Video-Based
Aural Rehabilitation Guide

Enhancing Listening and Spoken Language in Children and Adults

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Look for this icon indicating there are related videos on the companion website ▶.

Preface

This video-based textbook was conceived as a format in which to present over 200 captioned videos that illustrate aural rehabilitation (AR) practices to enhance listening and spoken language in individuals who have hearing loss, ranging from infants to older adults. It is intended to educate undergraduate university students in speech-language pathology, audiology, and education of the deaf and hard of hearing; enhance the knowledge and skills of practicing professionals; and assist persons with hearing loss, their families, and communication partners in understanding hearing loss and aural rehabilitation. The extensive videos also serve as a resource for graduate students who are enrolled in an aural rehabilitation practicum or those who are involved in student teaching.

The chapters and videos represent information regarding professional practices in AR used with a heterogeneous group of children and adults with hearing loss. The importance of interprofessional practice and collaboration is integrated into each chapter, to provide optimal patient care. Videos feature audiologists, speech pathologists, listening and spoken language specialists, teachers of the deaf and hard of hearing, early interventionists, otologists, and occupational therapists practicing in settings such as clinics, private practice, schools, hospitals, and the community. The discussions of personal hearing devices and other hearing assistive technologies along with strategies to enhance listening and communication are presented with the intention of optimizing communication functions of persons with hearing loss for greater participation in the hearing-speaking mainstream. Topics covered in the text of the chapters and videos include hearing technologies, AR procedures for children and adults with hearing loss and their families, factors that affect outcomes, fundamentals of assessment, education, and the psychosocial well-being of persons with hearing loss. Some topics appear in more than one chapter, as they are integral to the focus of that chapter. Similarly, a small number of videos are presented in more than one chapter, as they support a wide range of topics.

The framework of AR presented in this video-based book focuses primarily on the use of listening and spoken language (i.e., Auditory-Verbal communication) for children and adults with hearing loss. In addition to listening and spoken language, other modes of communication are discussed and demonstrated in videos as is the communication philosophy of individuals who identify with the Deaf culture. Taken together, the approaches included in the chapters emphasize how to improve communication function in children and adults with hearing loss while respecting client and family choices. With improved communication, individuals can enjoy expanded opportunities and more fulfilling experiences in socialization, education, employment, and recreation. Whereas verbal communication underlies most social interactions, the roles of family, friends, coworkers, and other communication partners are discussed and their involvement in the AR process is illustrated in the videos.

As an introductory teaching guide, the chapters in this video-based textbook provide background knowledge on a number of topics, and the videos illustrate the application of this knowledge to AR services. While a wide range of topics and current issues are addressed in this textbook, they are not intended to be exhaustive. The activities demonstrated in the videos are for illustrative purposes. The activities and practices presented in each video were selected for the individual seen in the video and may or may not be applicable to another child or adult with hearing loss. All AR services should be completely individualized and tailored to meet the needs of the individual and family. It is our hope that this video-based book will inspire students and practicing professionals to assist people with hearing loss in improving their communication function and expanding their opportunities in life.

Table 1–2. Descriptions of Tests Commonly Used to Identify Hearing Loss

Hearing Tests	***Description***
Auditory brainstem response	An electrophysiological response to sound from the brainstem, measured by electrodes placed on the scalp. It can provide an estimate of frequency-specific thresholds.
Otoacoustic emission	Low-intensity sound generated as a result of vibrations of the hair cells in the cochlea in response to a sound stimulus. Measured with a sensitive microphone placed in the ear canal.
Auditory steady-state response	ASSR consists of neural potentials in response to modulated auditory stimuli measured via surface electrodes. It is used to estimate frequency-specific thresholds.
Tympanometry	This test provides information concerning the mobility of the tympanic membrane and status of the middle ear transmission system.
Acoustic reflex measure	The acoustic reflex is an involuntary contraction of middle ear muscles in response to loud sounds. This measure is helpful in identifying whether retrocochlear pathology is present.
Visual reinforcement audiometry	A child is conditioned to make a head turn toward visual reinforcers (e.g., lights, mechanical toys) in response to sound.
Conditioned play audiometry	The child is taught to perform an action with a toy upon hearing a sound presented by the audiologist.
Conventional audiometry	Also known as pure-tone audiometry. Pure tones are presented at various frequencies and intensities to a person, who indicates when the sound is heard.
Speech detection threshold	A measure used to determine the lowest hearing level at which a patient can detect the presence of speech on 50% of the test trials.
Speech recognition threshold	A measure designed to find the lowest hearing level that a patient can identify or repeat words on 50% of the test trials. The most common stimuli used are two-syllable words with equal stress on each syllable (i.e., spondees).
Suprathreshold speech recognition	A measure of the percentage of single syllable words and sentences correctly identified or repeated at various loudness levels. Tests are available for children and adults.

