Applying the Early Start Denver Model to Children Who are Deaf or Hard of Hearing

A Practitioner Manuscript

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**Introduction to ESDM**

The Early Start Denver Model (ESDM) is an evidence-based intervention developed for children who are 12 to 60 months old with autism spectrum disorder (ASD). ESDM is aligned with the principles of applied behavior analysis and uses a multidisciplinary approach. The ESDM curriculum addresses several core areas of development including communication, social, motor, play and imitation skills (Rogers & Dawson, 2010). The curriculum reflects a research-based understanding of developmental strengths and needs of children with ASD: however, it was developed based on assumptions of complete access to language. Therefore, utilizing the curriculum with children who are Deaf or hard of hearing (DHH) who also have ASD requires modification.

The receptive and expressive language domains of the ESDM curriculum checklist start with the assumption that children have acquired certain basic auditory skills. However, because many children who are (DHH) do not have complete auditory access to the full repertoire of sounds, and particularly speech sounds, they may demonstrate auditory skill delays that negatively impact speech and language acquisition. In contrast to children with ASD with typical hearing thresholds who acquire these skills through exposure within their environment, children who are DHH may need to be explicitly taught these skills to facilitate speech and language development. Furthermore, the ESDM checklist assumes that children acquire language through listening and spoken language. However, some children who are DHH primarily access language visually and communicate using a signed language, such as American

Sign Language (ASL) which is not at all reflected in the ESDM curriculum checklist. Early

identification of hearing loss, amplification, intervention and visual access to communication

can support speech and language development for all children who are DHH (Lieu et al., 2020;

McCreery & Walker, 2021). In order to meet the needs of children who are DHH with ASD,

strategies used in early intervention for hearing loss can be combined with ESDM strategies to

support strong expressive and receptive language outcomes. This practitioner manuscript

summarizes aspects of development affected by reduced hearing, which will inform

modifications to the ESDM curriculum making it accessible to children who are DHH. In

addition, practical strategies informed by the perspective of a teacher of the deaf, are provided

to demonstrate application of these concepts.

**Intervention for ASD and for Hearing Loss: Areas of Overlap**

Both the ESDM and early intervention for DHH children consider parent involvement a

top priority for the success of the programs (Cruz et al., 2013; Moeller et al., 2013; Rogers &

Dawson, 2010). A parent coaching model has been adopted across a variety of DHH early

intervention teams in answer to the requirements of IDEA (2004) which necessitates the

development and implementation of a routines-based individualized family service program or

IFSP for children enrolled in Part C of IDEA (2004). Therefore, the developmental and caregiver

focused aspects of ESDM appear well aligned with traditional DHH intervention models. We

hypothesize that by marrying principles unique to DHH intervention such as auditory skills training

and visual communication strategies with ESDM strategies, language outcomes for DHH children

with autism will be enhanced.(Cruz et al., 2013; Moeller et al., 2013; Rayes H., Al-Malky, G., &

Vickers, D., 2019;  Rogers & Dawson, 2010).

**Language Acquisition**

Typically developing children who are DHH born to Deaf parents meet language developmental milestones largely within the same time frame as typically developing hearing children of hearing parents (Tomaszewski et al., 2019). However, more than 90% of children who are DHH are born to hearing parents, many of whom have never had any experience with hearing differences. Early intervention programs for children who are DHH work to support families in learning how to make language accessible to their child in order to improve language outcomes. DHH children who do not receive early intervention or are late identified often experience significant language deficits (Ching et al., 2017, Cruz et al., 2013).

