CHAPTER 5

BEST PRACTICES IN EARLY INTERVENTION AND PK-12 EDUCATION OF DEAF AND HARD OF HEARING CHILDREN

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Abstract

Deaf and hard of hearing (DHH) children may have inconsistent access to language from infancy. Language deprivation may happen as a result, which could consequently impact their linguistic, academic, cognitive, and socio-emotional development. This chapter provides an introduction to audiological terminology and the hearing process, a description of two differing perspectives of deafness, a summary of the implications of language deprivation, and an explanation of best practices in education for DHH children. Best practices for DHH children focus on early identification and intervention services, including audiological and family-centered interventions, language and literacy interventions, and educational placement and learning environments. Using the best practices described in this chapter, educators can ensure that DHH children receive appropriate educational interventions and services to meet their unique needs.

Keywords: best practices, early intervention, language deprivation, K-12 education, deaf and hard of hearing

Introduction

The purpose of this chapter is to present a scoping explanation and summary of best practices in education of deaf and hard of hearing (DHH) children and to discuss how these practices can be used to improve linguistic, academic, and social-emotional outcomes for them. We begin this chapter with a description of the hearing process and what it means to be deaf or hard of hearing, including the medical and cultural perspectives. As a foundation for both perspectives, it is important that the reader understand that deafness in and of itself does not cause developmental delays. It is the lack of access to and development of a natural first language that causes these delays. Going forward, we refer to this as language deprivation (Humphries et al., 2016). After a description of the hearing process, a section describing differing perspectives of deafness is provided, followed by an implications section that describes the linguistic, academic, cognitive, and social-emotional consequences of language deprivation experienced by many DHH children. Finally, the best practices section describes issues around identification, early intervention, K-12 education, and the needs of special DHH populations.

The Hearing Process

Before discussing deafness, one must understand how hearing works. Figure 1 shows the parts of the ear that support the series of steps that change sound waves in the air into electrical signals to the brain. Sound waves enter the outer ear through the pinna and travel through the ear canal which ends at the eardrum. The waves vibrate the eardrum which sends mechanical signals to the tiny middle ear bones, the malleus, incus, and stapes. The Eustachian tube connects the middle ear to the nasal-sinus cavity and balances pressure in the middle ear. The middle ear bones increase the sound vibrations and send them to the inner ear, specifically the cochlea which is a snail-shaped, boney structure filled with fluid and hair cells. The vibrations from the middle ear cause the fluid and hair cells in the cochlea to ripple. The hair cells near the wide end of the cochlea detect high-pitched sounds, such as birds chirping, while the hair cells in the narrower center of the cochlea detect lower-pitched sounds, such as a large dog barking. Projections, called stereocilia, sit on top of the hair cells and create electrical signals that are picked up by the auditory nerve. The auditory nerve sends the sound to the brain where it is recognized and processed. The inner ear also contains the semicircular canals, that assist with balance, and the vestibular nerve, that sends messages to the brain about motion and position.

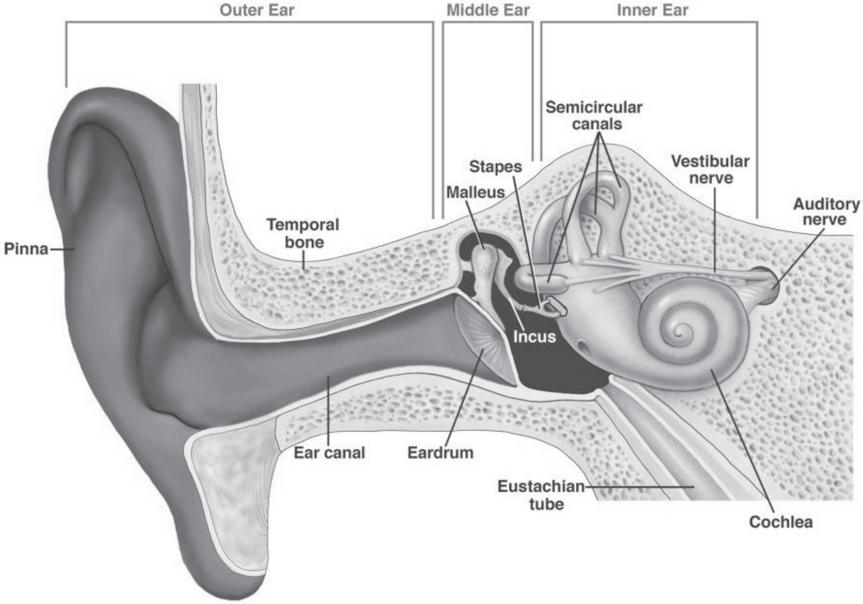

Figure 1: Parts of the Ear. Retrieved from the National Institute on Deafness and Other Communication Disorders, https://www.nidcd.nih.gov/health/how-do-we-hear

Perspectives of Deafness

How does one define deafness? How does deafness differ from hard of hearing? What description is there that can apply to all DHH children and persons? The deaf population in the United States (U.S.) is not easily categorized, due to its heterogeneity (Mitchell, 2017), but there are two main perspectives that can provide insight: medical and cultural (Kermit, 2009; Mitchell, 2017; Young & Temple, 2014). All perspectives agree on one common characteristic: a level of hearing loss. How deaf children and adults respond to and incorporate their deafness in their lives is where the perspectives differ. What is known, however, is that deaf students have unique communication, language, and cultural characteristics (Lane, 2005). Some students may use visual language modalities such as American Sign Language (ASL), while others use spoken languages like English or Spanish (Cawthon et al., 2015). Some may alternate between both modalities. The accommodations available to students may range from sign language interpreters, hearing assistive technology, and speech-to-text recording

(Cawthon, 2009). Whatever differences there may exist amongst the perspectives and their educational implications, many DHH students experience language deprivation and have significant delays in language and language-related competencies, which are enduring challenges for deaf educators (Antia & Kreimeyer, 2015).

Medical Perspective. The medical perspective centers on the hearing loss itself, including the type and degree of hearing loss, hearing function, potential medical and technological interventions, and treatment plans. Table 1 provides a list of terms and definitions associated with the medical condition of hearing loss. Roughly 90% of DHH children in the U.S. are born to hearing parents who use spoken language (National Institute on Deafness and Other Communication Disorders [NIDCD], 2015). For these parents, their first encounter with a deaf person may be their own child (Knoors, 2016). As such, these parents may rely on information from medical professionals and other hearing parents to make decisions regarding communication, which is often in support of spoken language development since that is the language of the home (Meadow-Orlans et al., 2003).