Severity of Hearing Loss and Access to the Speech Spectrum

As mentioned earlier, hearing loss may be congenital or acquired. Hearing loss can also be stable, fluctuating, progressive, or sudden. It can occur at any point in life and can change throughout life. Hearing loss severity can be minimal, mild, moderate, moderately severe, severe, or profound (Table 1–3). In addition, hearing sensitivity may not be uniform across the speech frequencies and can be described with greater detail. For example, hearing loss can be within normal limits in the low to mid frequencies and severe to profound in the high frequencies.

Figure 1–4 shows audiograms depicting varying *severity of hearing loss*, *configurations of hearing loss*, as well as the *speech banana*, which indicates the general area of the *audiogram* which

Table 1–3. Hearing Loss Severity

Degree of Hearing Loss (Severity)	*Hearing Loss Range (dB HL)*
Normal	−10 to 15 dB
Slight/Minimal	16 to 25 dB
Mild	26 to 40 dB
Moderate	41 to 55 dB
Moderately severe	56 to 70 dB
Severe	71 to 90 dB
Profound	>90 dB

Source: Adapted from ASHA, 2015.

encompasses the *speech frequencies*. Audiogram A shows mild hearing loss with a cookie bite configuration; audiogram B shows a moderate hearing loss with a rising configuration; audiogram C shows a severe hearing loss with a flat configuration; and audiogram D shows a profound hearing loss with a sloping configuration. As seen in Figure 1–4, the severity of hearing loss impacts speech recognition performance. Word discrimination scores generally become poorer with increased severity of hearing loss. The speech banana depicted in each audiogram illustrates which phonemes (vowels and consonants) will be difficult to detect, discriminate, or identify given the configuration and severity of hearing loss. Thus, knowing the degree

