SPEECH TESTING IN SCHOOL AGED CHILDREN AND ADULTS

Calibration

1. set up audiometer and tape/CD correctly
2. adjust calibration tone to 0 on VU meter

Use of Insert Earphones for Speech Audiometry

Unless an audiometer has separate insert and supra-aural earphone sockets, the speech circuit will normally be calibrated for supra-aural phones.

For audiometers which have the speech circuit calibrated for supra-aural earphones the speech presentation level should be corrected by the same correction factor used for 1000 Hz pure tone threshold testing (ANSI 2004).

Instructions for Speech Recognition Tests

1. use clear, brief instructions (give an example of type of test item, but not one in actual test lists e.g., “say cat”, “say dog”)
2. encourage client to guess
3. always warn client before testing at high levels (e.g., if there is a severe loss or when testing rollover)

Test Levels

Choose levels appropriately based on pure-tone audiogram. The goal is to choose a range of levels that enable you to define a p-i function. It is not necessary to find the half-peak level precisely since this can be extrapolated from the p-i function. Be aware of possible loudness discomfort when testing at high levels and when using high masking levels.

**Generally you should not test speech at levels above 90 dB HL.** However, if the client has a severe to profound hearing loss or if they have a large conductive hearing loss it may be permissible to go to levels up to 100 dB HL if the client does not experience discomfort.

**Suggested levels for obtaining PI-max and Half-Peak Level (HPL) using AB words:**

**PI-max**

Present words at 30 dB above the average of 1000 and 4000 Hz thresholds (Dravitski, 1993).

If hearing loss has a steep slope, add less than 30 dB (e.g., 15-20 dB) to the average 1000 and 4000 Hz thresholds.
If hearing is within normal limits (≤ 20 dB HL) test at 30-40 dB HL.
If the person doesn't score well at this level, present at a level 5-15 dB higher.

**HPL**
Test 10-20 dB below PI-max level (Note that if person scores very well for p-i max you should decrease intensity by 20 dB rather than 10 dB).

**Using HPL to check for consistency with Pure tone audiogram**
The level at which the half-peak score occurs should be within (+ or -) 15 dB of pure tone threshold at 1000 Hz if the hearing loss is flat.
If the hearing loss is sloping, HPL should be within (+ or -) 15 dB of average loss from 2000 - 4000 Hz. (Boothroyd, 1968)

**Scoring**
1. record presentation levels in dB HL (not dial reading if it differs), insert or supra-aural earphones on score sheet
2. record speech noise masking levels on score sheet
3. always watch client to obtain visual cues
4. write person's actual responses on score sheet for counselling purposes and to check scoring later
5. score phonemes correctly
   (note that you are scoring the sound of each syllable - not the spelling)
   Treat each CVC as a vowel with a consonant (or consonant blend) at the beginning and the end. Errors of addition, omission or distortion are counted as errors.
6. score responses as they are said - you should not make allowances for common errors since errors are errors whether they are common or not and no such allowance was made when scoring was done in the normative subject group.
7. plot speech audiogram correctly on summary form - use the form with appropriate norms.
   **Note:** The norms differ for AB word tape and CD recordings. The form that is in current usage shows the norms for the new CVC words off the Millenium CD. The normative range shown on each form is the mean ± one standard deviation.

**Speech Detection Threshold (SDT) Procedure**
1. instruct client to indicate (e.g., press button, raise hand) when they first hear sounds (i.e., don't have to be able to identify word)
2. start at 10 dB below best pure-tone (AC) threshold unless a functional loss is suspected in which case you should start the speech presentation at a level well below the person's admitted pure tone thresholds

3. present one word at each level, increase level in 5 dB steps until word is heard

4. as soon as one word is heard go down 10 dB, then increase again in 5 dB steps

5. SDT = level at which client detects words on 2/3 ascending trials

Note: It is usually more efficient to test SDT last for both ears after testing p-i max, HPL and rollover since SDT instructions differ from those used for speech recognition testing. SDT should not be plotted on the p-i function since different instructions were used to obtain SDT (SDT is a speech detection, not a speech recognition measure). SDT in dB HL should be noted on the Results Summary sheet however.

