Hearing Aid Center

HAAP Workshop #6

Lessons 21 - 24

Objectives

• Demonstrate the application of appropriate masking techniques for speech audiometry.
• Accurately determine and document masked speech audiometric measurements for each ear.
• Demonstrate the application of various functional tests for hearing instrument fitting.
• Interpret tympanograms
• Discuss acoustic reflex testing.
• Interpret audiometric results
Lesson 21

MASKING FOR SPEECH AUDIOMETRY

Masking for Speech Audiometry

• Routinely required for speech audiometry
  – Especially for WRS

• Masking Noise = Speech Noise
  – Broad band noise that is filtered to mimic the spectrum of average speech.
**Rules for Masking Speech**

**Rule for SRT**
Deliver speech spectrum masking noise to the NTE when the difference between the unmasked measured SRT of the TE and the best BC threshold of the NTE at 500, 1000, 2000, or 4000 Hz exceeds the amount of IA for the transducer.

**Rule for WR Testing**
Deliver speech spectrum masking noise to the NTE when the difference between the presentation intensity of speech to the TE and the best BC threshold of the NTE at 500, 1000, 2000, or 4000 Hz exceeds the amount of IA for the transducer.

*IA for Insert Earphones = 60 dB for speech stimuli*

All AC & BC thresholds must be determined (with masking when appropriate) so that the rules for masking speech can be accurately applied.

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**Speech Recognition Threshold (SRT)**

- SRT establishes the threshold for speech
  - The intensity level at which the member can correctly identify 50% of the words presented.
- Performed to check the reliability of the pure tone thresholds and should be within 10dB of the PTA.
- Uses spondees: Two-syllable words with equal emphasis on each syllable.
SRT Masking Procedure

Masking Level for SRT = NTE SRT + 10 dB
1. Set the audiometer as follows:
   1. Air Conduction
   2. Output transducer
   3. External or Recorded Source - Calibrate the spondee speech list using the VU meter and the recording’s calibration tone.
   4. Speech masking to the NTE set to SRT\text{NTE} + 10 \text{dB}

SRT Masking Procedures Cont.

2. Using the audiometer talk-over microphone at a comfortable listening level for the patient/client, re-instruct as follows: “Now, you will hear words in your (right/left) ear. You will also hear a continuous noise in your other ear. Ignore the noise and repeat the words. The noise will get louder, but continue to repeat each word you hear. If you are not certain of a word, take a guess. Do you have any questions?”
SRT Masking Procedures Cont.

3. Deliver the speech-maskning noise to the NTE at the initial level. Present a spondee in the TE at the previously established SRT.
   1. If the patient/client correctly repeats the spondee, decrease the speech presentation level by 10 dB and re-establish SRT using ascending/descending method.
   2. If there is no response, increase the presentation level in 20 dB steps until a spondee is repeated correctly. Then, re-establish SRT using the ascending/descending method.

4. Increase the speech-maskning noise in the NTE by 5 dB and re-establish SRT in the TE. Repeat this process until the speech-maskning noise has been increased three times (the 20 dB plateau) and the SRT in the TE has not changed. The true SRT in the TE has been established.

5. Record the masked SRT on the audiogram in dB HL. Also, record the final or effective masking level used.

6. Repeat procedure in the other ear, if necessary.
SRT Masking – Alternative SRT Method

Masking Level for SRT = TE PL - 20 dB

1. Set the audiometer as follows:
   1. Air Conduction
   2. Output transducer
   3. External or Recorded Source - Calibrate the spondee speech list using the VU meter and the recording’s calibration tone.
   4. Speech masking to the NTE set to PL<sub>TE</sub> - 20 dB

SRT Masking – Alternative SRT Method

2. Using the audiometer talk-over microphone at a comfortable listening level for the patient/client, re-instruct as follows: “Now, you will hear words in your (right/left) ear. You will also hear a continuous noise in your other ear. Ignore the noise and repeat the words. The noise may get louder, but continue to repeat each word you hear. If you are not certain of a word, take a guess. Do you have any questions?”
SRT Masking – Alternative SRT Method

3. Deliver the speech masking noise to the NTE at the TE PL – 20dB. Present spondees in the TE at the previously established SRT.
   1. If the member repeats 50% (3 out of 6) of the words correctly with masking score the test.
   2. If they do not repeat 50% of the words correctly, increase the PL in the TE by 5dB and adjust the speech masking noise in the NTE to be TE PL – 20dB and present another series of words. Do this until the member correctly identifies 50% (3 out of 6) words.

4. Record the masked SRT on the audiogram in dB HL. Also record the final masking level used.
5. Repeat masked SRT procedure in the other ear, if necessary.
Since WR testing is always performed at suprathreshold level, the need for masking occurs more frequently than for SRT.