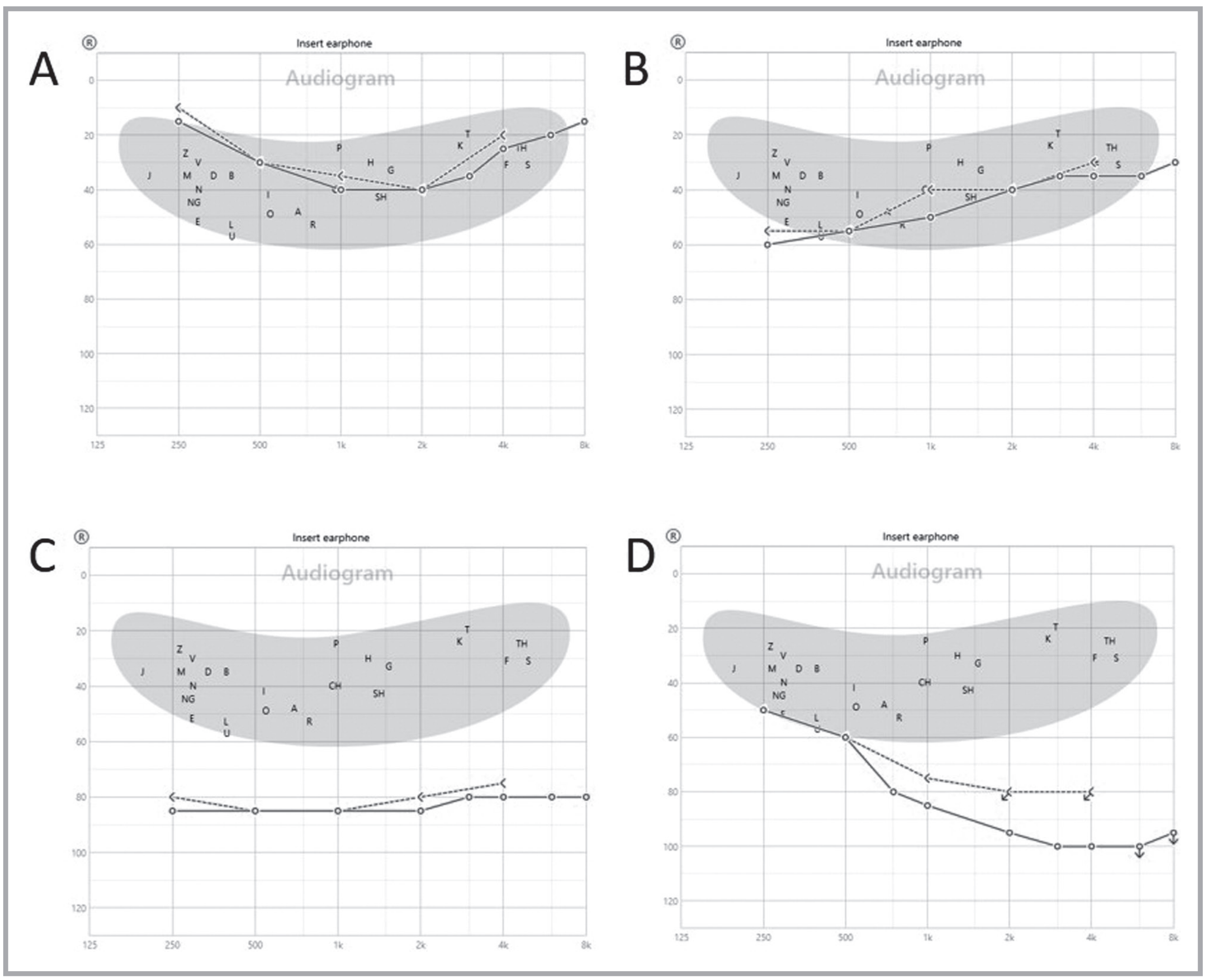

Figure 1–4. Audiometric configurations, severity of hearing loss, and the speech banana.

to which a PHL has access to the speech spectrum will assist the audiologist in counseling, helping the individual understand how the hearing loss relates to their difficulties in speech recognition, and in explaining the expected benefits of hearing technologies. These concepts are explained by a clinical audiologist in Video 1–6.

The effects of severity of hearing loss on speech recognition can also be conceptualized from a *familiar sounds audiogram* (Figure 1–5). The familiar sounds audiogram provides examples of phonemes and environmental sounds that may not be heard or misunderstood by a PHL based on configuration of the listener's hearing loss and benefit from hearing technology.

Individuals may have symmetrical or asymmetrical hearing. The same type, degree, and configuration of hearing loss in both ears is a *symmetrical hearing loss*. In *asymmetrical hearing loss*, the degree of hearing loss is different in each

