The Devil is in the Defaults: How Various Signal Processing Strategies Influence Fine-Tuning Decisions in Older Adults

Presenters: Navid Taghvaei, AuD, ABAC, CCC-A, Brian Taylor, AuD

I want to welcome everybody. The course is titled the Devil is in the Defaults. How Different Signal Processing Strategies Influence Fine Tuning Decisions in Older Adults. I'm Brian Taylor, and with me today is my friend and colleague. I'm very pleased that he's here with us, Navid Taghvaei.

Welcome, Navid. We split this up into a couple of different sections. So I'm going to go ahead and go first and then I'm going to turn it over to Naveed, and then I'll wrap up at the very end. Just a few housekeeping slides. Melissa mentioned some of these things already.

Here are the learning outcomes. I think the most important thing to remember here is our main topic is kind of overlapping. We're going to be talking about some of the normal aging effects in the auditory systems, their implications on hearing aid selection and fitting. We'll talk a little bit about some of the first fit what I call out of the box, default settings from both Signia and Widex, how those default settings might differ. And then what I think is really probably the most clinically relevant part of this presentation, or at least the most interesting to me, is we're going to be talking about some recently published just two years ago, standards and guidelines around fitting older adults.

And and we want to kind of weave those three main topics into one coherent presentation. Here are our disclosures. I think it's important to know that both Navid and I are employed by WS Audiology. And with that, we'll kind of go ahead and jump right in. There's a couple of different analogies that I want to use about normal aging.

The first really has nothing to do with hearing and audiology, but I think it's a good story that emphasizes the impact of aging, and that is from my own, from my own time. I recently ran a 5k race, and I'm getting close. I hate to say it, but I'm getting close to 60. And running in that race a couple of weeks ago was a reminder of the effects of aging. And it kind of goes something like this.

I grew up in a small town in rural Wisconsin, raised on a farm, played a lot of sports. And in the summer after baling hay, we would go to the lake and swim. And then because I was training for football, I would run home. It was at least three miles, and this is in the mid-80s. And back in 1984, 1985, I could run those three miles pretty quickly.

Well, just two weeks ago, I ran pretty much that same route 40 years later. And it probably took me three times as long. And I don't have any chronic conditions. I'm a relatively healthy person. And it was really a reminder of the normal effects of aging and how we slow down.

And the same thing happens with the auditory system. As I'll talk about next, I want you to imagine a patient of yours in 1975. Maybe that person is 25 years old and they're socializing in their favorite gathering spot. You see a photo of it here. And in 1975, when they're a mere 25 years old, the signal to noise ratio can be quite adverse.

There can be many people talking and some of them might even have different accents. And, and even in a really challenging adverse situation like this, the 25 year old does pretty well. Let's move the clock ahead 50 years. And that same person now is 75 years old. It's 2025.

And maybe they're returned to their favorite socializing, favorite gathering spot to socialize. And maybe their hearing isn't really all that bad for 75, at least on the audiogram. But in that same gathering place, maybe the signal to noise ratio has to be a incredibly favorable plus 10 dB, maybe one talker only. And that person talks without any accent and familiar accent to our, to our patient. And this is the situation where that person starts to maybe notice communication is beginning to break down.

So it's this difference in an important socializing situation like this that really I think underscores the aging process as it relates to the auditory system. The audiogram may not change all that much. Likely our 75 year old has some high frequency hearing loss. But nevertheless, the listening situation is far more favorable if, when they're 75, for them to carry on a conversation. So that kind of, I think, is a nice analogy of normal aging.

And as you notice here, because there's two of us speaking and we have a lot to say, we're going to go an extra 15 or so minutes today. Hopefully it's worth your time. But normal aging and its implications, as we talked about some of those basic principles around from the guidelines that we're going to talk about and how they relate to the default out of the box signal processing strategies from two leading brands. So that's sort of the, the sequence of events today. And we're going to get and try to look at the devil and the defaults, defaults being the, the out of the box first fit settings of those two major brands.

Now, I've already mentioned these selection and fitting guidelines. Here's a screenshot. This was published a little over a year ago in Frontiers in Neurology. It's a pretty dense paper that go through a lot of it's fairly long. And luckily, 20Q under the Editor and leadership of Gus Mueller has broken it down into very clinically friendly components.

You can see back last year in January and February, these two 20Qs were really a nice summary of the key points of that larger paper published a year prior. So anyway, we're referencing these and I want to make sure that you know that they're available because we rely on them pretty heavily throughout this material today. Anyway, one of the, one of the key points in those papers from Wendell and colleagues is it kind of brings us back to the 1990s as we'll talk about in a second. But when I think about the 1990s, I think about things like this. You know, the two most popular shows back then was Friends and Seinfeld.

MTV was still sort of in its heyday. It was the rise of Nirvana and grunge, Tupac and Biggie, and some of these other things, including if you're into the political kinds of things, Monica and Bill. So back in the 90s, those are some popular things. If you're fitting hearing AIDS. In the 1990s, there was a lot of conversation about loudness growth and compression.

This was a very hot topic 30 years ago. Some of you might remember the I have and the viola fitting methods that were based on individual loudness growth. Some manufacturers even allowed you to do loudness growth testing. And there was this kind of debate about should we use individual loudness growth or average loudness growth settings to set our compression parameters. And of course, at the end of the 90s, because WDRC was so prevalent, the first, the end.

