Speech Audiometry
Learning Objectives

At the completion of this course you will be able to:

- Perform a battery of speech tests using appropriate speech stimuli and presentation levels
- Interpret speech test results for validity
- Make appropriate recommendations
Basic Speech Measurements

- We perform several speech tests in the quiet testing environment to assess the member’s ability to recognize speech at very soft levels, and to recognize words at comfortable levels. We also look to see what level of speech is uncomfortably loud for them to hear.
- These tests tell us at what overall loudness the person hears best, as well as where speech understanding begins and where it becomes uncomfortable.
- From the UCL and the SRT we can calculate the Dynamic Range, or the range of usable hearing.
- The Word Recognition Score (WRS) tells us more about the person’s ability to recognize speech at a comfortable listening level.
Recorded vs. Live Voice

- **Recorded Voice** – desirable
  - Consistent
  - Speaker chosen for voice quality
  - Good test-retest reliability

- **Live Voice** – not recommended unless special needs are present
  - Controlled vocal effort
  - Only use in special situations - ex. member who has had a stroke
Order of Testing

- Begin with the Speech Reception Threshold (SRT). After obtaining it for both the right and left ears verify that it is within +/- 5 dB of the PTA. If there is a discrepancy you need to go back and re-instruct the member and retest their air conduction thresholds.
- Then obtain the Most Comfortable Loudness Level (MCL) for both ears.
- Then proceed with Word Recognition Score (WRS) testing as it is recommended to be obtained at or above MCL.
- End speech audiometry with speech Uncomfortable Loudness Levels (UCL) as the member will have had time to acclimate to comfortable speech with WR testing.
Calibrate VU Meter

- Before beginning any speech testing it is critical that your speech stimulus and/or microphone be calibrated to 0 dB on the VU meter.
- For recorded speech there is a calibration tone prior to the series of word lists. Play the tone at 0 dB HL (so the member doesn’t hear the tone). The stimulus should peak at 0 dB on your VU meter.
- For Unity systems if the stimulus is higher or lower than 0 dB go into Settings and Sensitivity and adjust the level while the tone is playing (adjust CD1 and CD2 as needed).
  - Instructions for how to adjust the VU meter on your portable audiometer for your state exam will be provided by your Regional Trainer.
Spondees

- Used for SRTs only
- Two-syllable words with equal emphasis on each syllable

1. Greyhound
2. Schoolboy
3. Inkwell
4. Whitewash
5. Pancake
6. Mousetrap
7. Eardrum
8. Headlight
9. Birthday
10. Baseball
Speech Reception Threshold (SRT)

- The lowest level at which 50% of the words presented are repeated correctly
- If the entire word is not said correctly the word is not counted as correct
  - Ex. If the word presented was “hotdog” and the member said “hotdogs” it would not be counted as correct
Instructions for SRT

- Instruct the member on what they will be hearing and what response they should give:
  - “You will be hearing a recording of a man’s voice. He will be saying words like pancake, birthday, eardrum. I want you to repeat back to me what he is saying. Even when his voice gets very soft do the best you can to tell me what you think he is saying. Do you have any questions?”
Familiarize Them With the Words

- You can familiarize the member by showing them a laminated copy of the list of words and then take it away prior to beginning the test.

- You can also familiarize them by presenting and having them repeat a few spondees without changing the intensity.

- Please note that SRT is the ONLY test where the words can be familiarized prior to testing.

1. Greyhound
2. Schoolboy
3. Inkwell
4. Whitewash
5. Pancake
6. Mousetrap
7. Eardrum
8. Headlight
9. Birthday
10. Baseball
SRT Procedure - Traditional Bracketing Method

- Present one spondee at 30-40 dB above the PTA. If there is no response, increase the presentation level in 20 dB steps until a spondee is repeated correctly.
- Decrease the presentation intensity in 10 dB steps until there is no response (descending technique).
- Increase the spondee presentation intensity in 5 dB steps until there is a correct response (ascending technique).
SRT Procedure - Traditional Bracketing Method

- Continue the descending/ascending technique until 50% of the responses are correct at the lowest presentation intensity.
- Document the SRT on the audiogram in dB HL.
- Repeat procedure on the other ear.
Ex: SRT Procedure  Traditional Bracketing Method (PTA 20)