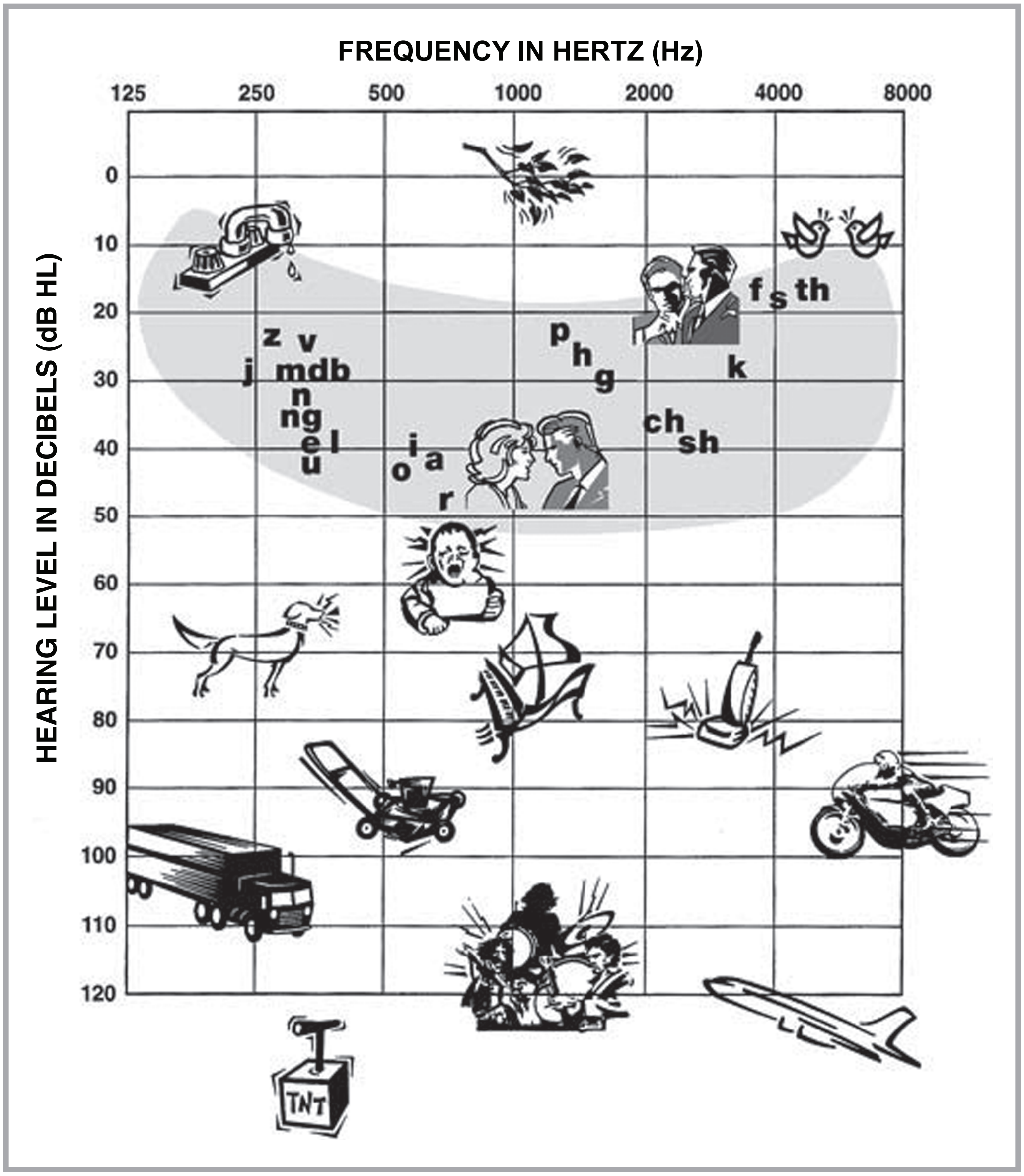

Figure 1–5. Familiar sounds audiogram. From *Hearing in Children, Sixth Edition* by Jerry L. Northern and Marion P. Downs. Copyright ©2014 Plural Publishing, Inc.

ear. If one ear has normal hearing and the other has a profound hearing loss, it is referred to as *single-sided deafness (SSD)*. Another example of asymmetrical hearing is a mild hearing loss in one ear and a severe hearing loss in the other.

