Speech Audiometry Testing:
A Guide for Parents and Teachers

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KEY TERMS

- speech audiometry
- speech recognition threshold
- spondees
- word recognition score (WRS)
- phonetically-balanced (PB)
- carrier phrase
- "aided" testing
- electroacoustic analysis
- signal-to-noise ratio
- acoustic immitance (AI)
- otoscope
- tympanic membrane
- within normal limits (WNL)

In the last issue, we looked at the audiogram, the hearing testing process, and types and degrees of hearing loss. We'll now take a look at additional testing in the category of **speech audiometry**.

In addition to air conduction (AC) and bone conduction (BC) threshold testing, most comprehensive audiologic evaluations would also include speech audiometry, which typically includes the measurement of a speech recognition threshold (SRT)—the "softest" level at which a patient can point to or repeat back two-syllable words with equal stress on each syllable (called spondees or spondaic/spondee words), such as "baseball," "ice cream," and "cowboy." The SRT number reported is in xx dB HL. For children unable to repeat back the word or whose articulation/speech production might make scoring the accuracy of the words repeated problematic, one can use spondee objects/toys and ask the child to pick up the toy named or to point to an item on a picture spondee card. The SRT is "acoustically" more closely matched to low frequency hearing levels (e.g., 500 Hz) and the suprasegmental or melodic

information of the stimuli. The SRT is often compared to the pure tone average (PTA), as an inter-test reliability check (the SRT value should be within ± 6 to 10 dB of the PTA) and is used to help determine the internal reliability by the patient for each ear being tested. The SRT was developed to be an auditory-only threshold test or task, so that information obtained reflects the ability to perceive auditory versus auditory and visual cues.

The other commonly administered "speech test" is a word recognition measurement or **word recognition score** (WRS), often involving **phonetically-balanced** (PB) words. PB words are made up of sounds that are reportedly reflective of the frequency of occurrence of various phonemes used in spoken English. The most commonly used speech sounds are predominant in the sounds that make up monosyllabic PB words. An infrequent sound (such as the "zh" in pleasure), however, would not be a common sound in the words on the PB list. This testing is completed at the patient's most comfortable loudness level and reported as a percent correct at its specific presentation level. That intensity level must be reported and should be "interpreted" for the family (e.g., a presentation level of 45 to 50 dB HL approximates the loudness of conversational speech). Like the SRT protocol outlined above, word recognition testing should be based on auditory-only word presentation, so that information reflects auditory abilities, versus one's access to both auditory and visual cues.

For younger children a word recognition task might involve asking the child to point to his belly, touch her nose, and point to his/her shoulder. For older infants and preschoolers, picture books (e.g., Northwestern University - CHIldren's Perception of Speech [NU-CHIPS] or the Word Intelligibility by Picture Identification [WIPI]) are used, and the child scans the four (or six) pictures on a page and is asked to "Point to the dress." For older children and most adults, the prompt is for the individual to repeat back the last word in the **carrier phrase.** "Say the word _____" from an open set of possible word choices. A score on a 0 percent to 100 percent scale is calculated. As noted above, the intensity of the stimuli for the presentation level must be reported or the utility of this score would be minimal (again, 45-50 dB HL would be an "average loudness" level, however, numbers such as 65-70 dB HL reflect quite "loud" levels).

An example of a "Picture Spondee Card" with two-syllable words with equal stress on each syllable. CREDIT: DON GOLDBERG

Several other additional measures may be made by the audiologist. If appropriate, hearing testing for tones and/or speech stimuli may be made with hearing aids or cochlear implants on. This would be referred to as **"aided" testing.** Ideally the hearing aids will also have been subjected to a listening check and an **electroacoustic analysis** (EAA). For patients with one or two cochlear implants, an integrity test may first be conducted, and some tone and/or speech test measures may occur, ideally in all conditions possible (for bimodal users, one cochlear implant and one hearing aid, testing with both, testing with cochlear implant only and hearing aid only should be completed; for bilateral cochlear implant users and binaural hearing aid wearers, testing should include tests with both devices on, with right cochlear implant or hearing aid only and with left cochlear implant or hearing aid only). Should the patient also use FM technology, it is similarly important for the equipment to be cleaned, maintained and tested. Testing ideally needs to include both electroacoustic analysis and some soundfield-based and ecologically valid testing—in the actual classroom space, for example.

