Pediatric Grand Rounds, presented in partnership with Boston Children's Hospital

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Presenters: Briana Dornan, AuD; Cheryl Edwards, AuD; Alison Leschinski, ScD; Derek Stiles, PhD

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- [Presenter] At this time, it is my pleasure to introduce Derek Stiles, who is the director of the audiology program at Boston Children's Hospital. His wonderful team will be presenting the first ever pediatric grand rounds presented in partnership with Boston Children's Hospital on Audiology Online. Thank you, Dr Stiles, for being with us today, and at this time, I hand the mic over to you.

- [Derek] Great. First of all I wanna thank Audiology Online for inviting us to come together and prepare this presentation. I just wanna start to give you a description of Boston Children's Hospital for those of you who aren't familiar with us. Our department of audiology consists of 30 audiologists working across six clinic locations throughout Eastern Massachusetts, from Peabody near the New Hampshire border all the way down to North Dartmouth near the Rhode Island border. We provide diagnostic testing, including behavioral evaluations, auditory brainstem response testing, and auditory processing evaluations. We also provide hearing aid and cochlear implant services. Every year we see more than 16,000 unique patients in our audiology department, and more than 20,000 visits per year all together. For the sixth year in a row, Boston Children's Hospital has been ranked as the number one children's hospital by US News and World Report, and I'm not saying that that is because of our department that the hospital achieved this ranking, but what that ranking ends up doing is it draws patients from around the world who have rare and complex disorders, and many of them we're asked to perform audiological evaluations for. The title of our presentation is the ABCDs of Approaching Behavioral Challenges in Diagnostics, and this title was partly inspired by the coincidental arrangement of our initials. My name's Derek Stiles, I'm the Director of Audiology at Boston Children's Hospital. Presenting with me today are Alison Leschinski, who's an audiologist and the manager of our Boston satellite. Briana Dornan, who's an audiologist and manager of our Weymouth and North Dartmouth satellites. And Cheryl Edwards who's an audiologist and the manager of our Waltham satellite. Our disclosures include that we are all employees of Boston Children's Hospital. Also, Audiology Online is providing an honorarium to our clinic's

foundation for our presentation today. And Cheryl Edwards is a member of the American Board of Audiology Board of Governors, and the views presented in this presentation are not necessarily those of the ABA. We have our presentation today broken up into sections. I will be continuing the introduction, after which Dr. Briana Dornan will be presenting on conditioned play techniques and adaptations. Dr. Cheryl Edwards will then present on adaptations to visual reinforcement techniques. And finally, Dr. Alison Leschinski will share approaches to testing children with multiple handicaps and intellectual impairments. I'd like to start this presentation by asking a simple question. Why is it important to be prepared to test children with behavioral challenges? I would argue that the reasons are really no different than for testing children who are typically developing. Reduced hearing means children have limited access to the auditory speech signal, and the cumulative effect of undiagnosed hearing loss can lead to delays in speech and language development, which in turn can reduce academic performance.

So for any child, a diagnosis of hearing loss should be made as soon as possible so that we can initiate intervention, and the diagnosis should be as accurate as possible so that we can make the most appropriate management plans. I also just wanna point out this screenshot came from a Target commercial, so it's always nice to see children with hearing loss in the popular media. So, why is it hard, or really why do these children seem to keep coming into our clinics? And I think one thing we can look at is the prevalence of disabilities in children, many of these children with behavioral challenges are also diagnosed with other kinds of cognitive or intellectual disabilities. So in these slides I'm focusing on our New England state data, however you could find information for your own state at disabilitystatistics.org. You can see that in early childhood, zero to four year column here, that the prevalence of any disability is only at 1% or less. But as we get into older age groups, the increased percentage of disability is more apparent. And really, indeed, a lot of these younger children, they might have a disability that's just not yet diagnosed. If we drill down to different types of disabilities, we can see for hearing loss that there's not too much of a difference in prevalence

between the younger and older groups, and I think we could probably attribute that to the success of newborn hearing screening programs that were able to identify children with hearing loss quite early these days. However, at least on this site, cognitive disabilities aren't even reported for a younger group, they're only reported for the five to 15 year group. And you can see that the prevalence of those cognitive disabilities are much greater than hearing losses. So, this early childhood period is often a time when these disorders are being diagnosed, and often hearing testing is part of the battery of diagnosis as a way to rule out hearing loss as a reason for the child's presentation. For those of you who've been working with a pediatric population for a long time, you may have felt like you're seeing more and more children with these kinds of challenges, and the data would support that feeling. If we look at disability statistics published by the CDC, we see that about one in six children are diagnosed with some kind of developmental disability. And in the period between 1997 and 2008, the prevalence has increased by about 17% overall.

You can see that for autism, the prevalence has increased by 290%, and the prevalence of ADHD has increased by 33%. So, whether or not it's because there's more of these children or more of these children are being diagnosed, this certainly means that more of these children are coming through our clinics. One thing that we can look at to explain maybe why we're seeing more of these children is the premature survival rate. If we look at the graph on the left, we can see that the earlier in gestation an infant is born, the more likely they will have a neurodevelopmental impairment. So if we look at the 24 week infants, we can see that approximately 50% of those, 50% of babies who survive being born at 24 weeks gestation will have either a severe or profound neurodevelopmental impairment. And then if we look over here at the graph on the right, we can see for children born at 24 weeks, their survival rate in the 80s was only around 10%. And now, at least in the mid 2000s, that survival rate grew to at least 70% and has probably continued to grow into our decade now. So, that just means that more children are surviving premature birth, but that survival does come with potential neurodevelopmental consequences. The final bit of data I have documenting

the demand for audiological services for children with challenges comes from our own Boston Children's data. So one thing that we do when we schedule our patients is ask whether or not the child has any kind of developmental disability. And that will then send the child either into an assisted visit type or a standard visit type. So in 2018, which I'm showing here, what percentage of our patients were scheduled in assisted slots above the age of five, and what percentage of patients were scheduled in standard slots. And we can see that probably anywhere between 10 to 30% of those kids depending on the age were categorized as needing an assistant, which means that there was some sort of indication that they had a developmental disability that would require additional assistance in the test session. Now those are our new patients. If we look at our return patients, so patients who are coming back for another hearing test, that number jumps even higher to between 15 and 60% depending on the age. If we collapse this data across age, we can see that our overall rates of assisted slots is 20% for new to about 40% for return patients. I think that this is pointing to the need that these children may need additional tests to come up with a diagnosis, and also to the potential greater incidence of hearing loss among these children, and thus they need return appointments as well.