Table 1: Medical Terminology

Term	Definition
Audiogram	A sound chart that graphs the DHH child's hearing ability
Bilateral	Hearing loss that is present in both ears
Conductive	A type of hearing loss that is caused when sound waves cannot get through the outer or middle ear
Congenital	A hearing loss that is present at birth
Decibel (dB)	A unit that measures the intensity or loudness of a sound
Hertz (Hz)	A unit that measures the frequency of a sound
Later-onset or acquired	A hearing loss that occurs after birth
Mild	A hearing threshold between 25-40 dB with the DHH child missing some sounds in the speech banana
Mixed	A type of hearing loss that is a combination of both conductive and sensorineural
Moderate-to-severe	A hearing threshold between 55-70 dB with the DHH child needing amplification to access sounds
Profound	A hearing loss greater than 90 dB

Progressive	A hearing loss that continues to worsen over time
Sensorineural	A type of hearing loss that is caused when there is an issue with the inner ear
Severe	A hearing threshold between 70-90 dB; the DHH child may benefit from amplification to access sounds
Speech banana	The area on the audiogram where human speech is at a conversational level
Unilateral	A hearing loss that is present in only one ear

Audiologists and other medical professionals describe a hearing loss in terms of when it occurred, how many ears are involved, and the type and level of loss (Foust & Hoffman, 2022). If the DHH child has hearing loss at birth, it is described as congenital, but if the loss occurs after birth, it is described as later-onset or acquired. If the child continues to lose hearing, it is described as progressive. Unilateral means the loss is in one ear, but if the loss is in both ears, it is bilateral. Potential medical and technological interventions and treatments may depend on what type of hearing loss the DHH child has. A conductive hearing loss occurs when sound waves cannot get through the outer or middle ear, such as the presence of earwax, ear infection, or malformation. Conductive hearing losses may be temporary or permanent, depending on if a medical intervention, such as antibiotics to resolve ear infections or surgery to correct malformations, is available (Foust & Hoffman). Sensorineural hearing loss happens when there is an issue with the inner ear, typically the cochlea. In such cases, the loss is nearly always permanent, due to genetics, illness, or trauma. A mixed hearing loss is a combination of both conductive and sensorineural hearing loss.

The audiogram (Figure 2) is a sound chart that graphs the DHH child's hearing ability. Audiologists measure and record various sounds, or tones of different frequencies, in Hertz (Hz). The lowest pitch is 125 Hz with lower-pitched sounds on the left, while the highest is 8000 Hz with higher-pitched sounds on the right. The intensity, or loudness, of the sound is measured in decibels (dB). Hearing levels at each frequency and intensity are plotted on the audiogram for each ear. The yellow-shaded area, colloquially known as the "speech banana," is the representation of human speech at a conversational level. Other sounds are provided on Figure 2 for reference. The audiogram helps us understand what sounds a person can access, which are the sounds below their plotted levels.

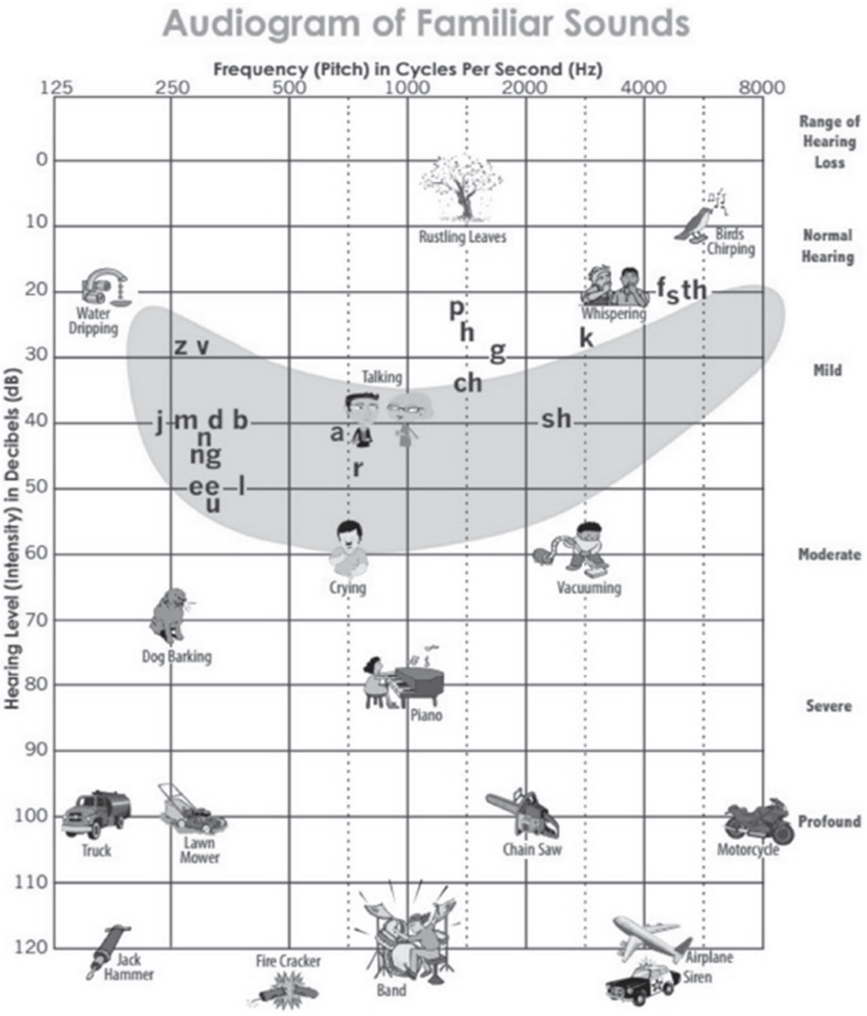

Figure 2. Audiogram with speech and environmental sounds. Retrieved from University of California San Francisco OHNS, https://ohns.ucsf.edu/audiology/education/peds

Children with normal hearing, defined as a hearing level at or above 25dB, are able to hear all the sounds in the speech banana. DHH children who present with a mild hearing loss (e.g., hearing threshold between 25-40 dB) would miss some sounds in the speech banana. A moderate-to-severe hearing loss has a threshold of 55-70 dB, and, without amplification, the child would not hear most of the sounds in the banana, if any at all. The threshold for a severe hearing loss is 70-90 dB. A hearing loss greater than 90 dB is considered profound. Medical treatment and intervention plans center on maximizing the child's residual hearing through hearing aids or recreating hearing through cochlear implantation (Foust & Hoffman, 2022). That said, it is important to keep in mind that sensorineural hearing loss is often accompanied by distortion of the accessible sounds. Hearing aids cannot correct these distortions, they will only amplify them along with the sounds at the given hearing level.

