MAKING SENSE OF THE AUDIOGRAM

Hearing loss prevents full access to speech which causes learning challenges. Hearing loss is not a learning disorder. The route to most learning, especially at the younger ages, is through verbal instruction and peer-to-peer communication. In order to maximize learning and prevent educational delays the first consideration for the student with hearing loss is how to improve his or her access to verbal communication.

The audiogram is the graph that displays the results of the hearing test and shows how well a child is able to detect sounds at different pitches in a totally quiet environment. The audiogram can inform us about the speech sounds that a child will have the greatest difficulty perceiving. The audiogram does NOT inform us of how well a child can use his or her hearing to comprehend speech in noise. No current amplification devices restore normal hearing. The usual hearing aid and cochlear implant fitting still causes a hearing loss typical to the reduction in hearing caused when you plug your ears with your fingers (20-25 dB HL). This is considered 'borderline normal' hearing, but if you listen in this manner the effect on attention and understanding, especially in noise and at a distance, is clearly evident. In general, a child with a hearing loss between 30-60 dB, when using working hearing aids, will be able to comprehend the speech around them in a 3-6 foot radius when in quiet. Speech occurring in quiet beyond 3-6 feet will usually be detected, but parts of speech will be missed that will impact the ability of the child to comprehend what was said. This is why a child will 'look' like he can hear, but still has challenges with following directions and listening comprehension.

Finally, because of missing speech sounds and less-than-normal hearing – even with hearing aids – children must spend more effort to listen in order to perceive as much of the speech around them as possible. The extra effort spent on attention and listening reduces the amount of cognitive resources available to actually process and comprehend what is heard. This all means that the child with hearing loss will need extra repetition, will expend extra attention than typically hearing students, and may still comprehend less than their peers due to the reduced access caused by hearing loss.

Audibility versus Speech Understanding

An audiogram informs us how a child detects sounds, not how they understand speech. The audibility of speech sounds provides the opportunity upon which speech understanding is based. As an analogy, imagine a student that perceived only 66% of speech energy (i.e., 66 pieces of a 100-piece picture puzzle). If the topic is a well-known children's story, then the child may understand much or all of what is being said because prior knowledge of the topic will fill in what is not fully heard. If the topic is new to the student (i.e., the Civil War, the water cycle, a new story about a child in a different culture with unknown vocabulary) then he or she may identify some of the words spoken but may miss too much to comprehend the new information. So it is the child's language level, previous knowledge, motivation, fatigue and interference from background noise, etc. that will determine how much of what is audible is actually understood (i.e., what meaning they can derive from having only 66 puzzle pieces).

Types of Hearing Loss

Hearing loss caused by a blockage in the outer or middle ear prevents sound from being fully conducted from the outer ear into the inner ear. We identify conductive hearing loss by using a bone vibrator on the skull through which sounds are presented. The cochleas are enclosed within the skull bone. Results of this testing will identify the perception of sound in the cochlea. If bone conduction hearing is within the normal range and hearing through headphones or ear inserts (air conduction) shows a hearing loss, then we know there is a blockage in the outer or middle ear (earwax, ear infection, etc.). If the bone conduction hearing and the air conduction hearing show the same amount of hearing ability and it is beyond the normal range, then a sensorineural hearing loss is present.

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The following chart has been divided into ranges of hearing loss, presenting general issues encountered and also the estimated audibility if a child heard at that level across all frequencies (with hearing devices or without hearing devices). Three audibility levels are presented: 45 dB HL or conversational speech (i.e., typical loudness in quiet from an arm's length distance); 35 dB HL or soft speech (student answering a question from across the classroom, peers talking softly behind the student); and 50 dB HL or teacher speech (teachers often speak more loudly than this, but typically speak at least at 50 dB during verbal instruction). Representative speech sounds that are inaudible/audible have been included. Not all sounds are represented. This will vary based on configuration of loss.

Degree of Hearing Loss	**General Issues with this Degree of Hearing Loss**	**Audibility of Speech Sounds** (puzzle pieces available for understanding)		
		"Soft speech" 35 dB HL	**"Conversational speech" 45 dB HL**	**"Teacher speech" 50 dB HL**
20-25 dB	Impact of a 20 -25 dB hearing loss can be compared to ability to hear when index fingers are placed in ears. A 20 dB or greater hearing loss in the better ear can result in absent, inconsistent or distorted parts of speech, especially word endings (s, ed) and unemphasized sounds. Behavior may be confused for immaturity or inattention. May be unaware of subtle conversational cues which could cause child to be viewed as inappropriate or awkward.	40% Missing Sounds f, s, th, p, k, v, z, g, sh, ch	80% Missing Sounds f, s, th, p, k, v, z	95% Missing Sounds All sounds detected but not as loud as normal
25-30 dB	Child can "hear" but misses fragments of speech leading to misunderstanding. Degree of difficulty experienced in school will depend upon noise level in the classroom, distance from the teacher, and configuration of the hearing loss, even with hearing aids. Will miss unemphasized words and consonants, especially when a high frequency hearing loss is present. Often experiences difficulty learning early reading skills such as letter/sound associations. Barriers begin to build with negative impact on self-esteem as child is accused of "hearing when he wants to", "daydreaming" or "not paying attention." May believe he/she is less capable due to difficulties understanding in class.	25% Missing Sounds f, s, th, p, k, v, z, g, sh, ch, l, a, j, m, d, b	65% Missing Sounds f, s, th, p, k, v, z, g, sh, ch	81% Missing Sounds f, s, th, p, k,
30-35 dB		15% Missing Sounds f, s, th, p, k, v, z, g, p, sh, ch, l, a, j, m, d, b, ng, o,	45% Missing Sounds f, s, th, p, k, v, z, g, sh, ch, l, a, j, m, d, b	60% Missing Sounds f, s, th, p, k, v, z, g, sh, ch
35-40 dB	Child begins to lose the ability for selective listening, and has increasing difficulty suppressing background noise causing the learning environment to be more stressful. Child is more fatigued due to effort needed to listen. FM needed to access verbal instruction. Repeat key student discussion.	10% Perceived Sounds u, e, l, ng	30% Perceived Sounds J, m, d, b, ng, i, a	45% Perceived Sounds J, m, d, b, ng, i, a, sh, ch, g
40-45 dB	Even with hearing aids, child can "hear" but may miss much of what is said if classroom is noisy or reverberant. Without early amplification the child is likely to have delayed or disordered syntax, limited vocabulary, imperfect speech production and flat voice quality. With personal hearing aids alone,	0% Perceived Sounds None	15% Perceived Sounds u, e, l, ng	30% Perceived Sounds J, m, d, b, ng, i, a
45-50 dB	High risk to effective learning in class using personal hearing aids alone; FM is necessary for access in class.	0%	0%	15%
55-60 dB+	Conversation is inaccessible without amplification.	0%	0%	0%