When describing the communication of children who are DHH, the literature has previously emphasized the idea of communication mode, referring to listening and spoken language, visually supported access to spoken language (e.g., sign supported speech, total communication, simultaneous communication, cued speech), and formal sign languages (e.g., American Sign Language) (Hall & Dills, 2020). For very young children, especially children with developmental differences like ASD, it can be difficult to determine how effectively their brains are accessing spoken language or sign language, particularly when they appear inattentive to communication in their environment or when they have reduced expressive language. At this stage, it is sometimes unclear what the child's preferred way of accessing language or expressing themselves will be.  It is critical to ensure that children have easy, reliable access to communication. Providing visual access to communication (e.g., through signs and gestures) in

addition to spoken language may be appropriate. The ESDM model provides a nice framework for thinking through data based decision making regarding how communication is reinforced and the acquisition of receptive and expressive language skills, which could be helpful for gathering observations about the child's most reliable means of accessing language and communicating. However, ESDM decision tree for choosing initial teaching procedures used for determining when to add visual supports has hearing kids in mind (Rogers & Dawson, 2010, p. 131). Therefore, it is important to emphasize that sign language and visual communication should be considered the child's primary language in an ESDM model, rather than a visual support, even if the child has not yet attained fluency in it.

**Environmental considerations**

Preparation for an ESDM session with a child who is DHH accessing auditory information requires special attention to the environment to promote  auditory  access. It is vital to provide unobstructed and uncluttered visual access to the environment and to those who are communicating. Lighting should be bright enough to allow the child to see the gestures and facial expressions of others, while backlighting coming from a window or light fixture should be minimized by closing blinds or moving away from a light source. Noisy environments or rooms with poor acoustics can also make it difficult for children who are DHH to comprehend spoken language.  If the room has hard floors, it can be helpful to put down a throw rug or to put things on the walls to reduce background noise and to improve the acoustics. The clinician should make a sweep of the room to identify and remove things that may be producing passive

sounds, such as a fan, an aquarium, a wobbly table/chair, or anything else that creates ambient noise.

For use of spoken language to be successful, the adult must first get the child's attention and be within a 2–4-foot speaking distance to make sure the child receives the best auditory signal. Additionally, all equipment must be checked to make sure it is functioning properly. A malfunction in hearing assistive technology (HAT) can cause a child to look like they are refusing to comply with an adult's request, but faulty equipment and an inability to hear the instruction could be to blame.

**Considerations for Receptive Language Skills for Children Who are DHH**

***Auditory Skill Development***

The ESDM curriculum checklist begins with localization to sound and quickly advances to expecting the child to turn when their name is called. This is predicated on the assumption that the child with autism has auditory access to sounds. On the contrary, children with hearing differences are often unable to access speech sounds that support their understanding of verbal communication (Refer to Speech Banana in Appendix A). When children initially receive their hearing aids or cochlear implants, they require explicit training to teach them to discriminate between a wide variety of sounds.  If the family has chosen to use spoken language with their DHH child, a functional auditory performance indicator (FAPI) or other auditory screener can be used to assess areas of strength and weakness for listening skills of young children. (Refer to FAPI in Appendix B) Once the FAPI has been completed, children who are DHH will need explicit training in the auditory skills they are missing.

Once the environment has been prepared and strengths and weaknesses in auditory skills have been determined, objectives can be written as precursors to localization and turning to the child's name being called. This could include skills such as sound detection which could be denoted by a child's eyes widening to the sound or exhibiting a physical startle response upon detecting a loud noise. Once sound detection is accomplished, the next step would be to teach them to orient to sounds by producing a noise on one side of the child, outside of their line of vision. For example, a rattle or noisemaker could be shaken outside of the child's view. The child and facilitator could look for it together to help them understand the need to localize to a specific or novel sound. Again, the same thing could be done by the parent outside of their visual space making playful vocal sounds like clicks and raspberries. At first, the facilitator alerts the child to the sound and helps them find it. When the source is found, everyone should celebrate with the child.  This helps them understand that localization to sounds can be enjoyable. Once they understand the process, the facilitator will reduce or fade the prompting so the child can learn to localize to a sound source and vocal sounds consistently on their own. Then the child and facilitator can work on turning to a variety of people when hearing a voice alone and in the midst of background noise.

Once the child can localize to a sound source, they can begin to learn that sounds have meaning. Sounds can be an alert to the beginning of daily routines or the fact that Mom or Dad are home from work. They are part of the foundation of establishing joint attention routine sequences (JARS)(Rogers & Dawson, 2010). This is evident when a parent turns on the bath water and the child goes into the bathroom and signs or says bath or when the child hears the refrigerator door open and they walk to it and reach for, sign or say milk or food. While playing,

the adult can also make a choo-choo sound and pick up the train or wait for the child to find it.

