1. This document was created to support maximum accessibility for all learners. If you would like to print a hard copy of this document, please follow the general instructions below to print multiple slides on a single page or in black and white.
2. This handout is for reference only. Non-essential images have been removed for your convenience. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.
3. Copyright: Images used in this course are used in compliance with copyright laws and where required, permission has been secured to use the images in this course. All use of these images outside of this course may be in violation of copyright laws and is strictly prohibited.
4. Social Workers: For additional information regarding standards and indicators for cultural competence, please review the NASW resource: Standards and Indicators for Cultural Competence in Social Work Practice
5. Need Help? Select the "Help" option in the member dashboard to access FAQs or contact us.

How to print Handouts

On a Mac

- Open PDF in Preview
- Click File
- Click Print
- Click dropdown menu on the right "preview"
- Click layout
- Choose # of pages per sheet from dropdown menu
- Checkmark Black & White if wanted.

On a PC

- Open PDF
- Click Print
- Choose # of pages per sheet from dropdown menu
- Choose Black and White from "Color" dropdown

2022 Signia Expert Series

AUDIOLOGYONLINE

Hearing aid fitting nuggets mined from recent research

Presented by: H. Gustav Mueller, PhD

signia

Upon completion of this course attendees will be able:

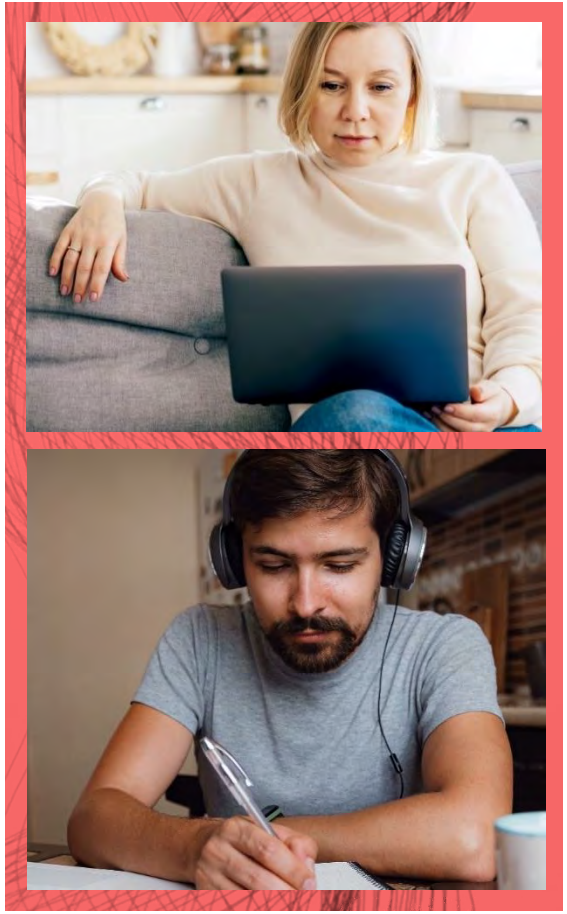
1. To relate the value of the HHIA/E to hearing aid selection.

2. To describe potential negative effects of using instant-fit earmold

3. To describe the effectiveness of modern hearing aid signal classification systems.

4. To describe the satisfaction rates of new hearing aid users for different listening conditions.

5. To describe the typical jnd's (dB) for frequency response changes in the hearing aid fitting.



H. Gustav Mueller, PhD

Dr. H. Gustav Mueller holds faculty positions with Vanderbilt University, the University of Northern Colorado and Rush University. He is a consultant for WSAudiology and Contributing Editor for AudiologyOnline, where he has the monthly column “20Q With Gus.” Dr. Mueller is a Founder of the American Academy of Audiology, a Fellow of the American Speech and Hearing Association, serves on the Editorial Boards of several audiology journals, and is a Consulting Editor for Plural Publishing. He has co-authored 12 books on hearing aids and hearing aid fitting, including the recent three-volume Modern Hearing Aids series, and the clinical text on Speech Mapping and Probe Microphone Measures. Gus is the co-founder of the popular website www.earTunes.com, and resides on a tropic North Dakota island, nestled between the tundra and reality, just outside the city of Bismarck.

Hearing aid fitting nuggets mined from recent research

Did you know: There are over 300 articles published each ear related to the design, processing and fitting of hearing aids?

Each year, Catherine Palmer, Ryan McCreery and I do a review of hearing aid research at the AAA annual meeting . . .

It wouldn't be possible if it weren't for the "Human Search Engine" audiologist Lori Zitelli, who tracks down all the articles.

Some of the articles I'm referring to today were provided by her. Thanks Lori!

Four general areas:

- Pre-fitting Considerations
- Signal Processing and Features
- Verification
- Post-fitting/Validation

Four general areas:

- Pre-fitting Considerations
- Signal Processing and Features
- Verification
- Post-fitting/Validation

Determining unilateral or bilateral hearing aid preference in adults: A prospective study.

Glyde H, Dillon H, Young T,
Seeto M. & Roup C.

IJA, online: 08 Oct 2020

From the past . . .

Performance-Intensity Functions as a Predictor for Binaural Amplification

Mueller, H. Gustav; Grimes, Alison M.; Jerome, James J. **Author Information**

Published 40 years ago!

What they did . . .

Questioned if it was possible to predict who might benefit from bilateral vs. unilateral amplification.

Performance was assessed on:

