Research QuickTakes Volume 4: Debunking Some Beliefs About Fitting Hearing Aids

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When is a Prescribed "Fit-to-Target" Really a "Fit-to-Target"?

- Hi everyone, and welcome to another edition of "Research Quick Takes." I'm Brian Taylor, and believe it or not, we are already on research "Quick Takes Volume IV." And in this edition of "Quick Takes," we're gonna be talking about misconceptions. And with me today as usual, is Dr. Gus Mueller,

- Absolutely

- Senior consultant for Signia. Welcome. Good to have you back, Gus. Good to see you.

- It is, it is. Well, I can't believe that we're already on Volume IV I guess, of our "Quick Takes."

- Volume IV.

- It seems like we were just on volume one yesterday, but time flies.

- Time does fly. And this is a really interesting topic, I think, we're gonna be talking about. Six different misconceptions and maybe we could talk a little bit, Gus, about where these misconceptions come from.

- Yeah, well you know, I should preface the fact that probably for all of you listening, all six of these are not a misconception. You know, we sat down and looked at what are common misconceptions and then where do the misconceptions come from. You know, I have to admit personally, Brian, I don't know about you but a lot of these misconceptions, I got from looking at the audiology social media pages where somebody says something and then they get 25 likes for saying it, and it's wrong. And so, at least I know a few of these misconceptions are floating around out there, you know, and, I mean, we all have misconceptions about various things, even outside of

audiology, but it could be because we think we learned them way back in school or we think we read them or some rep came in and told it to us.

So, therefore, it must be true. Sometimes it's just our fitting experiences, you know? There are certain things you just sort of remember, and sometimes you remember incorrectly 'cause you remember when things work out, and you tend to forget when things didn't work out. And sometimes there are just things you've always believed. My daughter and I have had this discussion a lot in the last month or two of whether poke is poke-y or po-kay and I've been calling it poke-y for 30 years, and she's telling me it's po-kay, you know? I mean, we have these things, you know.

- Never heard that one before.

- And why do I think it's poke-y? 'Cause I've always called it poke-y. I mean, I just believe it's true.

- Well, that's a good point.

- There's a lot of things in audiology like that, and so, we're gonna hit a few of 'em. One of 'em, you know, and this is interesting because in one of our other "Quick Takes," we talked about how important it is to use probe-mic and to match targets. So, this is a little odd because we're gonna almost back off a little bit because there seems to be a misconception that to match the target, you have to perfectly hit this dot on the fitting screen. I've supervised students many times where a student has come up and said, "Oh gee, I've tried really hard, but I just can't match targets." And I look at the results, and they're 3 to 4 dB below the dot. The point of what we're gonna talk about in this little segment is that it's not a dot. So Brian, you've matched a lot of dots in your days, haven't you?

- I sure have. And I think this is a really good one to start our series off with because, speaking for myself, I know it's really easy to think that it's important to be precise about matching that target. And I can think of myself, you know, spending many minutes trying to get it exactly right. So, I'm curious to know what you have to say about this topic.

- Yeah. Well, let's just start with the basics. Now, perhaps some of you out there watching or listening to this have never done probe-mic measures, but I'm guessing most of you have what we have are validated prescriptive targets and these are those little crosses on the screen that you see. And the goal end is for soft, average, and loud, which is green, pink and blue respectively, for us to get the output to match those. No one would argue that this is not a fantastic match. So much so that you take a picture of it and use it in a talk 'cause it doesn't happen very often.

- Exactly.

- This is a little more- well, I say it's also easy to decide 'cause I think we'd all agree this is not a good match for target, particularly at soft, which is the pink on the bottom. Notice that the output of the hearing aid at some frequencies is almost 20 dB below. So, those are the easy ones. When it's not a match and when it is a match. But then we get something like this. Is that a match to target, or isn't that a match to target? Are you done doing programming, or do you need to continue to do more? And that's the point that we'd like to make. To make this point, it's important to go back to all the research that was done with the the NAL-NL1.

As most of you know, that was out for about 12 years before NL2 come out. And during those 12 years, the people who developed the NAL weren't just sitting around but they were collecting data to see how good NL1 was. What you see on this chart is from, I believe it's about 190 different ears. And this is preferred listening level,

preferred listening level, and they compare it to NL1. I made a simpler chart of this that I want to go to, and that is this chart here. So, the zero line on here would be a perfect match to NL1. The red vertical bars are the range that they saw. And what you see is the range is fairly similar based on the pure-tone averages, it doesn't vary too much, for all the different groups.

And what you'd want is that zero line to be right in the middle of the range. It isn't, which is why for NL2, they lowered everything by 3 dB, and I drew in a dotted line there where NL2 is, and you notice NL2 is now in the middle of the range, okay? The key word here is "range," and that is what is the general range that we want to be. Most people have considered that if you're plus or minus 5, plus or minus 5, you are okay, and not only okay, that's a match. Because that's just the variability of the people of how their preferred loudness level is. And just in case there's one or two football fans out there, in fact you don't have to know an awful lot about football to understand this point.

And that is when somebody is kicking a field goal, they too have a range. Think of that range between the goalpost as being 10 db, I actually think it's 16 1/2 feet or something like that, but for right now think of it as 10 db. So, we're gonna keep score here. So, what happens if the kicker kicks it right through the middle? That's hitting the dot, right? How many points does the kicker get? Three. What if it sort of veers off to the right but still goes through the goalpost? Does he only get one point? No, he still gets three points. What if it bounces off the side of the goalpost and still goes through? How many points for that?

Three points. The reason is the target is the range, it's not the exact center. The exact same thing when you're fitting hearing aids, it's a range because we don't know the exact preferred loudness level of one given listener. Here's what we do know though. We do know from the NL2 data that one standard deviation was about 5 db. So, that's

very reasonable then to be plus or minus 5, that gets us in that 10 dB range. There's also earlier research with the NAL that showed that benefit and satisfaction did not change until the RMS error was greater than- well, greater than 5 until it reached 6 dB. So that, again, supports the 5 dB issue. And then Robyn Cox, did some research a few years back where she found that differences among prescriptions were preserved as long as the RMS error was 5 dB or less. So, not only are we reasonable, but there are data to support this. You're okay with this, Brian?

- I am. I guess one thing that we probably need to tackle is what we mean by RMS. And I think you're probably gonna get to that.

- Oh yeah, good point. Yeah, yeah, I did put in a slide on that. RMS is "root mean square" which is almost the same as the absolute average of the misses, but not quite, not the misses, but the mistakes, not misses or miss or misses. Okay, so here we go. In a perfect world, all of our fittings would look like this. And remember now, we have this window, plus or minus 5. The little vertical bars on here in green are 3 dB. So, just to help you out with this drawing here, this is within the 10 dB window. This is a fit to target. You wouldn't say, "Oh gee, I'm under target." No, you'd say, "I fit to target. It is within the range." Okay?

But then you could have this. It's a little unusual. I don't think this would happen too often, but I wanted to make the point that you can be within 5 dB, which this is for each key frequency, but this isn't a very good fitting because to make those low frequencies softer, we're gonna make the mid frequencies way too soft to pump up gain around 1k where it's below, you're gonna get way too much gain up at 4k. So, this still needs help even though it does meet the plus or minus pump. So, you still have to think a little bit. Now, some probe-mic systems help you out with the thinking. This happens to be from the Verifit, and could be that other systems do the same thing.

They provide a little chart for you. Again, their vertical bars are 3 dB, so I drew a line at 5 dB 'cause that's what we're going to use. And so, on this particular scale then, you very easily could see when you're within 3 or when you're within 5 dB of target. You notice here that you have some work to do out in the 3k to 8k region, but overall it's not a bad fit. Now we're back to the RMS error. And again, some of your prob-mic equipment will calculate this for you. And again, as I said before, you want the RMS error to be 5 dB or less. So, in this particular case, they've calculated it for 5, 1, 2, and 4, all equally weighted. And you see the RMS error is 4.1 dB. Now, at least on some prob-mic equipment, you can customize this.