- 50 dB HL- baseball (correct)
- 40 dB HL- hotdog (correct)
- 30 dB HL- airplane (correct)
- 20 dB HL- sailboat (incorrect)
- 25 dB HL- hothouse (correct)
- 15 dB HL- railroad (incorrect)
- 20 dB HL- bathtub (incorrect)
- 25 dB HL- birthday (correct)
- 15 dB HL- sunshine (incorrect)
- 20 dB HL- grandson (incorrect)
- 25 dB HL- greyhound (correct)

The lowest level that the spondee words could be repeated back 50% of the time was at 25 dB HL. The SRT is 25 dB HL.
SRT Procedure - Alternative Method

- Presentation level begins 10-15 dB above the PTA of the test ear.
- Use spondee words
- Use the bracketing method
  - 6 words per series
  - Decrease stimuli in 5 dB increments
  - Record the lowest level that can be understood 50% of the time.
### Ex. SRT Procedure - Alternative Method (PTA 20 dB)

<table>
<thead>
<tr>
<th>PL</th>
<th>1st Word</th>
<th>2nd Word</th>
<th>3rd Word</th>
<th>4th Word</th>
<th>5th Word</th>
<th>6th Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 dB</td>
<td>baseball</td>
<td>hotdog</td>
<td>airplane</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 dB</td>
<td>sailboat</td>
<td>hothouse</td>
<td>railroad</td>
<td>bathtub</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 dB</td>
<td>birthday</td>
<td>sunshine</td>
<td>grandson</td>
<td>grayhound</td>
<td>oatmeal</td>
<td></td>
</tr>
<tr>
<td>20 dB</td>
<td>stairway</td>
<td>padlock</td>
<td>headlight</td>
<td>doormat</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Because 50% of the words could not be obtained at 20 dB HL there is no reason to decrease to 15 dB HL. At 25 dB HL 50% of the words were repeated correctly. The lowest level that 50% of the words could be repeated correctly was 25 dB HL. The SRT is 25 dB HL.
SRT/PTA Agreement

- The SRT should agree with the pure tone average (PTA) ±5 dB
  - *Exception:* In steeply sloped high frequency losses, the SRT will be better than the PTA
  - In this case, add the thresholds at 500 Hz and 1000 Hz, then divide by 2
- If the SRT and PTA are not in agreement you should re-instruct the member on all testing that has already been obtained and retest.
  - It is more efficient to either begin with the SRT and then do pure tone AC testing or do pure tone AC testing first and then SRT.
Most Comfortable Loudness (MCL)

- MCL is the preferred level for the member to hear and understand speech comfortably.
- Stimulus is cold running speech (Rainbow Passage).
- MCL represents about half of the dynamic range and is approximately 40 dB above the SRT.
Loudness Categories

7. Uncomfortably loud
6. Loud, but o.k.
5. Comfortable, but slightly loud
4. **Comfortable**
3. Comfortable, but slightly soft
2. Soft
1. Very soft
0. No sound
“We are going to measure your most comfortable listening level. I’ll slowly increase the loudness of the voice that you will be listening to so that you can listen at different levels. Point your finger up if you want it louder and down when you want it softer. Please tell me when we reach the listening level you prefer. Do you have any questions?”
MCL Method

- Select the cold running speech passage and calibrate using the VU meter and the calibration tone. The VU indicator should be at 0 dB.
- Set the attenuator at SRT plus 20 dB.
- Slowly increase the intensity of the speech stimulus while monitoring the member’s listening level preference.
- Record the MCL on the audiogram in dB HL.
- Repeat procedure on the other ear.
MCL Practice

- Using the recorded speech stimuli, find the speech MCLs for your mentor.
- Record the MCLs below:

<table>
<thead>
<tr>
<th></th>
<th>MCL</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>dB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Dynamic Range

