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NCHAM  
SPEECH PERCEPTION/SPEECH AUDIOMETRY: BEYOND THE AUDIOGRAM

1:30 P.M. - 2:30 P.M. (ET)  
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>>SPEAKER: This webinar is brought to you by the National Center for Hearing Assessment and Utah State University, and again, we'll be starting at the bottom of the hour.

>>SPEAKER: We will be starting at the bottom of the hour.

>>SPEAKER: We are now being broadcasted. We are live. So this is an official audio check for today's webinar brought to you by the National Center for Hearing Assessment and Management. Don, if you could go ahead and say the title of your presentation, that would be great, and we'll have people who are on give us a little feedback on the quality of the audio right now.

>>DR. GOLDBERG: And just looking at the screen, do I need to make it full screen or it's going to be blocked for right now?

>>SPEAKER: Just do the audio check right now.

>>DR. GOLDBERG: The title is Speech Audiometry: Beyond the Audiogram.

>>SPEAKER: Thanks, everybody for your feedback. It looks like -- hey, Jeff, could you type a note to the one person who indicated they weren't getting audio to let them know what to do about that?

>>SPEAKER: Sure, I will.

>>SPEAKER: Thanks. So Don, your question about your display screen? Yeah, right now -- --

>>DR. GOLDBERG: I'm sure there's a section that says attendees, and a list of people. I only see part of my screen, but I'm assuming that will open up after we move the note questions to the side, right? Or is there something I can do to full screen it?

>>SPEAKER: So are you saying you're not seeing your entire Power Point slide?

>>DR. GOLDBERG: Correct. I'm seeing the left half. Oh, I'm fine.

>>SPEAKER: Are you seeing the note and question field now?

>>DR. GOLDBERG: Everything is there.

>>SPEAKER: Everybody who is signed on, we'll be starting at the bottom of the hour at -- in about 8 more minutes. You don't need to worry about being mic'd today. You'll have a text screen through which you can relay your questions to today's presenter at that time in the presentation when questions will be taken. So for right now, just adjust the volume to your liking using your head set volume setting or your computer speaker settings.

Don, just a reminder to you to be sure that your speakers on your computer are turned off or down all the way.

>>DR. GOLDBERG: Same computer. They're down or off.

>>SPEAKER: Okay. Great I'm going to continue to speak in case there is anyone having any challenges with audio speaker.

>>DR. GOLDBERG: I'll step out and then be right back in.

>>SPEAKER: Today's webinar is brought to you by the National Center for Hearing Assessment and Management at Utah State University, NCHAM is a National Resource Center on early hearing detection, funded by the Maternal Child and Health Bureau.

Once again, today's presentation is offered to us by Dr. Donald Goldberg and the title of it is Speech Perception/Speech Audiometry:

Beyond the Audiogram, and we'll be starting at the bottom of the hour.

>>SPEAKER: And for those of you who have just joined us, we'll be starting at the bottom of the hour in about four minutes. This is a webinar brought to you by the National Center for Hearing Assessment, and management at Utah State university entitled Speech Perception/Speech Audiometry: Beyond the Audiogram. You can adjust the volume to your liking on your end using the adjustments on your computer head set or computer speakers. You don't need to be worried about being mic'd today. We'll be opening up a text screen through which you can ask our presenter questions after he has completed his presentation for us today.

Again, this is a webinar brought to you by the National Center for Hearing Assessment at Utah State University. We'll be starting in about three minutes.

>>SPEAKER: I'm sorry, I had my phone on mute, so once again, I am -- that's a problem. If I have my phone on mute, of course, you're not going to be hearing my audio. So that was my error, and I apologize for that, everybody.

Once again, this is an audio check for today's webinar entitled Speech Perception/Speech Audiometry: Beyond the Audiogram. You can adjust the volume to your liking on your end, and we'll be starting in just a moment now. Never fear, if today's transmission is in any way inadequate for you, we will be posting it on our website for you to listen to and watch at another time at your leisure.

Okay. That looks like we're coming through fine so thank you

for that. Hold on one second, and I'll initiate recording.

>>SPEAKER: Good day, everybody. I would like to welcome you to today's webinar brought to you by NCHAM at Utah State University National Center for Hearing Assessment and Management. It serves as an a national resource center on early hearing detection and intervention with funding in part from the Maternal and Child Health Bureau.

Today's presentation is entitled Speech Perception/Speech Audiometry: Beyond the Audiogram brought to us by Dr. Donald Goldberg who is an audiologist and speech language pathologist from Cleveland, and I'll allow Dr. Goldberg to tell us a little bit more about his background. So without further ado, I will hand it over to you, Don, and we look forward to hearing what you have to share with us.

After Dr. Goldberg has completed his presentation, I'll be opening up a text field for you to submit your questions, and until an hour from now at the bottom of the hour, again. We will continue to take those questions and left overs Dr. Goldberg has agreed to take via email which you see over on the left there, his email address.

So without further ado, Dr. Goldberg.

>>DR. GOLDBERG: Thank you very much, Will, and thank you for the 117 people that are participants. I'm broadcasting from a computer in a basement lab at the Cleveland Clinic, and you may, if you're listening well, hear an obnoxious beeping sound in the background. It seems to go off with some regularity, so I apologize,

but hopefully my words come in clear.