The first nonlinear targets from now came into existence. Gain for soft, average and loud that we still rely on and of course have been fine tuned since then. Anyway, if you're looking for a good review of some of these hot topics from 30 years ago, there's an article there from Todd Ricketts that gets into some of the detail here around loudness perception measures. But that's really. When we talk about some of these guidelines, it harkens back to a day when WDRC and loudness growth was a really hot topic.

Still an important topic, and one we probably don't talk about enough. But it was certainly getting a lot of attention back in the mid-90s. Some of the things. Now back to these fitting guidelines for older adults. Some of the things you might be surprised to know in reference to those fitting guidelines is that in them they define an older adult as someone who's age 55 or older.

So if you're in your mid-50s, you might be a little shocked to know that you're considered an older adult by their standards. Also, I think it's important to remind ourselves that if an older adult is someone who's defined as age 55 or above in 90% of the caseloads in most clinics, they would be considered an older adult. And as they mention in these guidelines, and we're going to get into some of those details in a second, some of the most complex cases are these older adults that we see so many of them. So maybe we take it for granted that it's no big deal that you're a middle aged, 50, 60 year old person, but they make the point in the guidelines that they, for some of the reasons we'll talk about, are the most complex cases you'll see in your clinic. I also want to make the point that we have some recent, relatively recent research around extended high frequency audiometry and speech and noise testing that say the effects of aging are seen as early as the third decade of life.

I see your hand is raised, Rachel, and I forgot to mention that at the end, if everybody's okay with it, we'll take the questions at the end. So one of the things that you might hear is you hear this a lot in popular culture. You know, one of the marvels maybe of modern medicine, 75 is the new 55. But through the lens of these guidelines, it's really kind of reversed. 55 is the new 75, at least the way we might think about it in the clinic as it relates to fitting hearing aids.

Let's talk a little bit more about normal aging and the auditory processing pathways. And as a reminder, again, I think all of you are familiar with this, but as a reminder, remember that the auditory system is both a bottom up and top down system working in harmony. When it's working normally, the bottom up part is the cochlea, sensing sound information and sending it through the auditory pathways to the cortex of the brain. And the top down processing, of course, is the cortex, the individual's brain, their knowledge of language, working memory to help make sense of that message. And those two things work together.

And in normal aging, both top down and bottom up processing are affected. It's also important to note that there are some important differences between auditory, the auditory and the vision system. And this is illustrated by the Windle articles. This kind of shows you on the left you see the auditory pathways, and on the right you see the visual pathways. Notice for the auditory pathways, because of its complexity, we really only see the right ear, but you see that crossover through the brainstem you see for the visual pathways, both the left and the right eye.

I think this is a nice illustration of just how much more complex the auditory pathway is relative to the vision visual system. And they make the point that maybe because the visual or the auditory system requires more energy to run, it's more susceptible to some of the effects of aging. Meaning that you might see the effects of aging in a 50 or 60 year old in the auditory system before you might see them in the visual system. So let's look a little bit more detail. There's four things that I think clinicians need to think about or consider when it comes to normal aging and the hearing and auditory processing pathways.

So these are four things that I think are all sort of interconnected that would influence the way we go about selecting and fitting hearing aids on anybody who is considered an older adult, that is age 55 and above.

@ least how it's defined by Wendell and his colleagues in those guidelines. The first thing to think about is this loss of temporal fine structure in this visual, you see the speech envelope that's represented by the red line. So we're kind of going back to your hearing science days here. And then the gray squiggly lines is the temporal fine structure, the rapid oscillations in the sound wave. And it's the temporal fine structure, which represented by the gray there, that really declines as a person ages.

And there's quite a bit of evidence from the lab of Brian Moore in the UK and a few others that would suggest that even a person that has a normal audiogram at least through 8K is probably, if they're, you know, age 55 or above, maybe even younger than that, there's a good chance that they're already dealing with some of this loss of temporal fine structure. And of course, if you think back to your hearing science days, you might remember that temporal fine structure is really important for pitch perception, localization and speech understanding and noise. So if you lost a little bit of temporal fine structure, there's a pretty good chance that you're going to have difficulty in all of those areas.

We don't have time to get into the details here, but one of the some people believe that the underlying cause of this temporal fine structure loss is this cochlear synaptopathy, the loss of synapses, you know, if you work in the VA system, you might know that veterans that are susceptible to blast injuries might be suffering from some of this. But there's also an aging effect where that connection between the inner hair cells and the cochlea or between the cochlear nerve is affected. So again, there's no reason for us to get into the, into the details of this theory, but it kind of helps us better understand what's driving this loss of temporal fine structure. So that's the first consideration. The second consideration that I think is kind of connected to that, at least that you might see clinically is extended high frequency hearing loss.

So very few clinicians actually have the equipment or conduct extended high frequency testing. But there's some literature out there that would suggest that it's a fairly prevalent condition. And you see some of those stats there on the right hand side of the slide. Of course, you start to see this extended high frequency hearing loss as early as the third decade of life. As I mentioned a few minutes ago, here on the left here you see five different age cohorts represented by the different colored lines.

And this is high frequency audiometry thresholds. Notice here what it basically says as, as a person gets older, you're going to see more extended high frequency hearing loss. And you start to see some of that represented by the red square as early as the people that are in their 20s and 30s. So again, we're starting to see these normal aging effects at a relatively young age. We also say the same when it comes to speech understanding and noise.

Here's some data that was published a couple of years ago. I believe these are some Canadian researchers that use the quicksand. And on the. You kind of see two different plots here.