<table>
<thead>
<tr>
<th>dB</th>
<th>Normal</th>
<th>CHL</th>
<th>SNHL</th>
</tr>
</thead>
<tbody>
<tr>
<td>bL</td>
<td>SRT</td>
<td>MCL</td>
<td>UCL</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>SRT</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>MCL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
<td>SRT</td>
</tr>
<tr>
<td>70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
<td>MCL</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>UCL</td>
<td>MCL</td>
<td>UCL</td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>110</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>UCL &gt;120</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- This is an illustration of the dynamic range for speech for normal hearing, a conductive hearing loss (CHL), and a sensorineural hearing loss (SNHL).
- The difference between the SRT and the UCL is the dynamic range for speech. Note the narrow dynamic range for SNHL and the elevated, yet broad dynamic range for CHL.
- Because a member with a SNHL has a relatively narrow dynamic range between MCL and UCL we have to be careful about what level we conduct WR testing.
- Testing at too low of an intensity causes erroneous results and testing at too high of a level can cause discomfort and even pain.
Word Recognition Testing/Speech Discrimination Score (WRS)

- Select the recorded source and calibrate the speech list using the VU meter and the recordings calibration tone.
- Instruct the member using the audiometers talk-over microphone.
- Set the attenuator at the member’s MCL + 10 dB
- Present 25 words. Tally the correct responses.
Calculate the WRS. Each correct response is worth 4%. Record the WRS on the audiogram as a percentage and the dB level used. Repeat procedure on the other ear.
Instructions for WR Testing

- “You will now be hearing the man asking you to repeat back more words. His voice will be at a comfortable level and I want you to repeat back out loud what you think he is saying. If you aren’t sure of what he is saying it is fine to guess. Do you have any questions?”
Binaural Word Recognition Testing

- In individuals with poor monaural WRS scores or asymmetric WRS scores it is recommended that a binaural presentation be given.
- This can give an idea as to how they would do with binaural amplification.
- The dB level should be comfortable in both ears and should feel balanced to the individual.
Binaural Word Recognition Testing

- Present a 25 word list and score the percent of words correct.
- If the score is better than the two poor monaural scores this is a good indication of why they could benefit from binaural amplification.
Binaural Word Recognition Testing

- In cases of asymmetry, after obtaining medical clearance for amplification, if the binaural WRS is worse than the better ear WRS then this indicates that the poorer ear is affecting the better ear and amplification should not be used in the poorer ear (degradation effect).
- If the score remains the same or slightly improves then the ear with poorer speech discrimination is not hindering the speech discrimination of the better ear. The member may benefit from sound awareness and should be counseled appropriately as to the limited benefits of amplification for the ear with poorer WRS.
Interpreting WR scores

- Word recognition ability is extremely important to success with hearing aids. Clearly, the higher the score, the better chance for a successful fitting.
- Keep in mind too that these scores will often improve with lip reading, conscious or unconscious, and that binaural scores are often higher than those for either ear alone.
- This is crucial when working with persons with poor scores monaurally... they may see significant improvement binaurally or when closely watching the speaker.
## Interpreting Word Recognition Scores

<table>
<thead>
<tr>
<th>WRS</th>
<th>Word Recognition Ability</th>
<th>Degree of Impairment</th>
</tr>
</thead>
<tbody>
<tr>
<td>92-100%</td>
<td>Excellent/Normal</td>
<td>None</td>
</tr>
<tr>
<td>84-91%</td>
<td>Good</td>
<td>Slight</td>
</tr>
<tr>
<td>70-83%</td>
<td>Fair</td>
<td>Moderate</td>
</tr>
<tr>
<td>56-69%</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>&lt;56%</td>
<td>Very Poor</td>
<td>Very Poor</td>
</tr>
</tbody>
</table>
Rollover

- Speech intelligibility reaches a peak (PB max), and then either:
  - Remains high (normal), or
  - Drops at higher levels (rollover)
- Rollover is defined as a decrease of 25% in the WRS with an increase in presentation level.
- Rollover is a red flag and a sign of a retrocochlear pathology. This indicates a need for a medical referral!