I have two roles. One in as a professor in the Department of Communication at the College of Wooster in Wooster, Ohio, and my role is staff consultant for the Hearing Implant Program at the Cleveland Clinic where I will this afternoon go up and see patients all afternoon.

So without further ado on my part, let's move on. And I do encourage questions that can be posted as I kind of wind down my prepared remarks.

I don't really have a way to truly gauge this, but I'm just hoping and assuming that we have some parents in the audience, so welcome to the parents. I would advocate that the parents are probably the most important part of our whole team working with these children. I'm assuming some of you may be speech language pathologists, along with the other professional fields of teachers of the deaf, educators of the deaf, and audiologists. My joke about the audiologists is you probably know most of what I'm going to say, so you're excused or if you have nothing to do for the next 57 minutes, please stay with us.

I'm hoping and expecting that there might be some of my colleagues who listening, spoken language specialists, either certified as auditory-verbal therapists or educators. I welcome teachers, classroom teachers, self-contained classroom teachers, as well as other educators and guests.

So I'll just move along and any messages that need to be shared,

if I'm going too fast, probably send a message to Will, and he can secretly send me a message within our system.

Anyway, I wanted to show this slide. One, it's a cute baby but most importantly, I would advocate that the foundation of auditory teaching for children who are deaf or hard of hearing is, in fact, their audiology and audiological management. Although oftentimes audiologist may not be the primary person kind of overseeing the intervention program, without excellence in audiology an auditory based program would be certainly at great risk for maybe not providing the best signal for that child, and his or her family who is hoping for the child to learn to listen as well as develop spoken language.

So my mantra is: Audiology is the foundation of auditory teaching.

I'm sure most of you or hopefully many of you are aware that we're seeing more and more of the following finding that because of some of the incredible advancements with sensory technology, notably cochlear implants, digital hearing aids, and various assistive technology, children even with the most significant degrees of hearing loss, severe and profound degrees, can and are making use of auditory information for the development of spoken language, and they're developing their spoken language through listening.

I do want to make the caveat that it's a family's choice in regards to what mode of communication or opportunity for communication learning they so elect, but we do know from data from beginning in North Carolina that over 90% of the families when told about the range

of options that are available, over 90% of the families in North Carolina which tracks their data quite carefully are, in fact, electing a listening and spoken language option. That does not preclude that other families that we're working with can, in fact, participate and need to participate in some of these measurements that we're going to be talking about today in the world of speech perception.

Moving on, it's hard not to be excited about our jobs our kind of careers and lives working with children with hearing impairment, and I must say, sometimes I almost seem giddy when I find and learn that I'm about to see a young child. In fact, this afternoon I'm seeing a 2 month old, and a 3 month old upstairs at the clinic. Why am I excited or why can we be excited about the options for "success" is because of universal newborn hearing screenings our EDHI program in the United States. Some of the youngest children and premature children that just weigh very small amounts of poundage are oftentimes surviving and these at-risk infants oftentimes can present with hearing loss and other issues, and they truly do show us about the challenges but also the fight and perseverance of these little ones that are a part of our clinical lives and our family's lives.

And, of course, we're very much aware of the value of early intervention, and parent guidance since parents are much more important than any particular clinician, and I'm hoping we are also collecting data to prove and demonstrate our clinical efficacy. And there's no question the world of cochlear implants has changed the



landscape of deafness for the children we work with.

Moving on, this is just a review but I wanted to add in in addition to EI programs, hopefully we're seeing great pediatric audiology. I mentioned the incredible technology, but I'm also getting to see more and more clinicians and families that are doing excellent teaching, and what I prefer to call auditory learning versus auditory training. And clearly the Alexander Graham Bell Association for the Deaf and Hard of Hearing has an academy and, in fact, has a gold standard of a professional certification as a Listening and Spoken Language Specialist. So that is really important to be well aware of, and hopefully the numbers will continue to keep growing.

The audiological recommendations, which will be the primary focus of our talk, would include ideally that the audiology diagnostic program is part of the EI program. Ideally in the same facility, but if not in the same facility, great communication and great comprehensive services between EI and audiology.

At the Cleveland Clinic for any patient under three years of age, we make sure that we've scheduled a pediatric test assistant to be in the booth and, quite frankly, many audiologists would state the person in the booth may be more important than the person on the audiometer on the other side. We rarely would separate a parent from their child, but we do oftentimes need to instruct the parent not to give away any clues, so if a sound did come through the speaker, that wouldn't be the time for mom or dad to kind of lift their knees up and bounce the child because that might be a signal to the child

that he needs to respond or she needs to be responding.

So active parent participation -- and I might note, if we're doing testing that involves loud presentation or presentation of highly intense signals, we need to make sure that the parent is wearing ear plugs and/or earmuffs because they may be exposed to dangerous noise levels should the child not be responding as we continue to increase the intensity of the audiometer. And I -- my other mantra would be: Comprehensive testing and a comprehensive testing protocol is absolutely critical for the overall audiological management, including speech perception for these children.