Let me just kind of explain. Notice where my red arrow is there on the left. Those are all individuals that are under the age of 35. And on the right side, on the right side of the arrow, those are all individuals that are older, closer to 60. And notice we have the pure tone, the four frequency pure tone average on the x axis and then the Y axis vertically is the quicksand scores, SNR loss.

Remember, 0 is normal and 5 and 10 is when you start to see a mild and mild and a moderate amount of SNR loss as measured on the quicksand. I want to point out that everybody on the left hand side of my vertical red line has a normal pure tone audiogram normal described as 25 decibels and better. You could argue it's 20, but I'll use 25 here. And I want you to notice how many people on the quicksin have worse than a normal score, a mild or worse SNR loss. They're represented by all the people in the red box.

And I especially want to cue you into the people that are, I'm pointing to with my yellow line because those are all older individuals that essentially have a normal audiogram or near normal audiogram through 8000, but they have some speech understanding difficulty. And I don't know the exact percentage there, but there are a whole lot of open squares down there in that quadrant that I'm pointing to with my yellow cursor. So my point is with the quicksand, you can start to see how many people that have normal audiograms are having difficulty as a result of these normal aging effects. So that's sort of some, that's kind of a summary, three points around, bottom up processing. But also remember, there's another component that works together with it harmoniously, top down.

And it's important to at least acknowledge some of the age related changes that affect cognition. So here you see a schematic that looks at all of the different domains related to cognitive ability or general intelligence. And we won't get into the details here, but as you know, it's a very complex topic. There's many different broad domains represented by those gray squares in the center of the, of the, of the slide. But the ones that are designated with my red boxes are the ones that are impacted the most by age related changes to the auditory system.

So things like processing speed, working memory, retrieval, fluency, all of those are components of cognition that are influenced or affected by normal aging in the auditory system. And Wendell and his colleagues have this really, I think, interesting and helpful schematic that kind of shows some of the age related changes in cognitive abilities. And my red arrow here pointing downward is showing you the inflection point where age related changes really start to become apparent. And that's at about age 20 or 25, believe it or not. But notice we have crystallized intelligence, we have fluid intelligence, which is really episodic memory, processing speed, those kinds of things.

And notice the inflection point and it going downward, it starts to become, you start to notice a decline, albeit slowly, in fluid intelligence when you're in your 20s. Whereas crystallized intelligence, your knowledge of language, your accumulation of skills and knowledge, those kinds of things actually continues to ascend as you get older. And traditional intelligence, as far as how it might be assessed in, you know, in a medical practice that say, notice that that's represented or kind of the average between crystallized and fluid intelligence. So now hopefully you start to see the impact that age related changes might have on top down processing or cognition. So here are some things to think about as we kind of move away from this general idea here.

Some things to think about with respect to normal aging, that it occurs at a much younger age than many clinicians appreciate. If you look at those high frequency audiometry studies, you start to see a decline when a person's in their 20s and 30s. You start to see some decline in 30s when a person is in their 30s and 40s on the quicksand. And of course you won't see these age related declines if you're just doing conventional pure tone testing through 8K or, or single word testing in quiet. So those are some things that you might want to consider doing if you want to better or more maybe carefully assess some of these normal aging effects.

But regardless of your stance on doing or conducting those tests in your clinic, I think it's safe to assume that all individuals age 55 and above have experienced at least some normal aging effects. And that's something to think about when you're fitting and selecting hearing aids from then. And that's where those guidelines really come into play. So again, we're going to now move from looking at normal aging and the impact it has on the auditory system into how you might apply what we know about these normal aging changes to the selection and fitting of hearing aids. So now we'll get into some of the details of these selection and fitting guidelines.

And again, there's a screenshot of this article that was published back in June of 2023. I think probably the most important point that the authors make in those guidelines is that aging creates internal distortion to the signal. So mainly that loss of temporal fine structure creates internal distortion in the auditory system. That's the underlying problem. And they make a pretty strong case that when you fit hearing aids, you're actually adding more distortion to an already distorted system.

And so when you fit hearing aids, it's really important to minimize as much as you can all of the effects of distortion. Because of course, if you're over stimulating the speech envelope represented by the red, if you're overstimulating it with amplification, you can actually cause additional distortion. They also talk about cross modulation, which we won't get into, but I'll just take a quote here at the bottom. My final bullet point, which I think is really important. Almost everything we do in programming hearing aids introduces distortion with One exception and that is improving the signal to noise ratio with directionality.

So one of the key points here is minimize distortion and do whatever you can to improve the signal to noise ratio for the listener. And of course the best way to do that these days is with four microphone arrays, bilateral adaptive beamforming. So I'm going to turn it over to Naveed in a few minutes here, but I wanted to kind of get the ball rolling talking about four principles from those guidelines. So at the, at the center here you see all about trying to minimize distortion that you might impose into the system when you fit hearing aids. So the key point is minimize distortion.

And there's four principles represented by some, some abbreviations here that we'll get into that you can, you need to be aware of when you fit hearing aids to minimize distortion. So I'm going to introduce you to these four principles and then we're going to talk about, and I'm going to turn it over to Naveed and he's going to talk about the default modes and how they might address these principles. So the first one, Envelope speech envelope. Older adults will generally be more dependent than younger adults on the speech envelope for speech perception. They rely less on temporal fine structure.

Therefore they're more dependent on the speech envelope. And we want to make sure that we don't distort that speech envelope by creating more problems when we fit hearing aids. That's the first principle. Maintain the integrity of the speech envelope. Second principle is all about improving the signal to noise ratio.

