Introduction to Audiologic Rehabilitation

Facilitating Communication Across the Lifespan

EIGHTH EDITION

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Preface

Our introductory Audiologic Rehabilitation text first appeared in 1980 and with this new edition we (Ron and Mike) have been happily engaged with this editing for 45 years now. It is with profound gratitude and pride that, along with three new editors (Gabe, Kristina, and Chris), we bring you this eighth edition from our new publisher (Plural Publishing). We believe Plural will provide you with the very best in print and electronic versions along with website support. This textbook is intended for use by both undergraduate and graduate students in communication disorders and other related fields. Our new editors have certifications in both audiology and speech-language pathology (in various combinations) and so we have even more expertise to make this text inclusive. With this edition, we are bringing on not only new editors but also a new set of authors who are helping us transition and freshen each of the 12 chapters.

During the years since 1980 we have witnessed remarkable advancements in audiologic rehabilitation. This includes improved methods for early identification (ABR and OAE) and the miracle of cochlear implants. We have seen improvements in hearing aids and hearing assistive technology (HAT). The internet and Bluetooth have transformed wearable ear-level devices. Audiology as a profession has progressed and moved from the master's (MS) in audiology to the doctor of audiology (AuD) as the entry-level degree. More and more of those with hearing loss are identified earlier and in more settings. They are using these hearing devices along with other rehabilitative measures more extensively because the devices are more accepted and vastly improved.

The improvements from the previous edition include:

- Discussion of current issues and trending topics, including over-the-counter hearing aids
- Highlights related to telepractice and teleaudiology
- Updating of diversity, equity, and inclusion topics related to hearing health disparities and audiologic rehabilitation
- Updated recommended readings
- Updated references
- Updated websites

In addition, the text will now come with access to a PluralPlus companion website: **https://www.pluralpublishing.com/publication/itar8e**. For instructors, the site includes PowerPoint slides, a test bank, and activities. The interactive area for students includes videos, study quizzes, learning activities, links to related resources, and downloadable forms. Many of the supplementary activities have been carried forward from the previous edition, and there are new activities that professors can assign to students in a selective fashion. Jeff Brockett continues to provide a helpful website as he has in the past, with supplementary learning activities and resources to support the students and faculty members who use our text.

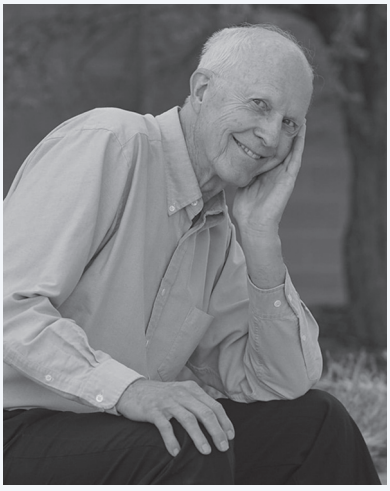
The suggestions of a large group of reviewers who use our text have helped us make improvements. We thank them for their input.

We thank our families and colleagues for their encouragement and enduring support, as well as the universities that have sustained us all these years and continue to do so. They all have been remarkable and have been good to us for more than four decades as we have worked on this text.

Our involvement (Ron and Mike) in this edition is diminished from the last one, but we have worked with all the new editors as they have been taking over and selecting new chapter authors with exemplary expertise. We are pleased with this new combination of talent available to you in these pages. We feel you will recognize that this new edition is comparable to what you have come to expect from us in this long-standing resource. We look forward to your feedback. We want you to know you can expect that we and our new editors, authors, and Plural Publishing will maintain this textbook and its companion website as a valued resource for you in the years ahead.

—Ron Schow, Mike Nerbonne, Gabe Bargen, Kristina Blaiser, and Chris Sanford

About the Editors



Ronald L. Schow, PhD, is Professor Emeritus at Idaho State University, where he has been a member of the faculty since 1975. He earned his PhD at Northwestern University, where his major advisor was Raymond Carhart, who started the first training program in audiology at Northwestern University in 1947. In 1980, he and Mike Nerbonne edited the first edition of this text and since that time have been leaders in audiologic rehabilitation. He is a charter member of the International Collegium of Rehabilitative Audiology and an ASHA Fellow. Dr. Schow also has made major contributions in self-assessment and auditory processing disorders (APD). He led an effort to do a national normative study on APD and, with Academic Therapy Publications (ATP) and coauthors, they published MAPA-2 in 2018. ATP provides a commercial version of the CD and supportive materials for MAPA-2. Dr. Schow continues to be involved in audiology with a grandson now majoring in the Idaho State University AuD program. He still enjoys his hobbies of hiking, travel, and family activities.