Let's talk about hearing, and although this is not an anatomy lesson, I do want to always show a slide that gives the perspective that everyone knows about the orifice or the pinna or auditory canal and meatus, ending with the tympanic membrane, followed by the three smallest bones in the body, in high school known as hammer, anvil, and stirrup but now known as malleus, incus, and stapes. The stapes would be going into the oval window of that snail-like cochlea. And we have that snail-like curled, wonderful organ of hearing called the cochlea which would connect to the auditory nerve on the way to the brain.

Clearly the ultimate goal is the what was called Heschl's gyrus in the auditory cortex. Most of the children we work with have left hemisphere dominance, and in the end a wonderful line from the University of Akron is: We have the ears as our gateway but we actually hear with our brain. And that's an important message proven and

demonstrated by wonderful work from people, including Michael Dormann, and looking at various radiographic studies of what is really happening at the brain level of our children and adults.

Just a wonderful slide that helps me understand and teach students in training that the conductive mechanism involves the outer and/or the middle ear. The sensory mechanism is focusing on the cochlea. We refer to sensorineural hearing loss as the majority of those hearing losses are sensory involving the cochlea. It is not impossible, but it's quite rare that we actually see neural hearing losses. Sensorineural hearing loss is a grab-bag term for being in the inner ear and/or the auditory nerve to the brain. And, in fact, we still do hear people talk about having nerve deafness and it actually is quite an uncommon type of hearing loss. In fact, if we didn't have an operational nerve, our children who received cochlear implants wouldn't have the connection to the brain for the good use of the cochlear implant.

Air conduction shown -- (indiscernible) -- pinna would involve the outer ear, the middle ear, on along in the inner air and to the brain.

Bone conduction testing, typically done with a bone oscillator or vibrator placed on the mastoid process of the temporal bone, goes directly to the cochlea, and it's by comparing the symbols of air conduction to bone conduction we've learned if the hearing loss is, in fact, in the outer, middle, or an inner ear or problem with all three of those areas.

Just as a quick review, I just want to show all the symbols you'll typically learn. If nothing else, I hope the handout back becomes a good resource sheet. The right ear by ear phones or ear inserts is typically depicted with a red circle.

The left ear by air conduction, headphones or ear inserts would be a blue X.

The right ear, interestingly enough, goes to the left of the vertical line symbolizing a response for bone conduction when the oscillator is on the right ear.

And the left ear the little caret symbol is to the right of the vertical line in blue demonstrating bone conduction with oscillator placed on the left ear. I would make the comment that when we're testing with bone conduction, the better cochlea response, regardless of which ear the oscillator is placed on.

On some audiograms you may see an A depicted in the junction of the frequency and a decibel level, oftentimes referred to as an aided threshold, and we oftentimes when we cannot get earphones on children, we will make use of the speakers and we put an S on that intersection of the vertical and horizontal or frequency and dB line to indicate a sound field response.

The other acronym I want to throw out at you is PTA for the pure tone average. The pure tone average is simply the mathematical edition of the threshold at 500 hertz, 1,000 hertz, and 2,000 hertz divided by 3, and you get a pure tone average.

One other thing I would note in the context of comprehensive

audiology is all of these symbols make for good testing, but when you're measuring you need to make note that the aided threshold ultimately should include responses from both hearing aids, should a child wear two hearing aids, but should also include an audiogram that reflects just the responses when the right hearing aid is at the right ear. Additionally, there should also be measurements of just the left hearing aid positioned at the left ear. So literally both ears, left ear, and right ear do need to be tested in their respective settings.

In addition, when it comes to cochlear implants, sometimes instead of an A, you'll see on the audiogram a CI for the cochlear implant response. Same deal, we need to measure with bilateral, both implants in place, and should the child have two implants, measure with just the right CI, across the audiogram, and we need to measure with just the left CI as well.

So a crash course in symbols to ultimately move on to a cheat sheet that was developed by Jennifer Akers (phonetic) who is at the DePaul School in the Pittsburgh, PA area. A wonderful cheat sheet that talks about the right, the left, the right and the left bone, the arrows showing no response, and then a masked response, which can be discussed at a later time. A or CI or C for cochlear implant response. It's a wonderful cheat sheet for people overwhelmed by all of this audiogram and symbols.

And here is an audiogram showing different severity levels. Rarely do we have a child with a completely flat audiogram profile.

More typically there might be a sloping configuration, a rising configuration, even something referred to as a cookie bite as if there was a bite taken out of the top of the audiogram, and it's fairly rare to have a completely flat line. But we do have mild, moderate, moderately severe, severe, and profound degrees of hearing loss.

If we put symbols on this might be, for example, be the idea of a moderate profound hearing loss in the left ear by air, and adding on the right symbols with something borderline down to profound for the right ear with the red circles. So just a picture of a typical audiogram which might follow up with a cochlear implant should the child test.

As we move to a discussion of speech audiometry, I would be remiss if I didn't bring to your attention the idea that there are really different levels of auditory functioning. Formerly referred to as an auditory hierarchy, it is preferred not to use the term hierarchy because of the idea that it suggests we just finish off the foundation and move on up. In true listening, we go back and forth to different levels of auditory functioning. But the most basic level would be detection. Was there sound?