Whenever masking is needed for SRT, it will also be needed for WR testing. If masking is not needed for SRT, the rule for WR masking must still be applied.

WR Masking Level = PL for PB Words_{TE} - 20 dB

*If the patient/client reports the loudness of the masking to be uncomfortable, then decrease the masking by 10 dB.

WRS Masking Procedure

1. Set the audiometer as follows:
   1. Air Conduction
   2. Output transducer
   3. External or recorded source - Calibrate the speech list using the VU meter and the recording’s calibration tone.
   4. Speech masking to the NTE set to PL - 20 dB.

2. Using the audiometer talk-over microphone at a comfortable listening level for the patient/client, instruct as follows: “You will hear the recording of a man’s voice in your right/left ear. You will also hear a continuous noise in the other ear. Ignore the noise and repeat each word you hear. If you are not sure, please make your best guess. Do you have any questions?”
### WRS Masking Procedure Cont.

3. Set the attenuator at the patient’s/client’s MCL + 10 dB
4. Present 25 PB words. Tally the correct responses. Any response other than the word presented is an error and is marked wrong, for example, changing a singular to a plural or vice versa.
5. Calculate the WRS. Each response is worth 4%
6. Record the WRS on the audiogram along with the level of speech-masking noise used.
7. Repeat procedure on the other ear, if necessary.

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**Lesson 22**

**ADDITIONAL TESTING FOR HEARING INSTRUMENT FITTING**
**UCL Measurements**

UCL - Uncomfortable Loudness Level

AKA - Loudness Discomfort Level (LDL) and Threshold of Discomfort (TD)

Purpose of measuring is to determine the upper limit of the patient’s/client’s usable hearing.

- Essential to program hearing aids so that this level is never exceeded.

UCL measurements with PT are preferred for two reasons:
1. PT’s have no intensity variability and are much easier to control than the intensity fluctuation in speech.
2. Manufacturer’s software uses frequency-specific UCL’s for setting output, not a single UCL for speech

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**UCL Procedure for PT or Speech**

1. Set the audiometer as follows:
   a. Select output for pure tone or speech
   b. Select transducer

2. Instruct the member as follows: “We are going to measure the level where sound becomes uncomfortably loud. You are going to hear (a tone or speech) in one ear at a time. Please raise your hand or say “stop” when the sound becomes uncomfortably loud and you cannot listen to it anymore.”
3. Starting with the better ear or the right ear if hearing levels are symmetrical, present a pulsed tone at 1000 Hz at 70 dB or conversational speech at MCL.

4. Increase the stimulus in 5 dB steps until the member signals you to stop.

5. Repeat the step above
   a. If steps 4 & 5 are less than 10 dB apart, average them and record this value on the audiogram using the letter “U”.
   b. If steps 4 & 5 are more than 10 dB apart, make another run and average all three. Record the UCL value as the letter “U.”

6. Repeat the procedure 2000, 4000, and 500 Hz.

7. Repeat steps 1 through 6 for the other ear.
You can use visual aids or the loudness category chart to help the member determine their uncomfortable level.

**UCL Procedure Continued...**

**Categories of Loudness**

1. VERY SOFT
2. SOFT
3. COMFORTABLE, BUT SLIGHTLY SOFT
4. COMFORTABLE
5. COMFORTABLE, BUT SLIGHTLY LOUD
6. LOUD, BUT O.K.
7. UNCOMFORTABLY LOUD

**Binaural WRS**

It can be beneficial to measure binaural word recognition.

- It can be a more realistic way to predict aided benefit.
- To demonstrate the functional advantages for speech understanding when listening binaurally
- To determine if binaural interference may be present
- Counseling tool
Binaural WR Test Procedure

1. Set the audiometer as follows:
   a. Select the appropriate test.
   b. Set the transducer for both ears
   c. Use the same presentation method as for monaural WR testing
2. Establish binaural MCL
3. Present 25 PB words. Tally the correct responses
4. Calculate the WRS. Each correct word is worth 4%
5. Record the binaural WRS on the audiogram as a %

Speech in Noise

• Pure tone audiograms are not able to predict with reliability how a person will hear in noise.

• Speech in Noise testing further provides the hearing aid specialist with a measure that can enhance counseling as well as the selection of amplification technology or programming that may be beneficial for countering the impact of background noise.