So, you can put in whatever frequencies you want. If you say, "Well, I've been missing target a lot at 1500, I'm gonna add 1500 to the mix, I'm gonna add 3000. I don't care about 4, I'm gonna subtract 4." You can customize this however you like. But these would be four key frequencies that I think would work quite well. And again, you still have to think a little bit, and here's what Brian's been waiting for, for those of you out there. There's the formula for calculating. You basically take the square of each number and then you take the square root of their sum. So, the point here is, doing that formula, you end up with an RMS error 5.3 but it's still not a very good fit. I'm not gonna let somebody walk out the door with that mismatch to target number in the high frequencies at 4k. So, you still have to think. Is that good enough, Brian?

- No, that's a good explanation. I think it's a good example of how you might be close with the RMS, but you still have to look at the overall curve to see where there's some obvious problems.

- It's a good general guideline. And there's one very large company in the US that rhymes with Costco that uses RMS error to look at the goodness of their fitting. And I'm guessing their fitters might be graded on how good their RMS error is, which it's okay with me.

- Yeah, that's a good

- Better than not grading them

- [Brian] standard.

- at all.

- [Brian] Exactly.

- And SII, we've talked about the SII before, but the SII is also a tool that helps you determine if you have a good fitting. And again, some probe-mic equipment gives you guidance for this. Here's just an example you see for soft speech for this particular patient. Their SII is 64, and they put in the lower and upper limits, which would be considered a good fitting. And of course, it looks like you're in good shape for this particular patient. So, there are some other ways to add to the plus or minus 5, but I think it works. So, we got five more of these to go, Brian. So this is, I think, our first "Busted Misconception" and that is that the fitting target is not a dot on a screen, it's a range. You know, and I actually wish, the probe-mic equipment, I wish they didn't put the dot on there. I wish they just did a plus or minus 10 dB range. I think

- It's a little misleading.

- maybe MedRx does that. Do they?

- I'm not sure about it. I haven't used MedRx in a while. I know that Audioscan and a few others have the range.

- Yeah. Well, that was the Audioscan I showed that had the vertical bar.

- [Brian] Right.

- Most people think it's across, but it's actually the range. Plus or minus 3,

- [Brian] Right.

- we're gonna go plus or minus 5 for clinical purposes. By the way, plus or minus 5 has actually been written into some guidelines. The British Academy of Ideology for example, uses plus or minus 5 in their guidelines, and ours from the AAA, I don't think we put in exact numbers, but-

- I think the BSA one is the only one that I know of that's got the 5 dB range.

- [Gustav] Yeah.

- But yeah, I think the main point here, Gus, is that for those clinicians out there that use probe-mic. don't think about hitting the dot, think about it more as a range.

- Exactly, keeping a nice smooth frequency response is also critical to go along with that

- Exactly.

- as we pointed out. Okay, I think we did it

- All right, I think we've covered all there is to know about how close is close enough.

- All right, good. Well.

- So, see you on the next "Quick Takes."

- Yeah, next time.

- All right, bye.

Venting Considerations When Using Instant-Fit Tips and Domes

- Hello everyone, and welcome back to another edition of Research Quick Takes. I'm Brian Taylor and we are on Quick Takes volume four. And with me today as usual is Gus Mueller. Welcome, Gus.

- Hey, thank you, thank you. Moving on, on number volume four.

- Right now we're gonna talk about venting and all the things you need to know and some of the possible misconceptions around venting. And this is a really, to me, a topic that I'm really curious to hear you talk about because back in the day when I was fitting a lot of hearing aids, everybody was fitted with custom ear molds.

- Sure.

- And I think these days that's not so much the case, and I think that some of the issues around venting need to be rethought and that's why we have you here.

- Yeah, well, thanks, thanks. As we'll talk about as we go through these various so-called misconceptions, some of you might already know all this and it's not really a misconception for you. But these are things that Brian and I have just picked up from casual conversations and what we've heard people talk about. So one of 'em, in fact I'm quite certain that at least for some people this one is indeed a misconception. And that is how much venting do you really have when you're fitting your hearing aids? Now, the easy way to determine that is simply to do what's called an REOG or an REOR illustrated over on the right of the screen. You see the open ear response, the REUG.

And then you see what happens when you use an open mold, when you use the sort of closed mold, and what you use when you have a pretty tight fitting closed mold. So if everybody did the REOG, we wouldn't be doing this talk right now because there'd be

no misconception. Because everybody would immediately know how much venting they had. Unfortunately, most people do not do the REOG, so we're gonna keep going.

- Good point.

- Historically, we used to, I mean, if you're old enough to have gone to school when we were doing custom molds, you learned about diagonal vents, parallel vents. You probably did a few trench vents with a drilling tool yourself. We looked at the acoustical fence, related how long it was, the diameter of the vent. A pressure relief, one millimeter, two millimeters, and so on. You could spend a three hour class just on venting and in some classes you had to do your own vents with a little tool. Today, however, rumor has it that a lot of people don't use custom molds and they use instant thinning tips. And you can see here this particular company looks like they have five different kinds of tips. Brian, what's your best guess on what percent of hearing aids today are being fitted with these instant fit tips?

- Well, we know that about 80% of all hearing aids sold, at least in the US, are receiver in the canal, BTEs. And of that group, about 80 to 90%, and this is data that I collected within the last year, 80 to 90% of RIC devices are fitted with one of these instant fit ear molds. So.

- Wow.

- [Brian] Or tips, I should say.

- Ooh.

- Yeah, so it's a really high percentage. It's kind of the norm.

- The misconception, to make this clear, because maybe we haven't so far, is that when one of these tips are labeled closed or power, they probably aren't. So let's go through that. Instant fit, this isn't like the old days where you could pick something up and look at it and say, oh yeah I see that vent, there's gonna be leakage. What the leakage that we have with these instant fit tips is what's called slit leak. And slit leak is the leakage that occurs around the circumference of the dome where the dome meets the ear canal. And so first of all, they just have a lot more slit leakage than a custom mold because they don't fit as tight.

And the second problem is that the less contact that the mold has with the ear canal wall, the greater the slit leak effect is. And these instant fit tips don't, it isn't like they go eight millimeters deep and they have eight millimeters of contact. And so there's actually two issues going on, both of them meaning that there's a lot more venting than you might think. Well why does this matter? Well, let's, in your software, I assume that most of you do this, you can actually tell the software what type of mold you're fitting. So I have an example here of what the software would do depending on what you tell it. If you look at the chart on the left, this is when you tell the software it's a closed fitting. What if you really had an open fitting but you didn't tell the software that?

What you'd get is what you see on the right. In the low frequencies, 250, the software would put in 32 dB more gain to attain your target because it knows that's how much is gonna leak out. Even at 500, it would put in 21 more dB. So you see the problem. If the fit is really open but you tell the software it's closed because guess what? You picked up a little pack and it said closed on it, you're going to get an initial fitting that's not even close to what you want, even all the way up through 2K. Now, if you do probe-mic verification, this isn't really gonna matter because you're gonna correct everything when you're doing your program. But what if? What if there was somebody out there who didn't do probe-mic verification? You're gonna be making some serious mistakes

and you won't even know why. Here's the chart. Brian, did you have this in one of your classes?

- That's something we learned in school, yep.

- Absolutely. Absolutely. This is, I think, in every hearing aid textbook you're gonna find. And this is sort of what we've all grown up thinking, and take a look at what you would expect with a small, with a one millimeter vent. You would only expect about a two or three dB leakage in the low frequencies. And that's what we'd come to expect. With, you see with a closed, which is labeled occluded here, essentially there's no leakage at all. Well, let's look at what's going on now. This is, you work with many of these people here, Brian, right?

- Right, Laura Balling does a lot of great work in the lab at Widex.

- Yeah.

- [Brian] Sister company.

- Sure.

- [Brian] This is a really good study.

- Yeah, this is a great study that they did a few years back comparing all different types of instant fit. And and we don't have time today to go through each one of them, but the main point here that I wanna go to is look at the top left chart and look at the top line. The top line, the red line, is a double dome. That's as tight as you're gonna get. Except guess what? You still have 10 to 15 dB of leakage in the low frequencies. This is what we used to see with the custom mold with a three millimeter vent, which we

considered a big bent. So really picking something that's labeled closed is causing things to leak 10 to 15 dB in the lows. And that's the double domes, as you see when you go to the blue line on that, it's even worse.