The audiogram is a perfect example of symbols that reflect where the child hears the softest level of sound. When I'm working with a child in therapy, if an alarm clock goes off and the child moves his head around, I know he or she has detected sound.

If someone knocks on the door and the child pauses or moves his head up, that child is merely detecting and may need to be taught

when you hear that sound, it might mean someone is at the door. Let's go listen and see who is at the door.

Moving up the levels, we come to discrimination which by definition is is this sound different from another sound? A very simple example would be to ask a child if when I say Pa, Pa same or different or Pa or Ba, same or different? A fairly basic level of audition, a little higher than detection but it is a good way to diagnostically probe if a child is hearing differences between various consonants or differences in vowel sounds.

But where we spend much of our time, both audiology and in therapy is at the recognition and identification level. Recognition, by definition, is when a child is making a selection, a selection in a field of toys, a selection by pointing to a picture that has several pictures in the field or on the page. That's the idea of I need the cow, and the child picks up a cow with a cow and a horse and a pig in the field. Or on a word recognition measure where I say, show me smoke, and the child points to smoke coming out of a chimney.

Identification, on the other hand, is at a similar level, but it is slightly higher in that we ask the patient to repeat back a word. So in a phonetically balanced word list for kindergarteners, a PBK word list, we might say to a child say the word please, and they're repeating back the word please.

One of the reasons we sometimes will do recognition measures is if the child has any speech production issues, you want to make sure the child is not being penalized for not saying the word correctly

when, in fact, he or she actually heard it correctly.

And nirvana, of course, would be comprehension where you're understanding or demonstrating meaning of sound. I could say, for example, I need an animal, but it's not until I tell you it has four legs, it gives us milk, and it says moo would you really know that I'm talking about a cow, and I'll do a moo sound a little later for your entertainment.

As we move along getting ready for some of the speech tests, I do want to recognize or note that our speech sounds include vowels as well as diphthongs which are two vowels together as well as consonant sounds, but it's important to note that the vowels and diphthongs and consonants are not precisely frequency specific. On the other hand, in audiology you can test at 1,000 hertz, and that is singularly a sign wave representing 1,000 vibrations in a second.

But when I say ah, the vowel ah is made up of bands of energy called formants. When I say a consonant such as sh, I do have a center frequency with much of the energy, but it is not just at 3,000 hertz or a specific frequency level. So it is important that we do need frequency-specific measures. And, for example, when we are calling our kid -- my middle granddaughter's name is Lydia. When I call Lydia, is she responding because she heard the first syllable, the middle syllable, the last syllable, or is it because she just heard the melody of my speech? It's very important that we also get data in regards to individual frequencies from low, mid to high frequencies with audiometry.



And this is just an example of some of the vowel sounds which are produced in the back of the mouth, mid vowels in the central area, as well as front vowels. And oftentimes, many of you -- we'll go to the Ling sounds in a moment but, certainly, ah and oo and ee are three of the vowels that we sample with the Ling sounds and in fact sample back, mid and front.

This is just a quick slide. It comes from Advanced Bionics, and it shows one example of the first formant, and second formant made up of these vowels.

I'm currently teaching a course in hearing science, and all 29 of my students are recording their voice, saying ah, oo, and ee, and I would venture to say all 29 will have something slightly different than 270 and 2290 for the ee sound. These are averages. They vary for males and females and they vary for each person's larynx, mouth, and laryngeal cavity, and that's why they're doing the lab. What will be key is this first band of energy compared to the second band of energy will most likely have the approximately same ratio, but you cannot memorize these and assume everyone's F1, and F2 are exactly the same.

You should note that for a person with hearing loss to hear vowels, they must hear both F1 and F2, and ee is considered the hardest vowel to hear not because of the first formant which is actually quite low, but more importantly the second formant is a high frequency making second formant making ee the hardest vowel for most children to perceive when they have their worst hearing in the high frequencies.

This slide goes back to a textbook by Daniel Ling, and Agnes Ling. And I love this embedded in my brain. It's the same idea of the first formant, second formant and clearly demonstrating why oo is the easiest vowel to hear because you only need hearing to 1,000. Ah is a mid vowel, and ee, once again, the most difficult vowel for most people to hear because of the second formant being high frequency. And what is interesting to me from an acoustic standpoint is F1 for oo and F1 for ee are almost exactly the same, but you can't tell until you hear through -- until about 2,000 hertz for the ee.

Let's move on to speech audiometric measures. Many of you have heard of SRT, the speech recognition threshold, and a SRT makes use of stimuli referred to as spondee words. Hotdog, baseball, football, airplane, ice cream. Just as some examples.

The low frequency information in vowels is primarily measured when we do SRT. And to give you a quick demonstration, I could say any of those pictured words without the consonants, and I bet you would be able to guess which word I said.

For example, ou-oy, cowboy; oe-an, snowman; at-ub, bathtub.