Finally, I wanna share why I think pediatric audiology's only going to get harder, in the sense that why this proportion of difficult to test patients may grow. I think one factor to pay attention to is the increase of application based hearing screening systems. So we're seeing more and more of these kinds of games and applications coming onto the market, and they're either coming in as direct to consumer applications or through audiology distributors. So, Kids Hearing Game, this is one that you could download on your iPad and try it right now if you wanted. There's an automated smartphone audiometry that's being tested that has a bone conduction accessory that you can plug into your phone and complete bone conduction testing, and then some of you are probably familiar with the GSIM task, which is a kind of screening tool that you could have in your office. As more of these kinds of, I would say, child-friendly screening tools come on board, more and more typically developing kids or kids with hearing loss

are gonna be able to be successfully screened at the medical home, and they won't necessarily need to be referred as often for audiological testing. Which I think in a sense is a good thing because it means that the children that we will be seeing will just have that much more likelihood of having a hearing loss and need our services more than a typically developing six year old child with normal hearing, who really is, you know, not so crucial for them to be seen by a pediatric audiologist. If they can be successfully screened. So, these applications are making screening easier and cheaper, and can be adopted by physicians and schools, et cetera. And there's also we're seeing more non-traditional settings expanding into the health care delivery system. So places like CVS and Walgreens, and I know quite often I end up seeing the CVS health clinic for my own medical care. Things like flu shots and whatnot. So, I wouldn't be surprised if hearing screenings and things like that start to become a part of the health care delivery in these settings. So, what is left for us? Well basically, these easy to test children are going to be more easily served in their medical homes, and what will be left for us are these more challenging cases, children who may actually have hearing losses or children who just are not able to be tested in a more general environment.

So there are things that we can do to prepare ourselves for meeting these behavioral challenges in the clinic, and you'll see examples of these throughout the rest of this presentation today. We can adapt ourselves to the patient's presentation as opposed to trying to make the child adapt to our testing style. We can broaden our inventory of toys and tools in the clinic that can meet a specific patient's representation. We can create ways to elicit reliable responses and to better distinguish what is the response to the target auditory stimulus from noise or those kinds of patient behaviors that are difficult to clearly classify as a response. So, as I keep to our ABCD theme here, I also wanna introduce a framework that I think can be helpful in pediatric audiology, and one to keep in mind throughout the rest of this presentation, and that's the Antecedent Behavior Consequence process. So, in a conventional hearing assessment, the antecedent would be the presentation of the pure tone, the behavior would be the

patient raising their hand, and the consequence would be either moving on to the next presentation or maybe nodding to the patient and saying, "Good job." As audiologists, we can make adjustments to all of these components, so we can change the stimulus type, the antecedent, to something other than a standard pure tone. We can instruct the patient to perform any number of behaviors in response to the stimulus, so as in condition play, we have a play response and visual reinforcement, we have a head turn response that we typically are looking for. And then we can also provide any type of reinforcement as a consequence for the patient performing the behavior correctly. Ultimately, if we can find the right combination of A, B and C, then we should be able to get to D, which is the diagnosis. So, I think that you'll be able to see lots of good examples of ways that we do this in our clinic as I now change the presentation over to Dr. Briana Dornan and her condition play audiometry.

- [Briana] Thanks, Derek. Okay, so I'm gonna be talking about conditioned play techniques and adaptations today. And as pediatric audiologists, we know that toddlers and children with developmental delays are often our toughest customers. And the nature of our business makes them our largest group of customers on most days. So why are they hard? It's a big combination of things. Are they just nervous? No one told them where they're going today and they're not sure what to expect once they walk into the waiting room. Do they have medical anxiety? Are they medically complex and they've had lots of invasive procedures over the years? And this is one more trip to a doctor's office where they're not sure if it's gonna be okay. Are they trying to control the environment? Do they have diagnosed or undiagnosed delays in expressive language, delays in receptive language? These impact whether they can understand what's happening for our visit, what's happening for the rest of their day, and what's gonna be going on. Do they have delays or disorders of cognitive functioning? Someone told them they were coming, but do they have the ability to process what's gonna be happening during our visit? Do they have an undiagnosed hearing loss? And they don't know what's happening and they don't know what's happening most of the time because they can't hear what people are saying and everyone thinks that they just

aren't attending. And that puts them in a daily position of not knowing what's going to happen and we are one piece of that. So I wanted to give you today some ideas for successful conditioned play audiometry testing, and these are ideas if you don't have an assist available and you really need one for this visit. If you have an assist available but the child that you're testing is not succeeding in a two audiologist test paradigm, or if you're not sure if the child doesn't understand the task or if they're not hearing the stimuli.

So, Derek mentioned that when we look back at our statistics for kids that we're seeing, we have a smaller number of people who are scheduled with an assist. But when we look at how many come back for a return visit with an assist, that means that about 30% of patients we originally saw needed an assist and we weren't scheduled with one. And that happens often for lots of reasons. And so these are some ideas to help you if you find yourself in that situation and they are not yet ready to just tell you if they hear the beep once you put the stimulus on. So the patient I'm gonna be showing to you today is a two year four month old. It is a routine evaluation, and it is her first attempt at conditioned play audiometry. This patient has unilateral atresia, so I do have some idea that she's likely going to have some hearing loss, and we are going to see how she does today. We get started, for this age, doing this activity with some vibrotactile training. So, why is vibrotactile training a good idea to start with? When I am testing a little one, or an older one who isn't able to tell me specifically what they are experiencing, I am 100% confident that I do not know how they are hearing. I am 100% confident that I do know what they can feel. If I can feel a vibrotactile stimulus, I know that the person sitting next to me can also feel the same vibrotactile stimulus.