- Yeah, I think the really interesting point here, Gus, is that slide you showed previously from Dillon is not wrong. It's just showing the venting from a custom device.

- Sure.

- Or a custom mold. And now that very few custom molds are fitted on these kinds of products, you have to kinda rethink what happens when you put those non custom ear tips into the ear now.

- And it would be nice if somehow manufacturers could use these data in their fitting software. Maybe some are, but I'd be surprised. When I've checked it out, they typically are using the data from Dillon relative to venting effects.

- Right, and all the more reason to do a probe-mic measure on every single ear.

- [Gus] Sure.

- So you don't miss this stuff.

- In preparing this talk, I was interested in digging back and did we just find this out a couple years ago when Laura did that study? Well actually here are data going all the way back to 2009 many years ago. And look what you, look over at the right chart, and you see the mismatch to target for a closed dome. And then go over to the left chart and these are instant fit domes. Go over to the left chart and what you see is for an open. And except for one person, the results for the open are the same as for the

closed. So somehow, don't tell Paul that these data sort of got lost along the way somehow.

- Paul's a really good audiologist.

- [Gus] He is.

- And I remember when he did this study years ago.

- I mean, he was telling us this 13 years ago and I think people somehow sort of forgot about it. So it isn't like this is breaking news, but I think there's enough of a misunderstanding that's worth talking about it.

- [Brian] Right.

- Because if you want what's on the left, then you're really gonna have to, you're gonna have to to really fit a closed dermal. And here's another important factor. It's not just matching targets that this is going to impact. It's gonna impact all kinds of signal processing. And in particular, it's going to impact the SNR advantage for directional processing. Here's a really nice study actually done from some Sivantos people, Mathias and can't remember her first name. Nope, don't tell her I don't remember her first name.

- [Brian] Okay.

- Littmann, okay. Veronica, Veronica Littmann. So anyway, what we have over on the left are the REORs that I talked about way back at the beginning. I mean, excuse me, they're REOGs. And the bigger they are, the more open the fit is. And look what happens as we go from the very open to the very closed. On the right, you see the

SNR changing. This is for a group of 20 people or so with hearing loss wearing directional products. The directional advantage goes from two to three dB when the fitting is fairly open. And the advantage is five to six dB when you're fitting a closed product. That's a three dB advantage in SNR, which could change somebody's life.

That's gonna make a difference of what restaurant they can go to and still understand all because of the fitting. As you can imagine, I mean hopefully it's obvious, but if you have the fit that's open, the sound is gonna go straight to the eardrum.

- Right.

- So although the directional hearing aid is doing its best to cancel out all this sound, if there's a slit leak there, it's going straight to the eardrum and the directional hearing aid can't do anything about that. You are the ones who can do something about that. And as you might guess, it has the same impact on noise reduction because if the fit is open, again, the noise will go straight to the eardrum. So what you think you might be canceling, those important low frequency noises, which by the way is where most annoying noise happens to be. What is going to happen is there won't be any cancellation. 'Cause again, the noise is going straight to the eardrum.

This is actually as a reminder here, as some of you know, I'm a fan of doing probe-mic measures. This is a perfect reason why after you're done programming the hearing aid, one of the final things you might do is do a test with noise reduction on and noise reduction off. Be sure and use a noise signal. Don't use the speak signal, use a noise signal, and look to see how much noise reduction you have in the low frequencies. And that'll give you a good idea if you have the kind of fit that you want to have.

- Well then.

- So our misconception is don't be led astray when something's closed. If it's an instant fit and it's labeled closed, it probably isn't. And also then take this into consideration when in single processing. I mean, I still remember a case study that came up in a training seminar of a person who was trying to get rid of car noise and they kept changing, and they kept making the DNR stronger and stronger and stronger and stronger. And the patient kept saying, hey, the car noise is just as loud. What they didn't do was make the fitting more closed which would've solved the problem. So this is important stuff because you can take a fantastic hearing aid and when leaving it open, much of the good technology is gone.

- Well, let me just kind of reiterate what you said, Gus, and that is, as a Signia person, I think we have some of the most sophisticated processing when it comes to improving the signal to noise ratio. And if the direct pathway of sound is through the open ear canal and not through the hearing aid, you're gonna lose a tremendous amount of that signal processing capability. And I would even take it one step further and say that I think it's important to fit as many people as you can with custom RIC molds. It's a much better way, I think, to control for these variables. Yes, open domes have a place, but I just think they're, from my own experience, there's just a lot of variability even within the same individual. And always go with the custom when you can is my advice.

- Yeah, I've actually seen comments by people who say, I used to do those instant fit, and now I've gone back to 80, 90% custom. But those comments obviously aren't the norm or you wouldn't have the statistics that you do have.

- Exactly, and especially in the OTC world, I think it's one way to differentiate what you do from what you buy over the counter. So good topic.

- Yeah, oh, absolutely, absolutely.

- Thanks for all your insights as usual. And we'll see you the next volume, next edition.

- All righty, next time.

- [Brian] Next time.

MPO - Does the Default Fitting Software Get it Right?

- Welcome back, everybody to another edition of Research Quick Takes. I'm Brian Taylor and with me as usual is Gus Mueller. Gus, welcome back. Good to see you.

- Thank you. Thank you.

- And we're talking about potential misconceptions around fitting hearing aids, and we're already on volume number four of our Quick Takes talk and this is the third installment around this topic of misconceptions. And today I think we're gonna be talking about maximum power output. And--

- Yeah, this is a fun one. And let me say as I think I've said at a couple other episodes here that, you know, maybe this isn't a misconception for everybody but we're doing this for those of you who might have some thoughts that you thought you read some place or you remember, or a rep told you, or wherever those thoughts come from. So I have to say that this is a topic near and dear to my heart. In 1992, David Kirkwood of The Hearing Journal asked me if I could start a column, which we ended up calling Page 10. He needed the first paper done within a month. And I thought, how am I ever gonna get a paper done in a month? And I got ahold of Ruth Bentler and said, "What could the two of us write on?" And we both immediately decided how loud is allowed? And Brian, you and I wrote a paper on that, what was that? About 10 years ago or so?

- About 10 years ago about the profile of aided loudness, if I remember right.

- Yeah, yeah. We talked about, you know, getting loudness right. And so that's what this is really all about, and I think it's something that's incredibly neglected and I think it's neglected because people take too much for granted and believe the manufacturers know what they're doing. And that's the myth that I'd like to bust in the next few minutes. So it's a lot like goldilocks, lot like Goldilocks. The porridge could be too hot. In other words, the MPO is too loud. Now, good patients will turn down gain.

They won't have audibility. They'll only use their gain for certain situations and they may have some negative experiences and and just start using their hearing aids altogether. You know what, Brian, who had the hot porridge? Was that papa or mama?

- Well, you know, it's been a long time since I read Goldilocks in the three years.

- Oh, come on, you just read it.

- But I'm gonna guess that the papa bear had the porridge that was too hot. I think you were right there.

- That's what I'm going with. So then we got the mama bear. We'll call the mama bear has the porridge that's too cold. We all know that baby bear has the perfect setting and unfortunately, there's not a lot of baby bears out there when it comes to MPO. But anyway, so what happens if it's too low? Well, speech may sound distorted 'cause everything's hitting the ceiling. There won't be the dynamics and music will sound terrible. Loudness perceptions will be wrong because everything is all, again, falling right at the top. Loud speech will sound just like average speech. So you won't know when someone's shouting at you because it will sound just like average because everything's hitting the ceiling.

And actually, I have an example of this. It actually can make speech understanding worse. So here's an example of this group of women are sitting having a nice glass of wine. The background noise is 75 dB, not at all uncommon for any kind of a fun bar. The woman on your right wears hearing aids. And unfortunately, somebody used the default MPO setting and her MPO is set at 75 dB SPL. In case you think I'm just making that up, I have some data to show you in a moment that shows that a very popular hearing aid, that is their default setting. Now, her friend over there on the left

knows that it's loud and she does what you and I all do is you raise your voice to put your voice above the noise.