By using playful routines, families can ensure learning auditory skills is fun for everyone.

When teaching a child with a hearing loss to turn to their name, the facilitator should

be within a 2–3-foot listening distance at first. If the child doesn't respond by looking at the

adult, their name should be repeated and paired with a tap to their shoulder or arm. This

typically will cause the child to turn and look at the one saying their name. Eye gaze should be

rewarded with positive affect each time it is provided even after the child is reliably turning to

their name being called. All of these sound discrimination exercises should begin in a quiet

environment, and over time the background noise can be increased (i.e., signal to noise ratio)

to help the child learn to listen for the important sounds in the midst of background noise.

### *Visual communication considerations*

In ESDM the first portion of receptive communication development assumes access to

spoken language. However, many children and adults who are DHH access communication

through a visual modality, such as sign language. Modifications to ESDM taking into

consideration children who access communication visually are necessary.

One early item in the ESDM curriculum assesses a child's response to their name being

called. Not all children who are DHH can access their name being called through listening.

However, being able to obtain a DHH child's attention is necessary for safety and

communication. Therefore, culturally appropriate modifications to this item are necessary.

Adults and children in the Deaf community often wave within an individual's visual field or use

a soft tap on the shoulder or upper arm to gain the attention of someone nearby. Children who

are DHH with ASD may not  turn when tapped. Instead, they must be taught about the value of turning to the communication partner. This can be done by modeling the behavior, by tapping the child and helping them turn to the other person who then provides a reward, and finally by tapping and providing praise for turning. The goal is that the child will turn within 3-5 seconds when tapped to see what the other person is communicating. When a person is not in the child's immediate vicinity, they might tap the table the child is touching, wave in their visual space, or tap the floor with their foot to get the child's attention. Children with ASD may need to be taught to attend to each attention gaining method separately.

Gaining visual attention is the first step in providing a rich receptive language environment. Once attention is gained, signing with the child or others in the environment provides an opportunity to acquire receptive language. The ESDM strategy of joining in the child's play and providing language that matches can also expand the child's receptive language, social and play skills. When using visual language with young DHH children it is important to make the environment visually accessible and to use every fleeting opportunity to provide language relevant to the situation.

**Considerations for promoting expressive language for children who are DHH**

The acquisition of expressive language is predicated on a robust receptive vocabulary. Children require numerous exposures to language before they can understand it, and then many more before they can produce it themselves. When children have hearing differences, they often miss many opportunities to acquire language incidentally, so it must be explicitly taught. When autism spectrum disorder (ASD) is also present, the impact on communication is even more significant (Szymanski et al., 2012). Using the tenets of ESDM, parents and

caregivers can be coached to provide language through narration, play and joint attention routines.

Early intervention for DHH places a significant emphasis on language acquisition. Facilitators use narration, which entails explaining everything that the adult and child are doing using spoken words or signs. Some facilitators also use sentence stems for children to imitate and expand on. This is done by teaching a stem such as, "I want _____" to help the child make requests. ESDM builds language through the use of natural environments and play. ESDM providers set up opportunities in the environment that support the use of spontaneous language. By matching the language level of the child and using the one up rule, ESDM helps to promote receptive and expressive language development. ESDM practitioners masterfully incorporate the natural environment and routines in the home to accomplish their goals. These strategies work well with children who are DHH as well.

In addition to narration, numerous activities are used to accentuate the vocabulary the child needs to retain and produce. For example, if the adult wants the child to focus on the word "car", they might show them a car while saying the word or might use "acoustic highlighting" which is characterized by raising or altering the tone of voice when saying the word "car." Another strategy would be to take the car and roll it over the child's arm or up to the adult's face to capture their eye gaze while highlighting the word. To avoid children becoming dependent on external prompts for turn taking, ESDM recommends using strategies such as an expectant pause before prompting for words or signs. For example, one might withhold a preferred car briefly until a child says or signs the word. Once they make an

approximation, they should be allowed to play with the car for a short time before it is the

adult's turn again and they are required to ask for it again.