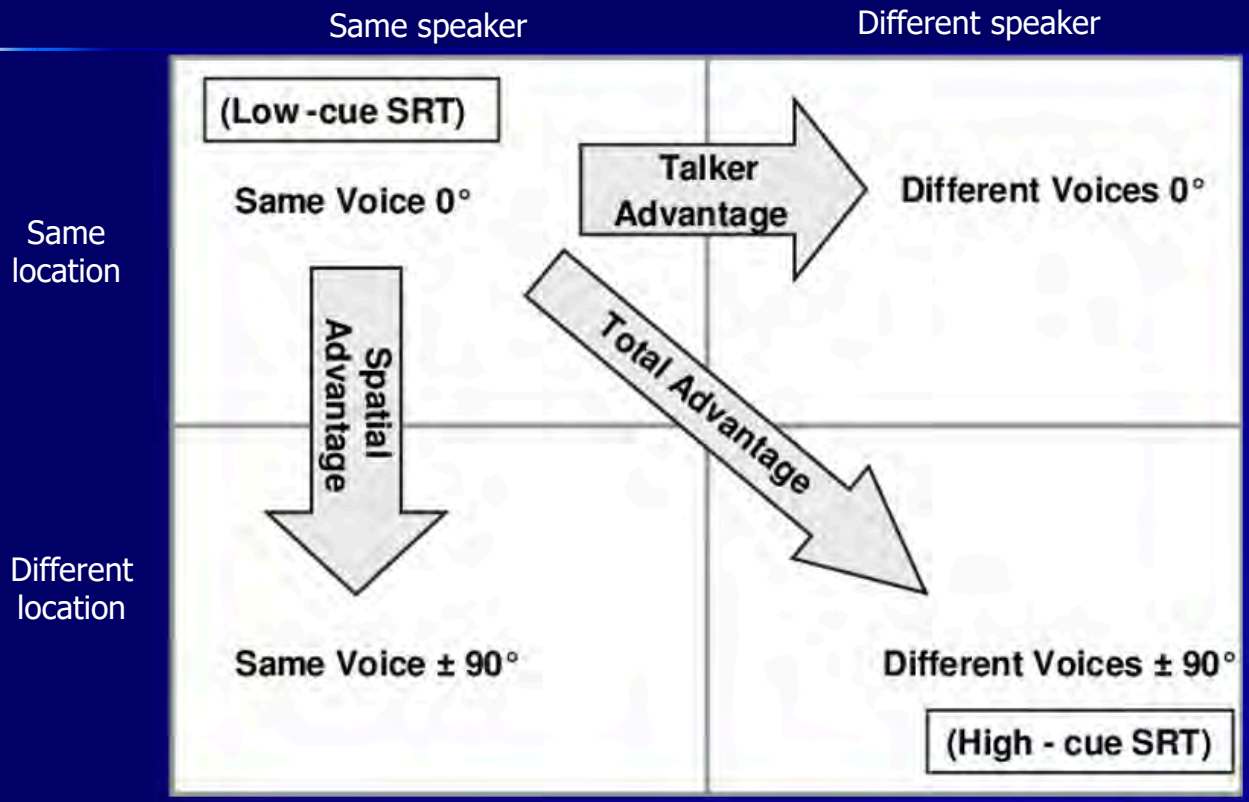
- Listening in Spatialized Noise–Sentences test (LISN-S)
- Dichotic Digits Difference Test
- Experiential Hearing Aid Simulator
- Grooved Pegboard Test.

Participants (95 new hearing aid users) were instructed to alternate between unilateral and bilateral hearing aid use over fourteen weeks post-fitting.

About the LISN-S

- The test is designed to determine speech reception thresholds (SRTs) for sentences presented from 0 degree azimuth in competing speech.
- The competing speech is manipulated with respect to its location in auditory space (0 degree vs. + and -90 degrees azimuth) and the vocal quality of the speaker(s). The speakers are either the same as, or different than , the speaker of the target stimulus.
- Advantage measures represent the benefit in dB gained when either talker, spatial, or both talker and spatial cues combined are incorporated in the maskers.

Illustration from Cameron and Dillon:



And the results . . .

- The LiSN-S bilateral advantage score related to overall wearing preference.
- But . . . “the accuracy of the predictor was too low to warrant implementation of this test prior to hearing aid fitting.”

And, the Clinical Nugget is . . .

It's okay to keep doing what we have been doing: Recommend bilateral amplification for most bilateral haring losses.

What is "normal hearing?"

What Is "Normal Hearing" for Older Adults and Can "Normal-hearing Older Adults" Benefit from Hearing Care Intervention?

The complexity surrounding definitions of hearing loss and accessibility

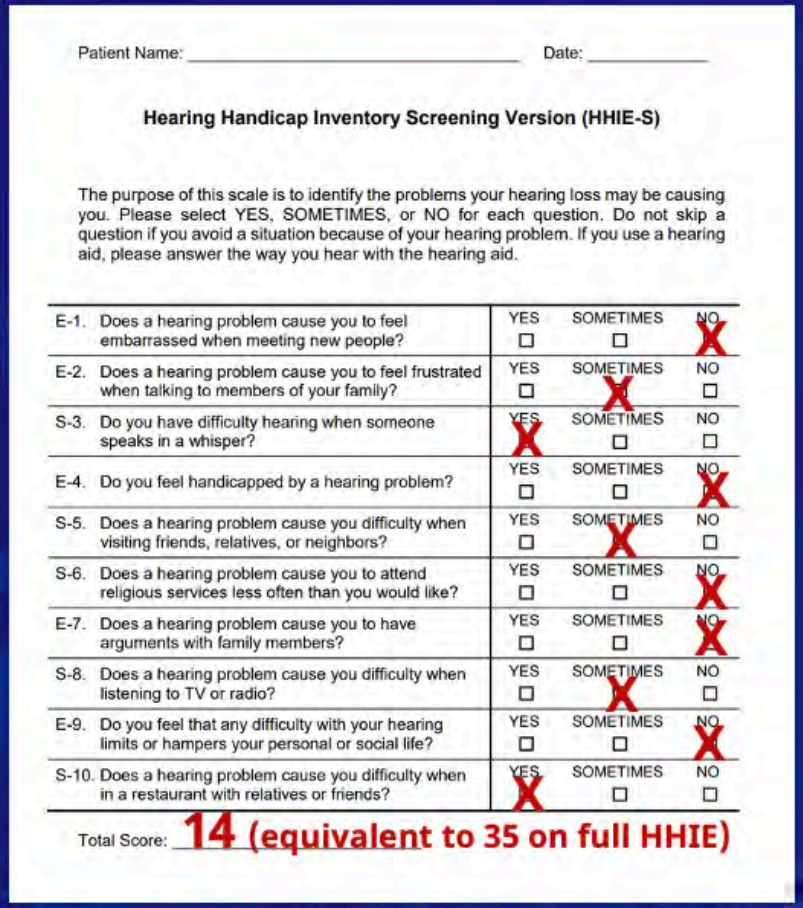
By LARRY HUMES, PhD

Hearing Review, July, 2020

World Health Organization (WHO) grades of hearing-impairment (better ear average of 500, 1000, 2000 & 4000 Hz)

- 0=No impairment; PTA better than 20 dB
- 1=Mild; PTA 20–34 dB
- 2=Moderate; PTA 35–49 dB
- 3-Moderately severe; PTA 50–64 dB
- 4-Severe; PTA 65–79 dB
- 5-Profound impairment; PTA 80–94 dB

Hearing Handicap Inventory for the Elderly (HHIE)



Patient Name: _____ Date: _____

Hearing Handicap Inventory Screening Version (HHIE-S)

The purpose of this scale is to identify the problems your hearing loss may be causing you. Please select YES, SOMETIMES, or NO for each question. Do not skip a question if you avoid a situation because of your hearing problem. If you use a hearing aid, please answer the way you hear with the hearing aid.