Treatment of Hearing Loss

Hearing loss may be treated with medication, surgery, and/or hearing technologies. For example, medication may be prescribed to treat serous otitis media. Surgery may be needed to correct conductive hearing loss resulting from a perforated tympanic membrane or disarticulated ossicular chain. Hearing technologies can improve hearing in most individuals with *unilateral or bilateral hearing loss*. The vast majority of PHL can benefit significantly from hearing aids. For those whose hearing loss is too severe to derive necessary benefit from *hearing aids* for speech recognition, a *cochlear implant* may be an option. In Video 1–7, Harry's mother discusses how the asymmetry, severity, and configuration of her son's hearing loss led to his use of two different types of hearing technologies.

If conventional hearing aids are not appropriate, implantable hearing technologies may be considered. Implantable devices, including bone anchored hearing aids, cochlear implants, and *auditory brainstem implants (ABIs)*, may be recommended following comprehensive hearing testing and medical evaluation. Hearing aids and cochlear implants are highly effective in providing access to the speech spectrum, which includes the frequencies that are necessary for understanding speech. Many children and adults with hearing aids and cochlear implants have achieved positive outcomes in speech recognition. In special cases, such as a child with absent cochleae or an adult with absent auditory nerves due to acoustic neuromas, an ABI may be an option. An ABI does not provide the sound quality of hearing aids and cochlear implants. However, with ongoing, intensive *auditory-based intervention*, some individuals with an ABI may acquire awareness and recognition of environmental sounds, prosodic patterns, and segmental features leading to some speech recognition (Allen & Daniel, 2016). Video 1–8 shows Aanya in an assessment session with her AV therapist probing her auditory skills for discrimination of prosodic and segmental features.

Hearing aids, cochlear implants, and ABIs are discussed in detail in Chapters 2, 3, and 4. It should be noted that some PHL do not elect to use hearing technologies due to personal preference or factors such as finances and cosmetics. Individuals who identify with the Deaf culture may not choose to use hearing technologies.

Deaf Culture

People who identify themselves with the *Deaf culture* use *American Sign Language (ASL)* as their primary mode of communication. They consider being Deaf to be their cultural and linguistic identity, take pride in their history, and prefer to use a visual-spatial mode of communication. Deaf culture perspective maintains that deafness is a difference, not a disability, and therefore, hearing technology is not necessary. Deaf culture perspective also maintains that Deaf people do not focus on their physical difference, but instead, capitalize on their strengths in visual communication, use of ASL, and sense of belonging within a linguistic-cultural minority (Marschark, Zettler, & Dammeyer, 2017). Deaf people may rely on visual technologies such as closed captioning, texting, Internet-based face-to-face communication technologies, and devices that use vision and touch for accessing environmental sounds. Examples of visual and tactile devices are flashing lights that signal the doorbell and a vibrating alarm clock, respectively. Many members of Deaf culture support residential schools for children with hearing loss and educational programs that promote a *bilingual ASL-English* approach to teaching communication and literacy. Deaf culture is discussed in further detail in Chapter 7. Video 1–9 shows a university professor explaining Deaf culture. In Video 1–10, the principal of an elementary program at a school for the Deaf discusses the role of the *Deaf community* in the lives of individuals who are Deaf.

Effects of Hearing Loss on the Perception and Production of Spoken Language

A PHL may have difficulty understanding face-to-face conversations, overhearing conversations of others, hearing at a distance, and understanding speech in noise. The degree to which a PHL has access to the acoustic properties of speech will affect *detection*, *discrimination*, and *identification* of certain phonemes, which, in turn, impact speech recognition and *comprehension* of spoken language. Speech perception, in turn, is inextricably tied to speech acquisition and monitoring through auditory feedback.