So it lets me fully understand if the participant has the developmental ability to participate in the task. If I am conditioning with a vibrotactile stimulus and they cannot connect the activity with the behavior, the antecedent with the behavior, then we're not going to be able to do this. And then I will move back to an easier task which would be VRA. So, let's go, I believe to the first video. So first today, we're gonna do a feeling

day. Are you ready? We're gonna put our finger right here and we're gonna feel this together. Oh, that's perfect, okay. Here it comes, we're gonna feel. I felt it. Ready, let's do it again. I felt that, did you feel that? Yes, ready, one more time, here we go. I felt it. All right, now I have some animal toys, and we're gonna do a game with our animal toys, are you ready? This is big mama sheep, we're gonna put mama sheep right here, can you feel right here for me? Okay, here we go, we're gonna feel. I felt it, and then we're gonna put it in. Great. So I have the bone oscillator stimuli on at 500 hertz at about 60 decibels. That gives you a nice vibration on the table, so we can feel it with our finger and then it will actually vibrate this little rubber toy that we're putting on, which are animals. Ready, as soon as you feel the beep, you put it in, ready? In, great. Here you go, piggy's turn. Awesome! All right. And let's go back to the slides. So the total vibrotactile training time took one minute and 30 seconds. Everything I was doing in that one minute and 30 seconds was prepping her for being able to respond to auditory stimuli if she could hear it. I was very close to her, I gave her two or three modeling activities, and then she was able to do the task on her own. So I know that if she can hear the stimuli, she's going to hopefully be able to respond to it.

So, following vibrotactile stimulation, we move quickly to bone conduction. And why is this a good idea? It's an easy transition from the vibrotactile task that we've just been doing because we were using the oscillator in our hands, and it is something that she's already comfortable with. It is a quick way to know if there is a sensory neural or a mixed component to the hearing loss that I'm going to be diagnosing. I tend to be of the camp that all kids I see potentially have hearing loss and I'm on guard for it from the very beginning of the test session. Responses to bone conduction are often more clear for children than via air conduction. It's just something we see frequently, that it's easier for them to identify that that sound is occurring if they have middle ear fluid, or if they are just listening through this mode for the first time. So let's go to this video. We're gonna put your headband on, and when you hear beeping, you put pony right in, okay? So at the beginning of the video, I was wearing the oscillator because I gave her three examples of how we're gonna do this task. I took the oscillator from the table,

put it on myself, listened for the sounds and showed her what we were going to be doing. Good job, big girl. Ready, we're gonna listen. That was the beep beep, and then it goes in. Yay, yellow page. That's it, oh my goodness, awesome. Ducky's turn, we're gonna listen. You heard it, perfect. Beep beep then in, let's listen. Yay, we're gonna listen. That was it, you are so good, here we go, beep beep then in. And let's go back to the slides. So in a total time of two minutes and two seconds, I was able to get unmasked thresholds at 500 to 4000 hertz. I'm kind of setting myself up to try to obtain all of the most important information that I can at first, and then my goal is if I can get everything that I think is most important, which is in this situation speech frequencies, 500 to 4000 hertz, then I'm gonna fill in when I have more time and I have found that I have kept her attention. Lots of things were in that session to try to keep her on task, I was leaned in, I was giving a lot of positive reinforcement. I was giving constant instructions with the beep beep then in. I try to keep the language very small to instructions and reinforcement without a lot of other conversation going on. Also, keeping a finger on her hand for a lot of the time helps her just stay focused on her hand which is holding the toy which is linked to the sound that she's listening for.

So now we're moving on to air conduction, and we will play this video. Yeah, next time I'll take, here we go, ready? We're gonna listen, we have our headphones on, oh, good girl. So good, all right, as soon as you hear beep beep, you're gonna put it in, are you ready? Okay, here we go. Yes, it goes in, awesome. Here we go, beep beep then in. Yay, beep beep then in, good job. You heard it. Okay, and let's go back to the slides. So, so far we've moved through three tasks. We've started with a vibrotactile task, then we went to bone conduction, then we started air conduction. And in that small amount of time, we've used three separate activities, but they're all linked, so they are really building on each other. So we don't need to reinstruct between different games, and they're very short games so that we can keep their attention for these limited periods of time which are giving us a whole bunch of information. In this next video, the person who was taking the video moved over so that you could see that I'm actually obtaining threshold in increments of down 10 up five, and figuring out exactly how she

is hearing, and let's play this video. All right, so first today, we're gonna do a feeling game. Are you ready? We're gonna put our finger right here and we're gonna feel this together. Oh, that's perfect, okay. Here it comes, we're gonna feel. I felt it. Ready, let's do it again. I felt that, did you feel that? Yes, ready, one more time, here we go. I felt it. All right, now I have some animal toys, and we're gonna do a game with our animal toys, are you ready? This is big mama sheep, we're gonna put mama sheep right here, can you feel right here for me? Okay, here we go, we're gonna feel. I felt it, and then we're gonna put it in. Great, here's pony, can you feel pony? Ready, as soon as you feel beep beep, you put it in, ready? In, great, here we go, piggy's turn. Awesome, all right. Okay.

So, in this section of this video, I just continued to obtain air conduction thresholds. And I started with the ear that did not have the unilateral atresia, which was my right ear, and in a total time of three minutes and seven seconds, I was able to obtain unmasked thresholds for the right ear at 500 through 4000 hertz. So I'm, again, setting my priorities for the most important information to obtain first, and that's my speech frequencies of my better hearing ear. I know that it's likely she has hearing loss on the atresia side, and I wanna know, does she have access to speech and language at least in her better hearing ear? And we did that really quickly. Next we're moving on to masked air conduction. Since she does have atresia, I know I'm gonna be using some masking today.

So let's try this video. Good job, big girl. Okey dokey, now we're gonna do some on this side. When you hear beep beep, you put it on, okay? You're doing so good. So I do start with an unmasked pure tone on the side that is loud enough to create crossover so that she understands the activity before we. Awesome, it goes on, perfect. All righty, new game. This one is monkey and bananas, are you ready? Okay, when you hear beep beep, you put it in. Here you go, ready, let's listen. Yay! Awesome, he says, yum yum. Here we go, let's listen for beep beep. Good job, yum,

excellent. Okey dokey, now we're gonna hear some windy noise on this side. When we hear beep beep, we put it in, okay? You're doing so great.

- Daddy!

- Yeah, Daddy is over there, he is so proud of you. All right, ready, let's listen for beep beep. So right there, she heard the masker and she was going to put the banana in. I didn't reinforce that, and she holds off to wait for the stimulus. Yeah, we're gonna get that. Yay, that was beep beep, good waiting! Awesome, here you go, next one, let's wait for beep beep. Yay for beep beep, so good. I am so proud of you. Next one, let's listen. Yay! So good, here you go. All right, let's listen.