		YES	SOMETIMES	NO
E-1.	Does a hearing problem cause you to feel embarrassed when meeting new people?	☐	☐	X
E-2.	Does a hearing problem cause you to feel frustrated when talking to members of your family?	☐	X	☐
S-3.	Do you have difficulty hearing when someone speaks in a whisper?	X	☐	☐
E-4.	Do you feel handicapped by a hearing problem?	☐	☐	X
S-5.	Does a hearing problem cause you difficulty when visiting friends, relatives, or neighbors?	☐	X	☐
S-6.	Does a hearing problem cause you to attend religious services less often than you would like?	☐	☐	X
E-7.	Does a hearing problem cause you to have arguments with family members?	☐	☐	X
S-8.	Does a hearing problem cause you difficulty when listening to TV or radio?	☐	X	☐
E-9.	Do you feel that any difficulty with your hearing limits or hampers your personal or social life?	☐	☐	X
S-10.	Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?	X	☐	☐

Total Score: **14 (equivalent to 35 on full HHIE)**

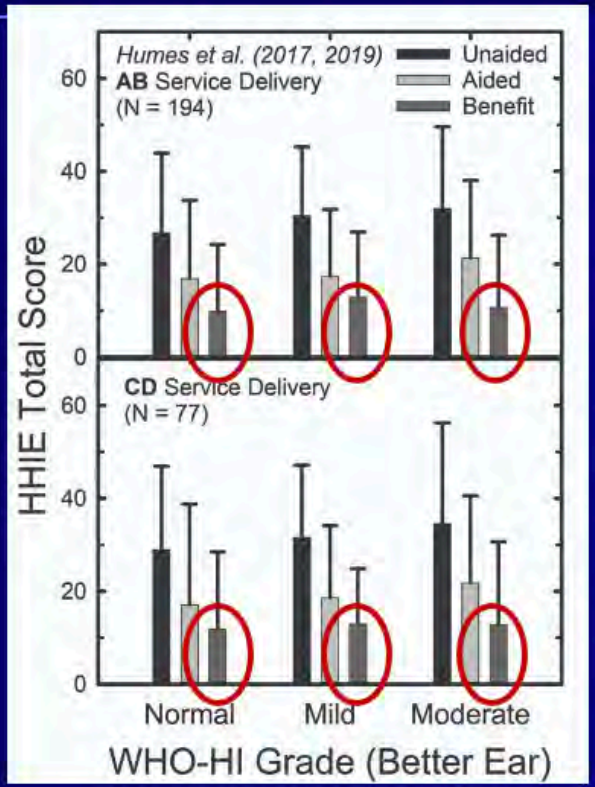
General HHIE-S Interpretation:

0-8: No significant perception of hearing handicap

10-22: Mild to moderate perception of a hearing handicap

>22: Perception of a severe hearing handicap

Chart based on revised WHO hearing-impairment grading system; severity quantified by the pure-tone average at 500, 1000, 2000, and 4000 Hz in the better ear.



- For the unaided HHIE scores (black bars), all three groups reported perceived hearing difficulties to be about the same, with mean HHIE-Total scores ranging from about 27 to 33.
- There were no significant differences in mean HHIE benefit among the three groups in either panel.
- At the end of the clinical trial, *nearly 80% of those in the "normal" group purchased their hearing aids.*

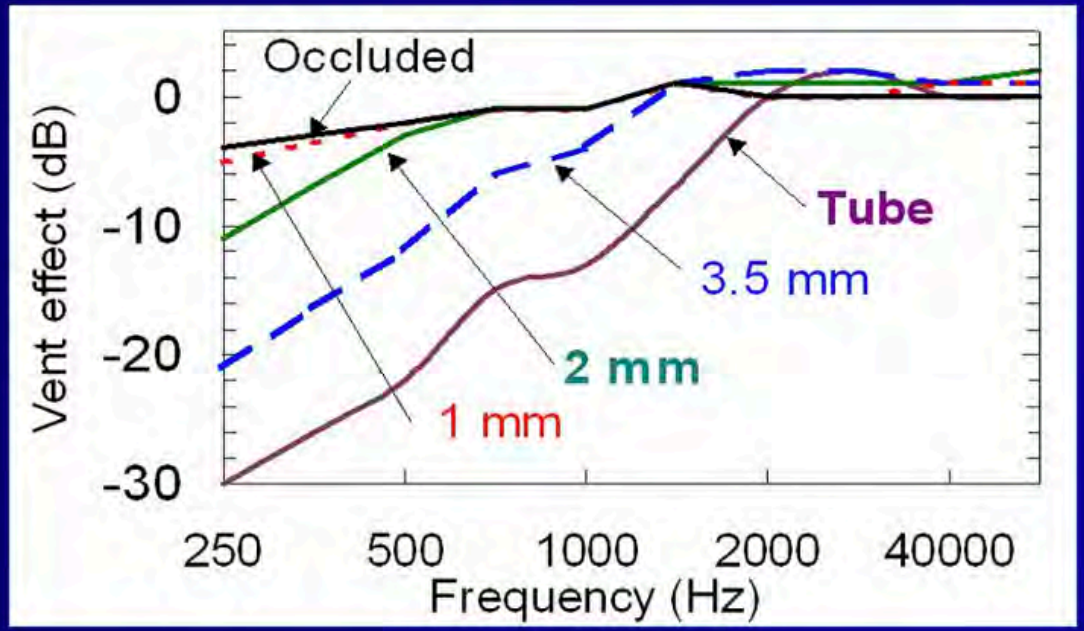
And, the Clinical Nugget is . . .

It is well worth the time investment to give the HHIE/A (screening version) to most all adult patients.

Four general areas:

- Pre-fitting Considerations
- Signal Processing and Features
- Verification
- Post-Fitting/Validation

How much does the earmold matter? You probably remember this chart from some point in your audiologic training