Subpar speech understanding and noise performance with age indicates a need to improve the signal to noise ratio with directionality. Directionality is and remains our best tool at helping a person understand speech and noise. Regardless of all of the cool AI based noise reduction features you see out there, which do I think tend to create some undue distortion, we're less likely to create distortion with a well functioning directional microphone system. Principle number three, listening effort. There is a risk that hearing aid processing might increase listening effort from that unnecessary distortion.

And hearing aids should be when we want to keep in mind that when we fit hearing aids, we're trying to minimize cognitive load, loudness, discomfort and other perceptual sound difficulties. And we also have to be cognizant of the fact that some advanced hearing aid features, namely frequency lowering, but also you could argue feedback reduction systems, they could potentially distort the signals in ways in a way that makes speech intelligibility even more difficult. Then finally, principle number four, which we're not going to really have Time to talk about today. And I think you see this maybe occasionally in the clinic, and that is binaural interference. Some older adults are susceptible to binaural interference.

Those are individuals that maybe do better with one hearing aid than with two. And something that we need to be aware of, but we don't really have time to talk about it much today. So that's where we can now get into this whole concept of the default out of the box settings. How do our various manufacturers out of the box in first fit mode, how do they align with some of these fitting guidelines and principles that come out of the Windell guidelines? So remember, we're going to talk in a little bit more detail now about three of the four principles.

The first one, of course, remember, is envelope distortion and making sure that we keep maintain the integrity of the speech envelope. Because remember, as you get older, you're more reliant on the speech envelope because of the loss of temporal fine structure. And so in this situation, what the audiologist really needs to do is to make sure that the compression parameters in particular ratio and speed or release times are in alignment with the guidelines. So I'm going to turn it again before I turn it over to Naveed, just to remind everybody about some of the compression basics. We've had WDRC Wide Dynamic Range Compression and hearing Aids now for since the 90s when it was a hot topic.

And remember, the whole idea behind this is to place the residual dynamic range of the range of the individual to place the sounds of the environment into their residual dynamic range. And that's represented by the top schematic in blue. You have the input level sounds in the environment, a wide range of them, trying to squeeze them into the individual's restricted dynamic range, usually restricted on the bottom end because of loss of sensitivity and of course wide dynamic range compression. I'll cue you to the bottom schematic. There is there to do the repackaging and provide more gain for soft sounds and less gain for louder sounds and basically mimic or make up for what normal outer hair cells are no longer able to do.

So that's compression ratio and then there's compression speed. How quickly is the gain change between loud and soft sounds? And of course, remember we talk about attack time. How quickly is the gain reduced? These days all hearing aids have a pretty similar attack time, but where you see some pretty big differences is in release time.

How quickly does the gain increase again when sounds fall into the lower level. And that's represented in my top schematic. If you look at those red squares you see attack time and release time clamping down, raising back up.

And then of course, fast acting or syllabic compression aims to restore normal loudness perception. And slow acting tries to preserve the temporal structure and the short term changes in sound, particularly of the speech envelope. And you see the impact of fast acting, a fast release time and a slow release time. On my bottom schematic, you can see the input level of the speech on the left side of that schematic and then you see some of the differences between them. Fast release times tend to distort speech cues by reducing spectral contrast within the temporal gaps of the speech signal.

And that's a particular problem when the background noise is present at fairly positive signal to noise ratios. And you see there with the fast acting compression, how those spectral contrasts are kind of negated or they go away because of the fast acting compression. And that can be a real negative with the aging auditory system. So, Navid, I'm going to go ahead now and turn it over to you because you're going to take a do some comparisons of hearing aids out of the box and how they might compare to the guidelines that we've talked about. Yes, thank you.

Let me just go ahead and bring up my slide. Okay, thanks again, Brian, and pleasure to be with you all and thank you for joining us. So what we did here in terms of addressing some of the principles that Dr. Taylor mentioned is to compare these two premium brands, Signia and Widex. You can see the, if you will, model and then technology level of these RIC instruments. And these were all downward sloping losses, as you can see with the audiogram displayed there, closed acoustic couplings for both of them.

So exact same coupling. And we wanted to look at the out of the box, as Brian mentioned, default settings. So how do those default settings then compare to the guidelines that we were just learning about, which I think are very important as you consider fitting hearing aids, especially with our older adults. So this is just a screenshot from the Widex software. As you can see with the Compass GPS software here, you can just go to fine tuning and under that first program, P1, look at the gain and compression settings, Widex being slower acting, and we're looking at both the targets here and simulated aided gain for the ists signal for 55, 65 and 80 dB.

And you can see that some of the simulated aided gain are not matching necessarily with the targets. And mostly those are in the high frequencies, probably because of the inability to produce stable, you know, significant gain in indoors highs due to the hearing loss. And here we're also looking at the, you know, from top to bottom, the maximum power output MPO insertion gain for loud, average and soft sounds. They call it insertion gain normal for average here. And also the compression ratios for the low for the low targets, average and loud targets.

Very good. Now with the Connect software for Signia again under fine tuning sound and loudness and kneepoints and ratios is where you would find this if you fit it to a traditional fitting algorithm for the Signia software. So for example, in NAL and L2, in this case, you have the choice of viewing things, you know, for adjustments if you will. 1, 25, 10, 20 handles. It depends on how much detail you want to get into.