It truly has equal stress on both syllables, bathtub. However, the information for identifying SRT will be from low frequency vowels. And although as audiologists we expect an SRT to match the pure tone average, I would venture to say, it doesn't have to be exact. In fact, my observations are typically the SRT is most similar to 500 hertz in the pure tone average of 500, 1,000, and 2,000 hertz.

SRT is very -- excuse me -- it's easy to go -- to practice with

kids I do SRT simulation in the therapy room with toys for the spondees or with a picture spondee card so then when they go to audiology, they'll know the words, and we've played the whisper game, airplane, ice cream, hotdog, snowman, and I get softer and softer, and if they've practiced the whisper game, they'll know when the audiologist says, even guess, if you think you hear the sound, it won't be the first time anyone has whispered to them these two syllable words.

And this is done with adults as well. Just not with pictures or toys.

The other slide that is important to see is the famous banana. I sometimes refer to it as produce. It's been talked about as a string bean or green bean. It just looks like a pickle in this picture. But what it is showing is that with the audiogram of frequency or with the audiogram of dB HL, intensity, we want the children to be hearing ideally at the top of the banana. The goal is to be in the banana, but this wouldn't be good enough for me by any means. I would look for responses at least at the top of the banana. But when you look at the sounds that are represented in the pickle, you'll see lots of nasal sounds, M and N. You'll see the hardest sounds to hear, Th, F, and S, and a variety of vowels and other sounds in between.

No surprise that Th, this theta in Greek, the theta is the hardest sound to hear because it is the highest frequency consonant and has low intensity or low or small number of decibels. Th is the hardest sound to hear. The sound ah actually is the vowel sound and the sound most audible to most individuals.

So it is important to think about the produce that we sometimes see on some audiograms. And we'll also see the banana in a lot of different places. So someone needs to do a new study and put the banana in the right place.

I do want to note that for some of our younger -- youngest kids, they're not going to point to a picture. They're not going to repeat back a word, so you need to think about other stimuli, or your audiologist needs to think of other stimuli, that can be used in the test booth. I'm going to demonstrate the Bronx cheer. Nothing is actually better than saying into the speaker in a booth for a child sitting on a parent's lap and go pbbbbbt. That child will whip around when he or she hears the raspberries. They really think that's a pretty silly sound. Or we call the baby's name maybe starting at the softest level, creeping the audiometer louder, and when the child hears his or her name they'll whip their head around to the speaker where the sound is coming from.

Other basic word stimuli you would use would include show me your eye. Point to your belly button, touch your nose, where is mommy? Various things can be done even though they're not following a word list or picture book.

I have been known to use the Ling sounds where with monitored live voice through the microphone I can find out how soft or how low intensity I can go for an oo, how low I can go for the ee sound, and how low I can go for s or sh and have a very good understanding of the aided audiogram to those Ling sounds showing low, mid, and high

frequency response.

As the kids get older, they may look at a book with four pictures called NU-CHIPS. They may look at a book in color with six pictures called the WIPI. The first one is the Northwestern University Children's Perception of Speech. The WIPI, the Word Intelligibility by Picture Identification which are called closed sets. The child would be asked at a comfortable loudness level to point to a particular named stimulus.

And with open set, usually around kindergarten age, we might go through a word list where he or she repeats back the word presented.

So the first measures might be basic with just identifying or an awareness or detection of when they turn their heads to the raspberry to going to SRT with the picture pointing which is a threshold measure. The softest we can go, and now we're talking in the last examples, word recognition, how are they understanding speech. So in a WIPI page, it might be a picture where you ask them to point to blocks but the other foils, the other pictures might be things like box, rocks, socks, and the only way you point to box, I think I said box -- the only way you point to the requested item is if they hear all of the sounds or they would be confused with other sounds that sound alike.

I do want to make the comment, lots of acronyms that you may see on audiograms. CNT. Could not test.

My goal is for any student that I teach for them to never write could not test. I find that unacceptable.

A good clinical audiologist should be able to find out something about the child's speech perception even if it's as basic as knowing the child can or cannot identify long versus short. I might take a train and go choooo-choooo, and I might take a rabbit and go hop, hop, hop. That is a basic auditory task can they correctly identify long versus short. And with an airplane go ahhhhh, and with a car go beep, beep, beep. Very different number of vowels, different number of stress patterns of long versus three syllables, beep, beep, beep.

Do not go into the path of saying I just couldn't find out anything. Maybe they wouldn't point to the spondees, but you certainly shouldn't just give up, and not try for something audiological in the booth about speech perception.

The next slide just shows that I actually really still blow bubbles, and that little one, her name is Skye. She's on a video from one of the cochlear implant companies, but Skye is just a little one who is now actually in third grade, but a great picture, of playing in therapy which might prepare the child in going into the audiology booth.

I would also encourage you to bring your clinician, your therapist, your parent/infant adviser from your EHDI program to audiology because that person may serve as a wonderful pediatric test assistant when they do get to audiology.

A few quick comments about Ling. Those are the six sounds. And I would suggest with your hearing aid patients to also teach no sound.

No sound is a response you want the child to say when you actually present absolutely no sound.