Cultural Perspective. The cultural perspective centers on the experience of being deaf, which includes community, identity, common experiences, and often sign language. Here, the use of terminology when presented in the context of the cultural perspective is particularly important. Some deaf people will use the big "D" as in "Deaf" to represent Deaf culture and identity. The lowercase deaf is used when discussing deafness from a medical perspective and the uppercase Deaf is used when referring to deaf people who share a common culture and language, usually American Sign Language (ASL; Padden & Humphries, 1990). For the purpose of this section, we will use the preferred term Deaf when discussing this perspective. It is important that the reader understand that sign languages are complete, natural languages that give the user the ability to convey abstract thought, emotion, and complex information equal to spoken languages (Stokoe, 2005/1960).

Deaf people see themselves as belonging to a community with a shared cultural identity, rather than as individuals having a hearing loss. While Deaf people may have negative feelings about being deaf, Deaf people consider themselves separate from people who have lost their hearing due to illness, trauma, or age (D'Silva et al., 2004). They do not use terminology such as hearing-impaired or deaf-mute. Typically, Deaf people may express pride in their deafness (Cherney, 1999). For instance, the term "Deaf Gain" was first coined by Aaron Williamson in 2005 when he wondered why doctors had told him he was losing his hearing as opposed to telling him that he was gaining his deafness. To better understand the concept of "Deaf Gain," Bauman and Murray (2009) suggest at least three of the following ASL signs (the ASL signs are provided in capital letters along with their associated English meanings in lower case letters): (a) DEAF INCREASE to express the opposite of hearing loss; (b) DEAF BENEFIT to show that Deafness is a benefit; and (c) DEAF CONTRIBUTE to show that Deaf people can and do contribute. However, Ladd and Lane (2013) posited that "deaf culture" is a term with a lack of historical perspective, suggesting the use of "Deafhood" in order to represent Deaf identities more fully while acknowledging audism and colonialism.

A few facets support Deafness as a culture: schools for the Deaf and educational centers that use sign language, Deaf clubs, organizations, and associations, Deaf children being born to and raised by Deaf parents and families, and sign language (D'Silva et al., 2004; Mitchell, 2017). Sign language is not universal; many countries have their own distinctive sign languages and other communicative approaches. ASL is an essential element of Deaf identity in the U.S. Cultural Deaf identity can be a fluid, everchanging process, particularly for Deaf children and teens who grow up discovering, confronting, rejecting, or accepting their identities (Ladd & Lane, 2013; Mitchell). The process of identity development may be more challenging for those deaf children with hearing parents instructed by educators who are not fluent in sign language (Hauser et al., 2010). For Deaf children to have better self-esteem, Bat-Chava (1993) identified three associated factors: (a) parents with a positive attitude toward deafness, (b) unimpeded access to communication at home, and (c) a sense of belonging and identification with people in the Deaf community. The medical and cultural perspectives do not necessarily exclude one another since they may intersect, but in the field of deaf education, they all hold different meanings and associated educational implications, so it is crucial for educators and practitioners to understand each one.

Implications of Language Deprivation

Communication is how people exchange meaning through ideas, thoughts, directions, and emotions. Most people communicate through spoken and written language (Knoors, 2016). Hearing babies begin their language development in the last 3 months of their mothers' pregnancies (Moon et al., 2012). When deaf babies are born to deaf parents who sign, they will begin using sign language after they are born, but when deaf babies are born to hearing parents who do not know sign language, they will have limited or no access to language which may lead to language deprivation and subsequent language delay. Despite the advances in hearing technology and early intervention, it takes time for the child to gain access to spoken or sign language. Researchers agree that the first 3 to 5 years of a child's life are crucial to language development, so delayed language access will result in consequences that may not be overcome (Cormier et al., 2012; Kral & Sharma, 2012; Mayberry, 2010, Mayberry & Lock, 2003; Niparko et al., 2010); delayed access to language can cause language deprivation (Humphries et al., 2016) and impact cognitive skills and cause mental health difficulties (Hall, 2017). Parents who choose listening and spoken language for their DHH child will turn to medical and technological treatments and interventions to resolve the communication issue, however, these treatments and interventions take time, and their children will experience a period of language deprivation should a visual modality not be used while waiting for medical interventions to take place. Because many hearing parents choose listening and spoken language for their DHH child without the inclusion of sign language (Gallaudet Research Institute, 2013), many DHH children begin their education with language, literacy, and general academic delays.

According to Easterbrooks (2021, p.52),

> "…..the more language a DHH child acquires, the better outcomes are possible across all domains; this is an indisputable fact."

One cannot read without a foundation language (Perfetti & Sandak, 2000), yet many DHH children lag in language-related areas when compared to their hearing peers. They have smaller lexicons, lower reading vocabulary, less incidental learning, and narrower conceptual understandings (Knoors & Marschark, 2014; Luckner & Cooke, 2010; Traxler, 2000). They experience challenges with understanding some concepts because of their abstract nature (Rusvold et al., 2018). As is the same for hearing children, there exists a strong correlation between vocabulary knowledge and reading comprehension for DHH children (Luckner & Cooke). Vocabulary growth has been linked to cognitive elements such as processing speed, phonological short-term memory capacity, and working memory (Montgomery et al., 2010). Researchers have found DHH students to have delays in these areas (Kronenberger et al., 2014). Despite the strong interest in DHH students' literacy from parents and teachers, it has been found that deaf students are delayed in reading (Antia et al, 2020). The struggle with language also appears in DHH students' writing (Trezek et al., 2011). Moreover, the struggle may extend to their math scores as well (Kelly & Gaustad, 2006). This has far-reaching implications as DHH students with better language scores tend to have better postsecondary outcomes (Convertino et al., 2009; Cuculick & Kelly, 2003).

Not only does language deprivation impact linguistic and academic domains, it also affects the child's socioemotional maturity and readiness to learn (Beck et al., 2012). According to Antia and Kreimeyer (2015, p. 2),

> "….hearing loss has the potential to isolate children and prevent them from the kinds of social interaction in which most children engage."