PB max-PBmin/PB max = rollover ratio
Make sure that when using Unity you are using all the words on the list. If you use a 50 word list and stop at 25 words the percentage is not figured correctly and does not accurately reflect the member’s test result.
Masking for SRT

- Deliver speech 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.
  - IA for Supra-aural and Circumaural Earphones = 40 dB
  - IA for Insert Earphones = 60 dB
Masking Formula for SRT & Instructions - Traditional Bracketing Method

- Speech masking to the NTE set to SRT NTE + 10 dB
- Re-instruct the member:
  - “You will be hearing a recording of a man’s voice. He will be saying words like pancake, birthday, eardrum. You will also hear a continuous noise in your other ear. Ignore the noise and repeat back to me what he is saying. The noise will get louder, but keep repeating the words that you hear. If you are not certain of a word, take a guess. Do you have any questions?”
● Deliver the speech-maskin noise to the NTE at the initial level. Present a spondee in the TE at the previously established SRT.
  ● If the member correctly repeats the spondee, decrease the speech presentation level by 10 dB and re-establish SRT using the ascending/descending method.
  ● 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.
Masking for SRT - Traditional Bracketing Method

- Increase the speech-masking noise in the NTE by 5 dB and re-establish SRT in the TE.
- Repeat this process until the speech masking noise has been increased 3 times and the SRT in the TE has not changed. The true SRT in the TE has been established.
- Record the masked SRT on the audiogram in dB HL and the final masking level used.
- Repeat this procedure in the other ear, if necessary.
<table>
<thead>
<tr>
<th>Masking Level</th>
<th>Spondee</th>
<th>Presentation Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 + 10 dB</td>
<td></td>
<td>65 dB HL</td>
</tr>
<tr>
<td>25 dB HL</td>
<td>Baseball</td>
<td>65 dB HL</td>
</tr>
<tr>
<td>25 dB HL</td>
<td>Hotdog</td>
<td>55 dB HL</td>
</tr>
<tr>
<td>25 dB HL</td>
<td>Sunshine</td>
<td>60 dB HL</td>
</tr>
<tr>
<td>25 dB HL</td>
<td>Airplane</td>
<td>65 dB HL</td>
</tr>
<tr>
<td>25 dB HL</td>
<td>Toothbrush</td>
<td>65 dB HL</td>
</tr>
<tr>
<td>25 dB HL</td>
<td>Hothouse</td>
<td>65 dB HL</td>
</tr>
<tr>
<td>25 dB HL</td>
<td>Whitewash</td>
<td>65 dB HL</td>
</tr>
<tr>
<td>30 dB HL</td>
<td>Armchair</td>
<td>65 dB HL</td>
</tr>
<tr>
<td>30 dB HL</td>
<td>Birthday</td>
<td>65 dB HL</td>
</tr>
<tr>
<td>30 dB HL</td>
<td>Iceberg</td>
<td>65 dB HL</td>
</tr>
<tr>
<td>35 dB HL</td>
<td>Rainbow</td>
<td>65 dB HL</td>
</tr>
<tr>
<td>35 dB HL</td>
<td>Cowboy</td>
<td>65 dB HL</td>
</tr>
<tr>
<td>35 dB HL</td>
<td>Eardrum</td>
<td>65 dB HL</td>
</tr>
<tr>
<td>40 dB HL</td>
<td>Sailboat</td>
<td>65 dB HL</td>
</tr>
<tr>
<td>40 dB HL</td>
<td>Sunshine</td>
<td>65 dB HL</td>
</tr>
<tr>
<td>40 dB HL</td>
<td>Pancake</td>
<td>65 dB HL</td>
</tr>
</tbody>
</table>
Masking for SRT - Alternative Method

- Present masking at TE SRT - 30 dB
  - The masking level remains at a constant ratio throughout the procedure.
- Record the SRT for the lowest level that can be understood 50% of the time with masking present.
<table>
<thead>
<tr>
<th>PL</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
<th>6th</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 dB</td>
<td>baseball</td>
<td>hotdog</td>
<td>airplane</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>sailboat</td>
<td>hothouse</td>
<td>railroad</td>
<td>bathtub</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55 dB</td>
<td>birthday</td>
<td>sunshine</td>
<td>grandson</td>
<td>grayhound</td>
<td>oatmeal</td>
<td></td>
</tr>
<tr>
<td>50 dB</td>
<td>stairway</td>
<td>padlock</td>
<td>headlight</td>
<td>doormat</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>eardrum</td>
<td>pancake</td>
<td>mushroom</td>
<td>hardware</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45 dB</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>50dB/20 dB</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
Masking for WR Testing