The reason for doing this is years ago before implants, we would go -- auditorially, and a lot of our kids repeated back F. Some of those kids later got cochlear implants and they would come back to the Beebe Center where I used to work and they would say, you know, Don, I never heard F, but whenever you said F, and I couldn't hear anything, I would just said F back. But I never heard it. So if you teach no sound, it's possible that when you present a -- especially with hearing aid kids -- and they really don't hear it, they know one of the options can be no sound.

And you can also auditorially present nothing, just bop your head, and you hope the child will respond to that saying there is no sound.

The no sound credit for what I refer to as a 7th sound goes to Rose Drouss who works at the NYU Cochlear Implant Center, and when working at the Beebe Center taught me about the no sound trick. The reason I talk about hearing aid kids is most kids with implants hear F and Sh with ease, so typically it is not a concern for most of my kids post activation.

Dan Ling was a wonderful man, a teacher of the hearing impaired and an audiologist, and I think many of us may be doing Ling sounds throughout the world and forgetting that it actually reflects one of the greatest clinicians and deaf educators in our history, Daniel Ling, a wonderful man that we lost way too soon. So, Daniel Ling,

we kind of take our hats off to your brilliance and your wonderful contributions.

I also do Ling sound testing. I do it in the booth. I might do it in the therapy room, and I also do it at different distances.

Most of my babies I'm pretty close to physically so I'll do it maybe at 2 feet, but my therapy table is specifically 3 feet across for an average distance, and periodically I learn quite a lot when I go to different distances. With the most notable F sound being the hardest sound to hear as you go to higher distances.

But by doing the Ling regularly, and I mean daily, by making an observation of what they do or do not do, that response information is extremely helpful to our colleagues who do programming of the cochlear implants. If a child routinely is missing oo and mm, they're missing low frequency signals.

If they're routinely having trouble with Sh or S, they may be having problems with the electrode area that controls high frequencies.

There is no ee electrode to fix, but if a child has difficulty consistently with the ee, the audiologist does want to know that because there will be specific follow-up in programming of the implant to help get the tweaking of the electrodes having to do with mid frequency hearing. So your errors or your child's errors tell us tons of information for possible programming changes.

I want to quickly show you just a few more tests of interest.

My real quick comment was there are good mistakes and bad



mistakes. I just said oo and M are low. So when I go oo and the child says mm, that's a good mistake. But if I said oo and the child responds F, he or she has made a bad mistake. I said a low sound, and they came back with a high-pitch sound. That would be an example of a pretty far off acoustic or bad mistake. So you want to know the pattern of their errors.

Some other measures of note. You should be aware of the early speech perception measure. Moog and Geers. This shows one-syllable words. Two-syllable words with unequal stress, stress on one syllable, spondees which we've talked about, and three-syllable words.

This is a measure of pattern perception. A good mistake saying fish and picking ball, a bad mistake saying hamburger and picking ball. One versus three syllables, not a good mistake.

The next subtest would be a spondee card which I oftentimes skip because I have my own spondee card.

And the third subtest, all monosyllabic words starting with the ba sound, the B sound followed by a vowel, and with the exception of bee followed by a final consonant. Boot and belt very close. Bus and box, very close.

So very important measure. If I had a limited budget, I would buy the EFP for sure. It also comes with toys representing the single syllable spondees and three-syllable words along with each picture card. I even use the ESP cards when I see some adult patients following activation of their implant.

A couple of other measures after the ESP might include a parent measure where you interview the parent, ten questions. Something called the IT-MAIS. For the youngest children, post implant activation, I administer THE IT-MAIS with the family at one month, two months, and three months post activation, and then at six months and nine months. Most of our implanted kids are demonstrating very poor IT-MAIS scores before the implant, and quick auditory development after being able to listen with their implant. The IT-MAIS has ten questions and the responses range from a point value of 0 to 4, 0 being a response of never does the child respond to his or her name in quiet. And it could go from never to rarely on up to always and ten times score for always would be the perfect score for 40 for wonderful auditory development, and any low number not showing very much auditory response.

There are other measures or -- in the ten questions including how they're doing with some environmental sounds, how they're doing with vocal tone, how they're doing with different voices in the home, how they're doing in regards to responding to their name in quiet versus noise. So very important measure.

There's also the MAIS, and I believe it's still available. There are IT-MAIS and MAIS forms that you can get from the Advanced Bionics cochlear implant company.

In addition, our wonderful colleagues in Australia have developed the PEACH which also has parent rating of auditory responses and different percents that come out, and for any of you who do have

some school-age children, I have provided for you a list of several of the measures that can be filled out by teachers and truly give us some functional auditory behaviors in the classroom that would be helpful for any audiologist.

The list of SIFTER's are especially notable and helpful, and I would note that I'm seeing more and more children who come and there's also some auditory processing differences and learning differences, and this is a quick 25-item checklist that will give me some idea of the probable need to recommend auditory processing measures as well.

Just a couple of other tests in my grab bag of favorites. You no longer can buy the Test of Auditory Comprehension. That is not the tackle for anyone in the speech language world, but the TAC. It was originally on a cassette. Now I've put it on to a CD, and I'm in the process of developing a new version called the Listening and Auditory Functioning, or LAF, measure. It's in development at this time.