Most hearing children have unimpeded access to linguistic communication at home and can learn about acceptable social behaviors and rules from their parents, but if DHH children are born to hearing parents who do not know or use sign language, their access to and ability to learn this information is impeded. Compounding these issues is the fact that DHH children placed in general education settings are often the only DHH child in the classroom or school and have only limited communication with their same-aged peers. These social and communication difficulties can result in undesirable behaviors such as tantrums and physical aggression at school or at home (Antia & Kreimeyer). According to Dammeyer (2010), it is estimated that emotional difficulties, feelings of loneliness, and behavioral problems are present in 20 to 50% of deaf children. They grow up unable to engage in social relationships with peers or not gaining societal acceptance (Janney & Snell, 2006). This kind of disabling social environment may endure into their adulthood (Mitchell, 2017), and often work.

Not all DHH children have delays across developmental domains, but it is likely that the neediest of DHH children have experienced significant language deprivation, which is a factor that educational practitioners should take into consideration. Howerton-Fox and Falk (2019) have argued that DHH children, particularly those who use sign language, function similar to children who are English Language Learners. It is easy to see how DHH children who learn sign language as infants from their deaf parents and DHH children whose home language is something other than English fit into this category. It is less clear how DHH children who are exposed to sign language from less-fluent parents fit into this group. These children typically experience the most significant language deprivation and would benefit from intensive language and academic supports.

Best Practices for Children who are Deaf or Hard of Hearing

Many factors influence best practices for DHH children, including socioeconomic status of the family, age of identification, presence of additional disabilities, early access to language, and school placement. While families wait for medical interventions to be put in place, support for language development does not have to be delayed if the family is willing and able to use sign language, which is an effective way of preventing language deprivation as it provides tactual and visual access to language from an early age (Knoors, 2016). However, if language deprivation occurs during the critical language learning period (i.e., birth to age 3), early childhood and school-aged services will need to be intensive and intentional to support the child's linguistic, cognitive, academic, and social-emotional needs.

Early Identification and Early Intervention

Early identification of hearing loss is critical to avoid the consequences of language deprivation (Hall, 2017). The earlier hearing loss is identified, the sooner early intervention (e.g., hearing aids, language acquisition, etc.) can begin. The younger a DHH child is when early intervention services begin, the greater the benefits will be to their social, emotional, linguistic, and academic outcomes.

In 1995, the World Health Organization recommended that universal neonatal screening be adopted in all countries that have rehabilitation services, with additional countries and communities joining as these services become available (WHO, 2010). Recent data shows that about 50 countries worldwide screened at least 85% of their babies (Neumann et al., 2022), and over 60 countries had no or minimal newborn hearing screening. In the U.S., the Early Hearing Detection and Intervention Act (EHDI) was established in 2000 and was recently reauthorized in 2022. Continuous reauthorization has allowed for monetary awards to states and U.S. territories to manage and evaluate progress in early identification of hearing loss and identifying gaps in services. Currently all U.S. states and territories have EHDI programs; however, the quality of the programs vary from city to city (National Center for Hearing Assessment and Management [NCHAM], 2023).

In 2007, the Joint Committee on Infant Hearing recommended that all infants be screened before 1 month of age (JCIH, 2009). This recommendation has now been established as a standard of care in hospitals throughout the U.S. In addition, the committee recommended that infants who do not pass the initial screening receive a comprehensive audiological evaluation by 3 months of age to confirm diagnosis of hearing loss. Once the presence of a hearing loss is found, the committee further recommended that early intervention services be established no later than 6 months of age. Taken together, this is called the "1-3-6 Plan." Researchers have found that DHH children of hearing parents have better expressive and receptive language outcomes when these milestones are met and DHH infants have consistent access to language (signed or spoken) by 6 months of age (Caselli et al., 2021; Vohr et al., 2014; Yoshinaga-Itano et al., 2017). To ensure this is accomplished, state-level EHDI programs employ early intervention specialists to track families after initial hospital screening has been completed. Some states, like California, have passed Language Equality & Acquisition for Deaf Kids (LEAD-K) laws that require departments of education to track language milestones of DHH infants and children, and provide families with resources to support language acquisition (CA EHDI, n.d.). According to the Centers for Disease Control, as many as 40% of families are lost to follow up, meaning after the initial hospital screening, they do not follow up on further diagnosis or early intervention services (CDC, 2020). LEAD-K laws and early intervention supports work to prevent loss to follow up.

Audiological Interventions

Once diagnosis of hearing loss is confirmed, early intervention services can begin. Early intervention services for children who are DHH fall into two categories: audiological/medical interventions and language interventions. Audiological interventions include surgical procedures that may fix or repair a structural issue of the ear, use of amplification to maximize residual hearing, or cochlear implantation which utilizes a mechanical sound processor to send digital signals to an electrode threaded through the cochlea and stimulating the auditory nerve to the brain (Foust & Hoffman, 2022). Each of these interventions serve to support the DHH child's access to and development of spoken language (Knoors, 2016). We will further discuss specific language interventions in the next section; however, it is important to note here that the language areas of the brain are not exclusive to spoken language development, these areas are activated whether language is signed or spoken (Nishimura et al., 1999).

Medical and technological interventions that support auditory development in DHH children include digital hearing aids, cochlear and brainstem implants, and frequency modulation (FM) systems. With the use of medical, audiological, and educational services, DHH children may be able to use amplification to reach developmental milestones along with their hearing peers (Dabrowski, 2022). Amplification through hearing aids and FM systems provide access to sound which supports development of auditory pathways and neural connections in the brain, which in turn create the foundation for spoken language. Audiologists will consider various factors such as the type and degree of hearing loss and desired amplification gain and output levels. Hearing aids are small electronic devices worn in and behind the ear with soft earmolds that will be remade frequently throughout infancy and early childhood. A typical hearing aid will have three basic parts: a microphone, amplifier, and speaker. The hearing aid receives sound through the microphone, converts sound waves into electrical signals before sending them to the amplifier. In turn, the amplifier makes the signals louder and, through the speaker, sends them to the ear. DHH children will usually use behind-the-ear aids since they and their ear canals are still growing. However, the greater the hearing loss, the greater the hearing aid amplification needs to be. For those people with severe inner ear damage, hearing aids may not be effective (NIDCD, 2013).

When hearing aids are not of sufficient benefit, cochlear implants (CIs) may be recommended. CIs are widely used to treat deafness medically; some deaf children are implanted before their second birthday (Duchesne, 2016). Figure 3 shows the parts of a cochlear implant and where they fit on and in the hearing mechanism.

