Enhancing Care with Audible Contrast Threshold (ACT)

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Hello everyone. Thank you for joining today. Today we're going to spend some time talking about ACT or the Audible Contrast threshold test which was introduced in 2023. And today we're here to give you a little bit of an update, including some recent research findings.

The content today will be presented by Virginia Ramachandran. Dr. Virginia Ramachandran is the VP of Audiology for Oticon and on the slide you can see her disclosures. My name is Ashley Hughes. I'm a field trainer for E3 diagnostics and here you can take a look at my disclosures before we get started. Here are the learner outcomes that will be covered throughout today's session and here you can see the risks and limitations inherent in today's course.

These are available in your course handout as well.

Over here you can see an agenda of what we're going to review today, talking about ACT as a diagnostic tool. Then we'll look at a clinical feasibility study. Then we'll move on to taking a look at ACT as a treatment tool and look at a clinical usage study.

So first, why ACT? ACT again was introduced in 2023 and it's a fast and language independent test that provides insight into the patient's ability to understand speech and noise. Beyond giving you deeper insight into your patient's hearing abilities. The ACT value is used to then guide your counseling. Since 2024, Oticon Genie 2 has used the ACT value to prescribe help and noise settings in specific Oticon hearing aids, ensuring that the hearing aids are fit optimally to your patient's needs and helping to support their brain.

Now, two years after the release of act, data are becoming available that show how ACT is received clinically. Again, this presentation is going to walk through two recent studies where ACT was implemented in clinics with highly positive outcomes, showing that ACT can be adopted widely to enhance patient care. Before we get into those studies, we just want to take a quick look at what is ACT

for anybody who may not be familiar yet. So we all know that audiometry is a very important clinical tool, but there are parts of our patients hearing experiences that we don't capture from pure tone audiometry. We really don't get the whole picture of how our patients are doing in the real world.

And we know that the ability to hear pure tones in a quiet room don't always reflect the typical demands that we have in everyday conversations, such as background noise, more complex stimuli that we're listening for, and more.

And when we do an audiogram, we of course are not just doing pure tone audiometry. We also have speech audiometry that can supplement our testing. And there are definitely pros to including speech audiometry. There are also some limitations. So it's great for the patients.

It's very relatable for them. It can give us some confidence in our pure tone thresholds. However, it is time consuming.

We don't really have clinical setups that accurately show us how our patients will perform in noise. There can be language barriers and more. And so ACT can kind of help fill in some of these gaps or limitations of speech testing.

ACT was being developed for over 10 years by these groups that you can see on this slide. So this was a huge undertaking, developing a new diagnostic tool like actual. And it was a collaboration between the Interacoustics Research Unit, Interacoustics, Eric's Home, and Center for Applied Auditory Research, Erkar we just want to make sure that we acknowledge all of the time and work and effort that it took. Act, or the audible contrast threshold, is a test of spectrotemporal modulation. And so before we look at what ACT looks like, just to make sure we're all aligned on what is spectrotemporal modulation or stm.

STM refers to the changes in both the frequency or spectral or timing or temporal qualities of a stimulus. And so we're changing the frequency over time and we're also changing the amplitude or intensity over time. Throughout today's session, you're going to hear us talking a lot about how the ACT value highly correlates to predicted aided speech and noise in an ecologically valid environment. So the value that we get tells us how our patients will do in noise with hearing aids in the real world. But I did say that this is a language independent test, meaning we are not asking them to repeat words back, we're asking them to listen for a modulated signal.

And so you might wonder, how do we take a signal that doesn't have any speech components to it and associate it with how a patient will do in noise listening to speech with hearing aids. And on this slide, you can take a look and see the speech spectrogram from a hint sentence along with an early ACT stimulus spectrogram. And we can see that there are similarities between the two. And that is what allows us to then glean information about how our patients will do in the real world with hearing aids on them.

Now we're just going to take a look at the ACT software and how it works, starting with a video. The audible contrast threshold test, also known as act, allows you to assess how well someone can hear in background noise. It does this by using a special signal that is non language specific.