There are two measures formerly available from Ling Systems called the Ling Listening Comprehension Test. It's in second edition for our younger children, and there's a Listening Comprehension Test for adolescents. So even though we've talked about, you know, aided audiograms and SRT's and word recognition measures, you also need to know that listening also includes higher level listening like listening in noise which is on the TAC. Or other listening functions like being able to identify the main idea in a story. Or being able

to reason or even understand vocabulary based on context, and that's what is wonderfully demonstrated in these two language system measures. I believe this system is now part of Pro-ed if anyone searches for it. The standardization data for The Listening Comprehension Test are with hearing children but they can be use and administered on a test A and a follow-up test B for our children with hearing loss.

There are also high-frequency word lists, including the California Test, the Gardner word test, and a host of other measures including SPICE, and AG Bio.

For anyone interested in full title or reference information, I would be happy to do that offline with you sending me an email identifying your test of interest.

My battery for my youngest kids would include the Ling sounds, possibly use of the ESP, the IT-MAIS, a common measure of parent report, and/or the PEACH. For our slightly older kids, our preschoolers, I would use a Ling, the ESP, maybe the IT-MAIS, maybe the MAIS, but there's also the Glenn-Donald Auditory Screening Procedure which includes subtest 3 and answering sentence comprehension questions such as auditory presentation of: What color are your shoes? How many people are in your family? What number comes after 7? How many legs does an elephant have? So they are auditorially presented and you can report how many of the ten sentences are understood.

I often am administering my TAC to 2- and 3-year-olds, and it

is measurable to children who are 17. And for my older children, older patients might have these measures and notably might have the listening comprehension test.

Number two, edition 2, or the adolescent version, as well as the SIFTER reports from the school personnel.

But in our world of all this speech audiometry, we need to remember unaided testing as well as testing with their technology is absolutely critical. And we need to get away from doing all of our testing in quiet. We need to measure speech perception at varying signal-to-noise ratios. The world is not quiet. We need to measure at, say, +15, +20, and on the TAC, for example, at 0 signal-to-noise ratio. And there's no question the cochlear implants have been notable for bringing sound and detectability as well as comprehension for many of our children. Clearly, a well placed cochlear implant with the electrodes is very obvious.

But I would like to make the note that even though cochlear implants have rocked our world, Helen Beebe and Doreen Pollack in the 1940s were teaching their patients how to listen and develop spoken language. Auditory-verbal often referred to as -- accu-pedic (phonetic) or uni-sensory by Beebe did not just start when cochlear implants were approved by the FDA. Those grand dames of auditory-verbal and listening and spoken language were doing this 80 years ago. Rather impressive for you to know the history.

And, finally, please remember that the Alexander Graham Bell Association based in Washington, D.C. in a beautiful building in

Georgetown -- you really -- it's a museum-like greatness and great objects from Alexander Graham Bell, museum quality type stuff is open Monday through Friday. If you happen to be in Washington, please be in touch with Gary Yates or one of our managers or Amelio Alonzo Mendoza, our CEO or chief executive officer to show you and give you a tour. I recommend that you visit the AG Bell website, and that you read -- and these will be, I believe, provided to you by NCHA and a little bit of self-promotion, two really good articles, one last year about hearing testing and the other about the speech audiometry topic that we've embarked on today.

Please keep coming to the AG Bell website, and learn that there is also a protocol that was released for a gold standard of the protocol of doing optimal and impressive comprehensive audiology for our patients. So that is also being released to you with material. Be aware that, LISL is a voluntary certification of note with expertise in a variety of areas around this pie. And please also note that the websites of all three of the manufacturers of cochlear implants have a wealth of information on their website, and paying particular note to the Communication Center and the Listening Room and the Bridge Program from the three companies.

And there's a happy child. He just liked to yank out his hearing aids so we put little swimming things on his biceps and as we tried to pull off his ears, he couldn't reach his ears. But there are other tricks to try to keep them on their head.

I work with the idea that children sometimes yank at things,

but in the end, it's much better to be able to hear versus yank off your technology. So these are a range of considerations, including this cool thing for goggles that might help. Not waterproofing but at least covering up the processor or the behind the ear hearing aid. Don't go in the water with your hearing aid but they're really good goggles.

And then finally consider wearing a Medical Alert bracelet which might state that the child cannot go near the MRI until the internal magnet has been removed and also just the fact that the child might have a hearing aid or an implant in case they can't talk to a first responder. Please come to Denver for AG Bell, and feel free to send me an email. The preferred email, I believe, that Will has released is goldbed@ccf.org, or at my college.

I believe I'm reading a question at a time, and feel free to type away, and we'll route them as best we can. And if I don't get to your questions, in about seven minutes, I want to make sure you get them forwarded to me at the email.

So I'm going to read a question. -- (Indiscernible) -- pediatricians are always talking about percentage of hearing loss. This drives me crazy. What can we do to explain to them that this term is out of date and explain medically what we use now?