From Dillon, 1985

# These authors will tell you: If you're using instant-fit tips and domes, you can forget about that chart!

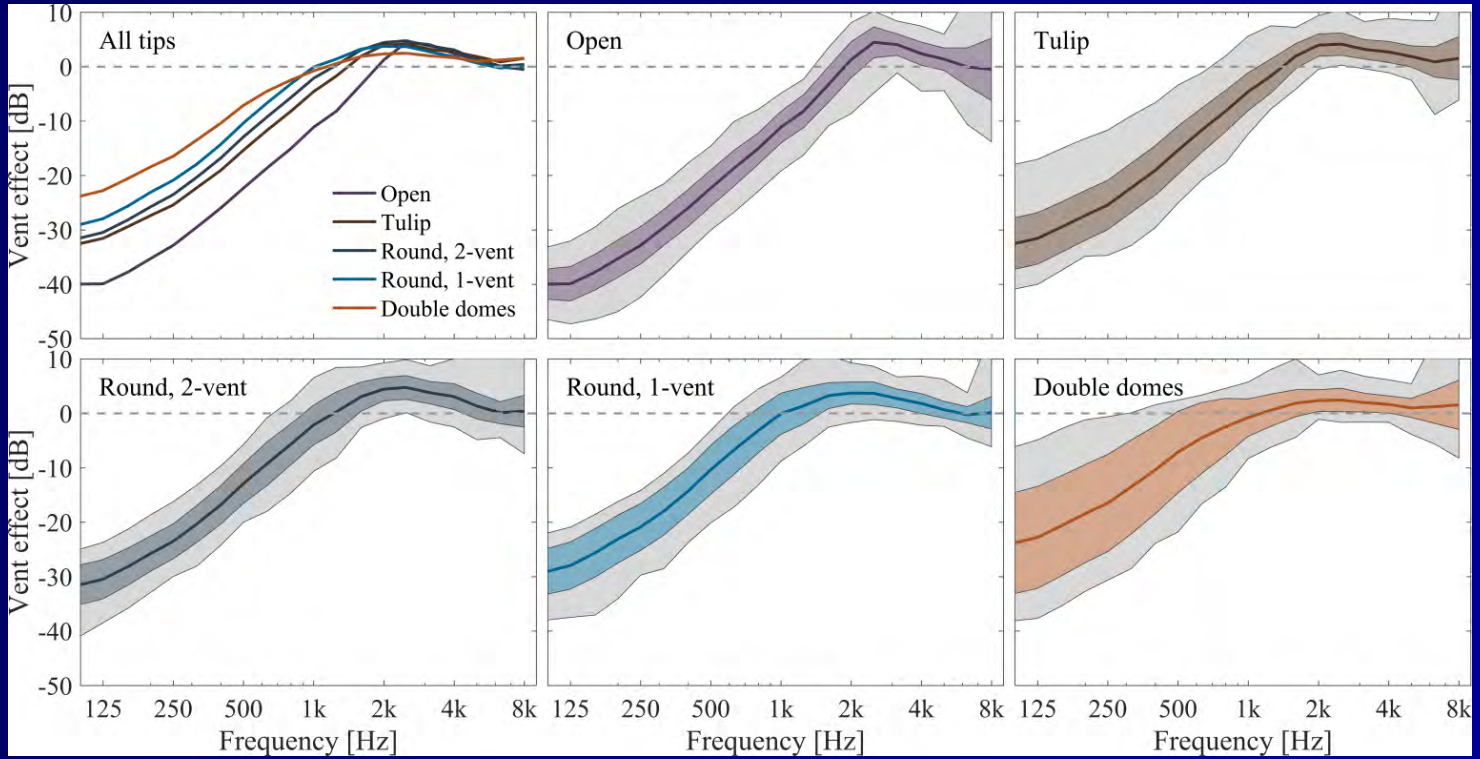
Challenges of instant-fit ear tips: What happens at the eardrum?

Balling LW, Jensen NS, Caporali S, Cubick J, Switalski W.

Hearing Review. 2019;26(12)[Dec]:12-15.

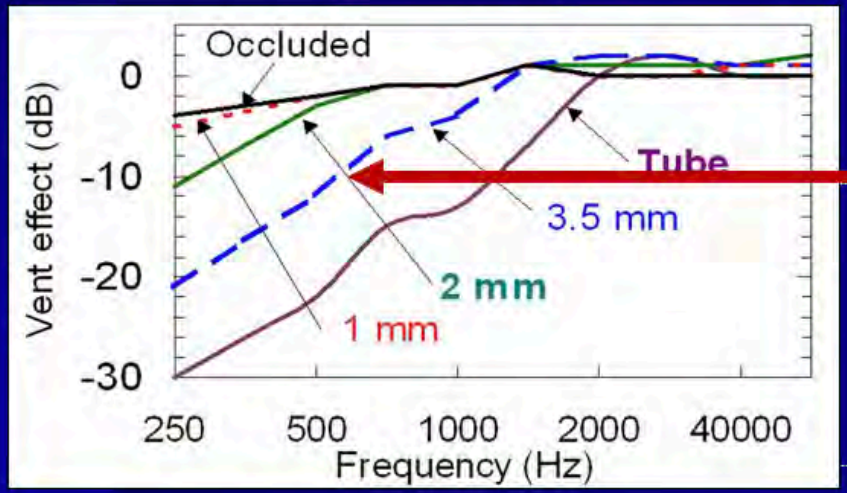
What we see from instant-fit tips is quite different

(From Balling, Jensen, Caporali, Cubick & Switalski, 2019, Hearing Review)

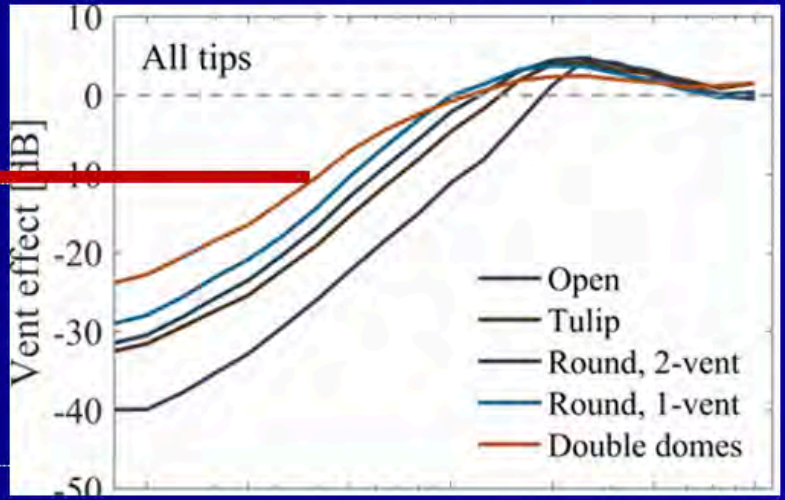


What are manufacturers using in their software for a "closed" instant eartip?

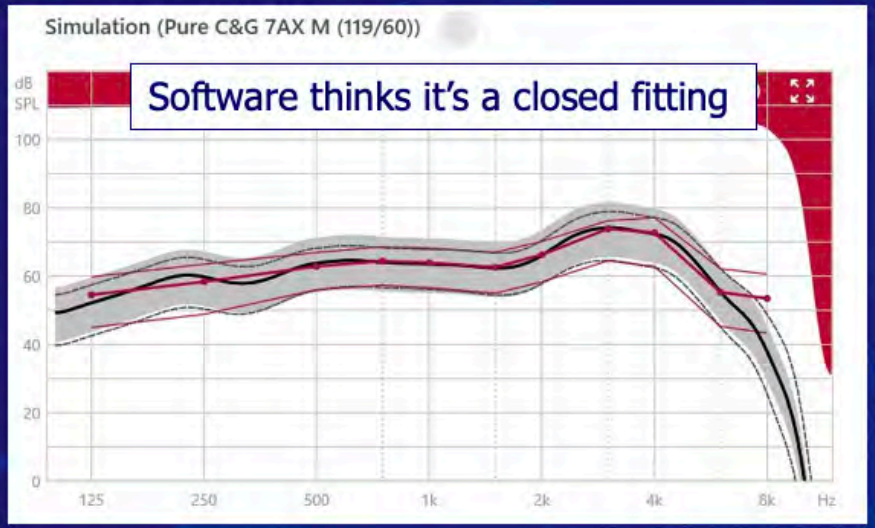
THIS?