ACT makes full use of the pure Tone audiogram, making this an above threshold test. To perform act, you will need an audiometer with the ACT license, headphones or insert earphones, a patient response button, and a completed binaural audiogram with threshold stored for at least the following frequencies 250Hz, 500Hz, 1Khz, 2Khz and 4Khz. Now we have everything we need. We can go ahead and perform ACT from the Audiogram screen within the Affinity Suite, go to Menu, select Tests and then click on act. An instruction box will automatically appear.

Instruct your client on what they need to do and make sure they understand to press every time they hear the special signal which sounds like a siren. Ensure that you have demonstrated the sound examples so that your client knows what to listen for.

Once your client is ready, click Proceed to Test and press Start. As soon as you press Start, your client will hear episodes of noise. The test starts at 16 decibels NCL. Press only once to deliver the siren at this intensity. If the client hears the siren correctly, a black dot will automatically appear on the trace.

You continue performing the test in the same manner as pure tone audiometry. Once a heard response has been stored, go down in intensity by two steps and present again. If the client does not hear the siren or does not respond to the sound in the correct time frame, a white dot will appear and you increase in intensity by one step. This two down, one up approach is the same as audiometry and the test will automatically stop and store a value once it has reached three out of five correct responses.

Once the relevant number of correct responses has been reached to produce an ACT value, a green bar will appear in the middle of the screen. You can now use this to counsel your clients about their ability to hear in noise.

Press on the Guidance tab to reveal our recommendations for the different ACT severity levels. Use this for counseling to adjust hearing aids, to recommend assistive devices, and to discuss rehabilitation and communication strategies. Selected hearing aid brands use the ACT value to automatically optimize their adaptive hearing aid features.

So you may have noticed that ACT is a fast test. That doesn't necessarily mean it's an easy test. We're listening for what might be perceived as a really small change in the stimulus, and it's important that we counsel our patients appropriately before we start the test. And like they showed in the video, we also want to present those stimuli so that they know what they're listening for what you'll need to perform

ACT is a compatible audiometer, headphones or transducers for your patient and a patient response button. So at this point it is required that they're able to use a patient response button in that video.

You saw ACT being performed on Inner Acoustics on the Affinity Compact. There are other compatible equipment that are available to perform ACT as Well, including the GSI AudioStar Pro firmware version 2, GSI Pelo firmware version 2, Interacoustics Affinity Compact. As you saw Interacoustics Equinox Evo, and then a handful of medrec's audiometers as well. Here you can see a close up of the ACT software screen. In GSI equipment.

You can see presentations across the X axis and DBNCL on the Y axis. You may not have heard of the NCL scale. Totally fine because it's new. It stands for normalized contrast level and it's a novel scale that was actually created for this test.

When we look at the presentations, we want to pay attention to 25. 25 presentations is where we start to risk patient fatigue. So we really want to lock in their ACT value before we get past 25 presentations. Your best tip to doing this is not to time lock the patient throughout the test. That way you don't lose any presentations to essentially or you can avoid losing presentations to false responses.

As you can see, channel one and channel two will list the intensity level for each ear and those are preset based on the patient's audiogram. That's why we have to have 250, 500, 1,000, 2,000 and 4,000 Hertz captured first, so we can ensure that the stimulus is super threshold across the stimulus. Something that sets us apart for speech testing where we never really know that it's super threshold across the entire speech stimulus. In the case of an asymmetric loss, we'll have asymmetric presentation levels. As you can see here as well, we are never adjusting the intensity.

What we are actually adjusting when we perform this test is the contrast level. And so essentially how different the modulated signal is when we're comparing it to the unmodulated signal. But the intensity

will always stay super threshold.

And now you can see the same test, but just what it looks like in a different piece of equipment. This is an interacoustics equipment instead of gsi.

Here we can see an ACT threshold that has been captured when the clinician introduces the stimulus. The software automatically determines if it's a correct response or not based on the timing. And so it's important that we follow what the software has determined. A correct response is a black filled in circle, an outline circle is a miss. Every time the patient gets it correct, a clinician will make it four db more difficult or two steps visually up.