Michael A. Nerbonne, PhD, received his PhD at Michigan State University and is Professor Emeritus of Audiology at Central Michigan University. He has published widely in professional journals, is coauthor of *Communication Disorders of the Aged*, and is coeditor of seven editions of *Introduction to Audiologic Rehabilitation*. In addition to his ongoing commitment to audiology, Dr. Nerbonne is focused on family time and fishing.

Gabriel A. Bargen, PhD, CCC-A/SLP, is Associate Professor of Audiology within the College of Health and Executive Director of the Health Science Center at Idaho State University. With a background in both speech-language pathology and audiology, pediatric audiology is her passion with over 15 years of experience teaching undergraduate and graduate courses including advanced aural rehabilitation and pediatric audiology. Dr. Bargen's research strives to improve education and training for audiologists and early interventionists to provide exceptional services to children who are deaf and hard of hearing and their families

Kristina M. Blaiser, PhD, CCC-SLP, is a Professor of Speech-Language Pathology at Idaho State University and the director of the ISU Helping Adults Talk to Children (HATCH) Family Support and the Idaho Hearing Education and Aural Rehabilitation (IHEAR) Graduate Training Program. Dr. Blaiser's experiences range from early intervention provider, aural rehabilitation specialist at a cochlear implant center, to executive director of schools for early education of children who are Deaf/Hard-of-Hearing. Dr. Blaiser's research focuses on implementing innovative ways to provide family-centered early intervention. Dr. Blaiser has served as the Coordinator of Special Interest Group 9, Pediatric Hearing and Hearing Disorders and the Special Topics Chair for the Council of Exceptional Children Division for Communication, Language, and Deaf/Hard of Hearing (DCD).

Chris A. Sanford, PhD, CCC-A, is a Professor in the Audiology Program in the Department of Communication Sciences and Disorders and Associate Dean for Research and Faculty Development in the College of Health at Idaho State University. Dr. Sanford has taught undergraduate and graduate courses in the audiology program, conducted research, mentored students in clinical and research activities, and served in administrative roles. He thoroughly enjoys working with amazing students and dedicated colleagues at Idaho State University! His primary clinic and research interests have centered on pediatrics assessment techniques with goals of improving diagnosis and treatment of hearing disorders and providing the best care possible for children and their families. When he's not at work, Dr. Sanford enjoys spending time with his family, including hiking, mountain biking, and trail running in the beautiful mountains of Idaho!

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CHAPTER 6

Language and Speech of Individuals Who Are Deaf and Hard of Hearing

Kristina M. Blaiser and Gabriel A. Bargen

CONTENTS

LEARNING OUTCOMES

After reading this chapter, you will be able to:

- List the communication modes commonly used with children who are Deaf/hard of hearing (DHH)
- Identify how hearing loss can impact speech development
- Describe a Speechmap and identify the amplification goal when using a Speechmap with children who are DHH
- Describe the benefit of full-time use of a hearing assistive device with children who are DHH
- Identify assessments that can be used with children who are DHH
- List three language characteristics of children who are DHH
- List three speech characteristics of children who are DHH

Introduction

A primary consideration for the development of children who are Deaf/hard of hearing (DHH) is the ability to access the language around them. Reduced access to language can have a tremendous impact on the communication development of young children with hearing loss and their families. Today, increases in newborn hearing screening and advances in hearing technology have significantly changed when and how young children can access language. One of the most important changes to the field of aural rehabilitation is the increased use of cochlear implants with young children. As of 2019, in the United States, more than 65,000 children have received cochlear implants (National Institute on Deafness and Other Communication Disorders, 2021). Because of increased opportunities for auditory access at younger ages, the speech and language outcomes of today's children are not limited by the degree of hearing loss; even children with severe to profound hearing loss can develop age-appropriate speech and language skills. Today's audiologic rehabilitation (AR) services often focus on helping children to develop speech and language skills close to the time that they were biologically intended to; this can be referred to as "developmental synchrony" (Cole & Flexer, 2020).

