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Gaining an Edge With Edge Mode+: The Research Behind the Clinical Benefits of an On-Demand-Hearing Aid Feature in Genesis AI

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Hi, my name is Michelle Hicks and I'm the vice president of education and audiology here at Starkey, and I'm excited to be talking to you here today about some really fun new research coming out of Starkey, talking about one of our new features. So I will be explaining today about gaining an edge with edge mode, the research behind the clinical benefits of this new on demand hearing aid feature. Now, before I get started, I do want to cover a few housekeeping notes. If you have any questions, be sure to use the Q and A feature on your screen. Also, take advantage of the resources tab.

There's a course handout for you there to follow along. And of course if you need the closed captions, just click show captions on the screen as well. For those of you earning CEUs after the webinar, just go to your pending courses and be sure to pass the multiple choice exam. So if you have any assistance or you need any technical support, just use the customer service audiologyonline.com dot so let's begin.

So what we'll expect to learn here today, we have three learning outcomes. At the end of this course, you're going to be able to describe one of the research outcomes that demonstrates how hearing aids can actually contribute to reducing listening effort. We'll have two evidence based patient benefits of using this feature, this edge mode feature and of course we also have three patient demographics that we've identified that demonstrate those that show greater benefit with edge mode. So this edge mode feature is a feature that is on our Genesis AI product family. It is a fully featured product family.

It consists of both standard and custom products and we have both rechargeable as well as zinc air product styles. Now, the majority of the family uses 2.4 GHz technology that allows them to work with all of those wireless accessories as well as our mobile application as well as it allows it to stream from mobile devices.

So specifically, all of those 2.4 GHz styles in the technology tiers are compatible with iOS and Android devices. In this, my Starkey mobile application, you're able to use that to control the hearing aids as

well as access a really wide variety of hearing aid features. This is just a brief overview of some of those features that you can find in the My Starkey mobile application. We have features that relate specifically to helping you hear better. We have some that are health features that are really unique and exciting to Starkey.

Things like being able to track your activity, have fall detection and some fun intelligent features as well. With a voice assistant, access to telehear and other features today, specifically, I'm going to be talking about one of those features that really help with better hearing, and that is our edge mode plus feature. This is an on demand feature that's developed to provide additional control to the patient just when they need to use it.

So Edge mode Plus, it was developed as an on demand feature. It's available directly from the home screen right on that mobile application as a way to provide additional assistance in challenging environments just when the patient needs it. So specifically, once the feature is selected by the patient, it allows the patient to identify their specific listening intent. It might be to enhance speech, or it might be to reduce noise, and that by doing so, it actually optimizes the hearing aid features for some preferred patient outcomes.

Now, why is a feature like edge mode important? Well, we know that listening in difficult environments remains a challenge for hearing aid users. These are results from the market Track 2022 survey. This was conducted by the Hearing Industries association, and it was taken on over 1000 hearing aid owners. And some of the things I want to highlight here are some of the satisfaction levels with different listening situations.

And while this isn't an exhaustive list of all the listening situations, I want to highlight just a few. We see at the top that satisfaction can be very high for hearing aid users. And that's a great thing for us. We see that patients are happy with one on one conversations and workplace environments, small group

conversations. And even in the very difficult situations, we see large group conversations, conversation and noise, you know, in the 70% satisfaction range.

And while that's a very high level, one of the things to think about, that means it's still about one in four individuals are still saying they're not satisfied in those environments, suggesting they may still need a little bit more assistance than what their current hearing aids are able to provide.

Also from this same survey, we grouped several aspects of amplification characteristics, and where we see that a large majority of the owners, specifically those who got their hearing aids in the last five years. So this was that subgroup. We see that about 85% of individuals are saying that they're satisfied with the physical aspects of their hearing aids. Fit, comfort, size, the appearance and reliability. For example, we also see a fairly high satisfaction rate, 81% of patients satisfied with the sound quality of their hearing aids.

So things related to noise reduction, naturalness, feedback, all of those elements that really drive sound quality. But when we pull out specifically the attribute of noise reduction capabilities, that is one of the areas where they're least satisfied, only about 77%. So again, while a strong majority. It still does indicate that it's about one in four individuals that are still not satisfied with the noise reduction capabilities of their hearing aids.