- Present speech-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.
  - Supra-aural and Circumaural earphones = 40 dB
  - Insert earphones = 60 dB
Masking for WR Testing

- Masking is presented from the beginning of testing and the level is never changed!
- Hint: If you had to mask for the SRT you ALWAYS will have to mask for WRS testing since it’s presented at an even higher dB level than the SRT.
- This is the only test where the need for masking is determined prior to starting the test. If you determine masking is needed you do not need to obtain an unmasked WRS for the test ear first.
Masking for WR Testing

- Re-instruct the member:
  - “You will now be hearing a man asking you to repeat words. You will also hear a continuous noise in the other ear. Ignore the noise and repeat each word you hear. If you aren’t sure of what he is saying it is fine to guess. Do you have any questions?”
Masking for WR Testing

- Set the attenuator for the speech stimulus at the member’s MCL + 10 dB.
- Set the masking level in the NTE to the test PL - 20 dB.
- Present 25 PB words. Tally the correct responses.
- Calculate the WRS. Each correct response is worth 4%.
- Record the WRS on the audiogram along with the level of speech-masking noise used.
- Repeat the procedure on the other ear, if necessary.
Uncomfortable Loudness Level (UCL)

- This is a critical measurement because it represents a point which the hearing aids’ output must not exceed.
- “Uncomfortable” is loud enough that you would not want to listen to the voice for a long time.
- Unless there is significant recruitment the UCL is not a level slightly above MCL.
- Masking does not have to be done for UCL.
- UCL may also be referred to as LDL (Loudness Discomfort Level) or TD (Threshold of Discomfort).
Loudness Categories

7. Uncomfortably loud
6. Loud, but o.k.
5. Comfortable, but slightly loud
4. Comfortable
3. Comfortable, but slightly soft
2. Soft
1. Very Soft
0. No sound
“You will hear the recording of the voice again with the sentences. This time the volume of the voice will get louder and louder. When the volume gets to the point that it is uncomfortably loud or a level that you would not want to listen to for a long period of time raise your hand (or say stop). Do you have any questions?”
Method for Speech UCLs

- Starting with the better ear or the right ear if hearing levels are symmetrical, present conversational speech at MCL.
- Increase the stimulus in 5 dB steps until the member signals you to stop.
  - Make sure to watch the member and stop when you notice a physical sign of discomfort (facial tension, eye twitch, etc) if they have not yet pressed the button.
Method for Pure Tone UCLs

- Repeat the step above.
  - If the indicated levels are less than 10 dB apart, average them and record this value on the audiogram.
  - If the indicated levels are more than 10 dB apart, make another measurement and average all three. Record the speech UCL value on the audiogram.
- Repeat the procedure for the other ear.
UCL Practice

- Using the recorded speech stimuli, find the Speech UCL for both the right and left ears.
- Record Speech UCLs below:

<table>
<thead>
<tr>
<th></th>
<th>UCL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>dB</td>
</tr>
<tr>
<td>Left</td>
<td>dB</td>
</tr>
</tbody>
</table>
Speech Test Battery

- By completing the four speech tests discussed in this presentation you have completed a speech test battery.
- You have assessed the member’s SRT and compared it with the PTA to make sure there was no discrepancy.
- You found their MCL for hearing speech and assessed their speech discrimination at this level or above. The MCL is important as they will most likely wear their hearing aids at this level.
- You have also found their UCL and know what level of speech is uncomfortable for them and need to make sure that the hearing aids do not exceed this level.
Speech Test Battery

- If you find that the results you are obtaining are just not making sense, consider the following:
  - Did you need to mask and didn’t? Is it possible that the better-hearing ear is hearing the words being presented to the ear with greater hearing loss?
  - Is their SRT better than their PTA? Do you need to re-instruct them for pure tone testing?
  - Do you need to make a medical referral? Is the word recognition poorer than expected for the loss, or worse than the other ear? Is the WRS getting worse as the volume level increases?