The term "hearing difference" encompasses all degrees and types of hearing loss, and is felt by some to be more inclusive than "hearing loss."

An important consideration for families of children with hearing differences is the language or communication modality that will match the family's goals for their child. When a hearing loss is diagnosed, families are introduced to the communication options available for children with hearing loss. It is the duty of audiologists, speech-language pathologists (SLPs), and other early intervention professionals to follow recommendations for best evidence-based practices that support a family's right to a thorough, unbiased explanation of the communication options as well as support of the family's communication choice.

"Language" is a broad term to describe a system of symbols used as a social tool for the exchange of information.

Communication Options for Families of Children Who Are Deaf/Hard of Hearing

It is important for families to be provided with unbiased information related to their communication options. The website BEGINNINGS for Parents of Children Who Are Deaf/Hard of Hearing (NC Beginnings, n.d.) offers a summary of communication options and brief

videos illustrating each of the approaches described below. Some communication options focus on developing spoken language as the child's first language by maximizing auditory skills through hearing technology. Today, auditory–verbal and auditory–oral techniques are combined under the label of "listening and spoken language (LSL)." In contrast to auditory-based communication modalities, American Sign Language (ASL) focuses on developing visual language with its own rules and syntax as the child's first language. There are also communication approaches that utilize a combination of visual information (such as signs and hand shapes) and auditory information (see Chapter 5 for additional descriptions of these communication approaches).

Systems Emphasizing Listening and Spoken Language

One form of LSL is the *auditory–oral approach*, which emphasizes the need for using residual hearing and consistent practice for developing spoken language. Full-time consistent use of hearing technology such as hearing aids, hearing assistive technology (HAT), and/or cochlear implants is an essential aspect of using spoken language, and caregivers are primarily responsible for supporting full-time use. Children enrolled in auditory–oral programs are typically educated in settings with other peers with hearing loss. In these settings, children typically receive therapy targeting speech, language, and auditory development, and caregivers are given related home activities to support these goals. While speechreading is no longer explicitly taught in most auditory–oral programs, the use of these visual cues is not discouraged.

The *auditory–verbal approach*, another form of LSL, also advocates the use of residual hearing for developing spoken language and is highly reliant on the use of amplification and/or cochlear implants. In this approach, auditory skills are emphasized instead of any visual cues. Auditory–verbal therapy focuses on teaching caregivers how to integrate LSL activities into daily life. Providers teach and support caregivers to be responsible for establishing full-time use of devices and are expected to integrate listening and language activities into their everyday life (such as getting dressed, washing dishes) and family routines.

Family-centered intervention involves shared responsibility with the caregivers for the child's intervention, with the family retaining the ultimate decision-making power regarding intervention goals and services. A major goal of family-centered intervention is to strengthen family functioning and communication, thus empowering the family to capitalize on its unique strengths when addressing the needs of the child who is DHH.

Manual–Visual Systems

ASL uses a distinct and natural language, different from spoken English, as the child's first language. Use of hearing technology is not critical to this approach; however, it remains an option. An essential element to successful acquisition of ASL is access to adults and community members who use ASL to provide fluent language models. If the caregivers are not fluent in ASL, they need extensive training and opportunities to practice the language. English is developed later as a second language with an emphasis on reading and writing (i.e., rather than spoken language). In recent years, some educators have embraced a bilingual–bicultural (or bi–bi) approach for education of Deaf children. In this model, children have exposure to both languages in their fluent forms: English is taught as a second language in written form, and ASL and Deaf culture are emphasized in the curriculum.

Adults who are Deaf or hard of hearing can serve as role models, or Deaf mentors, for families who have children who are identified with hearing differences. Access to these role models is considered best practice for family-centered early intervention (Garringer et al., 2015; National Deaf Center on Postsecondary Outcomes, 2019).

Bilingual–Bicultural

Parents of children with hearing differences have a wide variety of communication options for their children. While some families choose to use a communication option focusing on LSL, others use ASL or a bilingual–bicultural (bi–bi) approach. This method is based on the premise that children will learn ASL as the first and primary language,

with English taught as a second language in written form. It is important to recognize that many communication approaches vary from family to family. While some families who choose a bi–bi approach use no spoken language, others choose to supplement a bi–bi approach with some components of spoken language.