And when they miss it, the clinician will make it two db or one step easier, one click down, following the modified Houston Westlake bracketing approach. So very similar to what we do in pure tone audiometry, but now we're using 2 and 4 DB step sizes instead of 5 and 10. No need to worry about that because the software will automatically adjust to the appropriate DB step size for the test. And just a reminder, the clinician is never adjusting the intensity, but just the difference between the modulated signal and the base noise. Once the patient responds correctly at the same intensity, three out of five ascending trials, the software will automatically stop and provide you with the ACT value.

So we can see in the screen we have 1, 2, 3 out of 5. And so the software has stopped us. Or if we take a look at the same thing in inner acoustic Software, we have 1, 2, 3, all on ascending. So the software stops us. Now we can see when we look here, our three levels are 4, 4 and 4, but our ACT value is 3.9.

That is because the ACT value is pulled from the psychometric function, which allows us to take a look at all of the correct responses, giving us a more precise ACT value for that patient.

So now we have our ACT value and what are we going to do with it? As it was mentioned in the video, ACT values will fall into one of four categories, ranging from normal to severe. Generally speaking, the greater the ACT value, the more help the patient is going to need from their hearing aids and noise. So with a lower ACT value, the recommendation is going to be to pull back on advanced features. And then with higher ACT values, we're going to want to actually increase those advanced features and maybe talk about some additional accessories that can benefit our patients.

ACT values can be automatically pulled into certain Oticon hearing aids.

And then there's also fitting advice that's provided that can be used if you're unable to pull it into the hearing aid.

And so now if we think about fittings as they existed two years ago, two patients with the same audiogram, same age, would probably leave our office with similar help and noise settings, not because we weren't trying, but because we didn't have an objective tool to give us the confidence in making adjustments to these features and a more kind of customized approach. For them. Now, when we see those patients that have very similar audiograms, similar ages, similar concerns, we can take this ACT value and it can give us the confidence to decrease the setting for one patient and maybe really increase the setting or talk about a remote microphone with another patient, allowing them to succeed as much as possible from the beginning, decreasing follow up visits, decreasing returns, and most importantly, improving patient satisfaction and quality of life.

ACT is really a foundation for a better first fit. It is the first ever language independent diagnostic tool that tells us more about our patient's speech and noise abilities in the real world. It is fast and familiar. It takes about one to three minutes to perform. Again, it uses the audiogram to individually shape the stimulus to ensure audibility, making sure that it is super threshold across the stimulus, which we know we cannot ensure for speech testing.

It gives us a value that is predictive of a patient's aided hearing and noise ability in realistic conditions or in ecologically valid conditions. And then it uses a novel NCL scale.

Now we're going to take a look at a diagnostic clinical feasibility study that was performed with act. This was a Henry Ford study and it was performed in collaboration with Oticon. The study was led by PI Dr. Erica Bennett and you can see her in the middle on this picture and the team included Dr. Brad Stack, Dr. Josephine Moreno who was the external at Henry Ford at the time alongside Dr. Virginia Ramachandran from Oticon and the results were accepted and presented at the AAS conference American Auditory Society. If you want to take a deep if you want to take a deeper look at the study, you can read about it in the OTICON white paper which is based on data collected and conducted by Henry Ford.

Over a one month period. 108 patients were tested with actual at three audiology sites at Henry Ford Health in Detroit, Michigan. The patient's ages range from 22 to 96 years of age with a median age of 61 years. So very representative of the age range of patients that we might be seeing. ACT was incorporated into the clinical test battery at Henry Ford after the hearing care providers had performed admittance measures, pure tone audiometry and speech audiometry.

The results of the study were very promising. ACT proved to be feasible and easy to integrate into clinical practice, adding just one to three minutes to the test battery duration. So both for patients with or without hearing loss, it just took one to three minutes. For this test, 108 patients were tested and of those 108, 100 or 93% of them were able to successfully complete the test of the eight that weren't able to complete the test. Reasons included cognitive impairment and debilitating tinnitus.

In some cases, patients had difficulty understanding the task and for one individual, a language barrier made it difficult for them to comprehend the instructions. Generally speaking, if a patient is able to do

pure tone audiometry, they will likely be able to do ACT as well. Since the instructions are very similar, It's not uncommon in clinic. I'm sure we've all experienced this. You have a patient who reports concerns with their hearing on a daily basis, but their pure tone thresholds fall within normal limits.