You certainly would do it if you knew somebody who was wearing hearing aids. But we do it for people with normal hearing. So in theory, she's talking five dB above the noise, which would be a signal-to-noise ratio of plus five. Even a hearing impaired person might do pretty well at plus five. But because her MPO's at 75, everything, the noise is hitting the ceiling, the speech is hitting the ceiling and the resulting SNR will be zero dB. She's unable to take care of that. Now, Monday morning she walks into her hearing care provider and says, "Wow, I'm really having, you told me that these would help me in restaurants. I was in a restaurant and it really not doing any better than I did with my old hearing aids." The question is will that hearing aid provider raise the MPO? Is that the first thing they're gonna do is say, "Hey, let's go to the MPO and knock that up 10-15 dB and I bet you'll do better." I don't know.

- Probably not.

- Just as a reminder, the patient's LDLs are all over the place. The range is about 50 dB. These are data that we talked about in detail back in Quick Takes 3.4. So I'm not gonna go through it at again here. You can go back there and we talk about how to measure LDLs and then how to set the hearing aid accordingly. What I wanna spend our time today talking about is a study that we did a few weeks ago, well, a few weeks ago, a couple years ago that I did with the University of Iowa people. And what we did is we took hearing aids and we actually measured the OSPL90 for these hearing aids. And then we measured their MPO, the MPO that would be for a typical fitting, both for their proprietary algorithm and for a NAL fitting.

So what you see over on the left is the audiogram that we used and then down below are the predicted LDLs relative to the NAL. And we'll get back to those later. For those

of you who might not be aware, the NAL not only predicts targets for thresholds, but it also predicts targets for, well, it gives, yeah, I guess you could call it a target for the LDL, which is where we'd set the MPO. So I'm gonna walk through just a little bit of our findings here. This I know is a real busy chart and it's for the six hearing aids that we used. And so just to give you an idea, over here is the OSPL90.

Now, this is the ANSI OSPL90. So when you do the OSPL90 measure, as many of you have, you probably know that you minimize compression, you either turn it off or you put it at its minimal setting. So this would be the OSPL90. Now, when we're talking about maximum power output, we're talking about what it would be for a given programming. So what you see here is for the proprietary fitting. And what right away you should see is once we get to the programming, hearing aid F sort of stands out from the others. And I have some more slides to show you this and let's go over here. This is for the NAL. So this is the manufacturer's programming, not the fit to target but the manufacturer's programming for the NAL, the manufacturer's fitting for the proprietary.

And this is the MPO. I want to go back to the woman who is sitting drinking her wine, trying to understand and which I think is this slide goes back to reinforce that I'm not just making this up. Take a look at the black chart and in particular, the black tracing and in particular, the green tracing. These are two of the products. These are the premier hearing aids of major manufacturers. And this is their default setting for a NAL fitting and notice for particularly the green in the mid-speech frequencies, in fact, almost the speech frequencies, the output is around 75 dB. Keep in mind, go back and look at that audiogram. We would expect this person to have LDLs of around 100-105.

So what you are doing, what somebody could be doing today somewhere is depriving this person of 30 dB of useful gain, 30 dB that could change their life. It certainly will make music sound a lot better. Well, a second question we asked is what do

manufacturers set in the fitting software? So what we did, this is now not a coupler measure or a real ear measure. We simply went into the MPO tab in the fitting software to see what manufacturers might set. Now, the zero line on this chart is the NAL, so logically would be if you clicked NAL button in the software, you would expect that the output that the manufacturer would select would be the MPO of the NAL.

Well, not so. Notice that some are 10 DB below the NAL, some are 10 to 15 dB above the NAL. And here's the deal. Depending on what manufacturer you pick, your patients' MPO will be 20 to 25 different, whether if you pick the green curve manufacturer on the top or the black curve on the bottom. It's a great sign that the world needs us.

- Well, the point is to ignore what the software is doing and set it yourself with the measurements we talked about in that earlier version.

- Yeah, exactly, back in 3.4. It is. And yeah, the one other tidbit on this, going back to those other charts is it goes back to well, it actually goes back to one of our misconceptions I think we're gonna get to in a few weeks, Brian. The one product that actually had a decent MPO was the product whose NAL gain is truly equally to the NAL. So it all goes back to if the other companies underfit the NAL seriously. So because they underfit to the NAL, they also then underfit to the MPO. So there's actually two problems. Number one, you don't have enough audibility and number two, you're squashing the ceiling down, you know? It's like if you take the floor and put it way below the floor so it's not audible and then you take the ceiling and pull what used to be a 10 foot ceiling, pull it down to a five foot ceiling. And I can't jump too high when the ceiling's at five feet. Believe me.

- This is a really important topic for audiologists to really... Dispensers, anyone that fits hearing aids to know about. And I say that because not only because of the study that

you just cited, but with OTC being a hot topic for the last year, there's been a lot of authorities and experts that have been saying that hearing aids can cause harm, that they could be too loud if they're sold over the counter. So a lot of people, I think are tuned into the fact that hearing aids that are sold over the counter could be set with too high of an MPO but in reality, most of the hearing aids fitted today are way under the MPO that they need.

- Exactly way under the MPO. If you're up at a 100dB or so, I don't think there's gonna be any long-term noise induced. Yeah, I mean, I think that's overstated. I think that's overstated.

- And I think what people are missing is how much it affects speech understanding, right? It's important. So the idea, I mean, this is something that we all know is you don't rely on the default fittings. Obviously, manufacturers are gonna be conservative, but we know better and it's pretty easy to go in and change things.

- Well, it's all around customization. And without the professional involved, you can't customize MPO very effectively at all.

- Exactly. Exactly. So that's it, that's our little MPO story. Interestingly, when Ruth Bentler and I wrote that article in 1992, our big concern was too much because we're still using linear peak clippers. I never would've guessed that I was gonna be talking about too little, but--

- Yeah, it's really interesting.

- Things change over time.

- Importance of headroom, it's always an issue.

- Yep, it went from the papa bear to the mama bear. And we just need to find the baby bear somewhere and get that porridge, orrect.

- Exactly, all right, Gus, thanks for all the great information. See you next time.

- All right, thanks.

- Bye.

How Accurate are Hearing Aid Environmental Classification Systems?

- Welcome back everybody to another edition of Research Quick Takes. I'm Brian Taylor and we are on volume number four. We're talking about potential hearing aid fitting misconceptions. And our guest, as usual, Gus Mueller. Welcome back, Gus. Good to see you.

- Thank you. Thank you. This is a fun topic. I think if things work out, we'll probably do maybe a couple more of 'em. I don't know how many misconceptions are there out there in the world.

- I think we could probably come up with a few more.

- All right, good, good, 'cause it's sort of fun to talk about this. Hopefully some of the listeners, viewers are hopefully this hit home. Maybe it's something that you weren't too sure of or something you thought you knew. And hopefully we can come up with some things that might help you out in your clinical practice. Today, we're gonna be talking about signal classification. And just to give a little history, old guys like me like, we like to do history because, you know, a lot of people can't argue if you're right or wrong 'cause they weren't around. And so it's a pretty safe thing to talk about. Although I was not around in 1947, but it goes way back to Sam Lybarger who back then suggested that we really need different programs for different listening situations.

And he suggested that for noise, he had a device that you could turn low frequencies down. 1965, I mean 1975, directional hearing aids had been out for four years and I know for sure Unitron had a product that you could actually manually change the directionality and make it go from omni to directional or halfway in between. So this thinking has been around for quite a while. 1980s and into the '90s, a big thing then was what was called BILL processing which basically was a low frequency cut. Brian, you probably fit some BILL processing.

- Oh yeah, 30 years ago the Manhattan Two circuit from-

- Oh, yeah.

- Automatically cut the lows when you walked into a noisy place. Very nice little-

- No, that was, and we called it actually some of 'em were called ASP as in automatic signal something processing. I don't know what the processing's good for but they were called ASP hearing aids. President Reagan was fitted with a Siemens ASP hearing aid sort of back in that timeframe. Anyway, then people said, "Well wait, why don't we just have more programs?" And the one I remember the most just 'cause of the name was the Widex Quatro where you had four different programs. Then we got into automatic switching from omni to directional which I think came around around 2001 or so, shortly after digital hearing aids came out. Then in the late 1990s, we really ramped up to what we're gonna talk about today and that's automatic signal classification systems.