CIs are small electronic devices consisting of two components: one external part that is worn behind the ear and one internal part that is surgically implanted. A CI has several parts: a microphone, speech processor, transmitter, receiver/simulator, and electrodes. The microphone receives sound while the speech processor uses it to create electrical stimuli for the electrodes that are threaded through the cochlea. An external headpiece holds the transmitter and receiver/stimulator, which converts sound stimuli into a pulse. The pulse is sent to the internal electrodes which stimulates the auditory nerve. This is what makes cochlear implants different from hearing aids; hearing aids amplify sound while cochlear implants bypass the hearing mechanisms of the middle and inner ear and send sound directly to the auditory nerve. Researchers and clinical professionals broadly agree that the earlier a deaf child is implanted, the more optimal their spoken language outcomes can be compared to children who are implanted later (Holt & Svirsky, 2008; Kirk et al., 2000; Manrique et al., 2004). According to Geers and Sedey (2011), some deaf children may be able to achieve average spoken language scores a few years after implantation. This makes CIs an attractive option to some families; however, the success of a CI relies on many additional factors such as the level of hearing loss, age of implantation, and access to and success of auditory rehabilitation and speech services. Environmental factors may also impact CI effectiveness, such as access to spoken language and acoustic conditions (Knoors, 2016).

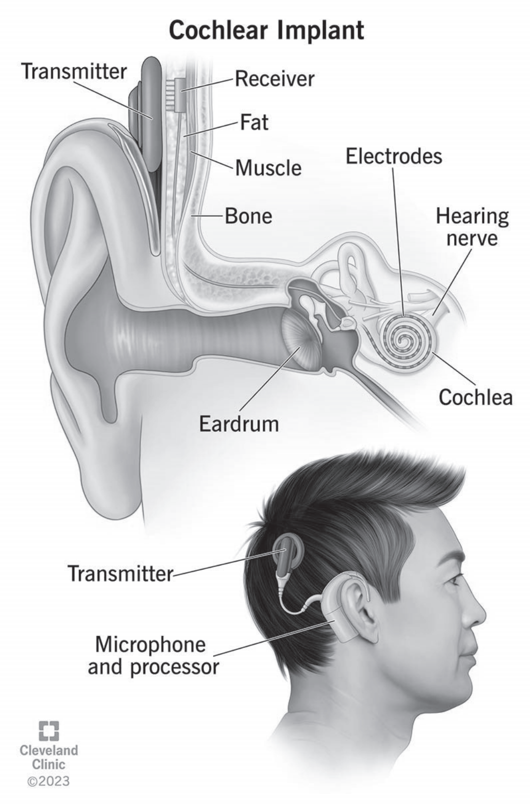

Figure 3. Cochlear Implant. Retrieved from Cleveland Clinic, https://my.clevelandclinic.org/health/treatments/4806-cochlear-implants

Another frequently used assistive hearing technology, particularly in schools, is the FM (frequency modulation) or DM (digital modulation) system. Since the ideal quiet hearing environment is not always feasible, DHH children may have trouble hearing and comprehending sound and speech at a distance or in the presence of background noise. Wireless transmission through an FM or DM system can assist by providing direct access to the sound source for the DHH child (Madell & Flexor, 2013). FM systems work by using FM radio waves, while DM systems use digitized signals that are less likely to receive interference from other frequencies. Each system works by having the child wear a hearing receiver or device that attaches to their hearing aid or CI, while the speaker uses a remote microphone that sends the sound signal directly to the child through frequency or digital modulation. Receiving sounds and language through a FM or DM system is beneficial because it reduces the impact of a high signal-to-noise ratio (Madell & Flexor). FM and DM systems are particularly beneficial in the school environment when there are multiple speakers and general background noise. Additionally, each system can be manipulated so that the child hears only the speaker without sacrificing sound quality. With the rapid advance of hearing technologies, there are newer systems like the Roger Pen and Bluetooth^{TM} that are “smart” and modern. Regardless which technology the DHH child uses, educational practitioners must monitor and accommodate their medical and technological treatment and intervention plans (Mitchell, 2017) to support optimal conditions for spoken language development.

Family-Centered Early Intervention

The focus of early intervention (birth to 3) services for DHH children should be on the prevention of language deprivation by ensuring the child has access to language. Language interventions provided during early intervention services support the development of spoken and/or signed languages so the DHH child acquires a foundation language. Providing consistent access to language (whether signed/visual or spoken/oral), supports the development of critical neural pathways to language, which support cognitive, academic, and social-emotional development. The language modality does not matter; the brain is hard wired to develop language regardless of modality (sign or spoken) or type (e.g., English, Spanish, American Sign Language, Lengua de Señas, etc.). Early intervention teams include a variety of professionals, but should include a Teacher of the DHH (TODHH). Family-Centered Early Intervention (FCEI) promotes the empowerment of families to provide the foundation of language that their DHH child needs to be successful once they start school (Moeller & Mixan, 2016). Through FCEI, caregivers and professionals work together to build on the strengths of the family that can support the DHH child’s overall development. In birth to 3 services, professionals go into homes to support family-DHH child relationships by building trust with the family and providing them with information and community supports. Additionally, through coaching the professional builds caregiver capacity to support the DHH child’s development.

In the past, a significant division existed in the field of Deaf Education, one which forced parents to choose between spoken language or sign language.

However, recently researchers and practitioners alike promote the development of each language modality in DHH children to improve language outcomes prior to cochlear implantation (Napoli et al., 2015; Pontecorvo et al., 2023), literacy skills (Easterbrooks & Maiorana-Basas, 2015), and social-emotional development (Tapia-Fuselier & Ray, 2019). Robbins (2001) suggested that DHH children be given the opportunity to develop both their auditory and visual communication abilities and preferences. Figure 4 (adapted from Moeller & Mixan, 2016) provides a visual representation of the "Auditory-Visual Learning Style Continuum" which professionals can use to ensure DHH children have opportunities to develop language abilities in multiple modalities and are able to adapt their language according to the needs of the environment and their own abilities.