Case 6–1. B. R.

B. R. had meningitis at age 7 months, and a severe to profound hearing loss was subsequently identified. B. R. received a cochlear implant shortly after the hearing loss was confirmed, and LSL was initiated through early intervention services in the home. At the age of 3, B. R. attended a spoken-language preschool program with other children who are DHH. B. R. is now 6 years of age and in a mainstream classroom in his neighborhood school. While in school, he receives services from a teacher for the DHH and attends LSL services from an SLP at an outpatient clinic. B. R.'s mother is highly involved in his LSL therapy and in fostering his educational success. She has integrated language stimulation and communication strategies into his everyday life. Her engagement and involvement in B. R.'s intervention is a significant factor in his overall success. While there are still some delays compared to his hearing peers, he is within normal limits on standardized assessments. Current therapy goals include use of possessive and plural /s/ markers in spontaneous language, following multiple-step directions, and advocating for himself when he doesn't understand in the classroom.

Systems Combining Visual and Auditory Information

Cued speech involves the use of hand positions and shapes to resolve some of the ambiguities associated with trying to speechread words that look alike on the lips. Unlike fingerspelling, which is based on letters, the hand supplements associated with cued speech are based on phonemes or sounds of a language.

A transliterator uses cued speech to convey the information that is presented auditorily in English or another spoken language.

The Total Communication (TC) approach advocates the use of manually coded English, fingerspelling, speechreading, natural gestures, residual hearing, and speech. Use of amplification and/or cochlear implants is usually encouraged. In this modality, a combination of signs and oral communication is used. TC can range in how it is presented, from a model that is primarily sign based with the addition of spoken language to a model that is primarily spoken with an occasional sign used for clarification. The term "pidgin sign language" refers to signs or vocabulary from ASL used in English word order.

The Cued Speech approach requires family members and therapists to learn and use cueing, a set of hand shapes and movements used to visually differentiate phonemes that look alike on the lips. Typically, this approach would also include the use of residual hearing and a goal of developing spoken language. Individuals communicating with the child would be expected to cue while speaking or use a transliterator.

All communication options require extensive family involvement to be successfully generalized for the child's communication. It is important to remember that any of the communication options above can lead to successful language development. However, most options require therapeutic intervention, consistent use of appropriately fit hearing technology, and a commitment from the family.

Because more than 90% of babies born with hearing loss have two hearing parents (Mitchell & Karchmer, 2004), many families are likely to choose an option focusing on spoken language development. In addition, because of newborn hearing screening and advanced hearing technology, there is a trend for more families to choose and/or incorporate spoken

A young child works on communication skills in a therapy setting.

language options as part of the communication used in the home. In a North Carolina study, Brown (2006), from BEGINNINGS for Parents of Children Who Are Deaf or Hard of Hearing, reported that in 1995, 40% of families chose spoken language options, whereas in 2005, 85% of families chose LSL options (i.e., auditory–verbal and/or auditory–oral approaches). These numbers have remained consistent, if not grown, over time. The focus of this chapter is on characteristics and assessment of language and speech by children using spoken language. Sign language approaches are discussed in more detail in Chapter 5.

It is important to note that there are different terms based on hearing status and communication modality. "Deaf" (with a capital "D") signifies a person with a severe/profound loss who identifies with the Deaf culture and ASL, while "deaf" (with a lowercase "d") is representative of a severe/profound level of hearing loss without the cultural identity while making full use of residual hearing. The term "hard of hearing" is generally used when a person has a slight to mild to moderate hearing loss. An emerging term, "hearing differences," is being used with more frequency and encompasses all degrees and types of hearing loss.

Hearing as the Foundation for Speech and Language

Hearing allows for the development of speech perception. By 6 months of age, children with normal hearing have learned to discriminate among the sounds of their native language (Kuhl et al., 1992). The critical importance of early hearing is also indicated by data that show the benefits of identifying and managing congenital hearing loss within the first 6 months. Children with hearing loss who have received appropriate management by 6 months of age often develop age-appropriate speech by age 5 (Downs & Yoshinaga-Itano, 1999).

In their often-cited study, Yoshinaga-Itano et al. (1998) found the following:

- The first year of life, especially the first 6 months, is critical for children with hearing loss.
- Young children (1 to 3 years old at the time of this study) who were enrolled in early intervention by 6 months of age demonstrated significantly better receptive and expressive language skills than did children who were enrolled in early intervention after 6 months of age.