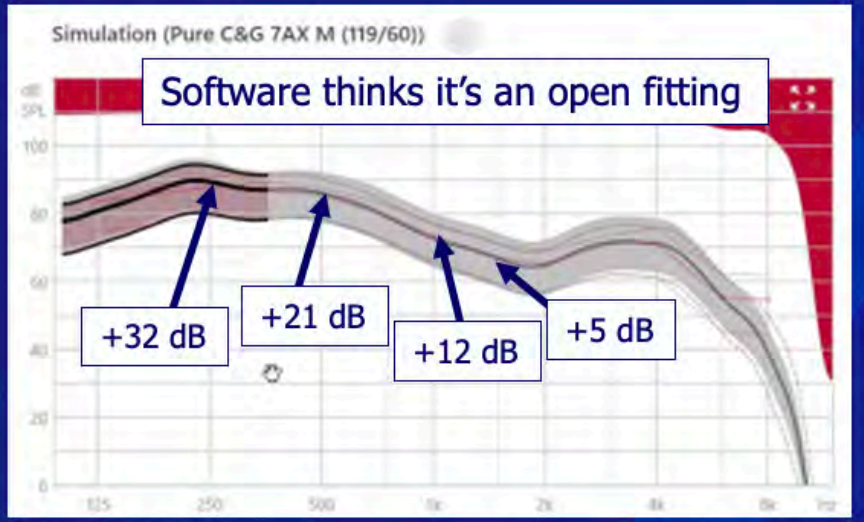


OR THIS?



What if . . . What if you didn't do probe-mic verification?





Simulated software-programmed output (2-cc coupler) for NAL-NL2 fitting for moderate downward sloping hearing loss

And, the Clinical Nugget is . . .

If you're fitting instant tips and not conducting probe-mic verification, you might end up with a very different frequency response than what is indicated by the software.

And how does the openness affect directional processing benefit?

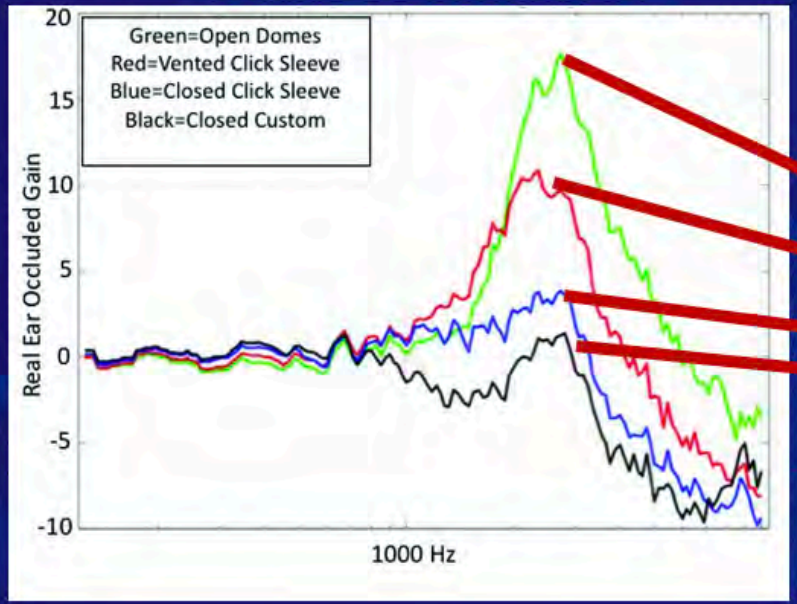
Matthias Froehlich, PhD, is head of Audiology Marketing and **Veronika Littmann, PhD**, is Team Leader of R&D Audiology Systems Development at Sivantos GmbH in Erlangen, Germany.

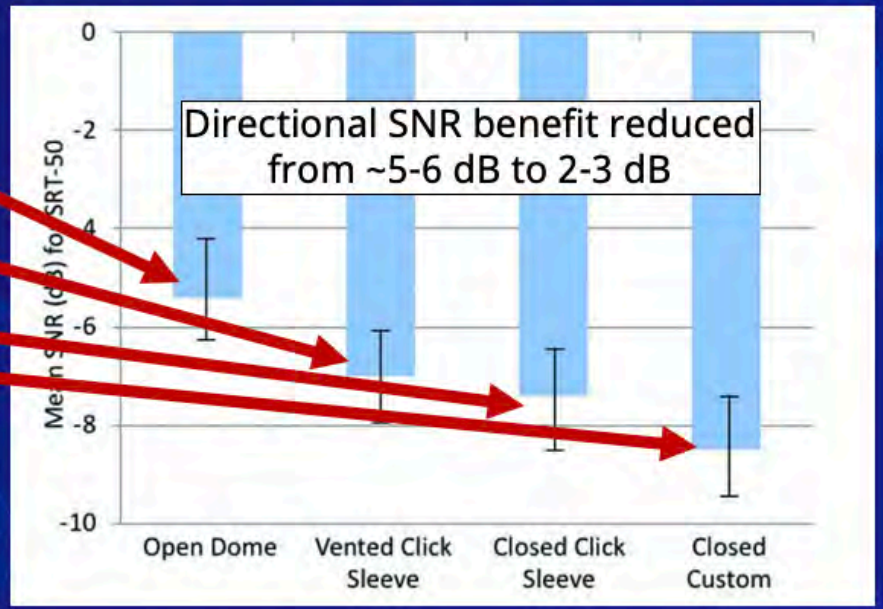
Closing the open fitting: an effective method to optimize speech understanding.

Froehlich M, Littmann V.

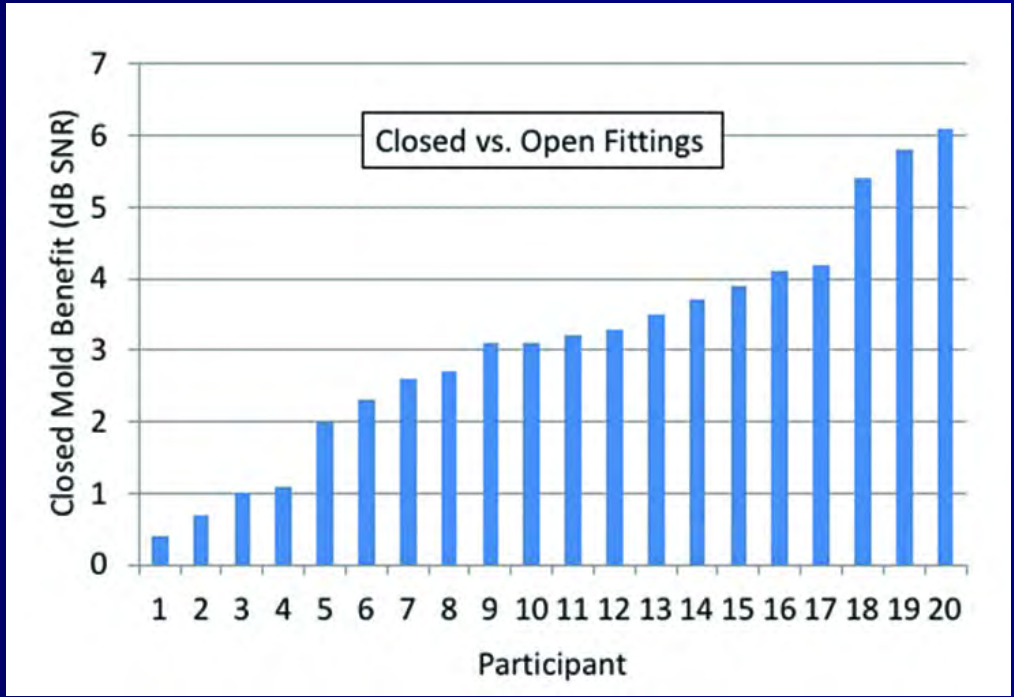
Hearing Review. 2019;26(4)[Apr]:16-20.