By default, syllabic is selected with adaptive compression and that uses adaptive time constants in compression channels that can improve sound quality. Dual and syllabic compression in those cases will be replaced with the proprietary compression time response. So that's previously said, you know, compression ratios and knee points that remain valid. The recommendation is to keep from the software to keep that adaptive compression enabled in those programs where adaptive directionality exists, which then assists in auto steering of directionality and also of noise reduction. Now according to the guidelines, you can add second program for slower acting compression.

So here showing dual compression scheme. Again the recommendation to keep adaptive compression enabled in those programs. But adaptive directionality, this helps in auto steering of noise reduction, auto steering of directionality. Those adaptive time constant behaviors are, you know, the time behavior of the compression system. And when it's in adaptive mode, it employs a broad range of attack and release times.

So in typical speech in quiet situations, the time constant behavior is slow. So the strategy results in very natural sound quality, enhanced speech intelligibility because it retains that general signal envelope that Brian just mentioned of running speech. But when fluctuations in the input signal then are faster, the adaptive compression also reacts more rapidly to key the signal comfortable within the dynamic range of the patient. As we, as we just discussed, we need to do, and I'd like to ask you to please keep your eyes on the ratios as I'm going through the compression knee points and ratios. You know, in hearing aid fitting, low compression knee points, low compression ratios and algorithms like NAL and L2 mean that amplification begins at softer input levels, increases gradually.

So this kind of setup enhances audibility for soft sounds without kind of over amplifying louder ones. It can be useful for users again with mild to moderate hearing loss. This kind of strategy, it may reduce speech clarity though in environments if the Background noise are amplified, so loney points are often more comfortable and natural sounding, promoting that better listening experience kind of on everyday sounds. On the downside, they may limit loudness growth management for those patients who may experience recruitment have recruitment. So as clinicians, we have to balance these settings based on the patient's dynamic range, of course, the listening preference of the patient.

At the end of the day, the implications depend on that patient's individual audiogram, their listening needs, of course, and the hearing environments in which they do their listening. Again, if you keep your eyes on the ratios, you can see different, very different ones here with the Signia software hind knee points larger ratios in algorithms like NAL NL2 mean, then amplification starts at a higher input level and increases more aggressively above the knee point. It reduces dynamic range of incoming sounds, helping to protect against loudness discomfort for those patients with reduced loudness tolerance. It can also improve comfort in noisy environments, limiting the amplification of background noise. But it may also compromise audibility of those softer speech sounds, especially in quiet settings.

Speech may also sound less natural or more distorted because of the rapid gain changes. So the settings are often used for perhaps more severe losses to profound or those that have reduced dynamic range. So careful fine tuning there is really essential to balance the audibility, the comfort and the sound quality of that particular hearing instrument. So what we wanted to have you look at talking about compression to show effective compression. This is for both the Widex and the Sigma instruments compared to each other.

And just take a look at what these mean. So an ALNL2 was used again default, right? And for 50db ISTs with using closed ears on a head simulator. So we also actually used multiple input levels. Usually we used 50 for soft, 65 for average and 80 for loud use.

The probe microphone that was placed in the ear canal measured real ear aided responses rears at each of those levels actually. And the differences then in the rears across those input levels show how the hearing aid is compressing sound. So less gain for louder inputs and more gain for softer ones. Now, as an audiologist, you can compare these measurements to the prescriptive targets, for example NAL and L2, which we used in this case to make sure the compression behavior matches the intended fitting. If the gain differences between that input are consistent with the prescription ratios, compression ratios, then the compression is considered to be effective.

So what you see here is effective compression for Signia, as you can see for 2000Hz as the input changes by 30dB. And those are indicated by the very Light gray lines, it may be hard to see, but I have my cursor on them right now. You can see as that input level changes by 30 decibels, output changes by 24. So that's at 2000 Hertz using the LTAs. And so that suggests an effective compression of the speech signal of about 0.8, also less than 1.

Here we are comparing effective compression of Widex again shows a smaller ratios actually in the software compared to the Signia software. But the actual measurement when you do the effective compression is actually the opposite of that. So I know this at 2000Hz you're looking at about 18dB for the input and then so differed by the 30db 60 to 90 that we saw, suggesting an effective compression of 1.7 in this case. And I'll just point out that if you and this, we've just used Signia and Widex in this case under WSA umbrella. But you can see there are other manufacturers and they certainly have different responses.

You're looking at OSPL 90 coupler measurements with the hearing aid set to NAL and L2. And from the box right there is different responses as we measure our electroacoustics. So that should be something again to consider what kind of physical components and the system are pushing the sound. And it certainly has an effect even on electroacoustic measurement like OSPL90. So if we were looking at the guidelines and how to, if you will implement this information in the clinic with our patients, one of the things we wanted do is first of all use slow acting compression as a default for older adults in noisy environments.

Both if you will, SIGNIA and widex align with those recommendations. And we just saw that with our little study here. Individual preferences, patient preferences vary of course. So it's helpful to offer both slow and fast compression options through separate programs. So that's a recommendation is to A secondary program with slower release times can be easily added to both SIGNIA and Widex fitting software.

And when we do use fast acting compression, the compression ratio should be kept low, ideally about 1.7 or lower as we discussed for older adults to minimize envelope distortion, as Brian so aptly talk about. And what. And while both of those support this, that real ear measurement is really necessary, right to to confirm the accuracy. Because as we saw what may show in the software isn't necessarily what's actually happening in the ear canal.