### *Spoken Language Considerations*

If a child who is experiencing a listening and spoken language program is not vocalizing,

activities can center around pairing simple consonant-vowel sound combinations with a variety

of toys. These consonant-vowel combinations can be incorporated into song and repeated

throughout a variety of routines to expose the child to the idea of using the sounds. As the child

begins to engage in making some sounds, they should be reinforced, and new sounds should be

added. To signal the opportunity for expressive language,  the adult can give an expectant look,

or they can use a pretend microphone to show that it is the child's turn to say the sounds.

Sounds can also be made while working on fine and gross motor activities. All these activities

reinforce use of vocalizations during play.

### *Visual communication considerations*

Typically developing children who are DHH naturally notice occurrences in their visual

environment. Moment by moment they are watching for clues about the world around them

whether it is formal language, gestures, or facial expressions. This attention to visual details

assists DHH children in acquiring a visual language. Children who are DHH with ASD often

demonstrate reduced visual attention to the world around them. Interventions such as ESDM

can be helpful to increase their visual attention to their social environment, but culturally informed modifications are necessary.

Furthermore, interventionists are not often used to considering the child's language environment. However, because many DHH children have hearing parents for whom visual communication or signed language does not reflect their native language, it is often important for interventionists to attend to how often language is being made accessible to the child. It requires many exposures to specific vocabulary/signs before a child can understand or express it. Bearing this in mind, a goal should be to encourage caregivers to narrate what the child is doing or what is happening in their environment, whether in their visual space, or any time they are giving visual attention to the adult.

*Natural developmental acquisition of signed languages.*

As DHH children become more aware of language, manual babbling may be observed. According to Pettito (1991), children use vocal or signed babbling to help them master the basic units of language. When a DHH child is observed using signed babbling, the adult communication partner can reinforce it by smiling and providing a positive affect. Sign babbling can then be shaped into meaningful signs and interactions. During this period of language development, sign approximations should be accepted as words.  For instance, if a child taps his mouth with his open hand during a snack session, that could be accepted and reinforced as asking for food. Again, it is important to note that errors in handshape, position and movement are common for young children who are DHH. Caregivers should be encouraged to recognize these approximations as a naturally emerging part of acquisition of signed language. They can

continue to reinforce this language development by correctly modeling the sign that the child is attempting to approximate.

*Joint Attention*

Children who are typically developing begin to employ joint attention between six and eight months of age, but this skill is often delayed for children with autism. Children who are DHH often establish joint attention in some ways that are similar to hearing children, but also in ways that differ. As with typically hearing children, joint attention can be established by manipulating the environment to make it easier for a child to shift their visual reference between a person and an object. For example, a child can be positioned across from an adult to increase the likelihood that they can easily make eye contact with the adult. Also, adults can hold objects up closer to their face to draw the child's eyes up and allow for easier shifting of gaze between objects and their communication partner. Once eye gaze is attained, the child should be rewarded with a smile or praise, and the pertinent sign so they will be more likely to refer to others for words in the future.

There are also several unique ways that adults can establish joint attention with a child who is DHH. For example, when engaging in play with objects or books, the communication partner can produce signs on the object or book. Additionally, joint attention can be established by parents signing from behind a child on an object. Parents or facilitators also sign between an object and the child to promote joint attention. Finally, children should be given the opportunity to explore a toy before others try to capture their visual attention to present signs or gestures (Spencer et al., 1992; Lieberman, 2012).

### *Attention to Facial Features to Access ASL Grammar*

American Sign Language (ASL) relies on facial expressions and movements of the mouth, eyebrows, and head to express grammatical structures (i.e., non-manual markers). For instance, to ask a yes/no question, the eyebrows are raised at the end of the sentence, in contrast, all other questions are asked by furrowing the brow at the end of the sentence. Focusing on visual-facial cues is imperative to understanding the intent of communicative interactions. This is another skill that relies on the adult using high affect as taught in ESDM to convince the child to engage in the interaction. Children with ASD tend to avoid eye contact and attention to the faces of others, so this skill must not only be explicitly taught, but it must also be highly enjoyable. If the communication partner captures the child's visual gaze, they can use high affect to naturally reinforce the child's attention to their face, highlighting these non-manual markers.