This can impose a challenging situation for clinicians and a frustrating situation for patients when our results don't validate what our patients are experiencing. An important finding from this study was that ACT was able to provide additional information and really take us beyond the audiogram. Out of the patients tested, 25 showed normal pure tone thresholds. Out of those 25 with normal threshold which was considered less than or equal to 20dB between 250 and 8000Hz in both ears, 14 reported concerns or problems with their hearing. And out of those 14 who reported concerns, four of them had elevated ACT values.

So that means for four out of those 14 people, it's over 25%. ACT was able to give the hearing care provider a deeper understanding of their patient's real world hearing abilities. In individuals with normal pure tone audiograms, ACT can really help capture and acknowledge the difficulties the patient is experiencing, reassuring them that their experiences are valid and potentially giving us a way that we can help them too.

Interestingly, if we look at the same group of 25 patients with normal pure tone audiograms, there were 11 who didn't report any complaints or any concerns but attended the clinic for another reason, for example dizziness. All 11 of those patients had normal ACT values. This demonstrates that the test has high specificity. So when the patient reported no hearing problems, the ACT test did not find any concerns with their speech understanding and noise. High specificity suggests that the test will not generate false positive responses or show an elevated ACT value in the absence of hearing concerns.

This can provide reassurance to us as hearing care providers when we're implementing a new test in the clinic.

Finally, the results showed the ACT was able to provide information beyond word recognition, testing and quiet. There were 37 patients who obtained 100% for Word rec scores. Of these, 35% of them had elevated ACT values, with 27% of them falling into the mild contrast range or mild contrast loss category and 8% into the moderate Contrast loss category. So this again gives us confidence that that word recognition scores in quiet may not be predictive of patients who may struggle in communicating in background noise. And additionally demonstrates that ACT can provide us with this extra information on top of our routine clinical test battery.

The studies presented here show that ACT can enhance clinical care across the entire patient journey. The ACT test is fast, practical and easy to implement clinically, having been carefully designed to integrate seamlessly into the clinical workflow. So if we do it after we do our pure tone thresholds, it just takes one to three minutes to get that value. The ACT value is meaningful, providing a deeper understanding of our patients abilities to hear in the real world with their hearing aids and enabling us as hearing care providers to identify patients who are more likely to experience difficulties understanding speech and noise even when their pure tone thresholds don't show us that so helping us help more patients.

Furthermore, the ACT value can enhance counseling by helping us as hearing care professionals explain speech and noise concerns to our patients and their loved ones and reassuring them that the concerns that they came in with are real and valid. The ACT value can also help provide realistic expectations for the benefits a patient might get from hearing aids and guide recommendations for different devices, including technology levels and assistive devices.

Finally, the ACT value provides a better first fit for our patients, improving the help in noise settings in a meaningful way to the hearing care provider and the patient. Taken together, ACT as a game changing tool with demonstrated benefit across the patient journey.

Now I'm going to hand it off to Dr. Virginia Ramachandran.

Thank you so much, Ashley.

Okay, so I'm going to be speaking to ACT as a treatment tool. And you know, Dr. Hughes did a great explanation of the diagnostic utilization of ACT when it comes to understanding suprathreshold function. We have a lot of options in our toolbox, right? We've got a lot of different types of speech and noise testing. And those speech and noise tests have a lot of face validity for patients in that they really resonate when they are using speech stimuli.

It helps them understand that you're validating what is typically their primary concern, understanding speech and noise. The challenge with the the language specific tests that are out there though are that we don't have an easy way to be able to adjust the hearing aids based on that information. So for example, if I was to do any traditional speech and noise test, I might find that I have an outcome that suggests a person might need more help in noise or less help in noise. And that can give me a general sense of what to do with that, their noise reduction strategies in their hearing aids. But it's not a very precise strategy because we don't know how it's going to be interacting with the actual technology.