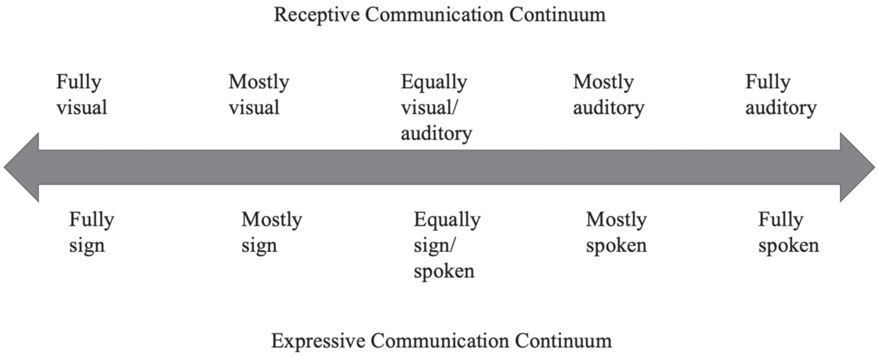

Figure 4. Ways in which a DHH child can receive and express language and information. (adapted from Moeller & Mixan, 2016)

Through the development of an Individual Family Service Plan (IFSP), early intervention professionals restore caregivers' natural communicative intuition, which in turn supports the DHH child's development across domains (Knoors, 2016). Through FCEI, caregivers learn how to intentionally create language-rich environments for their DHH child, which begins by gaining the child's attention through touch, communicating while in the child's line of sight, and waiting for the child's attention before directly communicating with them, all of which may not come naturally to hearing caregivers. Once the child's attention is acquired, caregivers must make sure the language modality they use is accessible to the child (Simms et al., 2015). This means the child's hearing technology is in good, working order at all times (e.g., batteries are charged, the child is wearing the device) and/or that sign language is used throughout the communicative exchange.

Additional supports to the family include ensuring they have access to community resources to support hearing technology and learning sign language. Within a language-rich environment, families provide abundant opportunities for natural interactions (Simms et al.), which supports language acquisition and age-appropriate development within other domains (e.g., cognition, academic, and social-emotional).

Language and Literacy Interventions

Once DHH children turn 3 years old, they transition from early intervention services (IDEA Part C) to school-aged services (IDEA Part B). Responsibility for the child's continued development shifts from families to teachers, though we know that families remain an important support system. Multiple assessments should be conducted, using the DHH child's primary language, to determine their ability levels and areas of need, which are described and targeted within an Individualized Education Program (IEP). Typically, language will continue to be a target of instruction, but additional focus shifts to the development of literacy and other academic skills.

The Simple View of Reading (Gough & Tunmer, 1986) posits that language comprehension (i.e., background knowledge, vocabulary, language structures, verbal reasoning, and literacy knowledge) and word recognition (i.e., phonological awareness, decoding, and sight word recognition) lay the foundation for skilled reading that supports reading comprehension. Most curriculums for students with typical hearing designed for use in general education classrooms were created with the assumption that children start school with a complete foundation language. However, due to language deprivation, many DHH children start school without a fully developed primary language, which affects their ability to learn to read and future academic success. Furthermore, with inconsistent or limited access to spoken language, DHH children whose primary language is a signed language need specially designed instruction that helps them learn how to decode words in different ways. Researchers at the *Center on Literacy and Deafness* focused much of their work on the creation and study of the effects of interventions specifically designed to meet the unique language and literacy needs of DHH children. In this section, we describe three of these interventions which are representative of the growing body of interventions designed for DHH children. Intervention for DHH children include practices that have shown to support continued language learning and academic growth. Such practices include pre-teaching/front-loading vocabulary, making explicit connections between English (spoken and print) and ASL, respecting the differences between the languages, and using foundation language skills to support literacy and content learning.

Explicit contextualized vocabulary instruction. Vocabulary knowledge in the early years is a predictor of later reading comprehension abilities (Tabors et al., 2001). Several research teams have found that the DHH children in their samples, both those who used sign language and those who used spoken language, began school with vocabulary delays (Antia et al., 2020; Harris et al., 2017). *Explicit/Contextualized Vocabulary Instruction* (ECVI) was developed as a systematic way to support vocabulary, connected language, and early literacy in DHH children through explicit and contextualized instruction (Antia et al., 2021). ECVI was designed as a way to intentionally teach vocabulary and language, while supporting early literacy and content knowledge so that teachers can make up for previously lost language-learning opportunities. In a series of three single-case, multiple probe design studies, Antia et al and Rivera (2015) examined the effects of ECVI on the vocabulary word and definition knowledge of young DHH students (K-2nd grade). They found that ECVI contributed to gains in word learning, definition knowledge, and spontaneous use of target words. ECVI uses unit-based instruction to ensure DHH children have multiple exposures to target vocabulary and opportunities to use the target words in context. Potential target vocabulary are selected from unit-specific books. After screening the DHH child on their knowledge of potential target vocabulary, a set of words are chosen to be emphasized through the use of ECVI components and strategies implemented throughout the unit

Five ECVI components should be combined into 20-minute sessions implemented over 8-10 days of instruction; typically two components should be used during each session. *Fast Mapping* should be used at the beginning of each unit to introduce the target vocabulary words. Following the Novel-Name-Nameless-Category strategy (Golinkoff et al., 1994), the teacher presents the student with a set of picture cards that includes one target word with two known words (i.e., a picture card of a word we know the child has in their lexicon, for example a dog, apple, or familiar toy). The teacher then prompts the student to identify the target word, which the student is more likely to do with the presence of the known words. The teacher then prompts the child to say/sign the new word and provides a child-friendly definition of the target word. The *Interactive Book Reading* component provides students with multiple exposures to the target vocabulary as well as opportunities to use target vocabulary within the context of discussions about the unit theme and books. While reading, the teacher asks the student three types of questions (Hamilton & Schwanenflugel, 2011):

competence (questions with answers that could be found directly in the text or pictures of the book), abstract (questions that required students to predict, infer, or solve problems related to the events of the book), and relate (questions in which students connect their own experiences to the book or unit topic). *Teacher-Student Conversations* provide a way for contextualized vocabulary instruction to take place. During conversations, teachers should use effective conversational moves to support vocabulary learning (Ruston & Schwanenflugel, 2010; Wood et al., 1982), including open-ended questions (questions that require more than a one-word answer), "tell me" statements (statements that prompt the student to expand on a previous idea), and linguistic recasts and expansions (statements in which the teacher models the appropriate use of the target word or more sophisticated syntactic structures using the student's previous move). Finally, two kinds of extension activities are designed to provide additional opportunities for explicit and contextualized vocabulary learning. *Drill & Practice Activities* provide opportunities for explicit practice with the target words and definitions (e.g., memory or bingo games with the target words). *Conceptual Activities* provide students with a way to apply unit concepts and use target words in context (e.g., role playing and science experiments). Conversational moves should be included while implementing conceptual activities.

Foundations for literacy. *Foundations for Literacy* (FFL) is a curriculum designed to support early literacy skills in DHH children aged four to six who have adequate speech perception. Using sound stories and language-rich, hands-on activities, children are taught phonological awareness, letter-sound correspondence, and blending sounds into decodable words. In a series of studies, FFL has been found to improve several literacy outcomes for DHH children, including syllable segmentation and initial sound isolation (Miller et al., 2013), phonological awareness and alphabetic knowledge (Lederberg et al., 2014; Lederberg et al., 2018), and word reading (Lederberg et al.). Tucci and Easterbrooks (2015) examined the use of FFL coupled with Visual Phonics (VP; Trezek et al., 2007), hand movements that represent articulation of phonemes, as a way to give DHH students who have more limited speech perception a way to learn the alphabetic principle and phonemic awareness. They found that FFL with VP supported DHH students acquisition of syllable segmentation, letter-sound correspondences, and initial sounds.