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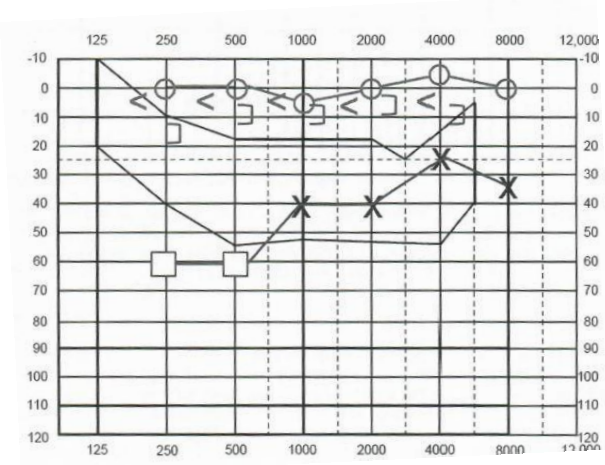
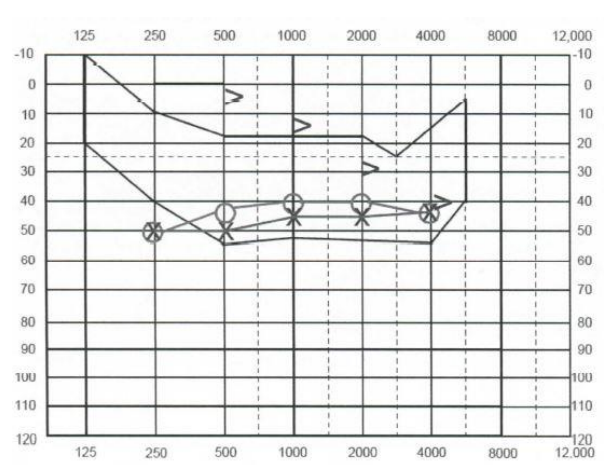
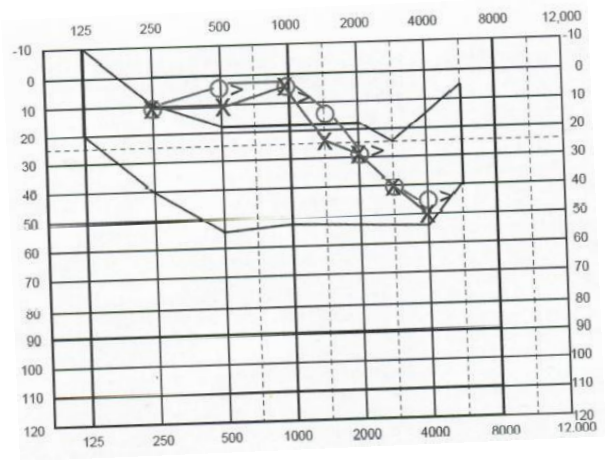
The audiograms below are for you to practice your interpretation skills. Consider how you would explain the impact of the hearing loss on development, listening, socialization and learning when speaking to a classroom teacher, administrator or family member.

- Bone conduction symbols are < > or [ ]. Air conduction right ear = O or △ ; left = X or □ ; cochlear implant response = R_c or L_c **Questions to ask yourself:**
- Type of hearing loss: conductive, sensorineural, mixed? Would medical treatment potentially help improve this hearing loss (medicine, surgery)?
- Would this child benefit from a hearing aid? If **A** is on the audiogram that represents the hearing level when the hearing aid is used. Does it benefit him?
- How would this hearing loss impact development of language and social interaction skills (1) if identified/amplified at 2 months (2) if identified at age 3?
- Imagine the child is age 3 and has almost typical language. How would placement in a cross-categorical (children with many types of disabilities in one room) potentially affect learning? Consider typical language models, noise, and lack of DHH support being regularly available
- What would be the child's general ability to learn if no amplification was worn? (assume no sign language for the purposes of this exercise) What would you predict about speech intelligibility?
- How would this student's ability to access communication in the classroom be affected by typical noise/reverberation? Is an FM warranted? Why?

A space has been provided below each audiogram for you to answer the questions.







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