- Daddy over there.

- He is so proud of you, let's listen. Yay, so good. You get your next one. Ready, wait for beep beep. So there I'm starting to lose her attention, she is two years, four months, and she's starting to be distracted and she's starting to be done with my activity. I'm trying to limit the conversation even more, keeping a hand on her hand to keep her focused and hoping we can make it through. Yay, you heard it, super duper. Let's wait again. Yep, and then we're gonna get a new game. You heard it, super. And let's go back to the slides. All right, and so in that amount of time from start to finish, I was able to get my masked thresholds for the left ear which indicate hearing losses in the moderately severe range which is consistent with unilateral atresia. And I have my complete speech frequencies for both ears. So, after I got the masked air, I went back and I got my masked bone, which was a nice fill in to make sure that there's no sensory neural or mixed component to the left ear hearing loss. Since I had then had my bone conduction oscillator on my left side, I had my super oral earphone on the right side, and I filled in the air conduction thresholds that I had not obtained before at 250 and 8000. So now I have the complete frequency spectrum for my better hearing ear, I have the mass thresholds for the atresia ear, and all of that was obtained in 13

minutes and seven seconds. So, really easy to do and very quick and we got lots of important information. Since I still had time during my 45 minute test slot after the 13 minutes and seven seconds of testing, I did have an assist come in and we were able to do speech testing. So one of the drawbacks of using a portable audiometer is that you can't do speech testing. But if you can switch between pieces of equipment, following that we were able to get a speech awareness threshold for both ears masked, and we're discrimination testing utilizing the ESP. So, what are some test behaviors that help to get fast information in a reliable way with very little kids and with kids who have developmental disabilities which preclude typical test session behaviors? I use very, very simple language throughout this test session, and in fact the entire evaluation can be completed only with gestures if necessary. This test can be completed using ASL, it can be completed using interpreters, as long as you can use your body language to indicate what the behavior is in response to the antecedent, then we are gonna be able to get the information and make a diagnosis. We use lots and lots and lots of frequent positive reinforcement. I almost never say no or that's not right or don't do that, I give a lot of attention to the desired behaviors and very little attention to the undesired behaviors.

So when she's pointing around the room, I'm just trying to refocus her on what the task is, beep beep then in. We have frequent changes in test activities. All of the activities ideally should be connected so that they scaffold so that we do not have to retrain for different activities, we want to be able to build one off of another so that we can seamlessly move between these skills. Placing just a finger on the hand holding the toy is often enough to ward off impulsivity. If you have someone who picks it up, puts it in, picks it up, puts it in. If you put one finger on that hand, a lot of times that will have them hold until they hear the stimulus. And we always wanna present the stimuli only when the child is ready. When you're in that test setup and you are six inches from the child, you really do have a sense of when they are on task and when they're not ready, and presenting only when they're ready really helps to shorten the test session, And on to Cheryl, Dr. Edwards.

- [Cheryl] Thank you, Briana, I appreciate it. While my part is about visual reinforcement techniques, I'm gonna cheat a little bit, and for this first part I'm actually going to talk about a technique that's a hybrid between conditioned play audiometry and visual reinforcement audiometry. This is a technique that we like to call magic button. Let's watch a video here as an example. And you'll see that the child is set up for a traditional play task, listening for the sound with an assist structuring the conditioning process. You can see when the sound is presented, the child presses the button with the assist's help and the reinforcer is turned on. So in this video you'll see a couple of conditioning trials, and at the end you will see that the child is solid at responding to the task on her own.

- Push in and on, good job. Are you ready, let's do more. What do you do? And on, good job. Yeah, we're gonna wait. Here it comes. Yay, go go, yes. Hi beep beep, let's wave together, let's get our hand ready. Yay, hi. Good job, let's get our hands ready.

- [Cheryl] All right, so you're able to see some of that. And you can get the idea, that when the child heard the stimulus, we were teaching her to push the button and then something would happen. What's great about the magic button technique is it's actually very low tech, and the magic button can be anything because it's magic. We have a tap light in one of our booths which is this first one here. And what's really nice about that is that when the child presses down on it, it actually moves like a button, but you don't have to have something like that. In the video we're using an overturned plastic bowl, that works just as well. And I think everyone working in pediatrics has a set of stacking cups, so you can use an overturned cup. You can also have a child press a block. You can use a magic dinosaur, literally anything. I worked with a child once who was very motivated by computers. I pulled a keyboard into the booth, not attached to anything, and he clicked a button on the keyboard every time he heard the sound, and that one worked like a charm. So, this technique is quite versatile. It serves as a good transition between a VRA task and a play task. The child in the video was

exactly 24 months. It was her birthday, she got an audiogram for her birthday, like every child wants. And we know that that can be a challenging age to test because VRA is not exciting enough, but conditioning to a traditional play task and waiting is really difficult. It's also good for children who are not very interested in the toys we are offering them. Children who are frequent flyers in the clinic for instance, who have gone through every single toy eight times over and they would like something new. And it's also good for patients with high false positive rates. In a traditional play task, completing the task itself on the child's own schedule can be a rewarding action in and of itself, like throwing the blocks all over the floor is really fun. The magic button seems not to be as intrinsically rewarding, the child can press the magic button, but nothing happens. And the toy itself is not that interesting. The child might press the button several times, but when she sees nothing happens, that behavior tends to extinguish, or at least greatly reduces the false positive responses. So we're gonna watch another video now, and this video is an example of where a false positive occurs, so you can see the assist's response to that.

- Yay, hi, giggy, good job. Hi, giggy. Okay, get ready.

- [Cheryl] Wanna try the other side?

- Yay!

- [Cheryl] Yes, it's over here.

- He's over here, hi, bunny. Hi, bunny, get ready. See if he comes back, let's wait. Yay!