The REOG (openness) is directly related to the SNR advantage provided by directional technology

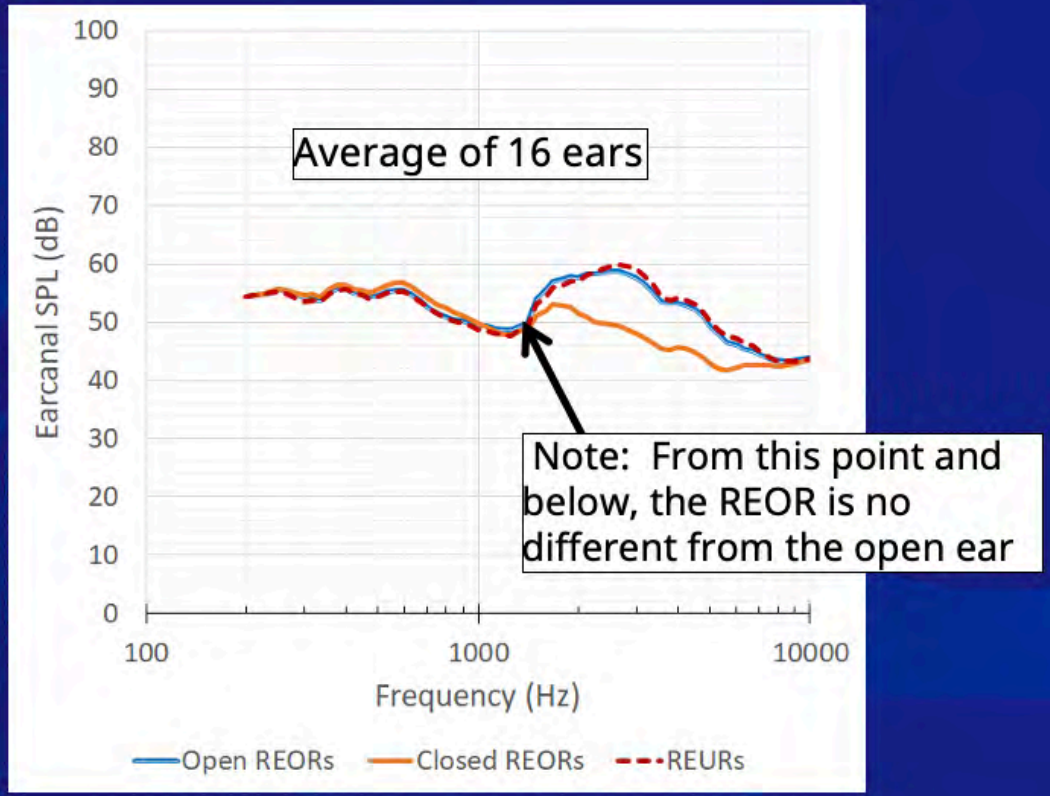




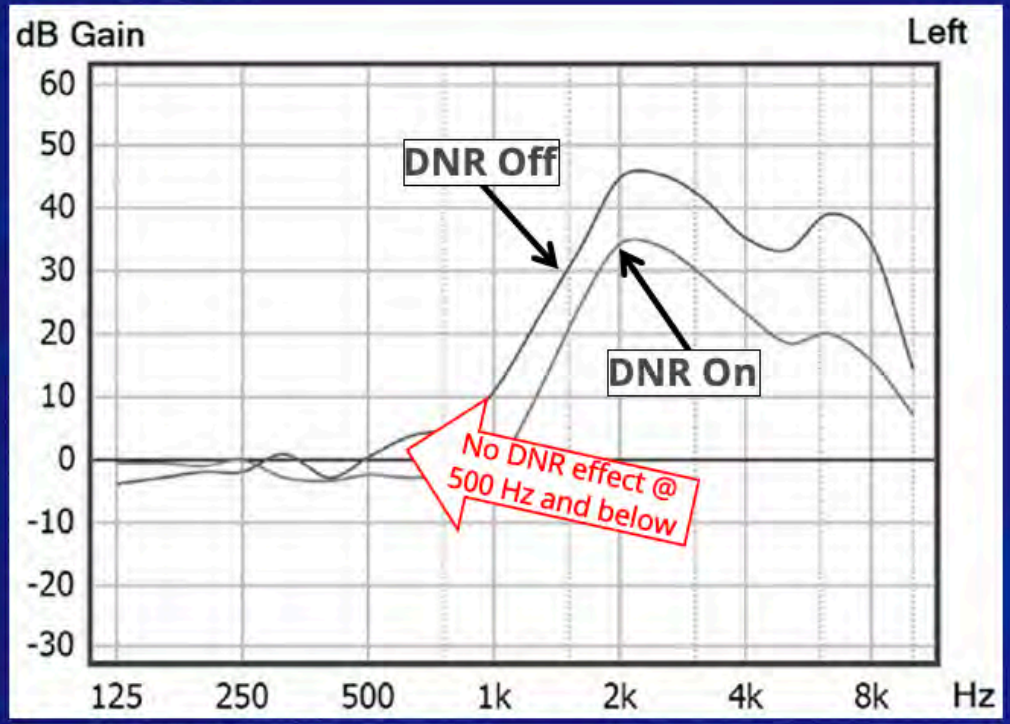
The “benefit” for the closed fitting was quite large for some individuals