In addition, ASL uses the entire body for communication. This is observed through body shifts to denote different speakers,the communication of emotions, or questions. For example, when signing tired, the whole body shows the effects of being tired. When surprised, the head and upper body jerk backward while the facial expression shows surprise. When asking questions, the person signing leans forward. These grammatical cues in ASL may go unnoticed by children who are DHH with ASD, even though they are more attentive to facial features than hearing children with ASD (Denmark et al., 2014). However, since this is a vital part of ASL communication children who are DHH with ASD must be explicitly taught to focus on body and facial cues.

Explicit teaching of ASL grammatical cues can be accomplished through a number of different activities, including playing games, telling stories, and by playing with dolls. These are natural times people exaggerate signs and tend to use high affect to convey information and enjoyment. By using activities the child is interested in, the adult sets up a learning environment that invites them to see how enjoyable language and people can be. Specific ESDM goals can be written to support learning basic ASL grammatical structure appropriate for a DHH child.

**Cultural Considerations for Supporting Expressive Signed Communication**

Deaf adults often use physical prompts when teaching young children to sign. The child can also be assisted in making the sign with hand over hand prompting or the sign can be formed on them. Each time, they should be rewarded with the object being requested. By using this type of prompting, they are able to experience the formation of the sign and how it helps them access the things they want. For children who are DHH with ASD who cannot tolerate physical touch, this could be modified by signing next to them. This also addresses the difficulty with learning the perspective taking aspects of ASL for children who are DHH with ASD. Some children who are DHH with ASD demonstrate unique errors in ASL including, incorrect palm orientation, handshape, or hand movements, that are thought to reflect underlying difficulties with perspective taking and shifting (Shield et al., 2020). By signing next to the child, it provides the sign from the child's perspective, making it easier for them to produce it correctly.

**Areas of Divergence from ESDM for ASL Acquisition**

ESDM typically employs a least to most prompting model (Rogers & Dawson, 2010). This model begins with a verbal prompt and increases the prompting level based on need. As was previously expressed, children who are DHH with ASD may require tactile prompting at the beginning in order to learn ASL. This is the cultural model for teaching the language that can be modified based on the needs of the child with ASD as was previously discussed. With children who are DHH with ASD, Deaf caregivers often sign or gesture on the young child's body or in their visual space. Some might consider this a most-least prompting hierarchy due to the presence of physical touch, however, signing on the child or an object, or in the child's visual field is used in natural language acquisition for children of Deaf adults who use ASL and should not be considered a violation of the prompting hierarchy. Just as the first step in least to most prompting is a verbal or picture cue, in ASL it is a sign cue that may be done on the actual child. The key is to make sure the child can physically and visually attend to the signed communication.

The ESDM curriculum checklist focuses on teaching children to turn when his or her name is called, however, gaining the attention of a child who does not have auditory access is established in a number of other ways that were previously discussed. A fingerspelled name or name sign is typically used for identification, but not for gaining someone's attention. Incidentally, once a child knows their name or name sign, their visual attention must first be gained before their name can be used to take attendance in a preschool setting, or otherwise it is used to refer to them with others.

Many of the techniques and strategies used in ESDM are also used when providing early intervention for children who are DHH. Modifications to parts of the receptive and expressive

communication domains for level one may vary depending on the needs of the child who is

DHH. The DHH population is heterogeneous, so there are few strategies that work for

everyone. Depending on the type of communication the child has been exposed to, different

modifications should be considered. These could include changes to the environment to

promote auditory and visual access, the use of a variety of attention getting strategies, and

learning about cultural ways to facilitate ASL acquisition. The strategies used in ESDM

complement those used to meet the needs of children who are DHH in early intervention.