- [Cheryl] So you can see, like Briana said, I didn't use the word no, I just said, "Oh, he didn't come yet, let's wait." So we were actually able to get a full ear specific hearing test on this child on her second birthday using this technique. So, you saw in that video that we had a second tester in the room with the child. We know that's not

always the case in every clinic, and it's certainly not always the case for us, either. This technique can be modified for use with only one tester. First, if you do have a slightly older child who will sit at a table without support, this is something that can be done without another tester in the room talking to the child and providing social reinforcement via the talk over. Second, it also seems reasonable that this could be modified for play on the portable if you have a VRA setup that uses a wireless remote control. You could be testing on the portable audiometer and use the VRA reinforcers that way. As long as you can keep the remote control out of sight of the child, if the child figures out that you have a remote control, we found out that can be way more interesting. And lastly, I will occasionally use this for older children who are doing standard techniques but may have attention issues or need additional support to complete the entire task.

A little more about testing by ourselves when we do not have an assist in the clinic. A common technique is to use the parent as the assist. The child is seated on the parent's lap or the child might be in their own chair with a parent in front of them. We give the parent really clear instructions on what to do. The parent can use any of the quiet toys we provide to them to keep the child centered and on their lap. And we ask the parent to try not to react to any of the sounds themselves and to keep the background as quiet as possible. If there are two parents, even better. We are not shy about recruiting both parents to help us out, where one parent might be sitting with the child and one is gonna be in front of the child in a more traditional assist setup. I should mention too, you may have noticed the assist wearing headphones. We do have a very simple, inexpensive talk over microphone that we can use to talk to the assist, and we can also use that with parents if we need to. For centering a child without an assist, some various systems, as you probably know, offer a third reinforcer. While this does work in a pinch, I have always wondered if this third toy could be confusing for some children. You have two toys that light up in response to a sound and one that lights up randomly that does not. Alternatively, there are other relatively low tech and inexpensive solutions like using a rope light like any of the ones pictured

here, or any other kind of light up device. We had one in the clinic once that kind of looked like a little disco ball kind of thing. This can be plugged into a wall plug adapter for a wireless remote like the one on the right. In this case, when you want to center the child, you can use that remote control to turn the light bar on or off, centering the child. A light rope and a wireless remote plug can be purchased for a total of maybe 50 or $60, which is a relatively small investment when you're talking about audiology equipment. And under the heading of necessity is the mother of invention, sometimes the testing audiologist needs to also function as their own assist as well. We certainly find ourselves in front of the audiometer with toys on the desk, picking them up and moving them around in the window in front of the child, making faces at them through the window, trying to keep their attention that way, as well as presenting the stimulus and activating the reinforcer, so multitasking and mental flexibility at its finest. One of the things we try to do with all patients, as I'm sure you do, but especially with those of your age, is to keep the children as happy as possible, when that is possible at all, sometimes it's not.

Of course with VRA and with play as well, we do require some level of calmness and interest. We all try to avoid situations which result in little baby meltdowns. To do that, we can consider test order. Obviously in a perfect world, I would complete otoscopy followed by tympanometry, and then on to a perfect behavioral test. Before any of that happens, though, I like to ask the parents, "How does the child usually react "when people look in her ears?" If the parent says, "Oh, she's usually okay," or, "She's a little squirmy but recovers quickly," then I'll move on with our tasks in the traditional order. But if I get the look of horror from the parent that says, "Oh, as soon as you take out that light, "she's gonna be a mess," then I'm often going to defer otoscopy and tympanometry to the end of the session and go into the behavioral testing first. Some of the questions we frequently hear from parents as well is, can he have his binky? Can he have his blanket? Can he have his stuffed animal? The answer to those questions for me is always yes. Any comfort object that is quiet and that is going to potentially keep the child happy is absolutely fine with me. And I found that usually comfort

objects are not too terribly distracting, the child kind of just hangs on to them like they're not there. One of the questions that's a little trickier is, can he have a snack while we do this? Snacks are crunchy often, and therefore loud. They tend to be really distracting because the children are rummaging for their goldfish in a bag or in a Tupperware, and the act of eating is way more interesting than anything else, at least for me. So I try to limit snacks as much as I can. But as a last resort sort of thing, like we're not getting anywhere anyway and the child's hungry and trying to get in their parent's bag, then I will be a little bit more flexible. But it's very much a if nothing else is working kind of thing. And also if the child is not upset, because we wanna avoid the introduction of a choking hazard, we don't want anybody to inhale their goldfish. Another consideration is where is the child going to be seated? In terms of seating, we want the child to be happy. We want them to be comfortable. We want them to be in a spot that is safe, 'cause we don't want them to fall. And we also, especially for testing the sound field, want them to be in the correct calibrated spot in the booth. So, we are gonna watch a video now. This is a situation that I'm sure you all will recognize which occurred when we were just 38 seconds into the appointments. That's actually fine right there. To the left.

- So, he can be down on the ground, that's fine, he just needs to stay kind of in this space right now. I know, we're gonna kind of pin him. ♪ Hot potato, hot potato ♪

- [Cheryl] Great, and we can go back to the slides. So this little guy you see is mobile, self-directed, definitely was not gonna stay in his father's lap. This happens all the time, and the assistant is instanced a great job coaching Dad on how to keep the child snuggly in the space between him and the table. This kid I believe was about 22 months old, we ended up getting a full test on him in the sound field, and we also, believe it or not, did get some information for him under headphones as well. So, we think about seating a lot. We've talked before that the child may be seated in a parent's lap, as long as the parent isn't giving them any cues about when they hear the sound. Sometimes a particularly independent 18 to 24 month old child may insist on sitting in

their own chair, but this may not be the first choice with this age range since the child is unlikely to stay seated for long. As we saw in the video, sometimes standing is okay, as long as the child is in the defined space. I can't say we do this very often, but occasionally we have children who are just more comfortable on the floor. I would say this happens maybe a handful of times a year, maybe a child with Down syndrome, or we saw a child recently with cerebral palsy who was happier and better supported on the floor. But if they're more comfortable on the floor then we are too. The assist usually gets on the floor to be eye to eye with them. One of the things that can work really well, particularly for children who we have seen before, children with difficulty with transitions or children who get very upset about being in the sound booth, is the stroller. If we know that they have difficulty with transitions or if that this is their second visit and the child arrives in his stroller happy as a clam, we will often take the child right into the booth and start the behavioral testing immediately without taking them out of their stroller. Having the child buckled into their stroller can really help because the child feels comfortable. They feel secure, and in their mind, there's no transition happening out of the stroller into a medical situation. So, that's helped a lot.