Speech Acoustics

An understanding of speech acoustics and its relationship to speech perception helps an AR practitioner determine which speech features a PHL may hear or have difficulty in perceiving. Speech comprises *suprasegmental* (e.g., intonation, word emphasis, syllable stress, juncture) and *segmental* (vowel and consonants) elements. Suprasegmental (i.e., prosodic) aspects of speech are conveyed by *varying intensity*, *frequency*, and *duration* across syllables or longer units of speech. Suprasegmental aspects are conveyed primarily in the low frequencies and are used to express emotions and meaning. Vowels differ from each other in terms of *tongue height* and *placement*. Similarly, consonants differ from each other in terms of *voicing*, *manner of articulation*, and *place of articulation*. These production differences are reflected in acoustic differences (e.g., intensity, frequency, temporal information). In general, vowels are more salient (i.e., louder), longer, and lower in frequency than *consonants*. In contrast, consonants are primarily in the higher frequency range, have less power (i.e., are softer), and are *shorter* in duration. The *acoustic cues* that are important in perception of vowels include formant frequencies (e.g., F1, F2), formant trajectories of the syllable nucleus, formant bandwidth and amplitude, vowel spectrum, vowel duration, and fundamental frequency (see Kent & Read, 2002 for basic descriptions). The acoustic cues that may be important for consonant perception include: burst frequency, noise intervals, formant transitions, voice onset times, and nasal murmur (see Kent & Read, 2002 for basic descriptions).

Effects of Hearing Loss on Speech Perception and Production

Many factors affect speech perception and speech production. These include: severity and configuration of hearing loss, the degree to which a PHL has access to the speech spectrum through the hearing technologies (e.g., hearing aid, cochlear implant, ABI), background noise, associated auditory disorders, and cognitive status. A PHL typically has more difficulty hearing and identifying consonants than vowels. Significant hearing loss in the lower frequencies may lead to confusions in vowel identification, voicing (e.g., /b / vs. /p/), and perception of suprasegmental features (e.g., perception of unstressed syllables). Hearing loss in the mid and higher frequencies is often associated with difficulties in perceiving cues related to manner of articulation (e.g., bee vs. see), place of articulation (e.g., call vs. tall), and either detecting or distinguishing between less salient consonants (e.g., /f/, /s/, /th/) (Nerbonne, Schow, & Blaiser, 2018).

Hearing loss, even with appropriately fitted hearing technologies, may result in an individual hearing an impoverished (i.e., degraded) representation of spoken language. During the acquisition of spoken language, *impoverished auditory input* and *auditory feedback* typically are reflected in speech production errors. Audio 1–1 and Audio 1–2 illustrate speech production differences in 3½-year-old twin girls. One of the twins has typical hearing and the other has congenital, moderate hearing loss and has worn hearing aids for 1½ years. Audio 1–1 is a short speech sample of the twin who has typical hearing, and Audio 1–2 is a speech sample of the twin with moderate hearing loss. As can be noted from these speech samples, the twin with hearing loss demonstrates atypical resonance and articulation errors. The *waveform* and *spectrogram* shown in Figure 1–6 demonstrate that the twin who has typical hearing was able to produce the phrase "I like juice" in a developmentally appropriate manner, whereas the sibling with hearing loss demonstrated omission of final consonant as well as phoneme substitutions.