• QuickSIN is an example of Speech in Noise testing.
QSIN

“A list of six sentences with five key words per sentence is presented in four-talker babble noise. The sentences are presented at pre-recorded signal-to-noise ratios which decrease in 5dB steps from 25 (very easy) to 0 (extremely difficult). The SNR’s used are: 25, 20, 15, 10, 5, and 0, encompassing normal to severely impaired performance in noise.” (Etymotic Research, 2006, p. 4).

QSIN

Set-up:
When presenting the QuickSIN test via sound field speaker, present it through one speaker only, with the subject seated facing the loudspeaker (0 azimuth).

Calibration:
Using the 1-kHz calibration tone on Track 1, adjust the audiometer so that the VU meter reads “0.” Some audiometers have two VU meters, one for each channel. When presenting the test via loudspeaker, it is only necessary to set the VU meter for the channel being directed to the loudspeaker.
### QSIN

#### Presentation Level:
For pure tone average (PTA) <45 dB HL, set the attenuator dial to 70 dB HL. For PTA of 50 dB HL or greater, set the attenuator dial to a level that is judged to be “loud, but OK.” The sound should be perceived as loud, but not uncomfortably loud.

#### Test Instructions:
“Imagine that you are at a party. There will be a woman talking and several other talkers in the background. The woman’s voice is easy to hear at first, because her voice is louder than the others. Repeat each sentence the woman says. The background talkers will gradually become louder, making it difficult to understand the woman’s voice, but please guess and repeat as much of each sentence as possible.”

### QSIN

#### Scoring:
Five key words are scored in each sentence. The key words are underlined on the score sheets. One point is given for each key word repeated correctly. The number of correct words for each sentence should be written in the space provided at the end of the sentence and the total correct calculated for the list. SNR Loss is calculated for each list by using the formula: SNR Loss = 25.5 – Total Correct.

Note: for greater accuracy, two or more lists should be averaged.

Lists 4, 5, 13, &16 are not recommended for use due to the fact that they are not equivalent to the other lists.
QSIN Scoring:

25.5 - # Correct = SNR Loss
12 + 11 = 23 ÷ 2 = 11.5
25.5 - 11.5 = 14dB SNR Loss

QSIN - Aurical
QSIN - Aurical
### QSIN - Aurical

#### Results

<table>
<thead>
<tr>
<th>Test</th>
<th>Ear</th>
<th>Type</th>
<th>SNR Loss</th>
<th>Lists</th>
<th>Category/Comments</th>
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<tbody>
<tr>
<td>1</td>
<td>Right</td>
<td>Standard</td>
<td>6 dB</td>
<td>2</td>
<td>AC - Mild SNR loss</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Left</td>
<td>Standard</td>
<td>14 dB</td>
<td>2</td>
<td>AC - Moderate SNR loss</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

May hear almost as well as normal hearing in noise.

Directional microphone helps. Consider array use.
QSIN - Unity

- Must be manually scored.
  - [http://intranet.costco.com/hearing_aid/pdf/1Copy%20of%20Validation%20Form%20%20NU-6.pdf](http://intranet.costco.com/hearing_aid/pdf/1Copy%20of%20Validation%20Form%20%20NU-6.pdf)

- Requires re-calibration of VU meter
Dynamic Range

Dynamic Range is the difference in dB between an individual’s hearing threshold and their level of listening discomfort (UCL).

This is the member’s usable auditory range.

Hearing Aid fittings should be programmed to fit within this range.

Reduced DR can present a challenge when predicting success of amplification.
Lesson 23

TYMPANOMETRY

Tympanometry

To be covered:
January 23, 2017
Determining the type, degree, and configuration of the hearing loss requires that the relationship between the AC and BC thresholds be examined.

Next, the relationship between right ear thresholds and left ear thresholds should be determined. Terms like unilateral, bilaterally symmetrical, and asymmetrical will be used to describe the relationship.

Then the configuration and degree of hearing loss can be identified.
Type of hearing loss is determined by the relationship between AC and BC thresholds.

Severity is categorized by the amount that the thresholds are elevated relative to normal hearing.

Configuration is defined by the slope or pattern shown on the audiogram.

Type of Hearing Loss

- Determination of the type of hearing loss has implications for medical referral and potential medical treatment.
- The relationship between the AC and BC hearing levels determines the type of hearing loss.
  - Type of loss reflects the location in the auditory system of the damage causing the symptoms.
Sensory/Neural Hearing Loss:
Both air and bone conduction thresholds are beyond the range of normal hearing for all or part of the audiogram. The air and bone scores are no more than 10 dB different for any freq. in the same ear.

Sensory/Neural is aka Sensorineural

The Sensory/Neural term enables the differentiation between a disorder of the cochlea (sensory) or the pathways beyond (neural).