And so this is where the hearing aid analyzes the signal and makes a decision. And I'm a football fan and we're recording this during football season, US football, that is. And so I just thought I'd point out that the way I, to me, these are so closely aligned because if you you're a foot football coach there's all these things that you do to assess the game: the score, the down, the yards needed, are you on the 20 yard line, the 50 yard line, timeouts left, and so on. And then the coach decides, okay, what am I gonna do now? Who do I put in? A fullback, a running back, a big tight end? Well, the hearing aid does the same thing.

This is just some of the things that automatic signal classification systems do. It looks at level and band specific findings, spectral peaks, spectral location, modulation rates, channel specific amplitude, and the depth and the rate and co-modulations. And we

can go on and on and on of all what a good classification system will do. Once it does all that thing, it says, "Okay, I got this signal analyzed." And the question then, just like the football coach who do I put in? And here's the players. Not a speedy running back but he does have directional processing noise reduction, sound smoothing, echo blocker, on and on and on. And automatically these things are put into the game, the game of speech understanding in most cases is what we're looking at.

Well, today's hearing aids, at least the Signia ones can classify into seven different categories. That sounds pretty cool and useful, but the question then becomes is how accurate are they? Do they really accurately identify into all these categories? There hasn't been as much research on this topic as you would think. I'd pulled out this article from 2017. This was actually done by Resound. So I would guess, like any company would do, they probably set up things that they assumed their product would look pretty good 'cause that would be the reasonable thing a manufacturer would do. But aside from that, I like to study because they used a hearing aid from each of the big six. And what they found probably to no one's surprise that for lists for identifying quiet and speech and quiet, all but one was good.

'Cause those are sort of the easy things. The problem though that they point out is that when we go to what is the most important thing to classify, which really is speech and noise, two of 'em were okay but four had accuracy of only 40 to 60%. And then when we get to music, things were all over the place. Again, two of them were okay, the other four not so good. One of 'em was only 5% accurate for identifying pop music, 55% for classical. I don't know how you could screw up classical. That seems pretty easy to identify as music. But anyway, so their results showed that some of these systems probably aren't working that great, which then led me to this particular article which I think you'll all like, mainly because it's only a year old.

So we're now talking about the signal classification systems of hearing aids that you might be fitting today or tomorrow. So this is pretty straightforward. They picked five premium hearing instruments. They might say the five different companies I'm not remembering, but it doesn't matter. I'm sure it's five of the big six or five of the big five depending on how they identified it. And they presented 28 different acoustic scenes that then eventually got lumped down into different categories. The scenes varied in content over SPL and in signal to noise ratio. I'm gonna go through some examples that'll make that clear for you. This is one of the many charts from their article which actually is, it's a nice way to display things in a scientific article.

For giving a presentation like this, it's a little complicated. But just to give you an idea of how they did it, I'm gonna go down to speech and music which is the third category from the top. And so the blacker something is that's the more correct it is. If we look at music, for example, hearing aid B 100% of the time classified music as soft speech. That's not good if you have a music program. Now if there, so that would mean that it should be pure white under the music category and we go over there and yes, indeed it is. So that's sort of how this chart works. The blacker it is, the more correct it is.

Well, in this case, it would be how correct it is. So if it wasn't classifying it as something it will just be white. Should also point out that hearing aid, let's see I guess it was the same hearing aid, hearing aid B, when it was loud music, almost 78% of the time, it identified it as speech and noise, which, in my mind, maybe they were thinking Metallica, I don't know. It depends on what you're... I don't know, Brian. Do you think of Metallica as speech and noise or you might be a Metallica fan maybe.

- Maybe just noise.

- It could be noise, it depends on. I'm not a big Metallica fan, but I know a lot of people are and good for you. They need fans, too. Everybody needs. Well, what I did just to

make this a little easier to understand is I made it into bar charts. I tell all those black and white squares and made it into bar charts. And what I'm showing here is correct identification. So the higher the bar, the better it is. And you have the five hearing aids of different colors. Now what would seem to be incredibly easy for signal classification would be a back and forth conversation between a man and a woman. Two people talking in quiet.

That's pretty easy. And notice when it was soft, the hearing aids did a good job. But look what happens when we get up to 70 db. Good old hearing aid C did not classify it as speech and quiet once. And I looked at their chart. They classified it as speech and noise. And so why is that? Well, it tells me that hearing aid C has a very basic classification system that just says whenever the SPL gets up to 70, call it speech and noise, which is the least sophisticated. It's not looking at modulations and all that stuff. It just has an SPL that says call it speech and noise if it's at 70. Notice had also screwed up when it got to be 85.

And at 85, we at hearing aid D also started to have problems. So for the most part though, three of the five hearing aids did an okay job. But this is pretty easy. Now we get into the more difficult stuff. This is a male and female conversation at a noisy food court, SNR at plus five. And again, it's at three different SPLs. So notice when in soft, three of the products are getting it right most all the time, two of them are not. So remember, this is where you want the coach to send in noise reduction and directional. That's what they should be sending in, right? Well, with two products, there's a good chance you're not gonna get it.

Go to 70 db and now things really get bad. And this is important because most speech and noise situations are around 70 db. And notice the only hearing aid that's really working correctly is hearing aid C. The other ones are not getting it right more than 40, 50% of the time, which is exactly what I showed you in that other study.

- Well, what's interesting is that hearing aid C was not so good for quiet, but it's pretty good for noise.

- Yeah, it likes, well, remember the mistake it made in quiet is it called it speech and noise?

- Thought it was noise, right, exactly.

- So basically, it just thinks everything's speech and noise. But we got one more slide to go. Let's see if it thinks, well, we'll see what else what other mistakes it makes. But yeah, you're right. So, yeah, it depends on what's the most important, you know, when you're picking your product. But this is, again, you know, this is really critical when you're a clinician and somebody comes back in and says, "Well, my hearing aids, you said they're gonna work in background noise but I don't really hear any benefit." Well, look at it very well could be it simply isn't classifying it as speech and background noise, and therefore, directional isn't even activated. They're in an omnidirectional setting.

Well, the final was music and I couldn't resist because it sounded like sort of a fun song, "My Baby Just Cares for Me." If I knew how to plug music into the talk, I might have done it. But you'll just have to Google it and listen to "My Baby Just Cares for Me," first recorded in 1930 by some guy named Cantor in a musical. But the big person who made it a big hit in 1959 was Nina Simone. It's really a cool song. What they used in the study was Ella Fitzgerald. And I assume it came from this album here. I don't have it, but it's a cool song with vocals, piano playing, a snare drum and a bass, a bass fiddles.

- People can stream it, I'm sure. So you could find it.

- That's basically like a typical jazz song. So it's definitely music. You know, I don't know how somebody could say, "Nah, that's not music." Well, hearing aids could say that, and a lot of them did. So let's go back to soft. Our friend the hearing aid B, as I showed you way back on the first slide, didn't even think it was music and didn't get it right once for soft sounds. Hearing aids A and D did a good job. When we go to average levels or a little above average at 70, we see a couple products doing well. And actually across the board, hearing a D did a great job, was up above 90% in all cases. All of a sudden, once we get up to loud music now hearing aid B goes back to having problems again.

Overall, hearing aid B is not good at music but you see how it varies. And you see that this really could change how your patient experienced their hearing aids. My thought on this would simply be no matter what product it is, don't allow the, if the patient wants to listen to music and that's important for them, give them a separate music program. Because I don't see that any of these work very well is my contention. Your thoughts, Brian?

- Yeah, no, a couple things. I think number one, I think over the next few years you'll see these automatic classifiers become more accurate just because the processing power inside of hearing aids is getting better. And so they'll be able to more carefully differentiate between these different scenes. So that's something to, I think, kind of look forward to. Number two, to your point, we're talking only about automatic switching here, kind of the defaults that you can't change. But that doesn't preclude you from setting up a manual program to specifically meet a patient's need to listen to music or speech and noise, whatever it might be, and then have a manual override with your smartphone or with a remote. So those just are some things to keep in mind. And I think probably the most important point is you can't change these things in the office, the automatic classification systems.

- Exactly. And you know, I've always wanted to program the music program myself anyway, because to me the changes that the manufacturers tend to make are more conservative than I would make. I mean, we know, for example, LDLs for music are 10 to 15 db higher than than they are for speech. So one of the first things I'd do is bump the MPO up 10 to 15 db. But many of these programs don't even do that, which we talked about in an earlier one of our Quick Take episodes.

