Chapter 4

Hearing Considerations

The assessment of hearing is within the professional domain of an audiologist or otolaryngologist, not a speech-language pathologist. However, speech-language pathologists are specifically interested in the effects of hearing impairment on:

- The assessment of communicative development and abilities
- The development or maintenance of a communication disorder
- Treatment recommendations and the selection of appropriate treatment procedures and target behaviors
- Academic, social, or vocational development

Speech-language pathologists are expected to have a basic understanding of hearing loss and implications of hearing loss on functional communication.

Overview of Common Hearing Disorders

A pictorial representation of the ear is presented in Figure 4–1. Hearing loss can occur when there is a problem in the external ear, middle ear, and/or inner ear. The three basic types of hearing loss are conductive, sensorineural, and mixed:

- *Conductive hearing loss* results from an obstruction in the outer or middle ear. Common causes include middle ear fluid, otitis media, external otitis, ruptured eardrum, poor eustachian tube function, excessive earwax, benign tumors, congenital malformation, or foreign objects stuck in the ear canal. When young children experience recurrent conductive hearing loss, speech and language development may be negatively impacted. Conductive hearing loss is usually temporary and repairable with medicine or surgery.
- *Sensorineural hearing loss* (SNHL) results from inner ear damage. It is the most common type of permanent hearing loss. Causes include illness, infection, trauma to the head, ototoxicity (damage from drugs), exposure to excessively loud noises, presbycusis (age-related hearing loss), genetic hearing loss, or congenital malformation of the inner ear. Hearing aids are usually prescribed.
- *Mixed hearing loss* results when a conductive hearing loss and sensorineural hearing loss occur at the same time. For example, an individual may have co-occurring excessive earwax, resulting in a conductive loss, and presbycusis, resulting in an SNHL. Treatment often includes a combination of medicine, surgery, and hearing aids.

Other common hearing pathologies are auditory processing disorder, unilateral hearing loss in children, cochlear synaptopathy, and tinnitus. These disorders are described below.

- *Auditory processing disorder* (APD) is a condition of listening difficulty despite normal or near-normal hearing acuity. People with APD have difficulty understanding auditory information and may struggle with memory, attention, and language. Noisy and distracting environments worsen the difficulties. Children with APD often struggle academically. They may be unable to follow complex verbal directions, exhibit spelling and reading deficits,

