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# Minimal Hearing Loss - High Risk for Academic Underachievement

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**H**earing loss is an insidious problem in adults, but even more so in children. Adults who experience hearing loss generally deny it for years but they possess the coping mechanisms necessary to get through the day; the ability to predict where the conversation is going, the contextual vocabulary that fills in the blanks of missed words, the linguistic experience to know a question is being asked if the slight upward vocalization is missed to highlight just a few. Adults also have developed key evasive measures when they are asked specific questions that aren't clearly understood such as a simple nod or a look of understanding. Very young children have not developed any of these skills. They can't fill in the blanks because they don't realize that they are missing part of what is being said. They know what they hear but have no idea of the sounds - the words or phrases - that are missing.

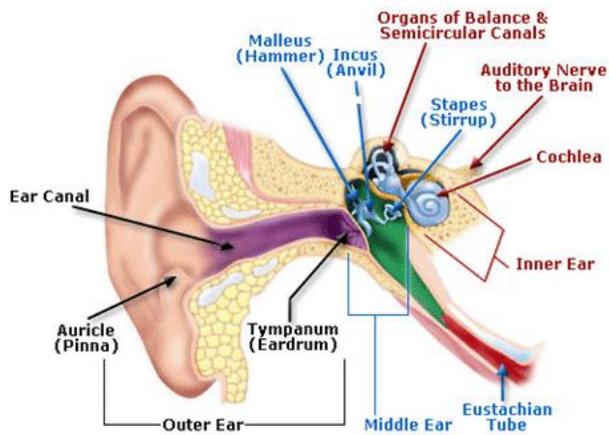
A minimal hearing loss (HL) can occur in one (unilateral) or both ears (bilateral) and usually inhibits the child from clearly hearing the higher frequency sounds. These children can hear many of the lower frequency, higher volume sounds around them but miss many of the softer sounds, like someone whispering even when they whisper them directly into the

ear.

Many things can contribute to a child's hearing loss, congenital (at birth) or acquired (after birth). Congenital hearing loss can be genetic but it can also be caused by premature birth, an infection during pregnancy, or an injury at birth. Acquired hearing loss could be caused by frequent ear infections, meningitis or measles, a head injury or exposure to very loud noises.

Hearing loss can be conductive or sensorineural. Conductive loss can be caused by an object becoming embedded in the ear canal or an infection in the middle ear. Most conductive hearing loss can be treated leaving no permanent issues. Sensorineural hearing loss can be caused by congenital issues, ototoxic drugs, aging, or exposure to loud noises. Sensorineural hearing loss is generally results in permanent disability.

Ear infections are a major cause of temporary hearing loss as they fill the air-filled space in the middle ear with a viscous fluid that puts pressure on the rear of the ear drum, dampening its movement thus reducing the volume of the sounds. The fluid also dampens the vibrations of the ossicles (the three small bones in the middle ear) which transfers the vibrations to the cochlea via the oval window. These infections can be very painful but with a course of antibiotics, the pain tends to go away within a few days, however, the child will experience various degrees of hearing loss



**Figure 1:** *Inner Ear - courtesy of OSHA*

for up to a few weeks after the pain subsides.

It doesn't take much of a hearing loss to damage a child's academic experience. While the American Medical Association (AMA) defines hearing loss as being greater than 25 dB HL<sup>1</sup>, a much smaller loss can greatly affect a child's education. A minimal sensorineural hearing loss (MSHL) as low as 16 dB HL can be a game changer for children in school. Problems hearing faint or distant speech; problems hearing subtle conversational cues; problems in tracking fast-paced conversations and problems hearing the word-sound distinctions all contribute to problematic academic performance. It is estimated that 5.4% - or more than one in twenty, roughly 2.5 million school-aged children exhibit MSHL. This does not include the children with higher levels, moderate or severe, hearing loss.[2]

Bess (1999) wrote that

The largest discrepancy between children with MSHL and children with normal hearing was on the subtlest communication. The