So how much of an adjustment do I need to make to things like directionality or noise reduction settings in order to get the optimal amount of benefit for a patient? Now you might be thinking, well, if I can just max out the noise reduction settings for a patient, then that would be an opportunity to give them the most benefit possible. The challenge there is that you could have some negative consequences of being able of, sorry, you can have some negative consequences to sound quality when you are too aggressive with noise reduction settings. So we just really want to be able to have the most precise treatment strategy possible for patients. So that's what our goal with using ACT as a treatment strategy is for, for patients.

So right now, as I said, we don't really have a lot of evidence to guide the best help in noise settings for patients. We have general information, but in a lot of cases it's based on their pure tone audiogram. Most of what we do from a fitting strategy point of view really is based on the softest sounds that they can hear and not the person's super threshold function. So we would really like to be able do that. In addition, we want to be able to do that in a language independent way because we know that we see a variety of patients and patients are seen globally.

So we wanted to make sure from our Oticon hearing aids that we were able to implement this in a language independent way. So ACT is the perfect strategy for doing that.

So in addition to having that pure tone audiogram which will predict the audibility, ACT is then used additionally to predict what the best hearing aid settings would be for that patient from the advanced features of the noise reduction. You saw this, that again, it's part of when you have that outcome of normal, mild, moderate or severe in terms of the ACT outcomes, you do want to give more help in noise for those more severe settings and potentially even add in additional accessories, remote microphone technology and so on that the patient might need. But we want to be able to do this in a more precise way. And so we did research to understand what would be the best strategy in order to give patients a very personalized, appropriate and evidence based noise reduction strategy. So a test was done for clinical implementation in several locations.

There were two international sites for this clinical study. One was in Germany at the University of Applied Sciences in Lubeck, and there were several sites in Japan that participated in this study. And you can see that these are very different languages and very different methodologies that were used for fitting these patients in these different settings. So we really wanted to make sure that this is something that could be globally implemented and applied.

And the research questions that were asked were about the relationship between the ACT values and speech understanding in noise in these two very different real life user groups. We also wanted to understand if ACT could increase the prediction of speech and noise ability compared to using the audiogram alone. Now there were some other additional research questions, but I'm going to start with these two and walk us through the methods and what the results were for this. It's really about can ACT do what we're asking it to do? So for these studies there were 100 participants.

They had pure tone averages from 29 to 79 dB HL. So this was a pretty broad group, inconsistent with who ACT is intended for, which would be adults who can perform pure tone audiometry. They were 32 to 79 years of age and they had a fitting of Oticon More1 hearing aids.

The German participants were fit to NAL NL2 fitting rationale. Their acoustic coupling was what was prescribed in the Genie 2 software. And the Japanese participants had a different methodology that was, that was recommended from guidelines from the Japanese Audiological Society. And following the local practice, they were all fit with non vented custom ear molds. And real ear was done for both of these groups.

ACT is designed to specifically assess and predict what a person's hearing ability would be in noise when they are aided. So audible is the audible component of audible contrast threshold. So the question is, when a person is aided, what would their speech and noise performance look like when they are aided? And so you can see that this test setup is designed to reflect that. So the person, each of the test participants was it with hearing aids.

They had ACT performed. So we knew beforehand what their ACT score was and then they did the hearing and noise test. So this is a speech perception and noise test, specifically the version that was hint. The hint test is used because it's been translated into many different languages. So it's available in German, it's available in Japanese and it's validated to be consistent in terms of its performance across

these different languages.

But it does have, it is an easier type of test to do. So in order to make sure that it was more reflective of real world performance, it was made a little bit more difficult than typical by creating an ecologically valid sound scene where the target speech was coming from. The front at 65dB split. Then interfering speech from a male talker that was mixed with speech shaped noise was presented behind the listener at 100 degrees and 260 degrees. The level of the background speech was set and then the target speech was adjusted to get the performance level.

The test person of course was placed in the middle of this situation. So you have an ecologically valid, fairly difficult experience that this person is listening in.

Now the hearing aids were oticon more hearing aids, more level one hearing aids. And they were adjusted so that there were three different levels of noise reduction. Sorry. So actually for different levels, if you consider off one of those levels. So when you have so one setting was that the noise reduction and directionality was off, then there were settings of low, moderate and high in the more sound intelligence screen.