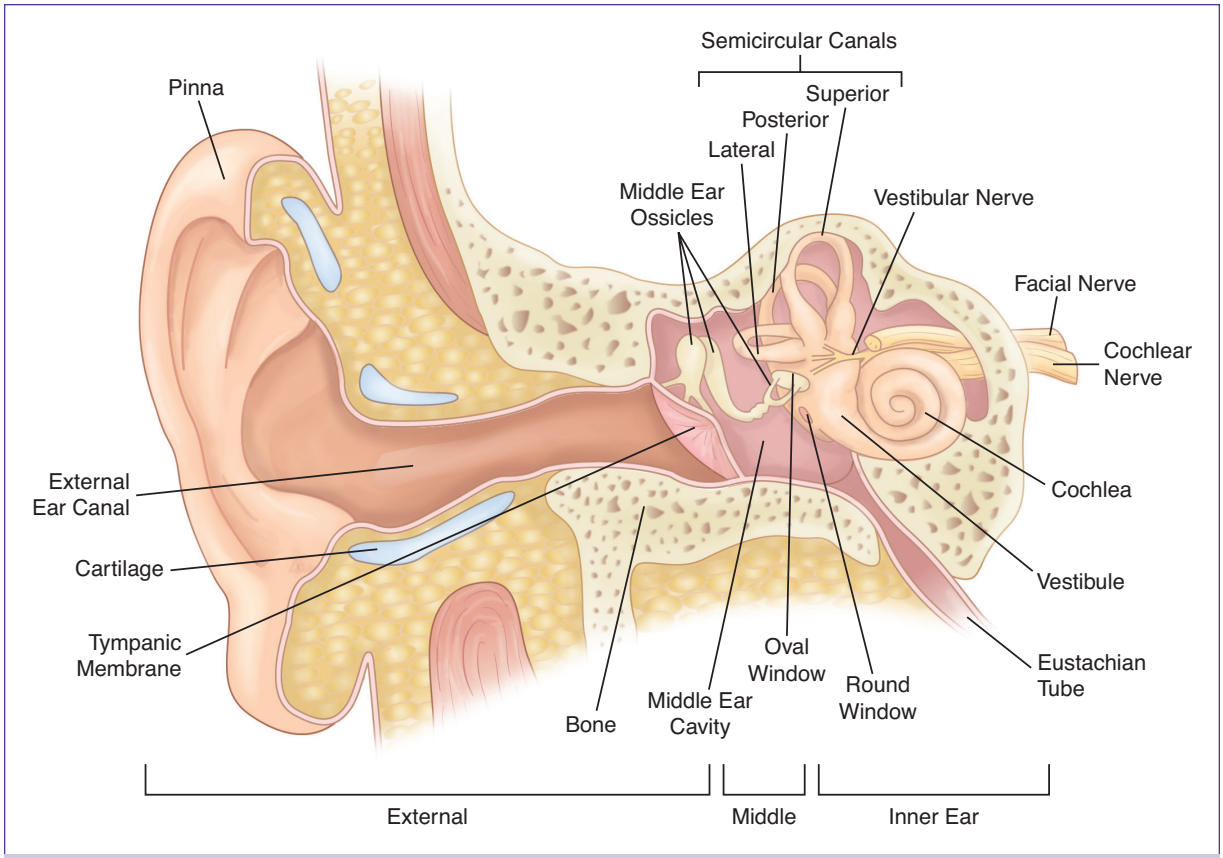

FIGURE 4–1. The ear. *Source:* From Shipley/McAfee's *Assessment in Speech-Language Pathology, 5E*. © 2016 Delmar Learning, a part of Cengage, Inc. Reproduced with permission. http://www.cengage.com/permissions

have difficulty engaging in class discussions, or have difficulty focusing and completing assignments. This condition is still largely not understood; it may be a manifestation of other disorders rather than a distinct clinical hearing disorder.

- *Unilateral hearing loss in children* (UHL) is hearing loss in only one ear. The child may have trouble localizing sound or understanding speech, especially in a noisy environment. UHL may cause speech and language delays. Treatment varies and is dependent upon the cause of the hearing loss. A hearing aid may be prescribed for some children.
- *Cochlear synaptopathy*, also called *hidden hearing loss*, is primarily an adult condition that results from damage to the nerve connections between the cochlea and vestibulocochlear nerve (CN VIII). An individual with cochlear synaptopathy has difficulty understanding speech in noisy environments. The loss is "hidden" because it is not detected via standard pure-tone audiometry. It is usually caused by aging, ototoxicity, and noise exposure.
- *Tinnitus* is a chronic or temporary ringing in one or both ears. It can sound like white noise, whistling, humming, hissing, roaring, pulsing, chirping, buzzing, or clicking. It is common, with most people experiencing tinnitus at least once in their lives. Causes include hearing loss, exposure to loud noise, stress, caffeine intake, Ménière's disease, infection, head injury,

headache, drug intake, anemia, high blood pressure, and cigarette smoking. In many cases, the cause is unknown. An audiologist can investigate possible causes of chronic tinnitus and explore treatment options.

Audiograms

An audiogram is a graph depicting results of a pure-tone hearing test. Pure-tone audiometry measures the function of the outer, middle, and inner ear by delivering pure-tone signals by air conduction and bone conduction. The softest decibel (dB) level at which an individual hears a tone at a given frequency (Hz) is called the hearing threshold. Hearing thresholds for each frequency assessed are plotted on the audiogram. The symbols used on an audiogram are shown in Figure 4–2. These symbols are often presented in differentiating colors to denote sidedness; red represents the right side and blue represents the left side.

Figure 4–3 depicts four basic audiograms showing normal hearing, a conductive hearing loss, a sensorineural hearing loss, and a mixed hearing loss. The hearing losses in these examples are bilateral (involving both ears), although unilateral hearing losses are also common.