Wonderful question. It drives me crazy as well. I sometimes do two things. One is, there's no such thing as 100% hearing and no such thing as 0% hearing. And they go, you're right. It's not on

or off. The other thing that might be helpful is you could just grab an audiogram. The 100% came about partly because people would look at the audiogram and the audiogram used to only go to 100 because that's as loud as we could get. So if they just see an audiogram, tell them they're rarely flat, and second of all, the audiogram doesn't go to 100, so stop saying percent

Will slides used today will be provided?

My understanding is the slides can and will be released and use them as handouts. Absolutely. And feel free to ask for any particular slides if you want me to send me you -- I couldn't send all 48 because of restrictions on bandwidth, but if you're dying for that Ling and Ling formant slide, send me an email. I'll send you a copy of any slide.

I've come across several situations this past week alone where although parents are concerned about the child's functioning that the pediatric audiologist will not aid the child because the loss isn't greater than 40 db? How can I be an educator -- (indiscernible)?

I have an interesting response. You could ask five audiologists what to do and get six answers. So that, first of all, suggests there's a controversy. But the second response I do to, should we aid mild hearing loss is first of all, provide them with some of the literature about the consequence of mild hearing loss. You can also provide them with literature references, about the consequence of unilateral hearing loss. But my real response to a 30, 35, 45 dB hearing loss is as an audiologist, I am trained to make any degree of hearing loss



audible. And 30 and 35 dB is not audible at a distance or in the presence of noise, and an ear with a hearing loss needs to get a hearing aid. I don't mean to be simplistic, but the push has to be hearing loss needs to be aided.

And, I guess I could make up a question. No question? Maybe you're just shy. I could tell you stories about my grandchildren. Or --

>>SPEAKER: Don, I'm going to chime in here. This is Will. We will be posting this webinar on the NCHAM website, and that link to where that will appear will be sent to everybody who registered for today's webinar, so if you'd like to share or go over any of this content again, there will be an opportunity to do that.

Here comes a question.

What is your recommendation for amount of service time based on a child's language delay?

>>DR. GOLDBERG: Great question. Without a documented answer in regards to what is most appropriate, there is a statement that has come out of ACIA, American Cochlear Implant Alliance, recommending at least weekly or two-time-a-week therapy for a child post activation, post cochlear implant. I think our challenge is we really don't have evidence about what is the exact ratio of service time. I am only part-time at the Cleveland Clinic and my general guideline is a child under 12 months, I usually see monthly. But the real message is to the parents who really need the help. So I hope our parent advisors, our EHDI program are really teaching the families what to

do in our absence because they're more important than we are. But oftentimes, my general guideline is approximately once a week or every other week, and then the real goal -- and I don't mean to be crude -- but my goal is to get rid of them. So if they're doing well and documentation shows they're doing well, I oftentimes will modify what might have been once a week to something like every other week, and oftentimes the data from my outcome studies are showing most of the kids are at age level by 3 to 4 years of age.

It's also influenced by if you're also being seen by parent advisors or if you're also being seen in a preschool setting by school speech language pathologists. So there really isn't an easy answer other than we have to get away from saying graduates because a 3-year-old or 4-year-old who tests within normal limits or at the level of their hearing peers is not ready for their cap and gown. We do need these kids to be monitored which might be monthly or every two or three months even when they're great and they're 3 or 4. I think we are close to time.

>>SPEAKER: We have two more questions, Don.

If a parent asks an audiologist for testing beyond the unaided audiogram, is there usually an additional charge? And to go further, will the insurance usually pay for an aided quiet and noise testing?

>>DR. GOLDBERG: Great question. It does depend on insurance coverage. It depends on how your institution is billing. But one of the things I'd recommend is that link to the AG Bell protocol is a very good document to use as a guideline so you're not saying, Don

Goldberg told you to do quiet and noise, but that you have a reference document that gives guidelines of what should be done, which would be beyond an unaided audiogram. I can't stress enough, even if there are additional charges, which may or may not be the case, you must get away from just getting yearly unaided audiograms, and that protocol also gives timeframes of three-month cycle of testing at different ages and then going to six-month cycles. So it really is important to use something and not just go in that you know more than an audiologist knows, but you'd like them to read this as a guideline for how they might do the next testing.

>>SPEAKER: We have one final question which is: Which auditory assessment was it that you recommended to look at auditory processing?

>>DR. GOLDBERG: It was the Fischer auditory Problem Checklist. It was not an assessment. It was a checklist to guide me to then recommend full APD testing by a qualified audiologist and auditory processing disorders.

>>SPEAKER: Great. Thank you, Dr. Goldberg, and everybody for taking the time to be on our webinar today. As I indicated earlier, today's webinar has been recorded and will be posted on [instanthearing.org](http://instanthearing.org) in a few days. We will be sending out to our registrants the link to that posting so that you can view this again or share it with others who you think might benefit from the information that was shared today. So thank you again, everybody, and stay tuned for future webinars on other topics.

We're going to close out the recording and this webinar now,

and it will take you directly to [infanthearing.org](http://infanthearing.org) if you have a few minutes to look at our resources there. We're always posting new things, so we invite you to do that. Again, thank you, Dr. Goldberg.

>>DR. GOLDBERG: My pleasure. Thank you.

(END OF WEBINAR)