Now, if we think about the evolution of hearing aids, when patients first had that ability to manually select on their hearing aids, switch between omni and directional microphones to where we are today with machine learning, you know, hearing aids have really come a long way. And in fact, most modern hearing aids today, they use an acoustic environmental classification feature to identify and then classify the current listening environment, and then automatically apply some environment specific changes, potentially to the gain, to microphone settings, to compression, and even to noise reduction settings. Now, the issue when hearing aid developers are developing these algorithms, we really have

to think about how do we make the majority of the patients happy the majority of the time. So again, thinking, if we can make 90% of the people happy 90% of the time, we've probably hit a really good target. But what about the other individuals?

Because if we think about the environment and making average changes, how is it that the classifier knows what the listener actually wants to hear? So we're making some decisions automatically, but a given listener may actually want something different than those automatic changes. And that's where a feature like edge mode comes into play. And that's what makes edge mode so unique, is that when it's activated by the user, the hearing aid classifies the listening environment, and it will apply very specialized changes to the hearing aid features that goes beyond what's available in the default hearing aid settings. And it's also based upon the listener's intent.

Now, these classification and adaptation schemes that are used in edge mode, they were derived via machine learning algorithms and using a deep neural network accelerator engine. These models, they were trained on a very large number of real life sound recordings. And then they were further refined using input from clinicians as well as listeners about what changes they would want in the hearing aid based upon those specific intents.

Now, to evaluate the benefit that a patient gets from edge mode, we designed three very specific studies. So we'll talk about each of those studies here over the next few minutes. First, we have study one, which is looking specifically at the benefits of edge mode on speech, understanding and noise.

So the way this study was designed is we had twelve experienced hearing aid users. They were split almost equally. We had five females, seven males, and they ranged in age from 42 to 84 years. So again, with a mean age of 71 years, it's a really good representative sample of our hearing aid population. All the hearing aid fittings were with starkey Genesis AI 24 RIC devices, and they were fit with audiometrically appropriate coupling.

It might be open or occluded or ear molds, whatever was appropriate for their hearing loss, and all were fit. Using estat 2.0 fitting formula for the speech understanding and noise task, we tested them with two conditions. First was the default hearing aid processing. So this is just the out of the box default setting in the personal memory when you were to program the hearing aids. The second condition we tested was with edge mode activated with the enhanced speech intent activated.

We used IEEE sentences as the speech material, and for each individual, they were presented at an individualized level that achieves approximately 70% speech understanding in that default hearing aid processing. The reason we did this individualized level is we did want to make sure that nobody was at ceiling or floor effects during the testing. The noise was a recording of restaurant noise at 63 decibels.

These are the results from that speech standing task. So what we saw was that the results, in terms of percent correct for those two conditions, and the results, as you see here, they were converted to rationalized arcsine units for analysis. What we saw is that these edge mode, it resulted in significantly better speech recognition and noise than the default hearing aid settings. You see an improvement there of about eleven percentage points.

So after demonstrating that, in fact it does improve speech recognition, we wanted to see if there were additional benefits as well. So in study two, this was designed to look to see whether or not edge mode plus also resulted in better listening effort. So in this study, we increased our sample size to 20 experienced hearing aid users, again thinking there might be a little bit more variability. With tests that look at listening effort, we had about five females, 15 males, and again, a wide range from 42 to 84 years, again, representative of our hearing aid sample. In general, the hearing aid fittings were exactly as they were in study one, which again, Genesis AI 24 RIC devices fit with audiometrically appropriate coupling.

And again using our proprietary estat 2.0 fitting formula.

As in study one, we were focused on two specific conditions. Again, the default hearing aid processing condition, and then the edge mode enhanced speech condition. So no changes there from experiment one. Then, the task here was something known as the adaptive categorical listening effort scale, or the acoustic test. In this case, the speech is the english matrix test, and it's presented in a background noise of modulated noise.