Standard Classification of Hearing Loss

A frequently used classification system of hearing loss severity is presented in Table 4–1. The classifications are according to average hearing levels obtained during pure-tone audiometry. Logi-

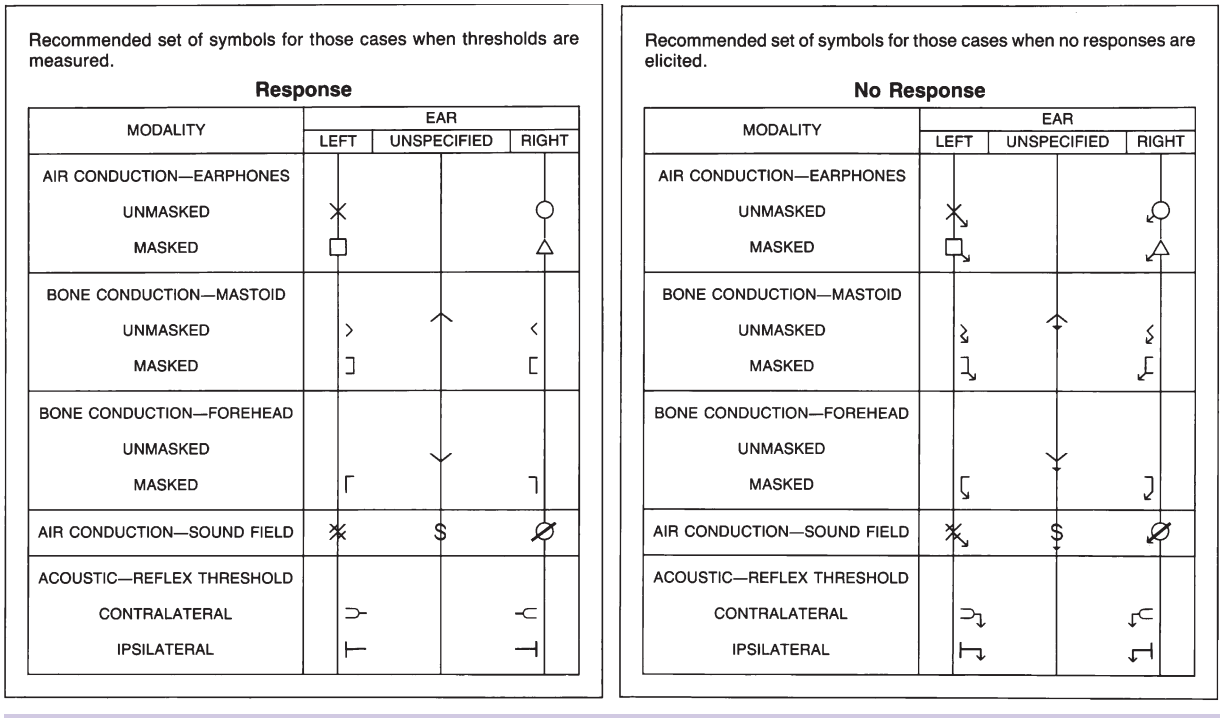

FIGURE 4–2. Audiometric symbols. *Source:* Audiometric Symbols Table from "Guidelines for Audiometric Symbols," *ASHA* (April 1990, Supplement No. 2), *32*(4), 25–30. Reprinted with permission.