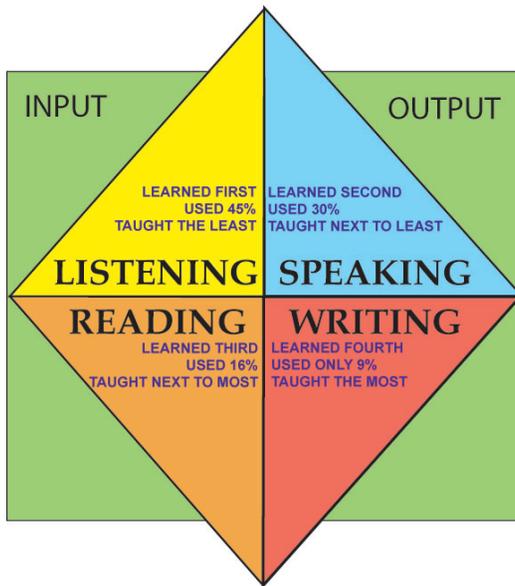
<sup>1</sup>Clinicians measure sound intensity in dB HL (decibels Hearing Level). 0 dB HL is considered to be the quietest sounds that a young healthy individual should be able to hear and 140 dB HL is the threshold of pain. An audiologist will test an individual's ability to hear sounds at various frequencies between 250 Hz and 8000 Hz by presenting pure tones at varying levels between 0 dB HL and 80 dB HL to each ear. By indicating when a tone is heard, the clinician can determine the amount of hearing loss at each of the frequencies. If the softer tones, between 0 dB HL and 25 dB HL are heard, the person is considered in the normal hearing range. Thresholds at and above 25 dB HL are considered diagnostic for mild, moderate, severe or profound hearing loss.

subtlest communication focuses on a student's understanding ability, vocabulary word usage skills, and storytelling abilities - all very important skills for learning in school. In fact, a child with MSHL is 4.3 times more likely to experience trouble in the area of communication than a child with normal hearing.

He went on to indicate that 37% of children with MSHL failed at least one grade compared to a district norm of about 3%. This not only affected the children's academics in a very negative way, but also placed a huge financial burden on the school district. With approximately 46 million school-age children in the United States, of whom about 2,484,000 will exhibit MSHL. Of these, 37% (919,080) will be projected to fail at least one grade. If one assumes that the average cost to educate a child for one year is \$6,000, the total expenditure for grade repetition exceeds \$5.5 billion. [2]

A study of children in the Middle Tennessee school systems indicated that "5.4% of the children had a minimal hearing loss and these children exhibited significantly lower scores on the psychoeducational tests or failed at least one grade as compared to children with normal hearing." "The study revealed that children with a minimal hearing loss clearly expend more effort in listening than children with normal hearing," said Anne Marie Tharpe, PhD, CCC-A, assistant professor, Department of Hearing and Speech Sciences, Vanderbilt University. "These findings suggest that class work may suffer if a child with hearing loss is expending extra mental or cognitive effort to listen to the teacher, take notes, and process what is being heard at the same time." [1]

McFadden and Pittman[11] wrote that there is a growing body of evidence that children with minimal hearing losses are at an increased risk for speech and language delays, poor academic performance, and social dysfunction compared to their normally hearing peers [3][5][8][10]. The focus of their study was to determine how children with minimal HL manage multiple demands on their attention; such as attending to a written assignment or taking notes while listening to verbal instructions. Adults, when faced with competing tasks, reduce their performance on one task to maintain their performance on another task. Children with minimal hearing loss have diffi-



**Figure 2:** *The Communications Diamond*

culty attending to multiple tasks if one of those tasks involves listening. They concluded that children with minimal hearing loss may be unable to respond to a difficult listening task by drawing resources from other tasks to compensate. They added

Unfortunately there remains a prevailing perception among physicians, parents, and teachers that the consequences of minimal HL in childhood are likewise minimal. Therefore, research to reveal the many consequences of minimal hearing loss in children is warranted.

Unless a child has a significant loss the chances of it being detected early is, unfortunately, quite low. Most states require a hearing test to be administered at birth, but for the most part, infants have to have a hearing loss greater than 35 - 40 dB before they are identified. The in-school hearing tests have been eliminated in almost one-third of the states, and even in those where children are tested, the testing fails to identify the milder forms of hearing loss.

Our ability to hear is the gateway to our ability to listen, or to understand what we hear. School children spend upwards of 70% of their school day engaged in some-type of listening activity - and its through listening, that a child learns to speak, read and write - the other three communication modalities.

A child with even a minimal loss of hearing acuity often presents symptoms similar to that of ADD/ADHD

- inappropriate responses, difficulty following directions or sustaining attention during a presentation; impulsiveness and more - and is often diagnosed as ADD/ADHD rather than having hearing loss or auditory processing issues. It is not until after various courses of medication - taking months, if not years - that failed to solve the child's problem, that their hearing and understanding levels are examined.

These children can miss more than 25% of classroom instruction, not only due to their hearing loss, but also the additional cognitive stress that poor classroom acoustics and noise puts on them [9]. Additionally, they often miss the more subtle conversational cues which causes them to respond inappropriately to questions or within a conversation. This can be a source of taunting, ridicule or even bullying by their classmates, especially in the early grades. To their parents and teachers they may appear to be a little immature and more fatigued than their better hearing peers because of the high level of cognitive effort they exert as they work hard at listening more effectively.