- 4.3.

- So anyway, to sort of wrap things up, I think we sort of already said this, but I think the misconception is that these things are gonna get it right all the time. It looks like at best, it's about half the time. Even the ones that seem to be the best at it are certainly not 100%. So I think we need to, this is... To me, it's really important for post-fitting counseling and maybe post-fitting adjustments. So, you know, often at times, I think when the patient comes in with a given complaint, like not understanding and background noise, it's easily just like to write it off that their expectations are too high. And you know, you say, "Yeah, I know, but you know, you have a hearing loss." But I think we need to walk through what are all the problems that could be going on. In a different Quick Takes, we talked about maybe the MPO is set correctly. Well, here's another thing, maybe the hearing aid isn't classifying it correctly.

- Exactly.

- I mean, actually, some of this you could probably check out in your office with data logging, I would guess, but.

- I think that's probably true. But well, that's a topic for another Quick Take.

- That's a talk for another day.

- [Brian] Exactly.

- Things to do in your office over lunch, if you get a lunch in your office. Right. See you next time.

- All right, thanks.

Reasonable Alternatives to a Verified Prescriptive Fitting

- Welcome back to another Research Quick Takes. I'm Brian Taylor, and again with me is our special guest, Gus Mueller. Gus, good to have you here.

- Yeah, great to be back again. It's always a fun time.

- Yep, and for those of you that are just joining us, this is volume 4.5. We're gonna be talking about potential hearing aid fitting misconceptions around the topic of prescriptive fitting targets. Should you use the validated version or should he use a proprietary or other reasonable alternative? And to help us kind of go through all that the pros and the cons is Gus. So, I'll let you take it away.

- Sure, yeah. The key here is reasonable, I guess. And, you know, we've talked in other Quick Takes about the use of a validated method, and then using probe mic measures to verify. The question becomes then, how many people are really doing that? This survey is, is a little dated, but we don't have a lot of other ones to use. And I'm not too sure things have changed tremendously. This is from what Aaron Paku and I did about 10 years ago showing that of people who are fitting hearing aids about 35, 40% are doing probe mic measures. Interestingly enough, it didn't matter much if they had the equipment or not. It only went up 10% when they had the equipment. And those scores are actually elevated.

We had some questions on there to say if people were truthful or not, and it actually should have been more like 25, 30%, but we'll forget about that for now. What I want to point out here is one of the things we also asked then. It said, "if you are doing probe mic," so this only went to the people who said they're routinely doing probe mic. "Why are you doing it? Tell us why are you doing it?" And they had to pick their main reason why they were doing probe mic. And interestingly of the audiologists, only less than 30% said, "The reason they were doing it was to validate targets." Hearing incident specialists, only 10% said, "The reason they were doing it to validate targets."

So I don't think things have changed that much. What it tells me is there's a lot of people out there fitting hearing aids who don't believe in doing validation of a validated fitting such as the NAL. So then, you have to ask, "What do this group, what do they believe?" To me, they have to believe one of these three things, that the NAL algorithm isn't very good, that the manufacturer's proprietary fitting is better. 'Cause, obviously then you don't have to verify it, and or three that you can just click on the NAL in the fitting software and you're going to get a fit at the ear and there's no reason to verify. So, one of these three has to be true.

I can't think of a fourth reason other than I don't really care. But, let's assume that people care. So, let's start with each one. I'm gonna take each one of these separately. Let's take number one. And that is, you don't believe that Harvey Dillon's 30 years of research got him anything and that this formula doesn't really work. And you just say, "Goodbye, Harvey. You're gone." Is this a good approach to take? Well, an important thing about using the NAL is that you have to start somewhere. You know, if you're sitting down to program a hearing aid, you have to start somewhere. And even if you're not crazy about the NAL, it's still a pretty good starting point.

Earl Johnson wrote a good article for me for the 20Q series a few years back, and he did a lot of math, and I just sort of want to get to the punchline, but even if you're a very experienced HCP, and you can say, "Well I need this, and I don't need this. And I need this and I need this." And, you know, response would be close you will still end up with 1,430 possible choices on your initial programming and hearing aid. The point being you gotta start someplace. Oh, and that's just for one input level. So the NAL has been around since 1977. It was revised in '86. It was revised again in 1999. And then, the version we use today was revised in 2011. We covered all of this in quick take six 4.1. 4.1, I believe about-

- [Brian Taylor] Yes.

- when a target is a target. So, I'm not gonna go into detail here, except to tell you that considerable research went into the NL1 so that they would know what to change for the NL2. First of all, they looked at gain, preferred gain and this is my simplification of the previous chart. And what they decided was they needed to lower gain by three dB. So, yes indeed, the gain that you have is supported by research of 100s of people who actually were outfitted using the NL1, and now it has been modified. A couple studies looking at if the NL2 algorithm really works. This was a real world study with trainable hearing aids, and what they found that for this was a hearing aid that trained in six different conditions.

What they found that after training, people were about two dB below NL2. They train down about two dB. I think that means that's a pretty good starting point. A separate study, this is the one done with the Bose self fitting hearing aid. What they found in that study, they had people out in the real world they started them off with insertion gain of zero dB. So, it was a blank slate and allowed them to program and program and adjust and program. And what they ended up with on average was a fitting that was only about two dB lower than the NAL fitting that was programmed by audiologists. Again, I would say that tells me that the NAL is a pretty good starting point. Brian, any comments on this?

- No, I think that 30 plus years of science is hard to dispute.

- Yeah, I agree. And so, I'm not sure why people are against it but some probably are. Reason number two, all manufacturers have a default proprietary fitting. Some people just call it first fit. Some people call it final fit, unfortunately. And this gives us a starting point that is believed to be better than the NAL. It's hard to talk about this quickly, about because there's been a lot of research comparing proprietary fittings to other

types of fittings. But, the first question, you know, might ask is, "Why do manufacturers even have a proprietary fitting when we already have the NAL and the DSL?" I might say, "Well, I guess first of all it makes a product sound sort of special and mystical." Like, "Our algorithms only work when you do our proprietary fitting."

And it's a secret. It's a secret. You can't get it written down. All the proprietary fittings have less gain in the highs, which means there's less feedback problems. People who fit hearing aids like to whine about feedback problems. And if you don't put any gain in the highs there won't be feedback. The NAL has considerable gain in the highs. Providers of hearing aids in various countries have different styles and techniques. I'm guessing some have never heard of the NAL, and maybe a proprietary fitting is attractive to them, again, making the product more desirable. And finally, new hearing aid users tend to like hearing aids that don't sound like hearing aids. And the easiest way to do that is to take out the gain, and then they don't sound like hearing aids anymore. So, for first acceptance that could be a reason why manufacturers have proprietary. Anything to add to that, Brian?

- No, I think that you've covered all of the main points. Maybe, I think just to make sure everybody's clear about when you say proprietary, I think all manufacturers have their own version of a first fit starting point. And it's an example of how marketing sort of bleeds into the clinical side of audiology.

- Sure. Well, and it does make the product seem special. Well, here's a typical what you'll see with the proprietary fitting. The top red line is the NAL. And so, you see what you might expect, as I mentioned, less gain throughout all frequencies, and particularly reduced gain in the highs. This is from a study from Mike Valente. He compared the NAL to a proprietary fitting. And this is the mismatched to target that he found for the proprietary. Notice in the high frequencies the mismatch is 15 to 20 dB. That's huge. That's huge. You would guess that, wow. That must affect speech understanding. It

absolutely does. And here are those data. What you see on the right is when, these are all the same patients, by the way.

It was a crossover study. What you see on the right is when their scores when they were fitted to the NAL. And what you see on the left is when they were fitted to proprietary. The box is the 25th to 75th percentiles, and the bars are the range. And you don't have to be an expert in statistics just to say that, "Yeah, there's a big difference." And it makes you wonder, why would you send somebody out the door with the proprietary fitting when there's gonna be differences like this? You say, "Well maybe that didn't hold true in the real world." Well it did. The APHAB was significantly better for the NL2. And of the 24 per participants, 19 preferred the NAL.

