. While she had a hearing impairment when entering school, her hearing did not begin to fluctuate dramatically until she was in the fifth grade. She had sudden onset deafness without return of any useable hearing and began using sign language in the sixth grade. She received her implant in the seventh grade and was soon able to complete open-set discrimination tasks. Her voice quality, articulation, and conversational language are age appropriate. This student is fully included with supportive tutoring and is highly perceptive in her ability to recognize difficult listening situations. She uses direct audio input FM with her speech processor for large group instruction but prefers not using the FM system for small group instruction and student discussion activities.

Our most recently implanted deaf student is four years old and is severely developmentally delayed. Prior to entering preschool, he had not used amplification so his school hearing aids were his first experience with amplification. He is just beginning his mapping sessions and it is uncertain how he will progress in light of his non-auditory disabilities and only partial insertion of the electrode array into the cochlea.

While we have a small number of students with cochlear implants in our district, the level of success appears to be tied to factors reported in the literature and the factors considered in determining optimal candidacy. These factors include post-lingual deafness, cognitive level, physical wellness, family commitment, and desire of the child to use hearing as a primary mode in communicating. Since school is one of the important natural environments for children, we would like to be more actively involved in providing data to the implant centers that would facilitate the clinical processes.

The Ohio Cochlear Implant Task Force is currently developing practice guidelines that will assist in clarifying the schools’ role in collaborating with implant centers and the children we both serve. There are many students who, by audiometric criteria, would be candidates for cochlear implantation, such as students who have profound deafness, who have not benefited from amplification, and whose families have not learned sign language. These are also the children that implant centers reject due to lack of compliance with pre-implant appointments and do not have family support for intensive verbal communication practice at home. Another half of our families whose children are deaf appreciate and value the benefits of Deaf Culture and choose not to pursue cochlear implantation as an option.

Conclusion

Although most students receiving audiology services have hearing impairment, many also have other disabilities such as learning disabilities, cognitive delays, visual impairments, or autism. Some students we serve have unilateral hearing loss, poor auditory comprehension of language, attention deficits, temporary hearing loss, or effects of past hearing loss. We assist school teams in determining accommodations and assessing the benefit of using assistive listening devices, along with the intervention process. Our audiologists maintain the district audimetric equipment, participate in a variety of administrative and teacher-based committees, consult with teachers and the Human Resources Department to assist in accommodating hard-of-hearing, deaf, and voice disordered staff. Like all audiologists, we continuously review technology changes, amplification strategies, therapeutic materials, test techniques, funding sources, and laws and regulations that impact our students and field of expertise. The “educational” in educational audiologist means that we must also continuously update our knowledge of academic curriculum and standards, teaching techniques, and district and Ohio Department of Education policies and documentation.

Being audiologists in the Cincinnati Public Schools is both rewarding and frustrating. Rewarding because we are included in teams with families, we get to see our students blossom in their daily lives, we receive administrative support allowing us to provide the highest level of technology available, and we feel appreciated for our work. Frustrating only because we would like to do more for our students and families, many who have obstacles of daily survival in their lives. We close this report by sharing one of our most unusual activities as educational audiologists. We teach individual science classes to fourth and fifth grade students as a means of introducing and reinforcing students’ knowledge of hearing conservation and noise pollution. This gives us the opportunity to experience classroom teaching, to reach out to many more students, and to practice classroom management techniques. Last year we started a poster contest for Better Hearing and Speech Month with some of the classes we taught. The students voted on their favorite posters for impact of the message and overall appeal. Here are the winner and runner-up posters. (Please see following pages for posters.)

Edited by: Beth D'Amico and Laura W. Kretschmer
Celebrate May Better Hearing & Speech Month

A loud radio hurts my ears.