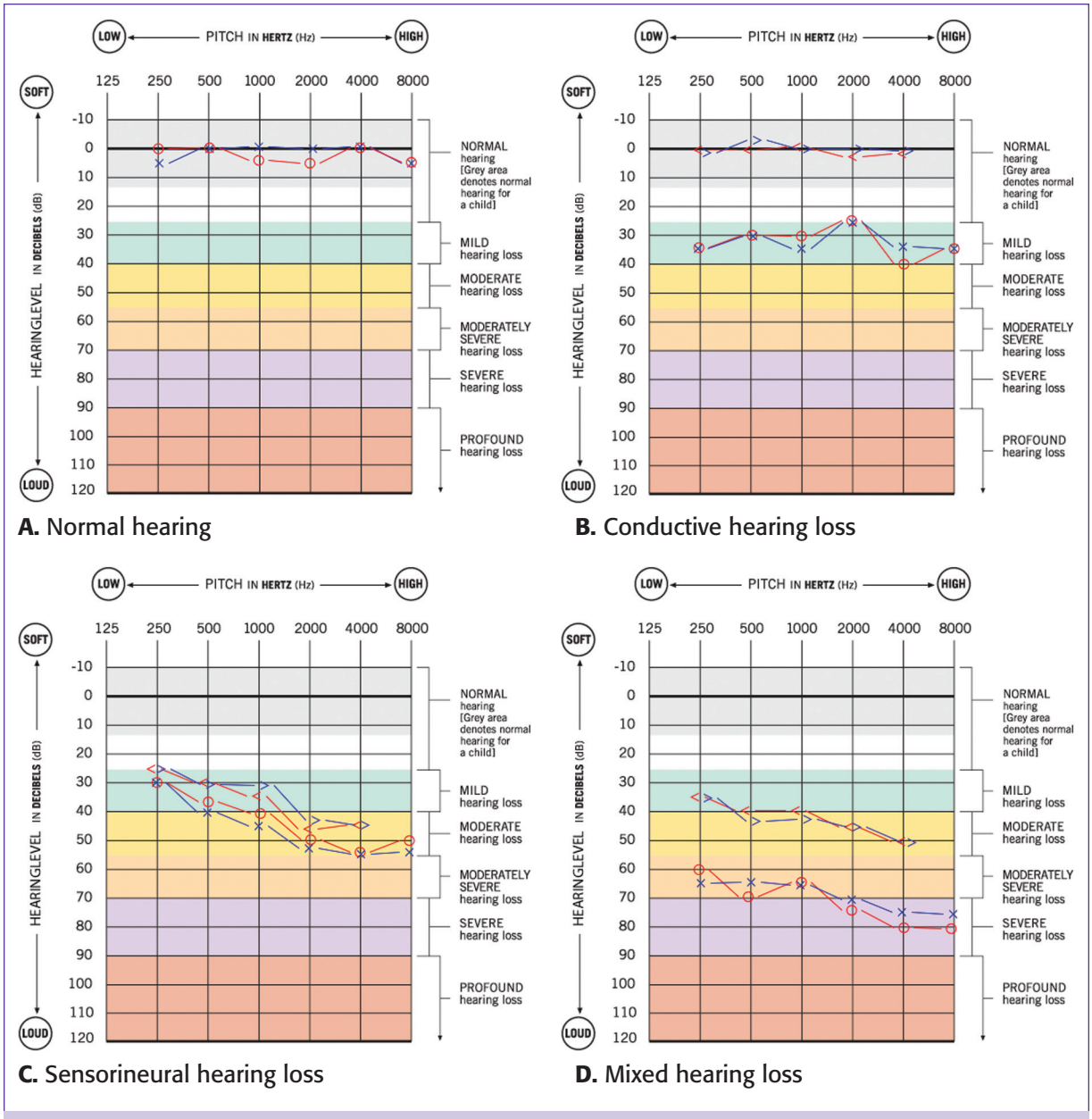

FIGURE 4–3. Four common audiograms. Audiograms created online at https://www.hearingaidknow.com/audiogram-creator Used by permission of Hearing Aid Know.

cally, the greater the severity of a hearing loss, the greater its potential negative impact on speech and language.

Effects of Hearing Loss on Communication

Hearing is fundamental for communicating and connecting with the world. Depending on hearing loss severity, a hearing loss can have a slight to profound effect on an individual's quality of life. Children with hearing loss may experience developmental delays, struggle with speech-language

TABLE 4–1. Hearing Loss Severity by Decibel Levels

HEARING LEVEL (IN DB)	SEVERITY OF HEARING LOSS
–10 to 15	Normal hearing
16 to 25	Slight hearing loss
26 to 40	Mild hearing loss
41 to 55	Moderate hearing loss
56 to 70	Moderately severe hearing loss
71 to 90	Severe hearing loss
91+	Profound hearing loss

disorders, exhibit learning problems, experience low self-esteem, and have difficulty making friends. Adults with hearing loss may feel socially isolated, develop anxiety, have strained relationships, struggle at work, or become depressed. Untreated hearing loss in older adults is associated with cognitive decline.

Table 4–2 presents the impact of hearing loss in a classroom setting. This information could be similarly applied to an adult in a work setting or social setting. These effects are general guidelines. Hearing loss affects individuals differently and is dependent upon factors such as:

- The type of loss
- The dB levels and frequencies affected
- Age of onset
- General health
- Current interventions (e.g., therapy, educational accommodations, medical interventions, etc.)
- Other learning concerns

The Speech Banana

The speech banana, shown in Figure 4–4, is a useful graphic for understanding how hearing loss can affect a person's ability to understand speech. Individual phonemes have different average frequency and decibel values during typical conversational speech. When these phoneme values are plotted on a graph, they form a banana-like shape. A client's audiogram can be superimposed over the speech banana to show which phonemes the individual may and may not be able to perceive.