The last item here is called a Rifton chair, and it's that, if you've not seen one of these before, some of you may have them in your clinics, but it's this one here. You can see the Rifton chair's very stable, it does not tip over, it's got very wide legs, it's very low to the ground. It also has a belt so the child is in one place and can't wander. It does have a space where the child can put their feet as well just to feel more secure, and the Rifton chair's very helpful for those independent sorts who do not wanna sit in a lap, whose main agenda is to wander and explore the room or get to the toys. And this is what it looks like in action. You can see that the child is comfortable in an appropriately sized and stable seat and is gonna remain in that spot. This is actually an older style Rifton chair, and the new ones have been redesigned with padding. These chairs are certainly not inexpensive, but they are durable and it can be worth its weight in gold. It is not an exaggeration to say that the Rifton is the sole reason that we have been able to obtain a valid test on some children with very high motor activity levels or children

who are not comfortable in a lap, like some children with autism spectrum disorder. Now with this age range, we do very often start in the sound fields, because we know a lot of children won't tolerate having headphones on for very long. Before we put headphones on a child, we will give instructions to the parents, as the parents can be very helpful if they're provided with specific expectations. It's usually something like, we're gonna slip these headphones on him, if he goes to reach for them, which would be a very normal thing for him to do, if you can just catch him by the elbows so he can't quite get up there to pull them off, but he doesn't feel as if we're holding him down. Some children will simply respond poorly to being restricted in movement if they're given a bear hug. So we try to avoid that and have the parent catch them lightly at their elbows instead. We try to get the wires behind the child, it is less for them to grab, and we try to move quickly. Children will often get upset if there's somebody standing over them, looming over them for a period of time, so we try to get the headphones on and get back seated quickly.

We're gonna watch a quick video now. This is just a really lovely example of how this can happen very quickly and very effectively. We all do occasionally have kiddos where we're not getting reliable responses to tones, speech stimuli, or the music that we have in the clinic. This is a technique that can be considered when all else fails, to try to get some indication of where this child's speech awareness threshold might be. You can use the child's favorite music, the sound from a favorite toy, a parent or sibling's voice, by using the external microphone or the tester boom microphone attached to your audiometer, and adjusting the test mic outputs so that the VU meter is peaking at zero dB as you usually would. We're lucky that we often have access to technology in the clinic through tablets or phones. If the child's favorite thing is "Paw Patrol," for instance, we can very easily go to YouTube or other sites and find clips of TV shows and music. A child's favorite characters or videos are no more than a touch away if you happen to have these devices in clinic with you or if the parents have brought devices with them. And you can just see here, this is the boom mic, this is where the sound comes out of the iPad holding them up here, and you can see my other hand is

adjusting the view. And I thought I would include my opinion of three things that a pediatric audiologist can't live without, particularly for getting OAEs or getting tymps, but sometimes we're getting audiograms as well. Bubbles and a bubble container that is spill resistant, although none of them are spill proof. And sometimes we do use that, the assist will use that in VRA, but that again is like if the child's really, really upset and nothing else is calming them down. Otherwise it's usually just OAEs and tymps. The center item is a very inexpensive soft, plastic fan with lights on it, and there are a ton of these kinds of toys available. And last, of course, is the tablet or phone. A lot of patients do come in with these, and we will occasionally use this for a VRA with the volume turned off, but this is another if all else fails kind of thing. There are some children who, again, we have difficulty keeping their attention or they're vocalizing quite a bit. Sometimes using the tablet can keep them in one spot and keep them focused. Now the trick to that, of course, is the tablet could be more interesting than anything I could possibly do, so that's why we do only try that at the very end of a session when we've kind of tried everything else. And I'm gonna turn the microphone over to Dr. Alison Leschinski, thank you.

- [Alison] Okay, everyone, can you hear me? All right, so, good afternoon. I'm gonna talk to you today about adaptations for multiple handicaps and intellectual impairments. And actually, the approach is exactly the same as what Briana and Cheryl described. We're still doing VRA, we're still doing CPA. But our technique and our method might be a little bit different, in that we use very clear instruction, we're very concise, we're very simple, we're very basic, but we also use a lot of exaggeration to get the teaching across. So, none of us are trained in ABA, but we tend to use that approach, and ABA is a technique that focuses on improving specific behaviors, it's called applied behavior analysis, and most of you probably use it whether you know it or not. We use it with patients, we probably use it with our own children, we use it with pediatric populations in general because it's innate and it works. But when we use these techniques in tandem with one another, we're creating a lot of redundancy, and redundancy is what's gonna work best when we're trying to elicit these behaviors. So

we use positive reinforcement. You saw that in Cheryl and Briana's videos. That's encouraging the behavior that we want. The child or the patient does something, we encourage it by smiling, by having some verbal reinforcement, something that makes the patient feel good about what they did. We tend to use a lot of prompting. You probably saw that as well, visual and or verbal cues to encourage the behavior. We might point to the speaker, we might tap on the headphone, saying we're gonna listen. Anything that has that physical kind of prompt. And we of course have to use flexibility and patience, creativity, with all of our patients. But again, I'm going back to that redundancy of hearing it, seeing it, feeling it, all of those things are gonna help with this special needs population. And the other point that I wanna get across is that we still always wanna make sure that the booth, if we're in the sound field, is really quiet. We don't wanna be talking over the stimulus, we don't wanna be talking over anything else that's going on in the booth to take away from what our stimulus is, whether it's speech or whether it's the tones, we still wanna keep the booth quiet. But if we have to use that verbal reinforcement, we're gonna do that to make sure that the patient is gonna respond.