You would say, "Wow, then I bet it really makes a difference for speech and noise." Absolutely. Here's a study from Ron Leavitt and Carol Flexer from a few years ago. They compared, this is with the quicks in. they compared speech and noise performance for now versus proprietary using the premier hearing aids. And what you see on this chart over here is improvement when they went from the proprietary to the NAL. Notice for two of the products, the improvement was almost 10 dB. That's crazy. I mean, imagine if you could sit in a noisy restaurant and sort of wave your hand and say, "Hey, could you turn the noise down by 10 dB?" Well actually you can do that. Just program the hearing aid correctly, and you will do that. So, it's huge. You're familiar with this study, I believe, right, Brian?

- Yeah, I mean it's kind of the the same old story we hear about how if you wanna understand something you have to be able to hear it first. And it's all about restoring audibility.

- Yeah. I mean it isn't anything magical, but I mean if you want your directional processing to work, then things need to be audible for everything to work, you know, or or otherwise it doesn't make much difference.

- Exactly.

- Moving on then to point number three, which also I believe some people do believe, and that is that if you simply click on the NAL in the fitting software, you'll end up with NAL in the real ear. This has been researched for at least 20 years. Way back in 2003, studies showed that when you had a perfect fitting on the screen, in the real ear it was seven to 12 dB below that. In 2007, this is amazing, they found that when you had a perfect fitting on the screen, you were missing now by greater than 10 dB in 64% of the cases. That study was repeated by the same authors in 2012 with different hearing aids. And it actually got worse. You were missing by 71%, and it goes on and on and on.

This shouldn't be a secret anymore, but people still tend to have a belief. This is a couple studies that were just done in the last three, four years. One of 'em in the blue, and this again is mismatched to target when you have a perfect fit on the fitting screen for the NAL. One of the studies in blue, that's the Amlani study. Notice that product sort of missed target by the same across board across the board, like it just turned down gain. Then the study that John Pumford and I did two years ago noticed that particular product really reduces it in the highs. Actually, the NAL fit looks a lot like the proprietary fit, if you could picture how that would affect it.

So, there's a ton of data out there to show that when you hit now NAL on the fitting screen, you won't really have NAL. This again shows that this is some some measures that we made, shows this is for soft. And you see that's where really the greatest mistake is. This is 16 different people, and you're seeing mistake of 10 to 15 dB for soft

inputs when it says you have a match to target. So, that takes us through all this, and I think we can summarize then. So, I'm ready. So, the one question was that the NAL algorithm is not a good starting point for the average patient. I think we showed data that's saying, "That's wrong." It is a good starting point.

Secondly, the manufacturer's default proprietor algorithm is better than the NAL. Are you kidding me? It's not even close. It is not even close. You saw the huge differences in word recognition and on the quick send. Finally, when the manufacturer's NAL is selected in the software, you have the NAL fitting in the real ear. My thought is very unlikely. Manufacturers do change products. When they change products, sometimes they change their fitting. You know, what I showed you is maybe a year old a year and a half old. I mean, it's possible that something's come out recently, but to date I think you can assume that it won't be a fitting in the real ear just because it looks like a fitting on the fitting screen.

- It's a a 20 year trend that says that.

- Yeah, it hasn't changed for 20 years.

- I have a question-

- It would be a little surprising if it changed now.

- So, if you're a clinician and you're concerned about your number one priority or high priority is restoring or optimizing audibility, and as you said the proprietary fitting formula is not effective the NAL that's in the fitting software is not effective or is off by quite a bit, especially for soft, high frequency sounds. What should the clinician do with respect to NAL? Should they use the formula that's in the probe mic system?

- Absolutely. The, you know, the probe mic systems don't have a dog in the fight. They have no reason to tweak the NAL. So, all the probe mic systems use the correct NAL. Essentially all the manufacturers have tweaked the NAL for the very same reasons that they have a proprietary fitting. If you roll off highs in the NAL, you don't have feedback problems. The patient doesn't say it sounds tinny and on and on and on. Yes.

- So, at the end of the day, you gotta get your trustee real ear system out and use what's in there.

- Absolutely. Absolutely. There is an alternative. Well, you know, I'm not gonna say there is an alternative, because I happen to know that we have 4.6 planned. And I think in 4.6, we're gonna say, "Is there an alternative?" And not only say that, but we're gonna give the answers too. Promise

- Well, we'll save that for another day.

- Save that for another day. See you next time.

- See you.

Other Ways to Verify the "Best" Fitting Besides REM

- Hi everybody. Welcome back to another Research Quick Takes. I'm Brian Taylor and we are on volume 4.6. Our topic in this edition is, Potential Hearing Aid Fitting Misconceptions and with me as usual is Gus Mueller. Welcome back, Gus. Good to see you.

- Thank you, thank you, thank you. This is the sixth episode of our misconception area. So I don't know if we have more left or not. This might be our last one.

- This is the last one I think, unless you can think of a new one, but we're gonna answer the question, are there any other ways to verify the best fitting other than probe-mic measures?

- Yeah, we sort of concluded before that you really do need to do probe-mic measures but there's always people who say, "But hey, wait a minute, wait a minute. I don't think you have to do that because what I do is this and it seems to work." So we tried to come up with some possible alternatives of what people have said that maybe they used, and I don't know how many there are, but we came up with five of them that we're gonna talk about. We're gonna start with the time honored speech recognition measures which go back to at least 1946 when Raymond Carhart wrote about them. By the way, they didn't have probe-mic in 1946 so he didn't have an awful lot of choices.

But let me tell you some problems with that. So let's say that you want to do comparative testing with different programmed settings, or maybe you want to try manufacturer A versus manufacturer B. So here's what the problem is in doing the testing. You need a test that avoids the ceiling effect which means you probably can't use monosyllabic, monosyllables and quiet for sure. You need to have something where people aren't gonna score 100% or you won't be able to see differences. You also then know, when do you stop the testing? There are oodles, and that's a very

scientific word, there are oodles of programming possibilities. So you program something and it gets 2% better and you program and it's 2% better, when is it gonna stop?

When do you stop? Sooner or later you and the patient are gonna wear out and you're gonna have to stop. And the other thing is speech material is incredibly variable and so when are you gonna know when one score is better than another? So you could say, "Okay, I'm not gonna compare one to another one to another, I'm gonna just take one product and I'm gonna keep programming it until I reach the patient's optimum performance." Well, you have some of the same problems. The main one is, how do you when you've reached optimum? If you get a QuickSIN score of six, how do you know that optimum isn't three? When do you stop? When do you stop?

And again, you have the variability of the testing. Most of you know the chart on the left from Thornton and Raffin, but just as a reminder, let's say that you're doing monosyllable words and you're doing a list of 25, which some people do. If with product A you get a score of 80%, with product B your score is going to have to be worse than 56 or better than 96 or product B is no different than product A. Rarely would you ever see a difference that big unless you just really programmed it in some crazy fashion. And the QuickSIN, you also have to look at QuickSIN scores and see when is a difference really a difference. So I think, I don't know what you think Brian, but I think it's pretty easy to eliminate speech recognition.

- Definitely.

- Gone, okay and good 'cause it's been gone for about 30 years, or 40 years, but some people still like to bring it back. Now I might add, you could do speech testing after you've programmed it correctly just to show the patient that the hearing aids have benefit. But that's a whole nother matter. Let's talk about functional gain. That was

popular in the late 1970s just before probe-mic equipment came out to verify prescriptive methods, in particular the Berger approach. Ken Berger was traveling the country promoting his approach and the way to verify it was to do functional gain. This one's an easy one to eliminate because let me tell you all the things wrong with functional gain. Functional gain, by the way, is when you test unaided, you're sitting in a test booth, you test unaided then you test aided, you subtract the difference.

That's the gain for that specific frequency. What are the problems? Your sound field has to be calibrated correctly. Many are not. The non-test ear has to be masked using an earphone. You just can't put in a plug. The expansion circuit of the hearing aid might suppress the tones the person's trying to hear because it wouldn't be uncommon that the expansion kneepoint would be 45 dB or so, if you're presenting a tone below that expansion will knock it down. The ambient noise of the room might mask out tones in a test booth. Even in a test booth you really can't test signals less than about 20 dB because the ambient noise of the room is amplified and will mask out those signals.