Hearing conservation

2004 Poster Contest Winner

COMMUNICATION for LIFE
Better Hearing & Speech Month

COMMUNICATION for LIFE

2004 Poster Contest Runners Up
The theme for the next issue of *Hearsay* is Literacy. The Guest Editor for this issue is Jo-Anne Prendeville, Ph.D., of the University of Cincinnati. In the past decade ASHA has published a number of position statements, technical reports, and guidelines for the roles and responsibilities of speech-language pathologists with respect to reading and writing. Professional competencies related to literacy are addressed in several ASHA publications, such as the Scope of Practice statement and the Code of Ethics. Speech-language pathologists and audiologists are obliged to address prevention of literacy difficulties, identification of children, adolescents, and adults with reading and writing problems so that they may receive appropriate attention, assessment of reading and writing abilities as related to spoken communication, academic achievement, and functional and adaptive behaviors, provision of effective intervention for problems involving reading and writing, documentation of outcomes, and provision of information and assistance to families, general education teachers, and other service providers.

In recognition of this broadened scope of practice, this theme evokes a wide range of subject matter. We are interested in submissions from speech-language pathologists and audiologists whose professional practice has included interventions with preschool and school age children, adolescents, and adults. We invite research and observations conducted by speech language pathologists and audiologists regarding children and adults’ initial acquisition of literacy skills as well as the rehabilitation of literacy skills in children and adults who have sustained loss. Speech-language pathologists and audiologists are invited to share their specialized knowledge related to the nature of literacy, including spoken-written language relationships and reading and writing as tools for communication and learning. Typical development of reading and writing, literacy difficulties that coexist with spoken language disorders, and clinical methods for targeting reciprocal spoken and written language enhancement. Possible topics include but are not limited to:

- Interventions related to reading and writing in children and adolescents are essentially collaborative in nature. Speech-language pathologists and audiologists work collaboratively with families, teachers, and other professionals to meet the literacy learning needs of preschoolers, school age children, adolescents, and adults with disabilities.
- For school-based speech-language pathologists and audiologists, a focus on literacy has occasioned interactions with students who are in the mainstream and not identified as having disabilities, but who may be struggling or are at risk for difficulty mastering the language and literacy demands of the curriculum. Prevention, assessment, and intervention strategies may be reported.

\[\text{• Reports of techniques or practices used to enhance phonological awareness and reading skills such as decoding, phonics, comprehension, and fluency}\]

\[\text{• Reports of techniques or practices used to enhance written language, including spelling}\]

\[\text{• Innovations in preprofessional development as might take place in graduate degree programs or at student teaching sites as well as innovative in-service and other professional development practices}\]

\[\text{• Information about literacy conferences, professional organizations in literacy, and Internet resources}\]

\[\text{• Information on efforts such as Reading Recovery, The National Reading Panel, and Reading First}\]

\[\text{• Observations on the nature of literacy needs in populations served by speech-language pathologists and audiologists, such as persons with learning disabilities or phonological impairments}\]

\[\text{• Literacy assessment instruments}\]

\[\text{• Providing literacy services for bilingual children and adults, interfacing with English as a Second Language and other programs, and providing services that are sensitive to linguistic and cultural diversity}\]

We invite you to submit articles pertinent to this theme, to seek out others who might be interested in writing, or to contact the column editors who are listed in the front of this journal to discuss your ideas. As always, we welcome submission of any research that would be of interest to our readers whether it relates to the theme for the next issue or not. Please send submissions for the next issue by e-mail to prendejw@email.uc.edu, by surface mail to Dr. Jo-Anne Prendeville, University of Cincinnati, OH 45267-0379, or by FAX at 513-558-8500. Phone inquiries are welcome at 513-558-8517. To send letters to the editor or to volunteer to serve as a column editor, forward correspondence by e-mail to Dr. Laura W. Kretschmer, Managing Editor, at laura.kretschmer@uc.edu, by surface mail to Mail Location 379, University of Cincinnati, 45267-0379, by FAX to 513-558-8500, or by voice to 513-558-8514.

*Monica Gordon Pershey, Ed.D.*

*Associate Editor*

*mgpershey@att.net*