Using SDT to check for consistency with Pure tone audiogram
The SDT should be equal to or up to 15 dB greater than the two frequency pure tone average (Best two AC thresholds out of 500, 1000 and 2000 Hz). (Brandy W, 2002; Katz 5th Ed)

Choice of Speech Measures

1. Obtain P-I function if suspicious of retrocochlear pathology

2. Obtain P-I function and perform speech in noise tests with hearing aid clients

3. Obtain P-I function and SDT as a reliability check, to test for a functional component, or if a more detailed speech curve is required

MASKING IN SPEECH AUDIOMETRY

1. Decide if you need to mask

Assume 40 dB IAA (ISO 8253-3: 1996; Yacullo 1999) for speech for supra-aural earphones (Martin and Blythe, 1977 reported speech IAA of 45 dB). Assume 50 dB IAA for speech for insert earphones. The speech IAA value for inserts has not been reported in the literature so 50 dB is estimated based on the finding that inserts have 10-20 dB greater interaural attenuation than supra-aural earphones for tones (worst possible case - Killion, Wilber and Gudmundsen 1985; see summary in Yacullo 1996). Because IAA is poorer for insert earphone (i.e., less) for high frequencies and
speech has significant high frequency energy, a conservative 50 dB IAA should be assumed for speech testing.

Mask for speech audiometry if the amount of speech crossing over to the NTE is audible to the cochlea in the NTE,

\[ \text{i.e. Mask if the presentation level for speech – IAA for speech (either 40 or 50 dB depending on transducer used) is equal to or greater than the best BC threshold at any frequency in the non-test ear} \]

Note: If bone conduction thresholds in the non-test ear were masked, make sure that you consider the masked thresholds rather than the unmasked thresholds.

That is, mask speech audiometry if:
Speech presentation level (in dB HL) - 40 (or 50) dB IAA ≥ best BC in NTE

2. Decide how much masking to use

Required dB dial of masking noise:
\[ = \text{Amount of speech crossing to non-test ear (as calculated above)} + 10 \text{ dB for speech peaks} + \text{largest air-bone gap at any frequency in non-test ear} \]

**Note:** Effective masking, as defined in the ANSI S3.6 2004 standard, is “SPL of a specified masking noise that masks a speech signal to 50% probability of recognition”, therefore to safely mask the entire speech signal, including the peaks which are up to 12 dB higher than the average, then an additional 10 dB of masking is required.

Or simply,

**Supra aural phones**

masking level = speech level – 30 (+ largest A-B gap)

**Insert phones**

masking level = speech level – 40 (+ largest A-B gap)

**Note:** A significant A-B gap on the NTE is relevant since speech will cross to the NTE via bone conduction but speech masking is applied to the NTE via a supra-aural or insert earphone. Therefore any significant conductive overlay in the NTE must be overcome by applying more masking than simply the amount crossing to the NTE.

**Note:**

1. Only include air-bone gap in calculation if it is significant (i.e., ≥ 15 dB)
2. If there is a large air-bone gap in the non-test ear this can result in very high levels of masking being required. The masking level can be reduced by using insert earphones (assume 10 dB less crossover due to greater interaural attenuation). Always check for comfort when presenting high masking levels - if necessary present at a lower than optimal level and note this on the audiogram.

2. For optimal client comfort always warn that masking will be used and increase level incrementally on dial rather than switching on suddenly at a high (and possibly uncomfortable) level.

3. Use speech noise masking if this is available on your audiometer as it is a more effective masker than white noise. Some older audiometers only provide white noise for speech masking. Unless an effective masking level calibration has been done for the audiometer, you would generally need to add an extra 5 dB to the calculated level of speech noise needed to provide effective masking for speech using white noise.

4. Remember when using insert phones for speech testing on an audiometer that requires correction factors for insert phones, both the speech and speech masking levels should use the same correction factor that is used for 1000 Hz. For example if 30 dB HL of speech masking is required, then dial level should be set to 25 dB if the 1000 Hz correction is +5 dB (i.e. insert phones are too loud by 5 dB)

**Examples of Speech Masking Calculation: (using supra-aural headphones)**

(1) Speech presentation level = 90 dB HL
    Speech noise masker level = 90 - 40 + 10 dB for speech peaks + A-Bnt
    = 60 dB HL**
    i.e. amount of speech noise required = PL - 30

(2) Speech presentation level = 45 dB HL
    Speech noise masker level = 45 - 40 + 10 dB for speech peaks + A-Bnt
    = 15 dB HL**
    i.e. amount of speech noise required = PL - 30

** Assuming A-Bnt (air-bone gap in non-test ear) ≤ 10 dB (i.e., non-significant)

Note:
Speech audiometry results measured prior to 2000, using AB words on cassette tape may have been plotted on speech audiograms in dB SPL, conversion to dB HL depends on the transducer being used.
- Insert speech dB SPL = dB HL + 12.5 dB.
- Supra-aural speech dB SPL = dB HL + 20 dB (12.5 + 7.5 for 1kHz).