It's the ICRA 250 sample of modulated noise. The way this test works is as the individual listens to the speech sample, they're asked to rate their listening effort across a wide range of signal to noise ratios, where the noise level is fixed and the speech level is varied to achieve all these different signal to noise ratios. And then the results are plotted as a curve showing the rating effort as a function of these signal to noise ratios. When you're comparing outcomes across two different conditions, as you see on that example data slide there on the right hand side, inspecting how the curve shifts along that SNR axis allows you to interpret whether or not there's been a change in listening effort. I so a shift leftwards indicates that the condition allowed for improved or reduced listening effort.

So, in other words, the listener's ratings changed such that listening to speech in more difficult environments has actually become easier or less effortful.

Now, compared to the default settings, the average signal to noise ratio benefit with edge mode was just over about one decibels, indicating that edge mode can in fact, on average, improve or reduce listening effort. Now, this was a statistically significant difference. Now, individually, however, what became very interesting is that we were seeing wide variety of performance on this specific test, and I've put two on the screen here that really exemplifies these differences. What you could see at the top of the screen is the fact that these two individuals have approximately very similar audiograms, but performed very differently on the listening effort task. If you look, for example, at participant two, we see

that over the entire range of signal to noise ratios, that curve shifted leftward, indicating that at all conditions, this particular participant found that using edge mode reduced listening effort, again across all the different signal to noise ratios.

Participant one, on the other hand, we see that leftward shift only at the more difficult signal to noise ratios, indicating that as an on demand feature, then edge mode plus can really provide significant benefit for those patients that need additional assistance in these different environments. So in the case of participant one, they may find that they can use edge mode in lots of different situations. Participant one, on the other hand, may just choose to use it in the most challenging situations.

So after seeing those results there, where we were seeing different individuals, even with similar audiograms, have different results of listening effort, we really wanted to delve more into those individual differences to see if we could see what it was about those types of patients that would suggest who might benefit more than others using a feature like edge mode.

So in this particular study, we had 20 additional 20 hearing impaired users. They were all experienced hearing aid users. We had ten females, ten males. Same fittings as before. The starkey genesis AI hearing aids fit with appropriate coupling and with estat 2.0 fitting formula.

Now, during this study, we were testing a large number of demographics about these patients, and I've identified just a few of them there on the right hand screen. So we have their age. We're looking at, again, a range of individuals. We're looking at their hearing losses. So we've got their four frequency pure tone average that we're collecting for each patient.

And we're also collecting some questionnaire data, specifically the revised hearing handicap inventory, as well as other demographics for these patients.

So, to look at these individual differences across patients, again, focusing on the same two conditions we've been looking at all along, the default hearing aid processing and then the edge mode enhanced condition. In this study, we actually have three different outcome measures. So, in the first one, we're repeating the study from study one where we're looking at speech understanding and noise, again, those IEEE sentences and the restaurant babel noise. Outcome measure two was the perceived task demand. This is a subjective effort rating scale.

It's based on the NASA task load index, and it uses a rating scale that when you ask somebody, you say, how mentally demanding was the speech task? And they give it a rating from zero representing not at all, to 100 representing extremely demanding. So it's just a subjective rating scale. Outcome measure three was vocal reaction time. Now, vocal reaction time, it's a behavioral or listening effort speech processing measurement, where faster participant responses to the stimuli may indicate less cognitive effort is used to complete the speech processing.

So, in this case, as the person repeats back the sentence after the test offline, we actually measure the time from when the sentence ended to when the person started to repeat back what they heard of. So, again, a longer delay there would indicate they're taking longer to process or they're using more cognitive resources to decide what the correct answer is.

So, before I show the individual responses, I will show the average responses first, because what you see here, for all the different outcome measures, we did see a benefit of edge mode over the default listening conditions. So we did see that the speech scores were significantly improved when using edge mode. We also saw that the vocal reaction time significantly decreased when we were using edge mode for the perceived test demand, while it did decrease with edge mode. That is the one condition that wasn't significant. But you do see the trend going in the direction we expected, and it's possible, with just a few more individuals added to the, to the data, what that change might have ended up being

significant.