**References**

Ching, T. Y. C., Dillon, H., Button, L., Seeto, M., Van Buynder, P., Marnane, V., Cupples, L., &

    Leigh, G. (2017). Age at intervention for permanent hearing loss and 5-year language

    outcomes. *Pediatrics, 140*(3)https://10.1542/peds.2016-4274


Cruz, I., Quittner, A. L., Marker, C., & DesJardin, J. L. (2013). Identification of effective

    strategies to promote language in deaf children with cochlear implants. *Child*

    *Development, 84*(2), 543-559. https://10.1111/j.1467-8624.2012.01863.x

Denmark, T., Atkinson, J., Campbell, R., & Swettenham, J. (2014). How do typically developing

    deaf children and deaf children with autism spectrum disorder use the face when

    comprehending emotional facial expressions in british sign language? *Journal of*

    *Autism and Developmental Disorders, 44*(10), 2584-2592. https://10.1007/s10803-

    014-2130-x

Hall, M. L., & Dills, S. (2020). The limits of "Communication mode" as a construct. *Journal of*

    *Deaf Studies and Deaf Education, 25*(4), 383-397. https://10.1093/deafed/enaa009

Individuals With Disabilities Education Act, 20 U.S.C. § 1400 (2004).

Lieu, J. E. C., Kenna, M., Anne, S., & Davidson, L. (2020). Hearing loss in children: A review.

    *JAMA : The Journal of the American Medical Association, 324*(21), 2195-2205.

    https://10.1001/jama.2020.17647

Lieberman, A. (2012). Eye gaze and joint attention. *NSF Science of Learning Center on*.

McCreery, R. W., & Walker, E. A. (2021). Variation in auditory experience affects language

and executive function skills in children who are hard of hearing. *Ear and Hearing,*

*43*(2), 347-360. https://10.1097/AUD.0000000000001098

Moeller, M. P., Carr, G., Seaver, L., Stredler-Brown, A., & Holzinger, D. (2013). Best practices

in family-centered early intervention for children who are deaf or hard of hearing: An

international consensus statement. *Journal of Deaf Studies and Deaf Education, 18*(4),

429-445. http://www.jstor.org.unco.idm.oclc.org/stable/42659889

Petitto, L. A., & Marentette, P. F. (1991). Babbling in the manual mode: Evidence for the

ontogeny of language. *Science, 251*(5000), 1493-1496.

http://www.jstor.org.unco.idm.oclc.org/stable/2875832

SPENCER, P. E., BODNER-JOHNSON, B. A., & GUTFREUND, M. K. (1992). Interacting with infants

with a hearing loss: What can we learn from mothers who are deaf? *Journal of Early*

*Intervention, 16*(1), 64-78. https://10.1177/105381519201600106

Rayes, H., Al-Malky, G., & Vickers, D. (2019). Systematic review of auditory training in

pediatric cochlear implant recipients. *Journal of Speech, Language, and Hearing*

