The LMH Test For Monitoring Listening
The Ling-Madell-Hewitt test or the Low-Mid-High frequency test
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We know that it is essential that children with hearing loss hear very well with their technology if they are going to be able to use listening to learn language and develop good literacy skills. That is the reason Dan Ling developed the 5 sound test (a, e, u, sh, s) which eventually became the 6 sound test with the addition of /m/. The Ling test has been very useful as a way to monitor hearing of some of the sounds of speech. We have always known that the 6 sound test did not measure all the sounds of speech. It was truly meant to be only a screening test. When we need more complete information we recommend testing all phonemes in whatever language a child hears using something like the Medial Consonant Test as soon as the child able to perform the task. But when screening is called for, the **LMH** test will provide more information than the Ling test.

In the time since the Ling 6 sound test was developed, technology has improved sufficiently so that we have much more control of technology settings. In addition, children are receiving technology much earlier so they have access to sound at an earlier age. When Ling developed the test we did not have cochlear implants and hearing aids were adjusted using only screwdrivers and had very limited options. With technology at the state it is now we have much more control over settings and we are obligated to monitor listening more carefully.

The Ling 6 sound test covers a range of consonant bands but there is not a lot of information in the 2nd and 3rd formant bands which are critical for consonant differentiation. We are suggesting the addition of 4 more consonants to round out the test and to provide a better balanced test covering *Low, Middle, and High frequencies (**LMH**).*

Introducing the **LMH** test (Ling, Madell, Hewitt or low, mid, and high frequency) test
We are introducing the **LMH** test which is a screening test for low, mid and high frequencies. With the addition of 4 consonants the test is more balanced. Figure 1 shows the test with the 4 additional consonants added to the Ling 6. With the addition of /n/, /h/, /z/ and /ʤ/ we can better expand the understanding of a child's speech perception. There is more information in the 2nd and 3rd formant which can help us quickly screen for problem areas of perception.

How to use the **LMH** test
When testing infants or children new to technology we are looking for detection. Can they hear the sound. We ask parents to report which phonemes a child hears at different distances. As children get older, they are asked to repeat what they hear. Some children are more comfortable pointing to pictures, while others will repeat back. Once children can imitate, we expect them to repeat back. Testing should be accomplished with the technology on the right ear, the technology on the left ear, and with both ears together. If testing is accomplished only in the binaural condition, it will not be possible to know if one ear is not performing well. Without binaural testing, we will not know if the technology worn in both ears together is causing distortion when used together.

All children need more complex speech perception testing to fully evaluate perception. This may include standard speech perception testing and/or use of the Medial Consonant Test to understand how they hear all consonants in their language. For very young children or children new to technology who struggle to repeat the medial consonant test using a VCV format, the consonant can be used in isolation. As they progress they need to use standard speech perception tests which are age appropriate.

Clinicians are responsible for teaching parents to develop the skills to do the technology screening on their own at home and reporting findings to the clinicians. As parents learn to provide reliable test findings, the clinicians' job changes from repeating the same test to helping the child move on to more difficult tasks and helping parents expand what they are doing to include more consonants and test in different conditions. In other words, once a child reliably detects the **LMH** at home for the parent, the clinician should be working on imitation. Once the child reliably imitates, the **LMH** at home, the clinician should be encouraging imitation of all phonemes.

How to use the results of the **LMH** test

The goal of the **LMH** test and of all speech perception is to determine what a child is hearing and what they are missing. Speech perception and production need to be monitored regularly so that we know what the consistent errors are. While testing with the **LMH** Test will give some information, testing all the consonants will provide much more information The information can then be used by the audiologist to adjust technology settings to provide better access to frequency bands not being perceived. Once the audiologist has adjusted the settings, the clinician can use the information obtained to plan remediation.

Figure 1 – The Ling, Madell, Hewitt (**LMH**) Test.
(Original Ling Phonemes are in black. Added phonemes are in red)

	Band 1 200-1000Hz VOICING	Band 2 1000-1500 Hz CONSONANT DIFFERENTION	Band 3 1500-3500 Hz CONSONANT DIFFERENTION	Band 4 3500 Hz + FRICATION
/u/	F1:300 Hz F2: 870 Hz		F3: 2240 Hz	
/a/	F1:730 Hz	F2: 1090Hz	F3: 2440 Hz	
/i/	F1: 270 Hz		F2: 2290 Hz F3: 3010	
/m/	250-350	1000-1500 Hz	2500-3500 Hz	
/sh/			1500-2000 Hz	4500-5500 Hz
/s/				5000-6000 Hz
/dj/	200-300 Hz		2000-3000 Hz	
/z/	200-400 Hz			4000-5000 Hz
/h/			1500-2000 Hz	
/n/	250-350 Hz	1000-1500 Hz	2000-3000 Hz	

The LMH 10 Screening Test
Ling, Madell, Hewitt or Low Mid High frequency test

Child		**Detection___**	**Identification____**	**Distance**
Date:		**Tester**		
	Right Technology	**Left Technology**		**FM system**
	Right	**Left**	**Binaural**	**FM**
a				
u				
i				
ʃ				
s				
m				
n				
h				
z				
ʤ				