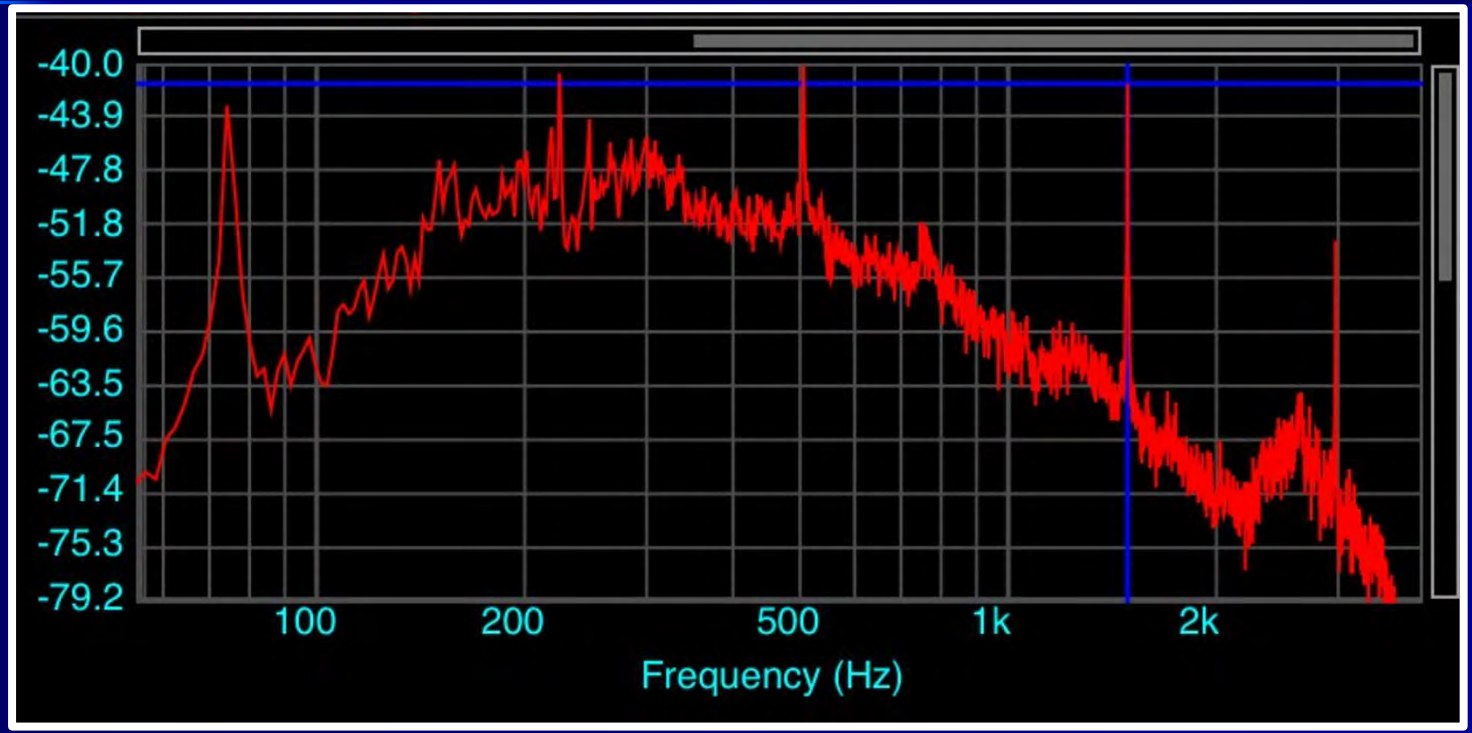
Sample average REORs using fitting domes labeled “closed”: Impact on DNR?



Effects of open fitting on DNR—Max setting



And where is the peak of most background noise?



And, the Clinical Nugget is . . .

If you think you're fitting a "closed" instant-fit dome, but it's really open, you might have very different signal processing than what you desire.

Facebook site: Audiology Happy Hour

I have a patient who really needs good noise reduction. What brands have you all been having good luck with?

Hey there hive—I need your help. What manufacturer has the best directional technology?

What I’ve never seen posted . . .

This article gives us a glimpse of how good signal classification systems really are

A Comparison of Environment Classification Among Premium Hearing Instruments

Yellamsetty A, Ozmeral E, Budinsky R, & Eddins D.

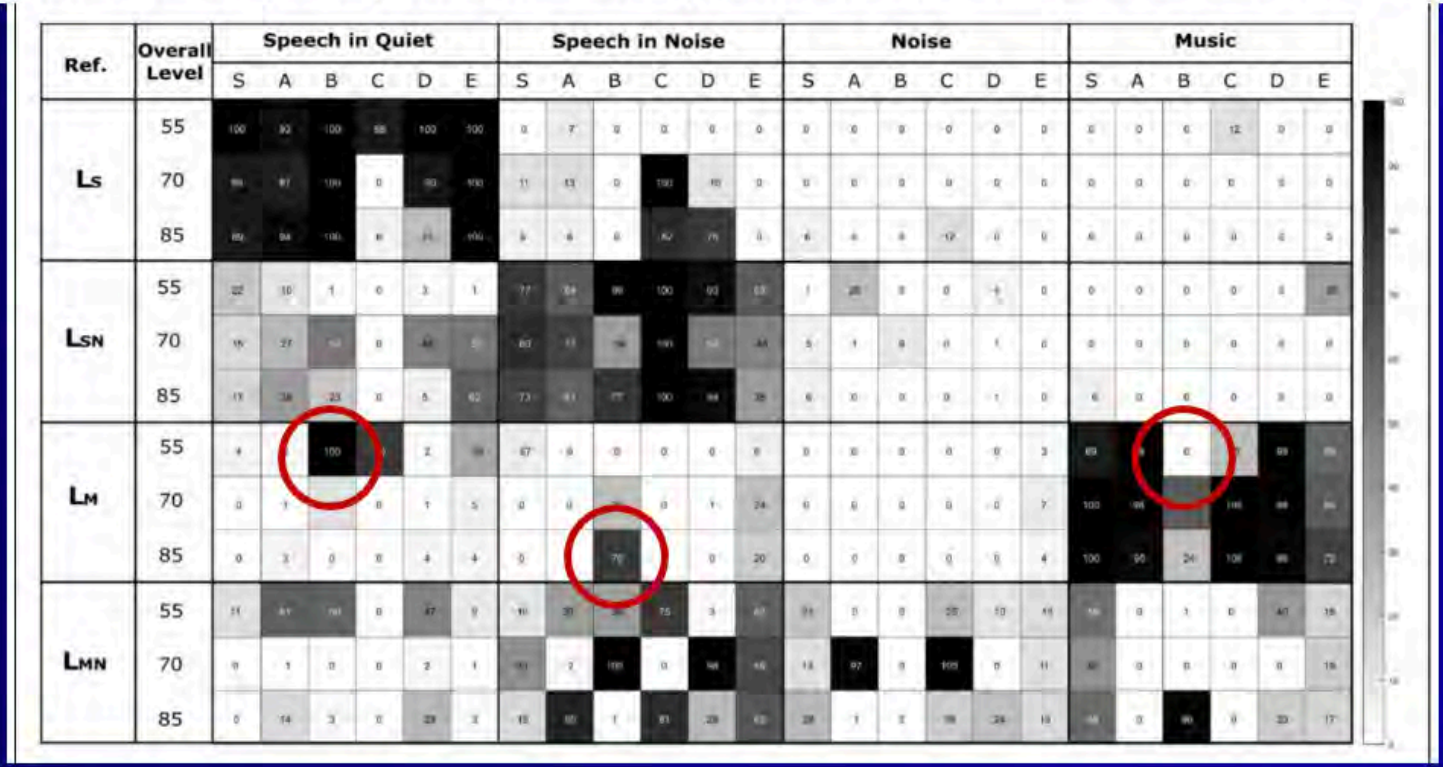
Trends In Hearing, 2021

What they did . . .