FFL is intended to be implemented in 60 minute daily lessons throughout the school year. The year-long curriculum follows Miss Giggle whose stories provide the foundation for teaching letter-sound correspondence based on semantic associations. Visual and semantic support for the acquisition of phonemes is embedded into FFL. Letter-sound correspondences, phonological structure, orthography, and word meanings are enhanced by acoustic highlighting and visual representations (e.g., sign language, fingerspelling, and/or Visual Phonics). Children are pre-taught vocabulary that they will see in the literacy and phonological awareness activities. Vocabulary and the sounds that correspond with them are taught in ways that allow children to make associations between sounds and words through meaningful ideas. Teachers use the stories to explicitly teach and scaffold sounding out and blending words in isolation to reading sentences and simple books that contain the target sounds and decodable words. Accompanying activities, such as role playing, storytelling, and games using vocabulary cards, give children multiple ways to practice using new vocabulary and reading target words in isolation and in connected language.

Fingerspelling our way to reading. *Fingerspelling Our Way to Reading* (FOWR) was created as a way to support phonological awareness in DHH children who have limited access to sound and use ASL as their primary language. Fingerspelled words can be categorized in two ways: neutral or lexicalized. Neutral fingerspelling in ASL consists of single handshapes that correspond with each letter of the English alphabet, while lexicalized fingerspelling looks more like ASL signs because of structural changes in the formation of the letters and movement of the hand (Haptonstall-Nykaza & Schick, 2007). In a study that investigated DHH children's ability to read and write new words when taught the words through either signs or lexicalized fingerspelling, Haptonstall-Nykaza and Schick found that students (aged 4-14) in the fingerspelling condition had better outcomes than those in the signing condition. The results indicated that these DHH students could reliably establish a print-sign link that supported their literacy development. These findings supported the development of FOWR. In a randomized control trial study, Schick and colleagues (2018) found that students who participated in the FOWR program performed significantly better on reading targeted words, receptive fingerspelling skills, fingerspelling production, and print recognition.

FOWR is a five-day per week supplemental literacy program for DHH children ages five to seven that supports phonological awareness of fingerspelled words to improve word recognition and reading skills. In the program, students use fingerspelling to identify and analyze word structure, breaking words into parts that connect to letters and letter patterns in print. FOWR designers created units of instruction with stories that include commonly used words from the Dolch (Dolch, 1948) and Fry (Fry & Kress, 2006) sight word lists. Three days of the week are focused on phonological awareness through fingerspelling and isolated word recognition. For the other two days of the week, students apply their word reading skills during reading comprehension opportunities. Pictures, signs, and fingerspelling are used to introduce the new unit vocabulary; through various activities and games, children have multiple opportunities to fingerspell the new words. On the second day, children watch a signed story that includes the unit vocabulary with varied meanings of the word (e.g., "I can run." and "I drank a can of soda."). On this day, students are prompted to identify internal parts of words by identifying the initial letter and last chunks of the words. In-the-air language is the focus of the first two days of instruction. Print is included on days three to five when children read and write the words in connected text. If students are unable to provide the sign for a target word, they are prompted to fingerspell the word, which provides them with a decoding strategy. These repeated exposures support an awareness of the patterns of written English, which gives DHH children more confidence to tackle the text independently.

Educational Placement and Learning Environments

The Individuals with Disabilities Education Act (IDEA) requires that children with disabilities be provided a free and appropriate public education (FAPE), which means that a child's educational programming must be designed to meet their individual needs (U.S. Department of Education, 2004). FAPE also requires that students with disabilities be placed in the least restrictive environment (LRE), which means that, to the maximum extent possible, children with disabilities should be educated with their nondisabled peers. The inclusion philosophy was created as a result of this law. Proponents of inclusive education purport that the implementation of classroom accommodations and modifications should be sufficient for children with disabilities to access the general education curriculum. As a result of this law, plus the advancement of medical interventions, the majority of DHH children are educated within general education settings, receiving specially designed instruction and educational and related services as required by their IEP (Gettemeier, 2018). However, for some DHH children, access to the general education curriculum is challenging even with accommodations and modifications. The general education curriculum assumes that children begin school with a foundation language. As described previously, many DHH children start school with delayed or incomplete language as a results of language deprivation from an early age, which means many are still learning language while also trying to make progress in the general education curriculum. As such, the general education setting may not be the LRE for all DHH children, particularly those whose primary language is ASL or another signed language. In fact, general education may be more restrictive because these DHH children's communication must frequently be facilitated through an educational interpreter (National Association of the Deaf, 2002). Exposure to the Deaf community and Deaf culture should be considered when making placement decision for DHH children as culture plays a key role in the development of self-esteem and identity (Tapia-Fuselier & Ray, 2019). Consequently, in 1997 IDEA was reauthorized to include Considerations of Special Factors for educational placement of DHH children. These special factors include consideration of the child's communication needs, opportunities for direct communication with peers and educational personnel in the child's language and communication modality, academic level, and need for assistive technology devices and services. When these factors are considered, schools and school districts must make placement decisions after reflecting on the needs of the DHH child and the full continuum of services and placement options, including schools for the deaf, which are self-contained placements, often on a campus where the majority of students are deaf and use a signed language as their primary mode of communication.

Once appropriate placement is determined, the instruction and services DHH children receive must be sufficient to support their continued language and academic development. High-Leverage Practices (HLPs; McLeskey et al., 2022), created by the CEEDAR Center in cooperation with the Council for Exceptional Children, provides practical guidance on best practices for inclusive education, but has relevance for DHH children within all placement options. When applied within a Multi-tiered System of Support (MTSS) framework, HLPs can provide TODHH with the foundations for delivering specially designed instruction to DHH children according to their language and academic needs (Rivera, 2023). MTSS Tier 1 supports students by providing them with access to whole class instruction using classroom-level accommodations. For DHH children, these accommodations may include hearing assistive technology, sign language interpreters, and speech-language services. Tier 2 continues the use of classroom-level accommodations, but also uses flexible instructional arrangements (Catalano et al., 2022) which place students within small groups so they can receive more individualized support. Finally, Tier 3 of the framework provides students with intensive supports, which, for DHH students, may include one-to-one instruction with an itinerant TODHH or placement at a school for the deaf where smaller class sizes allow for increased time in small group and/or intensive individualized instruction. HLPs describe best inclusive practices across four domains with 22 specific high-leverage practices divided among each domain. Each domain and suggested application to PK-12th grade DHH students are described below.