Many of the morphological markers that indicate plurality, tense and possessiveness occur with low energy (soft) sounds at the higher frequencies. While the vowel sounds carry much of the volume of a conversation, the consonants carry most of the information. Acoustic engineers have found that if you filter out everything below 500 Hz, you will only have a 5% reduction of speech intelligibility even though most of the speech energy (volume) is lost. However, if you reduce the volume of the sounds above 1,000 Hz by 30 dB, intelligibility is reduced over 40% [6].

The audiogram in Figure 3 shows that many of the key consonant sounds - /th/, /f/, /s/, and /h/ are at the high frequency end of our tested hearing and at very low intensity. The /th/ sound lies at roughly 5000 Hz at 20 dB HL, meaning that an individual with a hearing loss of just 20 dB HL will begin to lose, or at least confuse this with other sounds in the same range - /s/ and /f/ especially. It is the final /s/ sound that indicates plurality and possessiveness in many words. The confusion of these four consonant sounds can affect the understandability of many words.

It is critical that teachers have an awareness of the many issues faced by those students with even a minimal amount of hearing loss because the classroom environment only exacerbates the problem.

Classrooms are rarely designed for listening. School architects spend many hours insuring that the

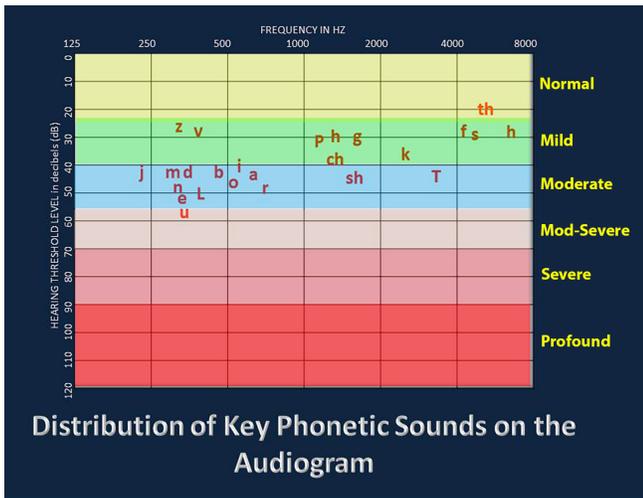


Figure 3: Standard Audiogram with Phoneme Overlay

classroom’s lighting is both sufficient and glare-free, yet, in general, spend little time on the noise and echo reduction necessary for better speech intelligibility.

Classroom size is also an issue because the laws of physics are not often broken. In a classroom that is 30 feet deep, the teacher’s voice volume differs by almost 75% from the front rows to the rear rows of seats. Since sound intensity halves as the distance from the sound source is doubled, if a teacher is speaking at 60 dB HL (normal speech intensity) to the students in the front row (6 feet from the teacher), the intensity drops to 54 dB HL (half) for those students only 6 feet back (12 feet from the teacher) and down to 48 dB HL (half again) for those 24 feet from the teacher. This is roughly the sound level of a quiet street or whispered speech - not at all conducive to accurately perceiving speech in a learning environment. And this does not take into account a child’s hearing loss! Add in the overall noise level in a typical classroom along with the soft echoes (reverberation) and the problems multiply for those children with even a minimal hearing loss.

With little outside help in the form of auditory testing for low level hearing loss, it is important for both parents and teachers to be aware of the signs and symptoms of minimal and mild hearing loss and to request that a child have a comprehensive auditory evaluation by a pediatric audiologist if the child exhibits any of the following symptoms. It is too easy for hearing loss to be overlooked with a quick diagnosis of ADD/ADHD, but this misdiagnosis could be the beginning of a lifetime of academic underachievement.

Some of the signs of hearing loss in children are:[4]

[7] [12] [13]

- Delayed speech.
- Speech is not clear (articulation issues).
- Does not follow directions.
- Difficulty with paying attention or behaving.
- Often says “Huh?”
- Turns up the volume of the TV, music player, game console, too high.
- Respond inappropriately to questions.
- Not replying when called.
- Watches others to imitate what they are doing.
- Complain of earaches, ear pain, or head noises.
- Have difficulty understanding what people are saying.
- Seems to speak differently from other children of the same age group.
- Difficulty with academic performance.
- Intently watches the faces of those speaking.
- Difficulty understanding speech when there is background noise.
- Not responding to voices over the telephone or continually switching ears when on the phone.
- Not ‘jumping‘ or becoming startled by sudden, loud noises.
- Unable to accurately determine where a sound is coming from.

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