Speech-language pathologists sometimes use the speech banana when counseling clients or caregivers on the effects of hearing loss on speech-language reception. For example, a client with a mild high-frequency hearing loss will have a hard time hearing sounds such as /f/, /s/, and /ð/. Counseling the client's caregivers to minimize using words containing high-frequency sounds (e.g., this, nice, fast) when speaking to the client and use more hearing-friendly synonyms when possible will help with overall communication.

TABLE 4–2. Effects of Hearing Loss in a Classroom Environment

Minimal hearing loss (16- to 25-dB HL)	At 15 dB, a student can miss up to 10% of the speech signal when a teacher is at a distance greater than 3 feet and when the classroom is noisy.
Mild hearing loss (26- to 40-dB HL)	With a 30-dB loss, a student can miss 25%–40% of a speech signal. Without amplification, the child with 35- to 40-dB loss may miss at least 50% of class discussion.
Moderate hearing loss (41- to 55-dB HL)	Child understands conversational speech at a distance of 3 to 5 feet (face to face) only if structure and vocabulary are controlled. Without amplification, the amount of speech signal missed can be 50%–75% with a 40-dB loss and 80%–100% with a 50-dB loss.
Moderate to severe hearing loss (56- to 70-dB HL)	Without amplification, conversation must be very loud to be understood. A 55-dB loss can cause a child to miss up to 100% of speech information.
Severe hearing loss (71- to 90-dB HL)	Without amplification, the child may hear loud voices about 1 foot from the ear. When amplified optimally, children with hearing ability of 90 dB or better should be able to identify environmental sounds and detect all the sounds of speech.
Profound hearing loss (>90-dB HL)	Aware of vibrations more than tonal patterns. May rely on vision rather than hearing as the primary avenue for communication and learning.
Unilateral hearing loss (normal hearing in one ear with the other ear exhibiting at least a mild permanent loss)	May have difficulty hearing faint or distant speech. Usually has difficulty localizing sounds and has greater difficulty understanding speech in background noise.

Source: Plante and Beeson (1999).

Environmental Noise Levels

An individual with a hearing loss will have trouble hearing certain environmental sounds. Table 4–3 lists typical decibel levels of many common sounds. This information, paired with the speech banana, is useful for counseling clients or their caregivers about a hearing loss and its effect on communication.

Hearing Aids

Hearing aids are electronic devices worn in or behind the ear to amplify sound. The hearing aid's microphone converts sound waves to electrical signals, which are then amplified and sent to the ear through a speaker. The three basic types of hearing aids are:

- *Behind-the-ear* (BTE). A BTE hearing aid consists of a hard plastic case worn behind the ear and connected to a plastic earmold fitted inside the outer ear. These hearing aids are recommended for mild to profound hearing loss and are appropriate for individuals of any age. Children usually use BTE hearing aids because the earmolds can be inexpensively replaced to accommodate the changing shape of a child's outer ear.