Okay, so I was talking about prompts, which is one of the techniques that's used in ABA. And prompts are really just supports, through any kind of a support that's used to teach a new skill. We're always gesturing, I'm sure all of you are pointing over to the speaker that the child's gonna hear something out of. We're gonna model. We wanna show or demonstrate the task for the learner so they can imitate. We're gonna use physical. So we're guiding the learner to do the task. So when we hold their hand to do hand over hand CPA, for example, we're not gonna just very laissez faire hold their hand and kind of just show them how to put it in, or we're holding their hand pretty firmly and we're making a really large gesture to put that block in the bucket. We want them to remember that. And then verbal, we're gonna say the instructions, or any other verbal kind of prompt that might help the child. So again, these prompts are used to teach the skill, and the hope is that it can be lessened or stopped once the learner can do the task. Sometimes we're gonna stop or lessen the prompt, and then we may have

to bring it back, we might have to remind the patient, oh, don't forget we're gonna do this, and we might even say to our assist, "Let's do two more hand over hands "and bring this patient back." And that's pretty typical with a special needs population. They need a lot of reminders, whether it be gentle or more exaggerated. If we lose them, it's not always a permanent loss for that session, we might be able to bring them back. All right. Okay, so, this first case that I'm gonna show is an eight year old boy. He has trisomy 21, history of hearing loss, he's a known patient to us. And if need be, I will pause the video to give some thoughts, but here we go, we can start the video. Okay.

- Good.

- [Alison] Good job.

- High five, yes! Okay, wait for the beep beep.

- [Alison] So you can see that the audiologist who's the assist, she's pointing, she's using her voice as a reinforcer, "Oh, good boy, good boy." She's using a huge facial expression as positive reinforcement. So try and notice that as we finish watching this video.

- Oh, high five. Oh, yay, high five, awesome.

- [Alison] We'll do 2000 and then I'm probably gonna try to get some headphones. Better. Yeah, good boy, so good, good job. I'm gonna do a put it in, so a put a toy on his lap. Go, go, put it in.

- No, no hurt, look. Look, see look, I have it, I have it. These for you, let's do it again. You want me to hold it for you? I'll hold it with the phone. Okay, I do it.

- [Alison] Go, go, put it in. Okay, so we can go back to the slides. So that was a really good example of so many things. What we see in that is the assist being extremely flexible. Okay, I'll sit on the floor. Okay, I will take the headphone off of the band because you are resistant to it, and I'll place it on your ear, why not. And it worked. A lot of patience, we need a lot of patience with some kids, they don't really feel like being here. They're not really sure what's expected. They might be anxious. And so we do what works for that patient, and reading the patient is really important. And that's what this little guy needed. The assist gave amazing positive reinforcement. She gave the verbal, she gasped, she had facial expressions, she clapped, she gave a high five. Again, going back to the word redundant, she gave so many redundant acts of reinforcement that it's just gonna help the patient to engage and encourage this behavior to continue. The prompts were also excellent. There was tapping on his hand to get him ready. One of the previous speakers spoke about that, if the patient's not what we call ready, the test isn't gonna happen, we're not gonna get the information that we need, so we do need to wait for them to have good hands and be quiet and be what we call ready. So she would tap his hand if you had noticed to kind of, okay, we're ready now. And then she would point over to the speaker as a cue to listen. And then she was quiet, she didn't talk.

So it was a queue of, we're ready to listen for the next sound. And again, something else that's really common in ABA or the applied behavior analysis is first this, then you fill in the blank. So she said, "First, listen, "then we high five," or, "Then we play the game," or, "Then we put that next tier of cake "on this tower we're building." And they know that, a lot of these kids are doing ABA at school, and so this is not new to them. So using that, first this, then that, they'll know that, they'll be familiar, and so we have a lot of success using that kind of phrase with these kiddos. All right, so let's move on. Okay, sorry, and those are the results that we got on this kiddo. Okay, so this next case is also a child with trisomy. This kiddo is a little bit older, he's 14, he's very quiet, he's subdued, you'll see that. He's got a bilateral conductive hearing loss. He had a trial with amplification in the past but unsuccessful in light of some sensory issues.

Parents had some recent concerns with the decrease in hearing. And he is verbally expressive. So you'll see that because he's a little bit older, the assist that's used is trying to gear that and work with that because he's older and more mature, and try not to treat him like a, quote unquote, baby. But he's still developmentally delayed, so he needs that highly structured environment, he still needs that ABA approach, he still needs the reinforcement, he still needs the structure. But it's done in a different way, so let's take a look at that video.

- Yes, that was it, good listening for that beep. Here's another red heart, let's wait and listen.

- [Alison] Right loud.

- Yes, thank you for putting it in when you heard it. Black circle, let's wait and listen. Thank you, that was perfect.

- Nice, drop it.

- Now it's orange, let's listen for the really soft one.

- [Alison] He should hear this.

- Wait, I heard that one, let's put it in. Let me do one real quick, I'm gonna do green, that's my.

- [Alison] So he is not there yet. He's not sure exactly what to do. So, the assist here picked up on that and intervened and basically said, "Wait," when she heard the sound, "Let's try that again, let me show you." So she's gonna help kind of train him or teach him again so he can get into the task and we can get the response that we're looking for. So let's see how she does that with.

- Put it in. Let me do one real quick, I'm gonna do green, that's my favorite color, I'm gonna wait.

- [Alison] Loud.

- Whoa, I heard it. Your turn, ready? Would you like purple or yellow? Yellow, let's listen for beep then in, okay, here it comes.

- Nice.

- Great work. They're gonna get a little softer.

- [Alison] Definitely audible.

- That was it, yeah! As soon as you hear beep, put those in. We're waiting.

- Yeah, good boy.

- Yes, great job, thank you.

- [Alison] Just dropping a little. Go five up, see what happens.

- Don't forget, as soon as you hear a beep, you put it in.

- [Alison] I'm gonna go put it ins.

- Ready, let's listen, new game.

- [Alison] All right, bud, put it in.

- Yeah, that was it, great work!

- [Alison] All right, bud, go, go, put it in. Go, go, put it in.

- Yeah, thank you for showing me with your eyes, again.

- [Alison] Okay, put it in. Go, go, put it in.

- Yes, good head bobbing, thank you.