If we look at snr. The, the second principle that, that we mentioned, reduced speech understanding in noisy environments, especially with age, highlights the need to enhance the signal to noise ratio. We discussed this just briefly using directional technology, as Brian mentioned, it has been and is the most effective, perhaps some would say the only solution in terms of giving clean directional signal to the delivering to the patient. Now for us, what we need to do of course is make sure that the hearing aids directional microphones are properly configured. Directionality consistently helps snr.

We know this, we just saw some data on this. Also consider addition of a remote microphone. So I think assistive technologies unfortunately get left out, but really very effective in terms of improving SNR in these challenging listening situations. And yes, so, so then for that second principle for these acoustically challenging listening situations, improving the SNR very valuable in these difficult areas, I would opt for custom modes. In fact, custom molds are the best way to fit hearing aids.

This was something that people way smarter than me figured out a long time ago. Now we know that open fittings can diminish the effective effectiveness of directional benefit and noise reduction for that matter as well. But really open fittings do some work against us and in these kinds of situations for this particular principle, if you look at directionality defaults under Widex, you'll see the WIDEX classifier analyzes the information updates every second to select one of the 11 sound classifiers that the technology has in it as environmental classifiers to make sure that it's stable. Both hearing aids agree on the same class three consecutive seconds before it actually switches. Once that class is confirmed, then a central controller fine tunes features like compressor, the HD locator, truesound softener, you know, low level noise reduction, transient handling.

These are all things that are being controlled. And the controller then adjusts between different environments, also refines that them within a single environment to maintain that optimal listening comfort and listening condition for the patient. If we were to look at Signia, Signia uses split processing, we call it augmented focus to separate the incoming sound into focus stream so for speech and then a surrounding stream for optimizing each their each independently. For better clarity, it creates greater contrast between the speech and background noise, making speech more prominent if you will, without muting the ambient sounds. And real time conversation enhancement adds three dynamic focus streams within the frontal hemisphere, so that that's layered on top of the primary focus streams that I just mentioned.

With split processing. Each of those dynamic streams then operate in its own zone if you will. It works independently to enhance speech. You can imagine how something like this would come in handy in a cocktail party kind of situation where you have multiple conversation partners around the wearer. So the streams use binaural beam forming and binaural noise reduction to then precisely target the conversation.

The width and the direction of these streams can then adapt so in real time to follow the conversation partners within each zone. So it, it actually allows for simultaneous enhancement of multiple speakers, actually up to three in our highest level of technology and different regions for a more natural group conversation, not just having the focus towards the front.

I will. So this was how we actually measured the directionality on Earth. I will say that on ear, directional microphone testing allows for a real time assessment of microphone performance in a worn position. That's very valuable, I think, for a clinician. So during the test, the rear speaker actually can be moved.

As you move that around the head, you can locate null positions or null points of those directional responses. The setup, you know, lets you determine if the null stays stable or is it shifting as, you know, as the angle of that jamming sound changes the curve separation that I'm about to show you can also be elevated dynamically. Sometimes it's not possible to do it in a fixed test box. So test box setups use stationary speakers, as you know. And this may limit some of the assessment of directional flex in some of the latest technology that we have in the hearing instruments.

So on ear tests allow help to elevate kind of the things like venting and microphone orientation and effective directionality. And overall, I think on ear testing perhaps gives you a more accurate picture of how directional system performs in real life use. I think that's the main point there. So when we look at directionality for signia, here is a screenshot of the right and the left ears. You can see that this was done with noise in the front.

So test 1 is the front, test 1B is the back and you can see the differences. I also put down the values on the screen at the bottom of the screen so you can compare it for yourself if you wish. Certainly a significant amount of separation between those two. On the left here you can see starting at about 1000Hz to about 4 to 6. Same on the right side, just the variation in, in terms of separation based on frequency.

So that's the signal directionality. Here's the widex directionality. Again, same kind of thing. Test 1F is the front. Test 1B is the back microphone, excuse me, the back speaker response.

And so then again you can see significant separation between the front and the back pointing to effective directionality. So if we actually look at effective directionality in challenging listening environments with poor signal to noise ratio, so around 70dB split with only one or two DBSNR bilateral beamforming can actually offer up to 2Db improvement compared to unilateral beam formers.

And actually, you know, you might say, when can 2db improvement be impactful? Is that something that I can kind of shake a stick at? Well, in those really tough situations, even smaller gains in SNR can really significantly enhance speech understanding, listening comfort. Let's have a look at that, actually. So if you're looking at how directional microphone technology can impact speech understanding and noise, using performance intensity function for a single hearing aid user as an example here.

So we start with a baseline which is an omnidirectional microphone setup, gives you about a 0,0dB directional advantage. And so on the PI function curve, this is plotted as this, you know, SNR 50 point, the signal to noise ratio where the listener scores 50 point 50% correct. Okay, so that's the omni condition. Now if we switch to a directional microphone system, that gives you about a 3 DB SNR improvement score is at approximately 30%.

And with now, so that's that. And then if you add another 5dB of directional advantage, the improvement now is significant. It's, you know, about 50%, especially in these challenging acoustic settings. So while a 3D advantage may provide a meaning, you know, a meaningful improvement, an additional 2dB advantage can really be transformative. And, and this is just a reminder this slide of how as you go from an open dome to a custom to a closed custom, so on the left side you see the effect of these in terms of real ear occlusion gain.

And on the right side you see open dome at the bottom on the left side of that graph all the way to closed custom. And you can see the SNR benefit mean SNR 50. And of course the lower the score in this graph in this particular setup, the better. So custom and close fittings offering the most amount of advantage in terms of SNR benefit, which is what we know gives patients that better speech understanding. So enhancing SNR signal to noise ratio very important for challenging listening environments.