So, again, positive data here for each of the three outcome measures. So this is the average data. Now, let's think about the individual data, since that is what we're trying to delve into here with this experiment. So, how do these three outcome measures relate to one another for each of the participants? So, in this case, the three measures were mapped onto each other using this color coded grid that you see here on the screen, the x axis that plots the change in speech scores relative the speech scores with edge mode relative to the default hearing aid settings.

So, moving to the right is an indication of improvement with edge mode. And along the y axis, that's the change in vocal reaction time with edge mode, where negative changes indicate faster responses with edge mode. So, again, that's the indication where we're seeing a possible freeing up of cognitive resources. And then the colors indicate the change in the perceived task demand, with blue indicating a reduced task demand when using edge mode. So, how do we interpret these results here?

So, in the quadrant that you see highlighted there, that results in that quadrant would indicate no benefit. So this would be an area where there would have been reduced speech recognition with edge mode, as well as increased effort. So less speech understood with more cognitive resources, and that would really be a poor result. And we really don't see any participants falling into that quadrant. In the quadrant identified here, this would also indicate no benefit.

So, in here, again, reduced speech recognition, so less speech understood, but with fewer cognitive resources used, this would also indicate a poor result, kind of an indication that the person may have just been giving up or not fully engaged with the task. We did see about two participants fall into that category. Two of the 20, about 10% of the patients fell there. So, again, it might have just been so challenging, they just sort of disengaged from the task.

And the quadrant highlighted here, this would be an indication of mixed benefit. So we are seeing more speech is understood, but we also see more cognitive resources being used. So they are getting more right, but they may be having to work a little bit harder. So that's why we indicate that it's a mixed benefit. And about five of the 20 or 25% of the participants fell within this quadrant.

And then in the bottom right quadrant, this is where we see the best benefit of edge mode, where we're seeing not only improved speech recognition performance, but also reduced listening effort. So, again, more speech is being understood with fewer cognitive resources needing to be used as well. And there were about eleven of 20 participants that fell here, or about 55% of the individuals. We also saw, if you notice on the lines themselves, along the boundaries of those, we did have two people fall right there on the line and they experienced no change in speech understanding, but did have a decrease in listening effort. So again, that could be seen as a benefit as well.

So again, they're still understanding the same amount, but they didn't have to work quite as hard.

Now then we assessed, we took all of that data and we compared it to the patient demographics that we had collected to see whether there were any associations with those patient demographics. And again, we looked at age, we looked at pure tone average, and we looked at that revised hearing handicap index score. We did not see any correlations with the speech or the vocal reaction time, but there were significant correlations with the change in the perceived task demand for all three of the demographic characteristics. So we saw, in fact, that age correlated with the perceived demand change. Where individuals who were older saw a little bit more benefit with edge mode, we saw that the poor ear pure tone average also correlated with perceived demand change.

So again, those with a poor hearing loss tended to see more benefit, and the revised hearing handicap also correlated with the perceived task demand.

So in summary, when we look across the results of these experiments, we see that an on demand processing feature like edge mode plus, used in very realistic environments, may be able to provide these broad benefits for both listening effort as well as speech understanding in hearing aid users. And specifically, there may be subgroups that see larger benefits than others, specifically those with greater hearing losses, older ages, as well as those with greater perceived hearing handicap. Now, these results further support, using really a multiplicity of measures when evaluating patient outcomes to really give a fuller picture of each participant's listening experience. So again, some people may see benefits with speech understanding, others may see benefits with listening effort, and some may see benefits in both domains.

I'd like to give special acknowledgements to the researchers who worked not only on this study, but on the feature itself. Special shout out to Jing Jingju, Brittany Jakel, Jumana Haryanawalla, and Kenneth Jensen, all great researchers and developers that worked on this edge mode plus feature.

If you'd like to learn more about edge mode plus, as well as any other research that we do at starkey, just visit starkeypro.com under that learning tab. The results that you see here are published in various white papers, so I encourage you, if you're interested and want to learn more of the details, to check out those white papers on the starkeypro.com website.

So I'd like to thank everyone for listening this afternoon. I've had a really great time sharing with you the exciting research coming out of Starkey specifically on the edge mode plus feature. So thank you so much.