- [Alison] Okay, and we're back to the slides. So, that was a great example, and very different from the first one. And the assist did an awesome job of really reading the patient very well. I hope you were able to see on that video 'cause it was a little bit dark, but he did some really, really great responses with some gentle reminders. He also was not picking up on the task, so that's why I intervened and went to some put it ins. I thought that that might be a really good support for him to kind of get back into that, and he knew, he knew what to do, 'cause that was a little bit easier hearing the language. And Kate's reinforcement, or the assist's reinforcement, just helped to solidify that for him. So we needed to use flexibility, we needed to be creative, we needed to kind of veer from the task that we were thinking about doing first and just doing something else. And that's fine, and we were able to, at the end, get a full test for him, so that's what we ended up getting, and that's a lot of information and it took a long time. Again, it requires patience, but we were able to get it. And I'm also hoping that you were able to notice that she did kind of modify her approach for a child who's 14 years old. Even though there's developmental delay, we're gonna use a different kind of approach than we might for a four year old who has trisomy 21. So, we're gonna move on to one last video. And this is a child who, she has Sanfilippo, or MPS, mucopolysaccharidosis. Really impaired. She has some behavioral challenges, and that's really the biggest factor in how we can get a test on her. She does have

intellectual impairment, but she really can go from zero to 10 quite quickly and it's difficult to know what's gonna trigger her or what will not trigger her. Mom is a little bit difficult to work with as well, because she knows that her daughter can be triggered quite easily and obviously doesn't want that to happen. So, let's take a look at this next video.

- [Tester] Bop, bop, bop, put it in. Bop, bop, bop, bop, bop, bop.

- [Alison] So you can't hear her, but what she said was, "Bop, bop, bop," and then I am actually the one who's assisting there. I said to the tester, "Oops, she said, 'bop, bop, bop,'" so she didn't look, but it didn't really matter because she used her voice and repeated what he said. I also just wanna add in, she has an iPad. We never want a child to have an iPad. The reason she has it is because that's one of her triggers, she came into the booth latching onto that so tightly. And we knew that if we removed it, there would be no chance in getting a test, so why not just start with her having it, and if we can gently remove it, we will. But we definitely didn't wanna start off on a bad foot with her.

- [Tester] Bop, bop, bop, bop, bop. Bop, bop, bop, bop, bop. Bop, bop, bop, bop, bop, bop. Bop, bop, bop, bop, bop. Bop, bop, bop, bop, bop, bop. Bop, bop, bop, bop, bop, bop.

- [Alison] The last slide. So, you could see that my responses to her response were extremely exaggerated, because I really wanted to have her feel proud and excited that she turned in response to the verbal stimulus. And she did, you saw that she smiled, I gave her a high five, I used a facial expression. I enlarged my eyes, I pointed at the reinforcer, I turned my body. Whatever you have to do to encourage that response. Again, like I said before, it almost comes innately to most of us, but again, using those redundancies and using all of them together is what's gonna help and elicit the best

response that you can with these kiddos. And I think, there we go, that was my last one. All right, so I'm gonna pass back off to Dr. Stiles, thank you so much.

- [Derek] All right. So, that concludes our presentation. Hopefully this first joint presentation between Boston Children's Hospital and Audiology Online was satisfying. We wanna thank all the families and children who agreed to be filmed for this presentation, they did all give consent. And I think that just shows what a collaboration pediatric audiology is between the families and the audiologists who work with them. So we'd like to open it now to any questions or comments that anybody might have. All right. We have a comment regarding Alison's presentation from Clara, and she says, with some of my older developmentally disabled adolescents or teenagers, I have also used a written yes on a piece of paper and have them touch the word yes on the paper when hearing the stimuli. I would use this when they outgrew or stopped doing play tasks but could not do conventional. I think that's the end of the comment, I can't tell. Thanks Clara, I think that's a great comment, and something that could not do conventional but for the raising hands method, I think that's a great suggestion and something I don't know if we've tried but would definitely be something to try. Then we have another question from Melissa. Some children have such severe handicaps that they cannot be tested behaviorally. When we have a known hearing loss, how often do you recommend ABR on a routine basis? I think I'm gonna pass that to Alison Leschinski who's one of our key audiologists in our ABR program, and our sedated and ORABRs.

- [Alison] Yeah, that's a great point, and we encounter that frequently. So if we cannot gain any information about what their hearing status is and we can't say that their hearing is adequate for their communicative needs, we're definitely gonna recommend some kind of sedated ABR or an ABR in the operating room if they're getting another procedure at that time. That's why we do try these techniques and try so hard, because some of them cannot have sedation or it's not safe for them to have sedation. So we will try otoacoustic emissions, we will try an awake ABR or a Vivosonic ABR

sometimes. But yes, we do definitely try an ABR under sedation or in the operating room. And just a good point is that we're not gonna try doing an ABR annually, we would do it as needed if we notice that there's some concerns, maybe that we know they have a hearing loss and parents say, "We feel like something "has changed, they're less responsive." We wanna make sure hearing aids still fit appropriately. Perhaps every three to four years, we might do it at that point. But yes, we do ABRS here at Children's Hospital.

- [Derek] We have a question from Karen. It says, hello, great presentation, wondering how you navigate the challenges with sound field audiometry and moving in space around the calibration point, I.e. when the child head turns around or is not perfectly centered or generates noise in the room. Also, the calibration point in space and all the various head locations or number of people in the testing booth. So, I will say that we do try to limit the number of people in the testing booth, because that is known to affect the validity of the sound pressure of the sound field stimuli, and we do make every possible effort to keep the child under the calibration spot in the booth. There are occasions when the child will wander or will have a hard time staying in that one spot, and what we find works sometimes is to just kind of let the child have a moment to wander around, play in the corner of the room and just not consider that really a period of testing. And then lure the child back to the center of the booth with whatever toys or items that the child might find attractive. And then when the child does happen to come back to the calibration point, then again, begin the testing. I might see also if Cheryl Edwards has any question in regards to that point, as that was also part of her presentation.

- [Cheryl] Yeah, so in a perfect world, obviously, the child wouldn't move. We haven't figured that out yet. You did have one question here about what if the child turns around. I'm wondering if you mean like turns around on the parent's lap and is facing the wrong way. We've had some children who have been really upset. And so, the only way that they would sit quietly would be to kind of hug a parent. What we have done in

those occasions is we actually turned the parent's chair around so the parent's back is to the assist, the child's head is looking at the assist over the parent's shoulder, and we just present in the sound fields to the side where the parent's head isn't blocking the sound so we don't get a parent head shadow effect. So that's the only thing I think I would add to what Derek had to say, thank you.

- [Derek] Well, that is all the time that we have for questions this afternoon. I would like to thank everybody who did join us today for paying attention to our presentation. I hope that you've learned something from this, I know that I learned something just even through the process of developing this presentation with my colleagues here. So, on behalf of Alison, Cheryl, Briana and myself, thank you again very much and thank you to Audiology Online.