Technology use is a key issue when families choose to use spoken language. Infants and children with hearing differences may be fitted with hearing aids, FM/DM systems, bone-anchored hearing aids, and cochlear implants. (Refer to Chapters 2 and 3 for further information on these devices). With hearing aid and FM/DM systems, many pediatric audiologists now use real-ear probe tube verification measures to demonstrate that speech sounds are within the child's residual hearing range. It is essential that audiologists effectively communicate with parents, early interventionists, and SLPs about the proportion of speech (or the "speech banana") and speech sounds that are audible with hearing technology.

Fruits and Vegetables of Hearing. The speech banana refers to the shape that is made when sounds of speech are graphed on an audiogram. The speech stringbean is the much thinner shape that is needed for speech to be audible for spoken language development.

When deemed appropriate, infants with hearing differences can and should be fitted with hearing aids within weeks of hearing loss diagnosis. Pediatric audiologists are key to successful hearing aid fittings for infants. Audiologists know about concerns and issues unique to pediatric fittings, such as the need for using estimated hearing level (eHL) thresholds based on auditory brain stem response findings; real ear to coupler difference (RECD) thresholds; and probe-tube real-ear verification measures, digital signal processing features, child-size earhooks, hearing aid retention devices, hearing aid insurance, childproof battery doors, frequent replacement of earmolds, ongoing hearing evaluation to further define hearing sensitivity, and the extensive parent support needed to establish full-time use of hearing aids. Newer signal processing strategies in digital hearing aids are of great benefit in the pediatric population, including feedback cancellation to allow for greater gain without feedback and frequency compression to bring high-frequency sounds that cannot be amplified into the audible range. In addition to ensuring optimal hearing aid amplification, the pediatric audiologist can also determine whether the fitting of an FM system may offer additional benefits.

The display that many audiologists now examine to verify pediatric amplification goals is the *Speechmap*, which is a graph of the child's hearing loss for one designated ear in decibels sound pressure level (dB SPL) near the eardrum (i.e., a value that is generally calculated based on threshold estimates from auditory brain stem evoked response measures or behavioral audiometric thresholds). Figure 6–1 displays a Speechmap using the wideband real ear to coupler difference (WRECD) on the Audioscan Verifit 2. The WRECD utilizes the 0.4cc wideband coupler in place of the more traditional 2cc coupler to raise the high-frequency SPL of the hearing aid, making the rising noise floor of the coupler microphone less significant (Audioscan, 2023). The WRECD Speechmap displays the response of the WRECD transducer in the 0.4cc coupler (smoother top line) and in the real ear as well as the difference between these curves, which is the WRECD. The WRECD is displayed toward the bottom of the graph close to the age-appropriate average WRECD shown for reference (dotted line). Figure 6–1 shows that WRECD approximates the average WRECD from 250 through 4000 Hz. On some test systems, this display can be plotted in decibels hearing level (dB HL), the decibel that is displayed on the audiogram, and that display might be more easily interpreted by those familiar with the audiogram.

Full-time use of hearing technology can be challenging with young children. Full-time use is achieved when children wear their hearing technology during all waking hours of the day. Full-time use of hearing aids and/or cochlear implants supports brain development that