When only pure tone and speech information are available for evaluation, the site of the damage in the auditory system cannot be as clearly defined, thus the term sensory/neural remains inclusive of both.
Conductive

A conductive hearing loss indicates outer or middle ear dysfunction or damage. It is demonstrated as air-bone gaps or conductive components (15 dB or greater difference between the air and bone conduction thresholds at the same freq.) across most or all of the frequency range.

A conductive hearing loss generally requires more gain and there is better tolerance to loud sounds than sensory/neural loss of the same degree.

Mixed

A mixed hearing loss reflects damage to or dysfunction of both the outer/middle ear and the cochlea/auditory nerve.

They exhibit both sensory/neural and conductive components.

The sensory/neural component is the loss by bone conduction.

The conductive component is the air-bone gap.
Audiograms are classified in seven basic shapes or configurations. In the interest of clarity - only AC thresholds are displayed.

Classification of Audiograms by Shape

Flat  Gradually Sloping
Corner Audiogram

Symmetrical

Asymmetrical
**Degree of Hearing Loss**

- One indicator of how thresholds relate to the degree of hearing difficulty is the Pure Tone Average (PTA).
- To calculate the PTA, the general rule is to add the air conduction thresholds at 500, 1000, and 2000 Hz, then divide the sum by three.
- This value in HL is the PTA.

**Hearing Loss Classifications**

![Diagram showing hearing loss classifications](image-url)
Degree of Hearing Loss

Figure 9-12. Bilateral moderate sensory/neural hearing loss with measured UCLs

Figure 9-13. Bilateral mid-frequency sensory/neural hearing loss ("cookie bite") with measured UCLs

Degree of Hearing Loss

Figure 9-11. Bilateral moderate high frequency sensory/neural hearing loss with measured UCLs
**Degree of Hearing Loss**

- The audiogram shown shows a hearing loss of 50 dB at 500 Hz, 60 dB at 1000 Hz, and 70 dB at 2000 Hz.
- The sum of these thresholds is 180. Dividing by 3 produces a 60 dB PTA.
- The PTA is a reasonable estimate of the hearing loss for speech and should be within ± 10 dB of the SRT.

**Figure 9-14.** Bilateral asymmetric hearing loss with conductive component in left ear

**Figure 9-15.** Bilaterally symmetrical conductive hearing loss

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**Three-Frequency PTA**

- The audiogram shown shows a hearing loss of 50 dB at 500 Hz, 60 dB at 1000 Hz, and 70 dB at 2000 Hz.
- The sum of these thresholds is 180. Dividing by 3 produces a 60 dB PTA.
- The PTA is a reasonable estimate of the hearing loss for speech and should be within ± 10 dB of the SRT.
Two-Frequency PTA

The three-frequency PTA is a convenient single value that quantifies hearing loss. However, it may not accurately describe the degree of difficulty a particular member experiences while listening to speech, especially when the audiogram shows a markedly sloping or precipitous high frequency sensory/neural component with some thresholds within the normal range.

If the threshold elevations between 500 and 1000 Hz or between 1000 and 2000 Hz are 15 - 20 dB or more, the PTA should be computed as follows:

Select the two frequencies that show the least loss (have better thresholds), add these thresholds and divide by two.

For the given audiogram we would add the 500 and 1000 Hz values and divide by 2.

\[ 50 + 70 = 120 \text{ divide by } 2 = 60 \text{ dB PTA} \]

High Frequency PTA

High Frequency PTA is used with losses like a precipitous high freq. loss where the two best freq. would show a “normal” PTA.

High Freq. PTA = 1000, 2000, (possibly 3000), and 4000 Hz added together and divided by the number of frequencies used.

\[ 15 + 65 + 75 + 90 / 4 = 60 \text{ dB PTA} \]

In all cases if a 2 or high freq PTA is used - document it on the audiogram.
## Typical Audiometric Findings

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise-induced</td>
<td>Hearing loss typically shows the greatest hearing loss at 3000 or 4000 Hz</td>
</tr>
<tr>
<td>Acoustic Trauma</td>
<td>Results in hearing asymmetries that reflect the ear with greater exposure.</td>
</tr>
<tr>
<td>Presbycusis</td>
<td>Age related, typically bilaterally symmetrical and worse in highs.</td>
</tr>
<tr>
<td>Otitis Media</td>
<td>Air/bone gaps at most or all freq.</td>
</tr>
<tr>
<td>Otosclerosis</td>
<td>Flat conductive HL with an elevated BC threshold at 2K Hz (Carhart’s Notch)</td>
</tr>
<tr>
<td>Congenital</td>
<td>From birth, often exhibits the cookie bite.</td>
</tr>
</tbody>
</table>

Costco Hearing Aid Center