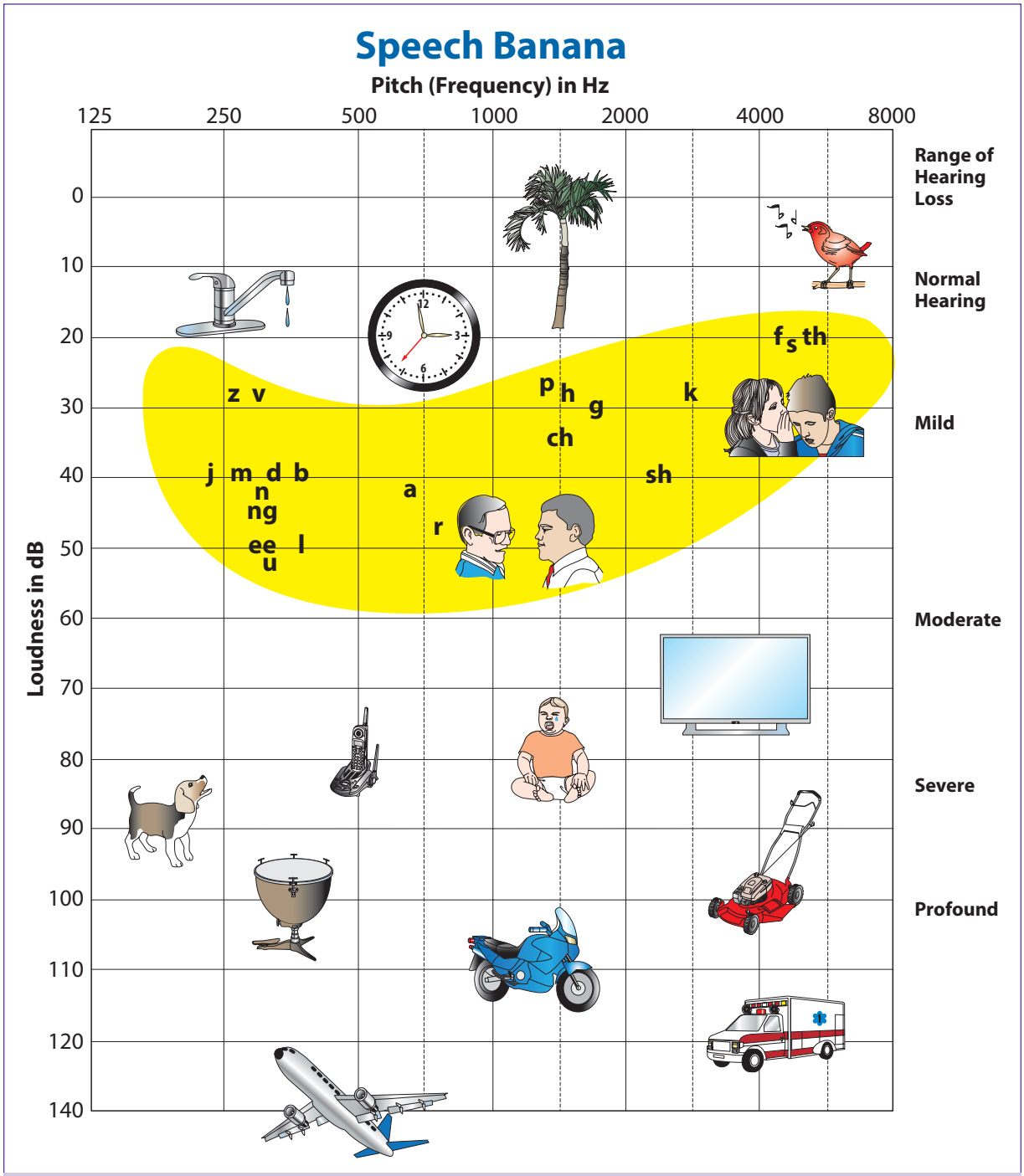

FIGURE 4–4. The speech banana.

- *In-the-ear* (ITE). These hearing aids fit completely inside the outer ear. They are recommended for mild to severe hearing loss and are worn primarily by adults. Some include a telecoil (T) that allows the user to receive sound through the circuitry of the hearing aid instead of a microphone.
- *Canal.* These hearing aids are very small and fit tightly in the ear canal. There are two styles: *In-the-canal* (INC) hearing aids are molded to fit the size and shape of the ear canal; *completely-in-canal* (CIC) hearing aids fit deeper in the canal and are almost completely hidden from view. Both styles are recommended for mild to moderately severe hearing loss and are worn primarily by adults.

TABLE 4–3. Environmental Noise Levels

DB LEVEL	ENVIRONMENTAL NOISE	DB LEVEL	ENVIRONMENTAL NOISE
0 dB	Barely audible sound	90 dB	Lawnmower
10 dB	Normal breathing		Shouting
	Soft rustle of leaves		Food blender
20 dB	Clock ticking		City traffic
	Bird chirping		Dog barking
	Dripping water	100 dB	School dance
30 dB	Whisper		Tympani roll
40 dB	Library noise		Chain saw
50 dB	Moderate rainfall	110 dB	Leaf blower
	Inside a typical home		Motorcycle
60 dB	Normal conversation (50–70 dB)		Car horn
	Department store		Loud thunder
70 dB	Television	120 dB	Thunderclap
	Freeway traffic		Hammering nails
	Vacuum cleaner		Ambulance siren
80 dB	Telephone ring	130 dB	Jackhammer
	Doorbell		Stock car race
	Alarm clock	140 dB	Jet engine at takeoff
	Noisy restaurant		Firecracker
	Garbage disposal		Air raid siren
	Blow dryer	150 dB	Artillery fire at 500 feet
	Baby crying	160 dB	Fireworks at 3 feet
		170 dB	High-powered shotgun
		180 dB	Rocket at takeoff

Sources: American Speech-Language Hearing Association (2018), Center for Hearing and Communication (2018), and Johnson (2005).