Both brands in this case offer SNR improvements, with Signia showing about a 1-2 DB advantage. Though you know, it's this benefit is lost when you're fitting to an open ear tip that are likely used in a lot of clinics, unfortunately. So to maintain that optimal performance suggesting to consider fitting custom molds and instead of open tips as open fittings can again significantly reduce directional microphone effectiveness. And if we talk about Principle 3, the listening effort we can see, you know, hearing aid can sometimes unintentionally increase listening effort. So important, it's really important to actually minimize the cognitive load, not increase it loudness, discomfort and other kind of perceptual challenges to the user.

So the recommendation here is to set the maximum power output just mpos just below the patient's loudness discomfort levels or ucls. Kind of enabling the digital noise reduction and making sure that the applied, you know, they're applied conservatively to avoid those negative effects of speech clarity. That's the main goal. So even a moderate level of noise reduction is generally recommended for most users. Maybe offering a secondary program with stronger noise reduction can benefit the wearers who prefer more of suppression in certain environments.

And always validating the noise reduction settings. And here's what you can see. This is what we did to just compare the two for you. Comparing the two Signia appears to apply stronger noise reduction in this case. At the same time Widex is more subtle in its processing.

Overall extent and approach differs slightly highlighting the importance of again matching noise reduction settings to the individual patients needs and preferences rather than, you know, relying on default. So measuring actually validating as I mentioned is important. And so measuring listening related effort in in the clinic was assessed by Dr. Taylor and I through a couple of studies. And we presented this last year, the year this year and the year prior at AAA meeting. And so we, we know that listening related fatigue is a common psychosocial consequence of hearing loss.

It negatively impacts productivity, mental health. We know social engagement is affected. Vanderbilt Fatigue SCALE the Short VERSION this is a brief 10 item version of the Vanderbilt Fatigue Scale that was used to measure fatigue levels before and after hearing aid use. We used 35 adults actually with bilateral symmetrical hearing loss. They were fitted with SIGNA hearing aids and then assessed at first fit.

First one month after the first fit and then six months. Those were the intervals. So first fit one month and six month. And we saw signal significant reductions actually in listening related fatigue as you can see with the diagram here with the graph after just one month of hearing aid use. And these improvements actually were maintained at six months.

So again statistical analysis showing meaningful changes based on from the baseline and both post fitting times one month and six, six months. No significant difference actually between one month and six. But again showing that benefit was maintained over a long period of time. Moderate correlations between the pre and post scores supporting the reliability of the fatigue reduction over time. Again the results suggest using the Vanderbilt Fatigue Scale valuable clinical tool for assessing hearing aid benefit beyond speech understanding by addressing listening effort and fatigue and how that might affect the patient.

So for the principle, the third guideline, a moderate noise reduction setting is generally recommended. And both brands typically apply conservative levels of digital noise reduction. Offering a secondary program with stronger digital noise reduction may benefit the users who prefer more suppression in specific environments. And we're going to go into some clinical nuggets with Brian that really kind of bring this home. And we can use this in the clinic.

And we always want to verify noise reduction settings with the patient to make sure that they align with the comfort and the listening needs of the patient. Of course. So with that, I'm gonna go ahead and pass it to my friend and colleague Brian, and stop sharing my screen here to go ahead. Thanks, David. Let me go ahead and share mine.

I may have to catch up here. Hold on one second.

Thanks for all the valuable information about those default differences. I think it's pretty telling and important to know that there's some pretty big differences, especially for output and gained for soft, when you compare these two brands. And given that, I mean, we have good survey data out there that says that the majority of hearing care professionals rely on first fit, and they don't make too many changes on that. You know, it's kind of important to know out of the box what those default settings might look like. So anyway, I just wanted to kind of wrap things up.

I know we're a little bit over time. I said at the beginning we're going to go probably 15 minutes over.

So I think it's important, really, the intent of this material today is to kind of use what we now know about the normally aging auditory system, what we know about those four. We only talked about three of the principles from the Windell guidelines that were published two years ago to put them kind of in the proper context clinically. So I wanted to kind of wrap things up by offering some thoughts on how you might integrate what we talked about over the last hour into your current clinical practice. And I'm doing this by just talking about five clinical nuggets. So I think the first nugget is we want to go beyond just simply matching prescribed gain targets.

Of course, it's a good idea as a first, as a starting point, to pick out your favorite validated prescription gain target and use those to match that soft, average and loud. But I think we have to think and go a little bit beyond that because, remember, one of the issues is we don't want to add any extra distortion to an already distorted system. And one way Probe Mic can help us with that is to make sure we visualize a smooth broadband response and that if we do it at multiple levels, input levels, we want to make sure that our compression ratio is 1.7 to 1 or less. And it's easy to do that just by kind of eyeballing it and making sure that it adds up. Another just beyond gain and frequency response, I think it's safe to say, based on the guidelines, that bilateral beam formers benefit all listeners regardless of the underlying compression speed.

And I want to point out a study, Varsha Rallapalli is the lead author, was published actually online in 2024 and published in Ear and Hearing a couple of months ago, that basically shows that with a directional system, it doesn't matter if it's fast or slow release times, that when the directional system is working, the improvement is pretty much the same, which kind of shows you the importance of, you know, gain within a certain spatial area that you get from a directional microphone system. So basically what that says is make sure that the directional microsystem microphone system is working properly. To Naveed's point, a closed system works better than an open system. And you can verify that easily with your probe mic equipment. And then the final point I make related to frequency response and sound quality and minimizing distortion is you can co listen with your patient.