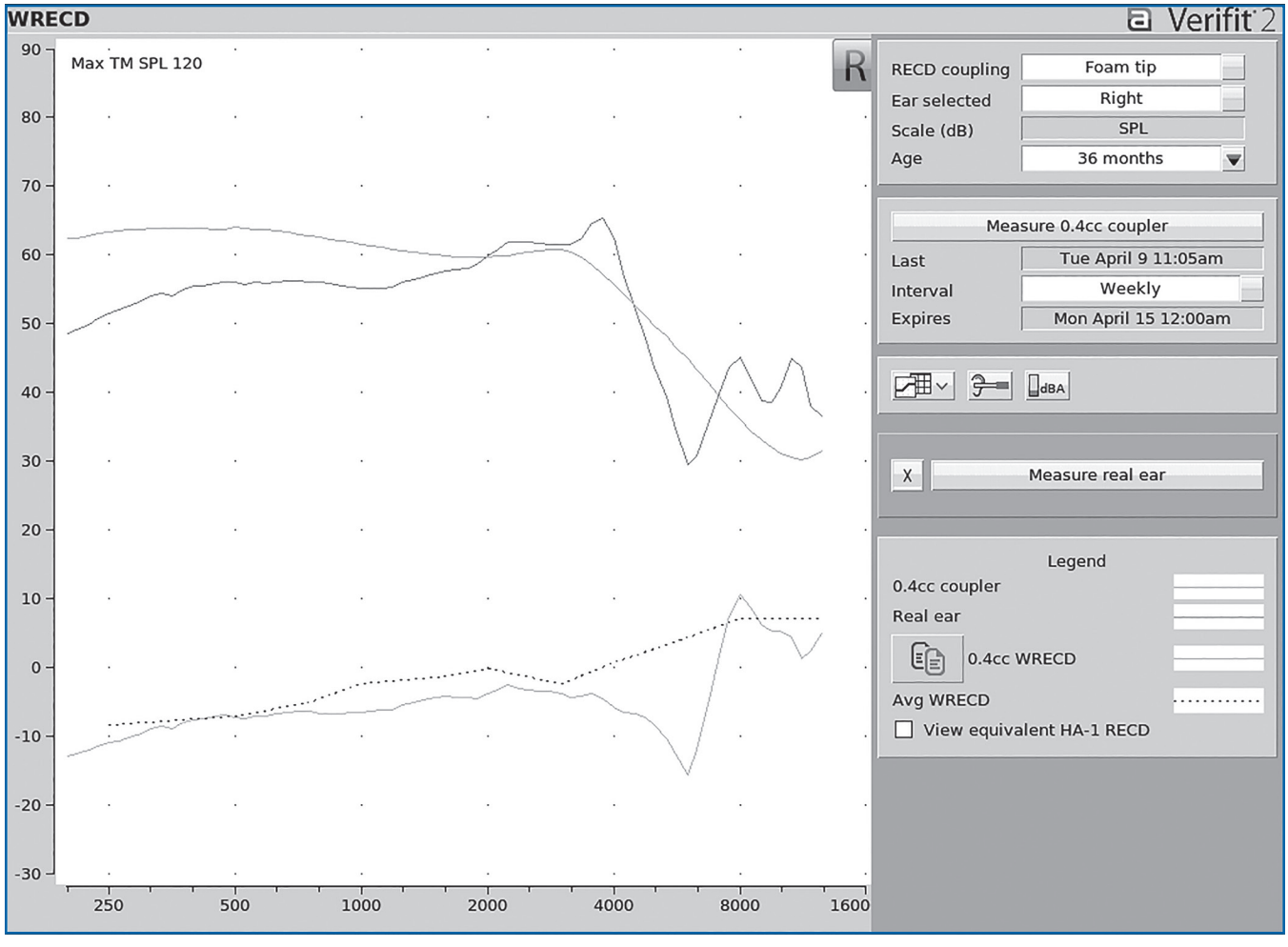

FIGURE 6–1. Speechmap for a 3-year-old child using WRECD with the Verifit 2. The WRECD measurement screen shows the response of the WRECD transducer in the 0.4cc coupler (smoother top line) and in the real ear; the difference between these curves is the WRECD, which is close to the age-appropriate average WRECD, which is shown for reference (dotted line). *Source:* Audioscan.

allows for maximizing speech and language development. Professionals (i.e., audiologists, SLPs, and early intervention providers) need to work together to help caregivers understand the benefits of full-time use and develop strategies for their child's hearing aids and/or cochlear implants. There should be open and consistent communication between professionals and caregivers to discover and address families' barriers to full-time use of hearing technology. Audiologists can help ensure the device is programmed appropriately for the child's hearing loss and make the device more comfortable (e.g., modify or make a new earmold); early interventionists can provide parents with retention strategies for use in the home (e.g., child-friendly "pilot" caps for the toddler who is pulling out hearing aids).

Ideally, most babies will be fitted with hearing aids by 3 months of age, and, in cases where limited hearing aid benefit is observed, cochlear implants may be an option. While U.S. Food and Drug Administration guidelines suggest that cochlear implants are surgically placed around 9 months of age because of the benefits of early auditory stimulation, some children receive cochlear implants prior to 9 months of age (Nicholas & Geers, 2013; Waltzman &