AUDIO

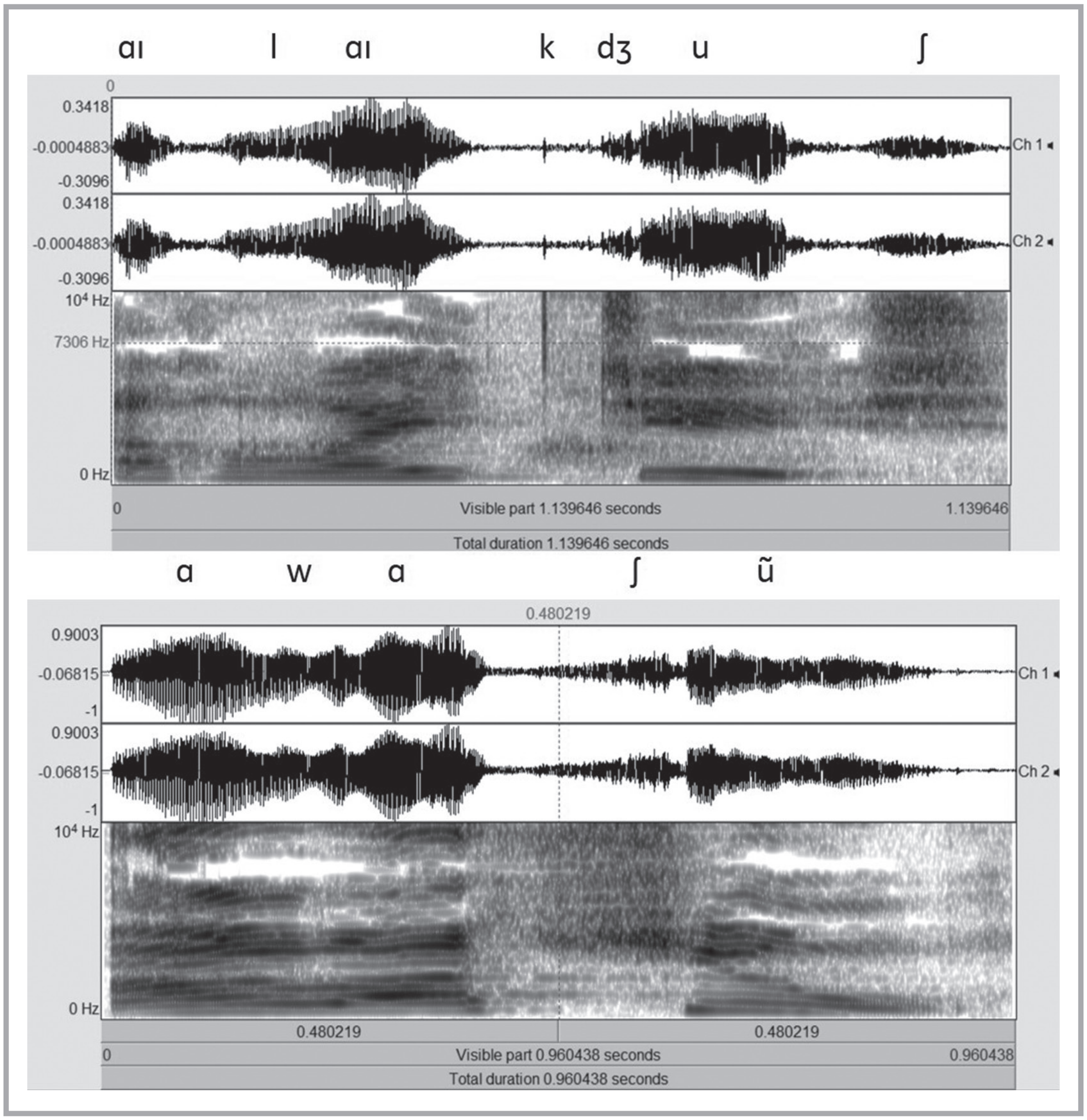

Figure 1–6. Production of the phrase "I like juice" by twins. Waveform and spectrogram on the top panel show productions by a 3.5-year-old with typical hearing and the bottom panel shows the production by the 3.5-year-old sibling with hearing loss.

Speech production characteristics of individuals with hearing loss vary depending on the degree of hearing loss, *access to the speech spectrum*, age of intervention, and quality of intervention. Some of the suprasegmental and segmental characteristics of the speech of PHL may include: higher F0; limited F0 ranges; longer durations of vowels, consonants, syllables, and phrases; abnormal resonance; deviant voice quality; restricted formant frequency ranges (often described as constricted vowel spaces); omission, distortion, or substitution of consonants; and abnormal voice-onset times (e.g., Bharadwaj & Assmann, 2013; Bharadwaj & Graves, 2008; Ertmer & Goffman, 2010; Osberger, 1987; Serry & Blamey, 1999; Tobey et al., 1991; Uchanski & Geers, 2003; Waldstein, 1990).

It is not uncommon for individuals with significant hearing loss to present with deficits in vocabulary, morphology, syntax, phonology, pragmatics, and world knowledge (e.g., Salas-Provance, Spencer, Nicholas, & Tobey, 2014; Tomblin et al., 2015; Walker et al., 2015). The effects of hearing-related language errors permeate the individual's receptive language, expressive language, reading,