So the results shown here were the measured speech and noise. So those signal to noise ratio where they were getting 50% of the speech correct, and the predicted speech and noise and the signal to noise ratio. So what you can see is that there was a very high correlation for the Japanese and the German participants. Both this was a significant correlation and very high. So when you look at this in a different way, the question was can you predict speech outcomes based on or the performance in aided speech and noise based on ACT and age and pure tone average, you can see that age actually did not have a significant impact.

It was significant, but it was very weak impact. Pure tone average was related to their performance, as it should be because audibility is an important factor. But ACT alone actually had a greater correlation with performance. Now ACT does incorporate pure tone average into this because you do need to perform the pure tone audiometry prior to ACT and it's taken into account so that you can have the audibility that you need to predict this. That's again part of the audible contrast threshold name.

The audibility is factored in. So that is something that you can see where you would absolutely expect that ACT would have higher than the pure tone average alone because it incorporates them. When you factor all of these in together, age, pure tone average and act, then you have the highest level of variance predicting what the speech performance and noise was going to be. And when we do the incorporation into the GENIE software, which I'll talk about in a little bit, we do have opportunity. Of course, pure tone average is part of the calculation.

You can add ACT into that. And age is typically put into GENIE as well and incorporated from NOAA so that you do have that information typically as well. To work with the test retest reliability was Calculated as well. And so for act, that was 0.96 dB within the same visit. And the average test time in this study was found to be 100 seconds.

So anywhere from one to three minutes is the typical time that it takes to perform the ACT test. And in this group, so we did see that ACT could help to predict performance better than the pure tone average alone, and that we could do it in this diverse group of patients, diverse languages, diverse methodologies in the clinics, and that their performance and their correlation in terms of that prediction was the same for both groups. So the third question that we wanted to understand is whether ACT could provide prescriptions that would lead to better outcomes than what the current defaults are in the Geni software for the Oticon hearing aids. Those are based off of, without additional information, you would be using basically the person's age and their pure tone average in order to have your defaults.

And so we wanted to see can we lead to better outcomes by adding ACT in to that situation.

So when you look at the prescribed level of help and noise audibility is again primarily what we've been working with. So you can, as you go down from normal to more severe hearing losses, you're going to end up with a higher level of help and noise prescribed by the default. But at the same time that does not necessarily provide you with all the information that you need. And so we also want to consider what super threshold function would look like. And so what you can see on this x axis here is as you go from normal to more severe contrast loss that was measured by act, you end up also having more help in noise that's going to be prescribed.

And so that's the idea behind how we would use this information with with the more within GENIE to prescribe the help in noise settings for more sound intelligence. So you could have a person with a mild hearing loss and having a low ACT value and then they would need a low help in noise is the assumption. However, if they had a more severe hearing loss and a severe ACT value, then you would have a more maximum type of setting. But you can also have different combinations otherwise where you might have a person with normal hearing, but they have a severe ACT contrast loss. So this would be a person where they might have that normal audiogram, but they have difficulty in noise.

And so we would prescribe more help in noise under that situation. And you can have a more severe degree of hearing loss, but less contrast loss. And so you might not need as much help in noise there either. So it's really A combination of those variables that's going to predict how Jeanne would prescribe the help in noise. But of course, we need to make sure that this is what is actually working for people.

And how much do we want to prescribe for that help in noise. As I said at the beginning, we don't want to over prescribe help in noise because that has could have a potential negative impact on sound quality. And we want to make sure that patients have access to the sounds around them. We know that

the brain works best when you have an open sound scene as much as possible, as long as you can give the brain a nice clear signal. And so if a person is able to separate out speech from background noise and do so in a more typical fashion, we don't want to restrict the sounds around them.

It's only when they have more severe difficulty that we would want to increase that help in noise setting. So we want to find out what's the minimum amount of noise reduction that we need in order to support the patient. So we had three groups of people with different X scores. We had people who had a good hearing and noise ability, moderate hearing noise ability, or poor hearing noise ability based on their ACT values. We wanted to see how the performance in noise changed when they were measured with the four different help levels.

Going back to that test setup, they were looking at again the speech and noise metric, which happened to be this ecologically validation hint testing.