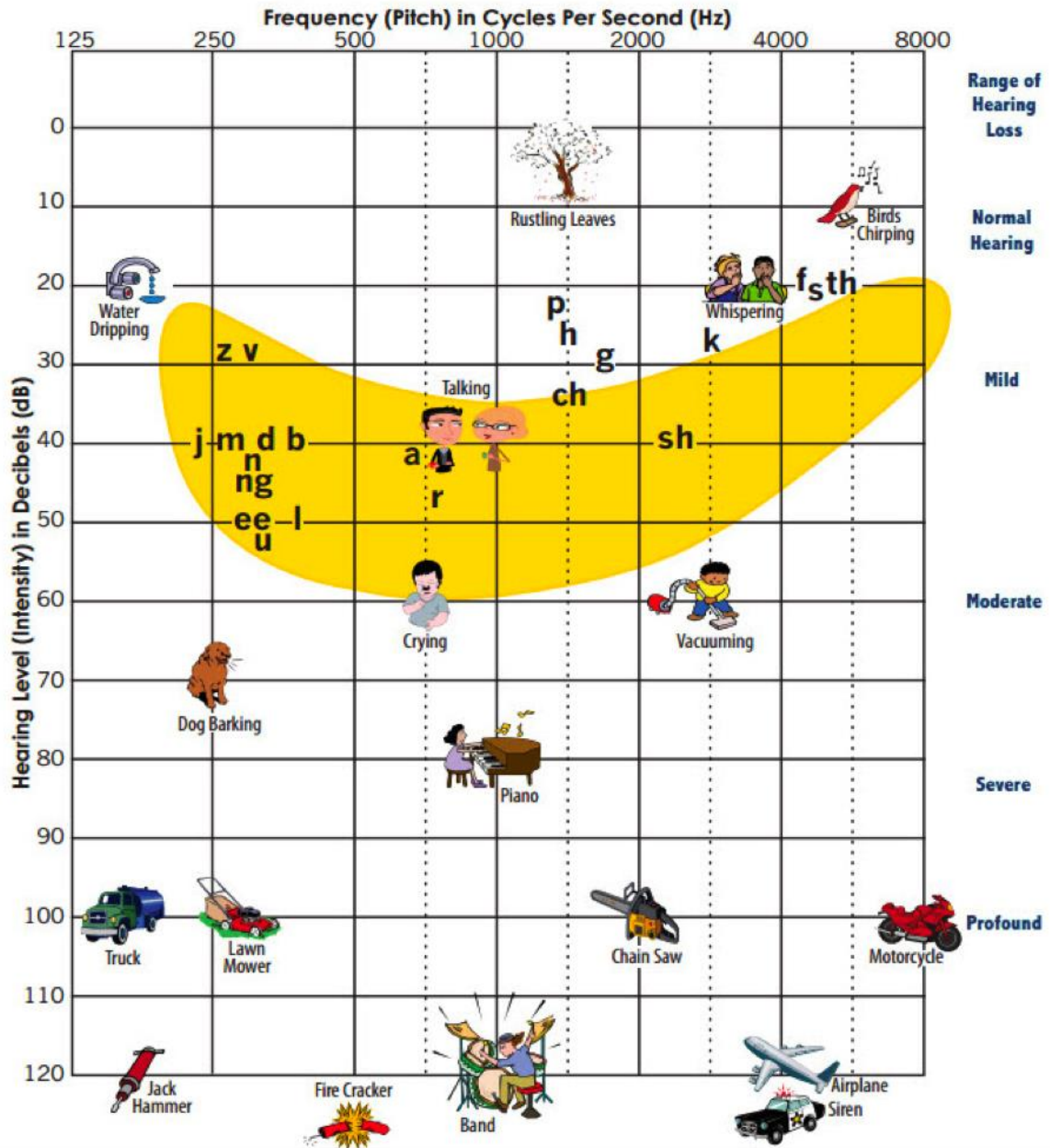*Research, 62*(5), 1574-1593. https://10.1044/2019_JSLHR-H-18-0252

Rogers, S. J., & Dawson, G. (2010). *Early start Denver model for young children with autism:*

*Promoting language, learning, and engagement*. Guilford Press.

Shield, A., Igel, M., Randall, K., & Meier, R. P. (2020). The source of palm orientation errors in

the signing of children with ASD: Imitative, motoric, or both? *Brain Sciences, 10*(5),

268. https://10.3390/brainsci10050268

Shield, A., Meier, R. P., & Tager-Flusberg, H. (2015). The use of sign language pronouns by native-signing children with autism. *Journal of Autism and Developmental Disorders, 45*(7), 2128-2145. https://10.1007/s10803-015-2377-x

Szymanski, C. A., Brice, P. J., Lam, K. H., & Hotto, S. A. (2012). Deaf children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 42*(10), 2027-37. https://http://dx.doi.org/10.1007/s10803-012-1452-9

Tomaszewski, P., Krzysztofiak, P., & Moroń, E. (2019). From sign language to spoken language? A new discourse of language development in deaf children. *Psychology of Language and Communication, 23*(1), 48-84. https://10.2478/plc-2019-0004

**Appendix A**



Audiogram of Familiar Sounds

**Appendix B**

**https://www.tsbvi.edu/attachments/FunctionalAuditoryPerformanceIndicators.pdf**