Troubleshooting Hearing Aid Problems

When assessing the speech-language skills of a client who wears a hearing aid, make sure the hearing aid is functioning as it should; otherwise, assessment findings are likely to be unreliable. It is helpful to keep a hearing aid care kit, which includes a listening stethoscope, a battery tester, a small air blower for removing moisture, and a small loop and brush for removing debris or earwax. Complete a quick listening check of the hearing aid by following these steps.

1. Look generally at all parts. Is anything broken or cracked? Are any parts disconnected? Are any openings blocked?
2. Check the battery. Is it missing? Weak? Is there corrosion in the battery compartment?
3. Look at the tubing. Is there built-up moisture? Is it bent or twisted? Is there blockage?
4. Alternate the on-off switch. Do you hear distortions? Crackling noises? Other unusual sounds? No sound at all?
5. Turn the hearing aid to low volume and gradually increase to maximum volume. Is the transition smooth? Distorted?
6. Produce the Ling sounds: /a/, /i/, /u/, /m/, /ʃ/, and /s/. These sounds represent the frequency range of all phonemes. Are they all audible and clear?

If a client is having trouble with a hearing aid, the speech-language pathologists may be able to help. Table 4–4 is a troubleshooting guide for basic hearing aid problems. Some problems can be quickly resolved with minimal hearing aid expertise. If unable to resolve the problem, refer the client to the audiologist or hearing aid manufacturer.

Hearing Screening as Part of a Speech-Language Assessment

A consideration of a client's hearing acuity should be included in all speech-language assessments. Poor hearing can negatively affect the validity of assessment findings. A client may be judged as not knowing the answer to a test prompt when, in reality, the client did not accurately hear the test prompt.

Informally judge whether a client seems to be hearing okay by speaking at a soft volume for a brief period of time. If the client is hearing softly spoken speech without missing any information, this may be all that is necessary. If the client struggles to hear softly spoken speech, additional screening is necessary.

There are apps available for iOS and Android designed for checking hearing. These are not a substitute for pure-tone audiometry, but they are easy to use with minimal equipment and may be an option for screening hearing. Two free apps are:

- *hearWHO*, by hearX Group (Pty) Ltd and available from the World Health Organization
- *Mimi Hearing Test*, by Mimi Hearing Technologies

TABLE 4–4. Troubleshooting Hearing Aid Problems

PROBLEM	POSSIBLE CAUSE
Hearing aid appears dead	Battery is bad, inserted upside down, or the wrong size Earwax is blocking the microphone or sound outlet Cord contacts are dirty, broken, or loose Tubing is twisted or collapsed Earmold is cracked Moisture has damaged the hearing aid Telecoil switch is on
Hearing aid is weak	Battery is bad Earwax is blocking the microphone or sound outlet Moisture or debris is trapped in the tubing or earmold Earmold is cracked
Sound is intermittent	Cord contacts or controls are dirty or loose Tubing is twisted or collapsed Hearing aid has trapped moisture Telecoil switch is on
Sound is distorted or muffled	Battery or battery connections are weak Earwax is partially blocking the microphone or sound outlet Cord contacts are broken or loose Moisture or debris is trapped in the tubing or earmold Telecoil switch is on
Hearing aid is producing acoustic feedback	Earmold is not inserted properly or no longer fits Earmold and receiver are loose Microphone is too close to the receiver Volume is too high Earmold, tubing, or earhook is cracked

A speech-language pathologist is not qualified to evaluate hearing beyond the scope of a basic screening procedure. If a client fails a screen, the client should be referred to an audiologist, otolaryngologist, or other medical professional for further evaluation.

Concluding Comments

Speech-language pathologists do not evaluate hearing or diagnose hearing loss. However, speech-language pathologists should have basic competence concerning audiological assessment and the impact a hearing loss has on a client's functional communication.

Sources of Additional Information

Print Source

Hull, R. H. (2021). *Introduction to aural rehabilitation: Serving children and adults with hearing loss* (3rd ed.). Plural Publishing.

Electronic Sources

American Speech-Language-Hearing Association
http://www.asha.org

Center for Hearing and Communication
http://www.chchearing.org

National Institute on Deafness and Other Communication Disorders
http://www.nidcd.nih.gov

My Ear Anatomy, app by Visual3DScience