So what you see here are the results of the measured SRT in noise for the three different user groups. So the first group in the left panel that was the highest performing, they had really good ACT scores. The group that had the moderate contrast level, loss in the middle and on the right side, the group with the poorest contrast level performance or the highest ACT scores. And then what you see at the very top here in this shaded area is what normal performance looks like. So if a person had normal hearing, normal ACT values, this is the area where their measured SRT in noise would be under this same testing paradigm.

So our goal is that we would want these folks who have hearing loss and difficulty in noise to be able to have the same level of performance that they would get if they had normal hearing. And so we want to see what's the lowest level of noise reduction support that is needed in order to reach that normal level. So first let me show you the group who had the good X values. You can see four different levels of help here. One in which the noise reduction was off.

Then we had a low level of support in more sound Intelligence, a medium level of support and a high level of support. As you can see, as you go from off low, medium high, you end up with better performance in noise for these three different groups. But we're looking for what's the lowest level of support that's needed to get into this normal hearing area. And so for this group that had good ACT values, the lowest setting was what allowed them to get that level of support.

Then for the group that had moderate ACT values, we actually found that the medium level of support was what would allow them to get into that normal performance range. And then for those folks that had the most severe ACT values, those even at the highest level didn't quite reach into that normal performance range. And so for them we would predict the, that we would need a high level of noise support. And in most cases we would recommend remote microphone technology in order to help them in the most challenging situations.

In looking at this group, we found that about 50% of the users would actually need a different setting than what would have been predicted by the person's pure tone average and age alone. So you could see that in half the cases we might want to go to a more higher level of help in noise or to a lower level of help in noise having the ACT value in place. So it does add substantially to the precision for which you're going to be able to fit your patient with that help setting. And so it's something that you should really be thinking about in terms of how can we make these fittings more precise, how can we make them more personalized and precision for a patient, it's not the ending point for them, but it is a place that we have at least an evidence base to start with that noise reduction above and beyond just the pure tone audiogram, which is again only telling you about threshold measures. So this is a good evidence based way to, to apply noise reduction measures.

And this is the first time we've really seen that within hearing aid fittings. So how is it working out clinically? We've had this. I'm gonna kind of just jump back here for a minute. We've had ACT values be

able to be incorporated into the GENIE software for the Polaris R instruments and forward.

So this is OTICON real and and beyond. So getting into Oticon intent as well. And now that we've had it in the software, we have had a chance to have it in the field and have people testing it out. So we want to see what that looks like in terms of clinical feasibility. Now that people are starting to Use it.

What have their results been? So there are a few things we want to understand for something to be adopted in clinic. What properties should any new clinical test have? So we looked at five different areas and used an anonymized online survey for five different categories. The first is about usability of act.

The second is, is there clinical value in act? Is there counseling value in actual, is there value in fitting the hearing aids? And what's the overall recommendation from the clinician in using ACT?

These were completed. These surveys were completed by 30 hearing care professionals from Demott Clinics that were operating in the UK, Ireland and Portugal. So again, different countries, different languages and different clinical flows. The clinicians had different levels of clinical clinical experience, but all of them were thoroughly trained in the theory and practical aspects of the ACT test. Prior to beginning the study, they were incorporated into the clinical batteries of these specific clinics and nearly 3,000 clients were tested with ACT.

So approximately, on average it was about 100 patients per hearing care professional. So they had pretty significant experience using ACT in the clinic. Again, this was an anonymous online survey and so they had an 11 point Likert scale. 0 to 3 was disagree, 4 to 6 was neutral and 7 to 10 was agree with their the statements that they were asked to rate against.

So with the usability of ACT there were several different areas that were evaluated. The first was is it easy to administer? And There was a 77% agreement from the clinicians for the statement. There were 93% who agreed with the statement that it is easy to integrate into the clinical routine, 77% agreement, easy to explain instructions, 100% agreement for understandable implementation or how they were going to use it in their clinic flow and 80% agreement in feelings of confidence. So you can see that here this was actually a usability that we found that people were able to use it clinically fairly well.

This is then consistent with what we saw with the Henry Ford study where it was deemed to be quite easy to use clinically. And you can see that it was able to be administered effectively in most of these conditions as well.