Finally, although most testing is administered in quiet in a sound-treated (versus sound-proof) hearing test booth, some measures in noise are also recommended. The concept of **signal-to-noise ratio** (S/N ratio or SNR) is based on the intensity level of the speaker in contrast to the intensity level of the noise (such as competing messages). If the speech stimuli are approximately 10-15 dB "louder" than the competing messages, most children with hearing loss can do well. The important role of an FM or infrared (IR) system should be a

non-negotiable requirement (in preschool through graduate school teaching environments).

One last type of testing should be briefly mentioned in this guide—specifically **acoustic immittance** (AI). AI primarily addresses the middle ear space and its functioning. Prior to the completion of acoustic immittance testing, most audiologists will have examined the outer ear and, with the use of an **otoscope**, have completed a visual inspection of the ear canal (the EAM), along with the **tympanic membrane** (TM or eardrum). Tympanometry is a specific AI measurement that involves varying the pressure in the ear canal, and evaluating the middle ear peak pressure point (or point of maximum compliance) and the "degree of flexibility" of the TM. A **Type A** tympanogram is **within normal limits** (WNL) and reflects a point of maximum compliance or peak pressure value, considered normal in relation to the degree of "mobility" of the TM. A **Type B** tympanogram reflects the absence of a maximum peak pressure point and minimal to no TM mobility. These tympanograms often reflect the presence of middle ear fluid behind the TM and are referred to as "flat" tympanograms, typically necessitating a medical referral. A **Type C** tympanogram is typically found with problems with Eustachian tube function, with the findings of a negative peak pressure point and mobility of the TM that is WNL (a "negative pressure" tympanogram).

For more, please see AG Bell's Recommended Protocol for Audiological Assessment, Hearing Aid and Cochlear Implant Evaluation, and Follow-up at www.agbell.org/Protocol.Audiological.Assessment, which provides a "gold standard" of testing for children and other patients. An important mantra to follow is that excellence in audiology is the foundation of any intervention program that emphasizes listening for the development of spoken language in children who are deaf and hard of hearing. VV

To access this article online as well as other helpful resources, including a Glossary of Terms, visit www.agbell.org/VoltaVoices/Jul-Sep2015/HearingTestingGuide2.

Glossary of Terms/Acronyms

AABR: automated auditory brainstem response testing
ABR: auditory brainstem response testing
ASSR: auditory steady-state response testing
AC: air conduction
Acoustic Immittance (AI): middle ear testing including tympanometry and acoustic reflex testing
Aided testing: audiologic testing with amplification (hearing aids and/or cochlear implants) being worn
Au.D.: Doctor of Audiology (the clinical professional doctoral degree for audiologists)
Audiogram: graphic representation of hearing testing
BC: bone conduction
BOA: behavioral observation audiometry
CPA: conditioned play audiometry
Cochlea: sense organ of hearing located in the inner ear
dB (plus HL, SPL, SL): an "intensity" level of sound
EAA: electroacoustic analysis
EAM: external auditory meatus or ear canal
Hz: Hertz (referent for frequency)
OAE: otoacoustic emissions
Otoscope: light source used for visual inspection of the outer ear
NU-CHIPS: Northwestern University - Children's Perception of Speech
PB words: phonetically-balanced words used in word recognition measurements
PTA: pure tone average (average of thresholds at 500, 1000, and 2000 Hz; calculated for each ear separately)
SNHL: sensorineural hearing loss
SRT: speech recognition threshold
S/N ratio or SNR: signal-to-noise ratio
Spondees: two syllable words with equal stress on each syllable
TM: tympanic membrane or eardrum
Type A Tympanogram: reflects middle ear WNL (pressure and compliance WNL)
Type B tympanogram: "flat" tympanogram suggestive of middle ear fluid (reduced or no pressure or compliance measures)
Type C tympanogram: "negative pressure" tympanogram suggestive of abnormal Eustachian tube function (negative pressure and compliance WNL)
Threshold (Greek letter "theta"): 50% response criterion
Eighth cranial nerve: auditory or auditory-vestibular nerve
VRA: visual reinforcement audiometry
WIPI: word intelligibility by picture identification
WNL: within normal limits
WRS: word recognition score

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