Collaboration. Effective collaboration between professionals who support DHH students leads to more effective problem solving. Open lines of communication through effective collaboration allows professionals to be more proactive and resolve issues quicker. Collaboration with families should continue beyond early intervention services. Collaborative consultation services (Luckner et al., 1989) with general education teachers ensures that DHH students can effectively access instruction and instructional materials within Tier 1 and 2 supports. In consultation with the general education teacher, an itinerant TODHH can provide instruction that front-loads vocabulary and concepts within Tier 3 services to best support student success when they return to the general education classroom.

Assessment. Using multiple sources of information, assessment should serve not only to determine a student's areas of need, but also their strengths. To avoid limiting DHH students to the medical model of disability, formal assessments should be administered by a professional knowledgeable of the background and communication needs of DHH students, including the effects of language deprivation. A TODHH is more likely to be able to assess the DHH student directly using their preferred language modality. Additionally, a TODHH can ensure results are communicated accurately with consideration given to the student's language level and that instructional practices align with the student's language and academic needs. Data collection through progress monitoring after day-to-day instruction, should be adapted to the needs of the student and purpose of the task. For example, DHH students' ability to convey their knowledge of a social studies or science concept should not be impeded by their gaps with written English. Assessing DHH students through spoken or signed language will be less limiting to their ability to demonstrate their learning. Itinerant TODHHs can provide support for assessments in Tier 1 consultation and Tier 2 services, and also administer assessments and progress monitoring measures as needed during Tier 3 services. Tier 3 services at schools for the deaf ensure that DHH students' assessment needs are met within their regular classrooms.

Social/Emotional/Behavioral. Language is highly related to the development of social, emotional, and behavioral skills. DHH students who have experienced language deprivation may have difficulty forming and maintaining friendships, understanding the social dynamics embedded into instruction, and demonstrating appropriate behaviors to communicate wants and needs. DHH students are more likely to experience these challenges during Tier 1 and Tier 2 supports. Maintaining a positive, organized, and respectful learning environment is key to supporting their needs. Explicitly teaching social behaviors and providing constructive feedback will also support their language and vocabulary. Itinerant TODHH can provide general education teachers with information about how DHH students differ from students with other disabilities, particularly how language deprivation impacts language and academic development. Behavioral concerns should always be considered in connection with the DHH student's ability to communicate fluently and effectively. TODHHs should be consulted if a functional behavioral assessment is being considered. Intensive Tier 3 services, possibly at a school for the deaf, will more likely provide the DHH child with access to a language-rich environment from which they can benefit.

Instruction. Systematic instruction for DHH students should be based on goals that align with their language and academic needs. Because of their experiences with language deprivation, many DHH students need intensive, explicit, and scaffolded instruction which includes opportunities for continued language and vocabulary learning. Use of assistive technology, adapted materials, and flexible groupings may be effective ways of maintaining student engagement. TODHHs infuse their knowledge of student backgrounds and language development into instruction. In Tier 1 or 2 services, itinerant TDOHHs can work with general education teachers to ensure that access is effective and materials are appropriately adapted for the student's language and reading levels. However, many DHH students will require Tier 3 services with their itinerant TODHH or within a school for the deaf where intensive language, vocabulary, literacy, and content area instruction can take place.

Special Populations

Unique groups within the larger DHH population require specialized supports and considerations. As many as 40% of DHH children have an additional disability. DHH children with one or more disabilities (DWD) experience greater delays in communication and language development (Davis et al., 2010). Bruce & Borders (2015) suggest that communication support for children who are DWD be designed using a four-aspect framework: (a) form (mode of communication), (b) function (the intent of the communication as interpreted by the communication partner), (c) content (information contained in the message), and (d) context (individual characteristics of all communicators, physical environment, and routines and activities). Form of communication requires access to a variety of communication modalities, including spoken language, sign language, and alternative communication forms such as pictures and gestures. Adult communication partners should serve as role models for communication forms and create multiple opportunities for children who are DWD to express a variety of intents, including protesting, requesting, naming, greeting, and making statements (Owens, 2020). Message content may not be immediately understood when expressed by a child who is DWD, and may require a familiar communication partner to support content comprehension through integration of contextual elements. Each aspect of this framework should be used to support targeted instruction for students who are DWD to become more independent communicators.

Another unique group within the DHH population are Deaf Multilingual Learners (DML). The DML population is difficult to quantify. Culturally and linguistically diverse families with DHH children include those who speak a home language other than the spoken language of the primary culture and also those families whose primary language is a signed language (e.g., American Sign Language, Lengua de Señas Mexicana, etc.; Cannon & Guardino, 2022), which makes up about five percent of the DHH population (NIDCD, 2015). The most recent data from the Gallaudet Research Institute (2013) indicated that DMLs make up 18-35% of K-12 DHH leaners in the U.S.; however, the National Center for Educational Statistics (U. S. Department of Education, 2019) reported that culturally and linguistically diverse learners are the fastest growing group among the K-12 population. It stands to reason that the DML population is growing at a similar rate. Though there is little research in this area, Crowe (2018) has concluded that there is no strong evidence that DMLs have either better or worse outcomes than their DHH peers from the majority culture. Researchers in this new area of study have suggested that multi-lingual and multi-modal development in DMLs can best be supported through family engagement, targeted and intentional instruction that focuses on content and language, and connection between language and the home culture (Pizzo, 2016).

Conclusion

Teaching children who are DHH involves much more than understanding their hearing levels. DHH children present with complex and unique needs that differ from children with other disabilities and children who are English

Language Learners. Professionals who work with DHH children and their families must consider both the medical and cultural aspects of deafness, which will best support all domains of development. Activating the language-learning parts of the brain and facilitating the development of a foundation language is a critical first step in development for any child, but is particularly important for DHH children to avoid the consequences of language deprivation. When language deprivation is present in school-aged DHH children, their teachers must continue to reinforce the establishment of a first language while simultaneously introducing them to literacy and academic content. Intensive, explicit instruction in both language and content is an effective way to support the needs of DHH children. Addressing the audiological, linguistic, social-emotional, and academic needs of DHH children will give them the best chance of developing the knowledge and skills they can draw upon throughout their schooling and lives.

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