The wide dynamic range compression might suppress the tone. If they have more hearing loss you're giving them a tone that is being compressed. So you might think it's 60 but it isn't 60 when it's reaching the patient's eardrum. Feedback reduction might pick up the tone as feedback and reduce it. And finally, test-retest reliability is pretty terrible because patients tend to move their head, there's reflections. One of the studies done by David Hawkins, was the lead author on this a few years ago, they found that you have to see differences greater than 15 dB between two different settings or two different hearing aids before a difference is really a difference. Which tells you that's not worth doing the testing 'cause you're basically never gonna see differences that big. So that's an easy one to eliminate. You ever do functional gain testing, Brian?

- Maybe when I was in school, but not since then. I know there are a few people out there that still do it but it doesn't make sense.

- You know, sometimes it's done with children or aided sound, I mean aided sound field will give you the very same, all those same problems apply, it's a mess. It's a mess, in fact, the AAA guidelines for children have a whole page telling you why not to do aided speech testing in the sound field. Seldom do guidelines tell you what not to do but they felt important to put that in there. Okay, let's talk about in situ testing. This is for those of you who are saying, "What the heck is in situ testing?" This is available from the software of all major manufacturers. Some promote it, some don't even mention it, but what this is is the hearing aid presents the signals and so it's a substitute for testing under earphones.

So why do people think it could be better? Well, because the fact that the signals being produced by the hearing aid, the hearing aid's sitting on the ear using the patient's own ear coupling system. So you're gonna get the same kind of leakage as you would with the real input and you should account for the real ear-to-coupler difference, assuming that you have everything the same as when the person's using the hearing aid. So that's the idea. Why it's better. Well I've heard from several people that this is something that has been said and that is the rep comes to town and says, "Never fear, if you do our in situ measures there's no need to conduct probe-mic verification."

Is this true? Well as you might guess, no, or we wouldn't be talking about it. Problem number one, this is a study that we did for our book, the book Todd Ricketts, Ruth Bentler and I did, where we took the six major manufacturers, did their in situ testing and what you see there are the results. At a thousand hertz, the range was 40 dB. So obviously there's some science lacking with this measure or otherwise why wouldn't they all sort of be the same? They were all done on the same ear. And problem number two, which we talked about in Quick Takes 4.5, even if you do in situ measures you are

still fitting to the targets that are in the manufacturer software which we know are wrong.

They're not only a little wrong they're wrong by quite a bit. As you see by this slide, depending on the frequency, they can be wrong by eight to 12 dB. So even though you've done all this in situ testing you're still fitting to the wrong targets which is why you need the targets from the probe-mic equipment. Well autoREMfit. Now in theory, autoREMfit would sound like it is probe-mic and so it should be just as good as probe-mic. Well, not quite. So for those of you who have never heard of autoREMfit, or autofit or REMfit, or whatever your favorite manufacturer calls it, it's when the software of the probe-mic equipment and the software of the hearing aid talk to each other.

The HCP has to do a few mouse clicks but the software goes back and forth and does the fitting pretty automatically. You can sit back and drink your Diet Coke or coffee or whatever and just watch things change on the screen. Sounds great, right? But, three problems. Number one, some autoREMfits only fit to 65 dB input. How good is the match for soft inputs then? Not very good in some cases which means you have to go in and redo the fitting for soft and when you redo the fitting for soft you will immediately change the output for average and loud which means you're refitting the hearing aid all over again manually. Another problem is, some of the autoREMfit programs use the patient's REUG.

It's mandatory that you do that testing. So this was a case where we had a perfect match using autoREMfit, but then as a crosscheck we went back and ran the ISTS REAR so what you see is the dotted line where we should have been and where we were for the autoREMfit and then you see the other unusual line with the peak at 2K, that's what we got when we did it in the more traditional way, that's not good. We're missing target by over 10 dB. And finally, the same problem that I've been saying over and over again, when you do autoREMfit, unless you're using a hearing aid paired to

the Verafit, if it's paired to any other probe-mic equipment the hearing aid software is the boss.

So even though it's an automated fitting, it's an automated fitting to the wrong targets, as we've talked about several times. And finally we're down to patient preference. How does it sound? Well, I think we covered this very nicely in Quick Takes 2.2, but that's not gonna stop me from hitting a couple highlights. One of the things we talked about was trainable hearing aids. And I won't go into detail 'cause indeed we covered it all in 2.2, but just to let you know this was a study where patients had been under fit and they all reported high satisfaction, they were very happy with their hearing aids. That didn't stop us from fitting them correctly, however, and what you see what happens after three weeks of training, they started out with, this is their average gain, they started out with that as their average gain and after training they had that as an average gain.

55% were using 10 dB or more gain for soft inputs than they'd been using before and they liked it. They'd been fitted to a proprietary fitting and it never had the chance of it. Many of you know the big study that Larry Humes did, it got a lot of press back when it was published in 2017, just to refresh your memory, he had three groups, there was a group fitted by audiologists to best practice, NAL-NL2 targets. Another one, the patient simply listened to different hearing aids and they picked what they liked the best. And the number three was a placebo group that they went all the motions of an audiologist best fit practice, except they were fitted to zero dB gain and they didn't have a volume control.

So they were fitted to zero gain. Well one of the findings from that study is shown here, and I know this is a little complicated, but what you have across the top is what the audiologists believed were the best fitting for the patients and you see, if you read down, most all the audiologists picked Y, well Y was the most important. Then you

said, what did the patient pick when they got to pick? Now you read horizontal and notice the big number is for the X and in fact, I calculated the percentages. The participants favored the wrong hearing aid 62% of the time rather than picking Y and overall they selected wrong 70% of the time. That's assuming that the NAL fitting is best and something else is wrong.

And in Quick Take 6.5, I think we pointed that out very clearly. And here's what I found the most interesting thing relative to, does the patient know what's best for them? At the end of this six week trial everybody came back, they had purchased their hearing aids as part of the experiment, that was one of the requirements. They actually had to buy their hearing aids. But at the end they would come back and they said, "Okay, you can keep your hearing aids or you can get your money back." Let's see how that turned out. For the audiologist best practice, 81% said, "I'm gonna keep my hearing aids." For the patient decides group half of them said, "Yeah, I'm gonna keep my hearing aids," not surprising 'cause they picked the wrong hearing aids.

And, but guess this, the placebo group, remember the placebo group fitted to no gain, zero dB gain. Would any of them want to keep their hearing aid? Oh yeah. 36%. 36%. How would you like have those people for patients, Brian, back when you were fitting hearing aids?

- Yeah, not so bad.

- You can just fit 'em with no gain and one third's gonna keep 'em.

- [Brian] Not surprising.

- Crazy, part of it was they were at a medical center and obviously they didn't know they were in the placebo group.

- The halo effect.

- Yeah, well I'm at Indiana University, it has to be. Okay, I just got a couple more tidbits to throw in. This is a study that Ruth Bentler did not too long after digital hearing aids came out where people were fitted with the same hearing aids but one group were told that they were digital, another group just were told that they were the standard hearing aids, conventional, all fitted the same, 83% said they wanted the digital product after a trial. They were all the same. In another study, they told people that one set was conventional, the other set was new hearing aids, 75% had a definite preference for new hearing aids. I think we can eliminate patient preference and you know where we are, we're right back where we've been at the end of other ones of our Quick Takes in that there's not a plan B. There just isn't a plan. There's a plan A which is you take a validated prescriptive approach and you do probe-mic verification that you're meeting your targets. It's as simple as that.

- Well, I think you did a good job of busting all those misconceptions one by one, the six different possibilities, and really none of them are a good fit, so thank you.

- You bet, you bet and we'll go on the road with more myth busting any day now.

- Well, speaking of on the road, Gus, I know I wanna thank you for your time here. I think that our audience needs to know that this is actually a condensed version of a two hour talk that you do on the road and if anybody wants to reach out to Gus to learn more about that two hour talk, please do so.

- Yeah, actually in the two hour talk I think I have 14 misconceptions that I managed to drum up. So yeah, it's a fun time.

- Yeah and it's really important information, I think. So again, thank you for your for your expertise and your time.

- Okay, you bet.

- All right.