Next we went to the clinical value of act. And so the ratings here were whether or not it was a clinically relevant tool. We had 84% agreement, 74% agreed that it helped to characterize hearing and noise ability more precisely. And so that gave them a lot of confidence in identifying which patients are more challenged hearing and noise, and so then knowing what to do with those patients. And 70% agreement with confidence in identifying clients who had challenges in noise.

And again, this is what we found from the Henry Ford study, that we had a greater ability to identify clients who had difficulty compared to just doing the pure tone audiogram or their speech recognition and quiet.

In terms of counseling value, 89% agreed that it improved communication with clients and their loved ones about hearing challenges. 85% agree that it gave more confidence in recommending hearing aid technology. And then 70% agreed that it gave more confidence that customers would return for their fitting appointments. And so this is an area where there's a lot of questions that I've seen as we've talked about this over the past few years, where people said, well, you know, is it going to be as beneficial as doing speech and noise testing? Because again, speech and noise testing has a lot of

very straightforward face validity for patients.

They hear speech in noise and they understand that that's what's being evaluated. Here you've got the spectrotemporal modulation signal. It's not speech, it's speech like. And so the question is that a lot of people have is, can eye counsel effectively using this? And this is what we did find, that there was substantial agreement that once they had the, the test score available to them, the clinicians were able to effectively use it to counsel patients.

And then what you could also see is that you could also potentially use the genie fitting screen and understand how ACT is directing that fitting screen and directing the noise reduction settings where you could then also see where you could have some counseling value there for the hearing aid fitting value. It definitely improved confidence to help fit the help in noise settings. Again, we have never really, as a profession had any solid evidence base for, here's how you go in and make changes in the fitting software for your help and noise settings. And so it's not surprising that there was such high agreement with the statement that this would give additional confidence, because now we have an evidence base for this. 89% agreed that it provided confidence in the hearing aid first fit.

And as I said, this is meant to be a more precise first fit as a starting place. It's not the end point necessarily for those hearing and noise settings, but it gives a much better, more informed start. And then 78% agreement that you would receive fewer complaints related to help and noise. And this is sort of the ideal outcome that we're looking for here, is that patients are experiencing the benefits that we would like. And so to see that patients are not having or that the clinicians are reporting that patients are not having as many challenges to where they need help in noise adjustments I think is a really strong statement here.

And then 74% were in agreement that there were fewer help in noise related adjustments that were needed, which of course goes along with the previous one about relative complaints. So being able to

more accurately predict what patients are going to need. And then clinicians noticing that patients were experiencing the benefits of that was a really positive outcome. They then asked questions about how likely would you be to recommend ACT to other clinicians? And we had an 89% agreement that they would recommend ACT to clinicians.

There were some neutral responses and of 11% and then there were none that disagreed with this. And another was the next question was ACT makes me stand out. Compared to standard clinical practice agreements, then in the range of 88% neutral was 12% and then there was zero in terms of disagreement. So we did see that people were very optimistic and positive overall about using ACT in their clinical fitting flow, both from a diagnostic perspective with the Henry Ford group and then in this group of clinicians that were using it both for diagnostic and treatment purposes here. And so it's something to consider about potentially implementing this in your clinical practice.

It's as I said, a newer test, but we are starting to see some really good clinical results coming in. We will continue to be implementing it in the Oticon fitting software and updating those prescription for the new products that are out there. So we're hopeful that this will give more confidence and just a better evidence base for how we go about fitting patients above and beyond just the pure tone audiogram. From the fitting perspective, we all know that we need to be thinking about that super threshold function. But now having the evidence base to support it and having a language independent, fast, easy to use and implement clinical tool to get us to that evidence and get us that personalized fitting for patients is really what we're hoping to do.

So we are will continue to share evidence as we collect new data in the future. But we hope that this will give you some confidence of the clinical feasibility and how you might use ACT in your clinical practice and with your hearing aid fittings as well. So with that I just want to share our reference slide. There are many publications on act. We also have white papers and we'll be able to share that with you as well.

And please don't hesitate to reach out to your E3 representatives, Interacoustics, Medrecs, GSI or Oticon if you have questions about actual. And with that I just want to thank you for your time and attention.