Susan Scully a year or so ago had a really good 20Q that talked about co listening and personally I think that's a great way to make sure that the hearing aids sound good. Because if it sound good to you, if it sounds good to you, chances are it'll sound good to the patient. 2nd Clinical Nugget Navid talked about this in detail, but it's important to know the defaults of your manufacturer. You can see in the Signia and the Widex devices as an example, some pretty big differences for gain, for soft, for directionality, for output out of the box. So you want to know what those differences are because when you know the differences, then you can start deviating from them for the individual.

And of course, when you with, with your knowledge and your expertise around the software, you can make all the hearing aids kind of do the same thing. And you can see that on your, on your Probe mic system. Clinical nugget number three, because there is so much individual variability. In other words, everything can match up, up really nicely on your probe mic equipment. You can be hitting targets, you can be seeing that there's no distortion and not hearing any distortion when you co listen.

But we still know that there's going to be some individual differences as far as preference. So one way to kind of account for those individual differences would be to use self reports to gather preference data. And there are a lot of validated self reports out there, the Profile of Aided Loudness. Naveed talked about the Vanderbilt Petite Scale, even the Cozy to a certain extent. But there are many, many others.

So I would pick one or two of these report self reports and I would use them with all of your patients to kind of account for these individual differences. In preference number four, we talked about the importance of directionality, how that can kind of overcome some of the effects of software or fast and short release times per the Rallipali study. And I think the quicksand is a great way to kind of guide the counseling process when it comes to some of these aging effects. In my in my experience, if the unaided quick sense score is 7 or worse in at least one of the ears, or if that patient in your through your case histories in a lot of adverse signal to noise situations, then not only is it important to set reasonable expectations, but you're probably going to have to introduce some supplemental technology like remote microphones, speech captioning on a smartphone. But that's a great conversation to have with those patients that have, you know, higher than 7 SNR loss.

And that leads me to the fifth and final clinical nugget. And this is especially important in the world of OTC that is now kind of sitting side by side with audiology driven care. And that is lean into your counseling skills and rely on and use best practice guidelines like those Windell guidelines that we've been talking about over the last hour or so and remind your patients that it's probably more important to see a premium provider who follows clinical guidelines than it is to fit premium devices for someone that's not following those or any other published guidelines. And I want to this is a really important randomized control trial from Iowa and Vanderbilt that was published in JAMA Otolaryngology a month or so ago. It basically shows us that in person care yielded the best outcomes.

But of course, in person care really is dependent on your ability to follow these kinds of guidelines and differentiate yourself from OTC and, you know, mail order and remote kinds of care that's out there competing head to head with with best practice in person and remote care. Anyway, those are the five clinical nuggets that I wanted to share with you to kind of put what we talked about into some context. Here are the key references that you might want to Go back and look at. And if anybody has any questions, I'll take. We can take those now or you can feel free to email me or Naveed.

So with that, we'll open it up to questions.

This is in question number four, the type of release times for older adults and slower dual release time. For clarification. Navit, since you covered that in detail, I'll let you take it first. So. Yep.

So I think the point there was, if I understand the question, to ensure that, you know, usually slower release times are better for older adults because of the, you know, difficulties that they may have with high frequency, you know, hearing loss and then loss of the, if you will, temporal fine structure. And so that tends to help with that particular problem. Yeah, I think if I could add on to what Naveed said, if you can go back to the slide that I talked about. Compression basics, compression speed. There's a lower schematic that showed with fast release times you get a lot more of the spectral contrast disappear because of the way the release time is so fast you lose the peaks in the speech wave.

And that is not favorable for somebody who's older. They rely on those things more because of the loss of temporal fine structure. But as I said, I think that study from Rallapalli tells a pretty interesting story and that is in noisy places where directionality might be activated, the difference that you get in the improvement that you might get in a slower release time might be negated. So I read that Rallapalli style, I think it's a pretty important one because it tells us that directionality sort of trumps compression speed, at least in noisy places. Thank you for that.

There's one question. Can you add better ovp? I'm forced to use open domes due to major complaint of own voice. If I understand that question correctly, is it okay to run Always processing? And the answer is absolutely.

It does not affect soundscape processing. That engine only works when there is when it detects the patient's own voice. So it doesn't. And now it's in a second generation. It's very accurate in being able to detect the patient's voice versus the soundscape or a speech in the soundscape.

So, and. And you will see, you could even test it yourself after running on voice processing, your real aerated responses or speech mapping will be exactly the same.

There is another question. I thought you said that dual release time is better. Brian, what are your thoughts? I would. I think that you're good to leave it in the default mode.

I can only. I can really only speak for Signia, but I think you're safe to leave it in the default mode. I would say my opinion is Signia is on the slowish side when it comes to release time and I think the default mode is your best bet.

Thank you for that.

I don't see any others in the Q and A, but we'll wait just a minute more.

Okay.

Well, for those of you who are still on, thanks for hanging out an extra 10 or 15 minutes with us. Yeah. All right. With that, I do think we are all set to wrap. Thank you both very much for joining us today.

As I recommend, as I mentioned earlier, if you have any further questions, you're welcome to reach out to Audiology online. We can also forward any questions to Brian and Naveed if they should come in.

And again, thank you all for joining. Hey, Naveed, I'll be back in touch with you, okay? Okay.

Thank you. All right. Good to see you guys. Take care. Bye, everybody.

Bye.