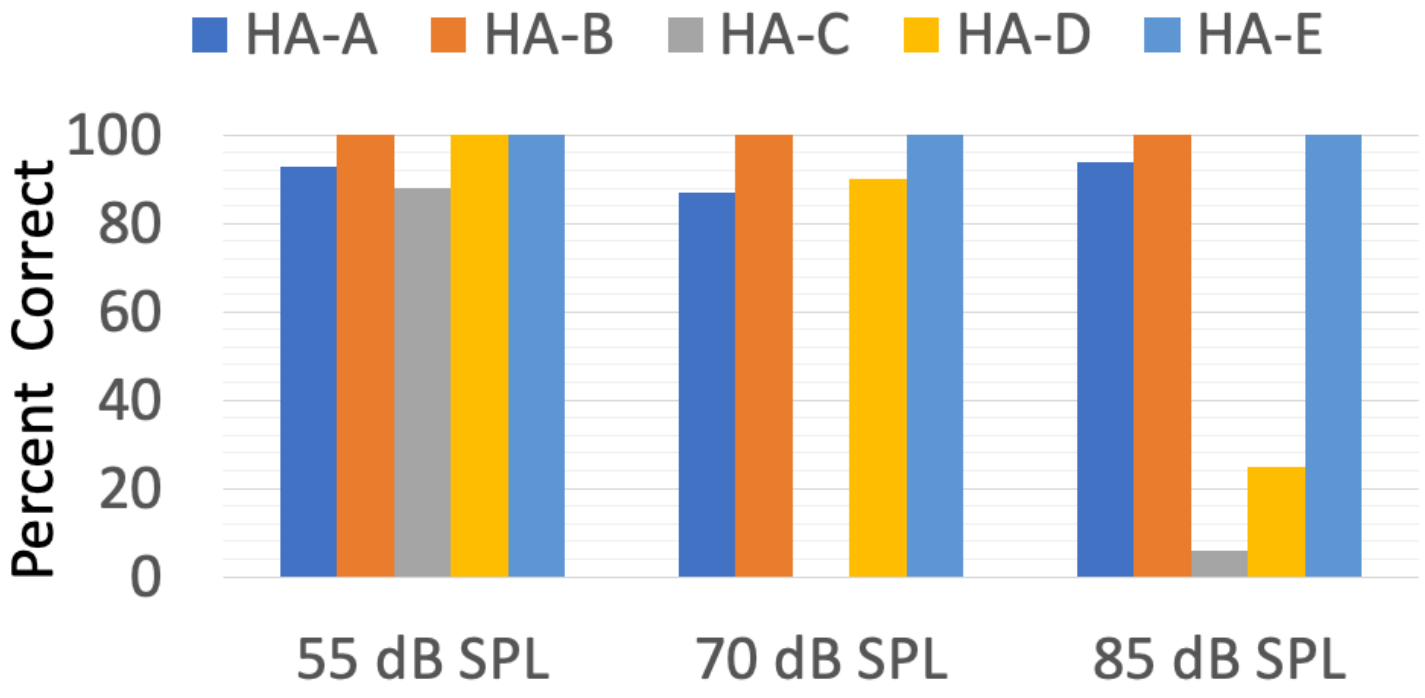
- Compared the classification schemes among five premium hearing instruments. Instruments programmed to each companies default proprietary algorithm.
- Twenty-eight acoustic scenes representing various prototypical environments were presented to the five devices mounted on an acoustic manikin. The scenes varied in content, overall SPL and SNR.
- The music was from jazz artist (Ella Fitzgerald, “My Baby Just Cares for Me”) presented in stereo from loudspeakers at 45° and 315°.

The ratings:

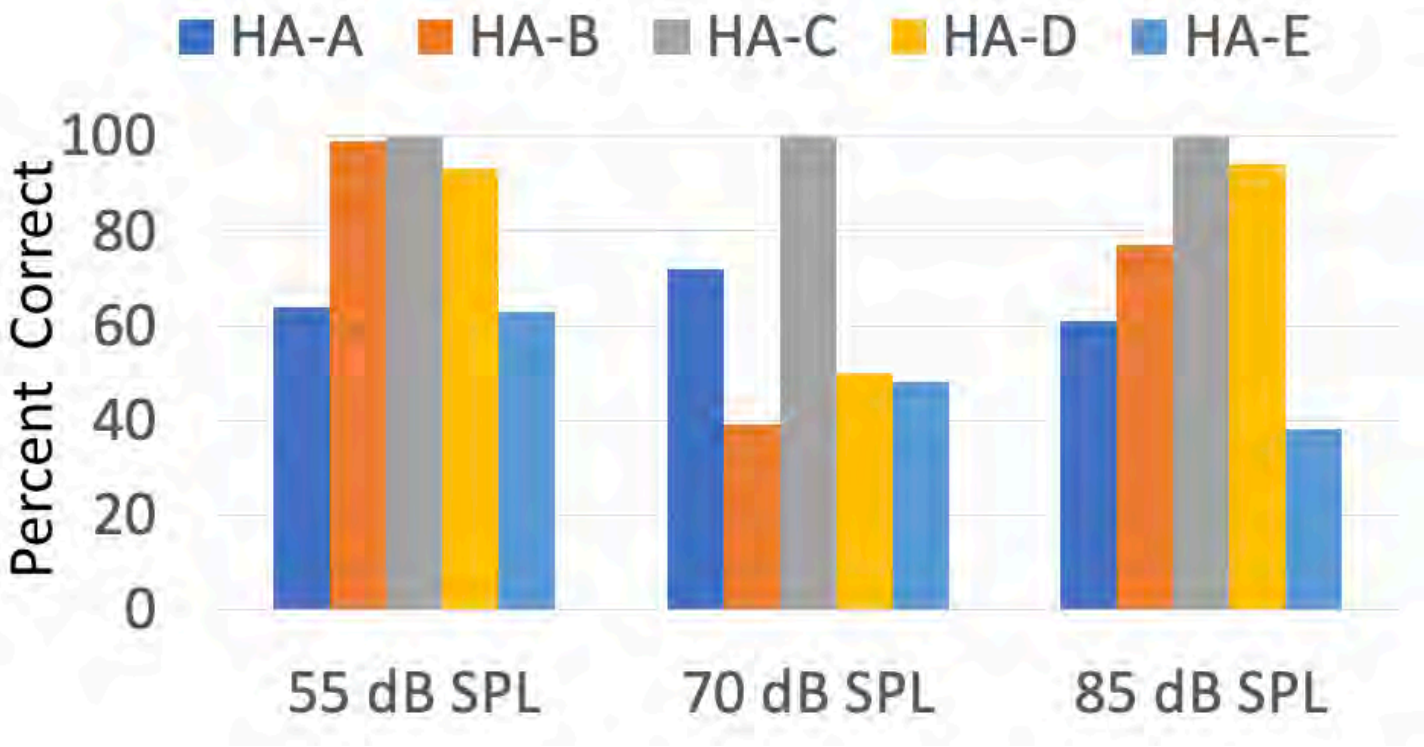
The darker the square, the more frequent the classifier selected that category



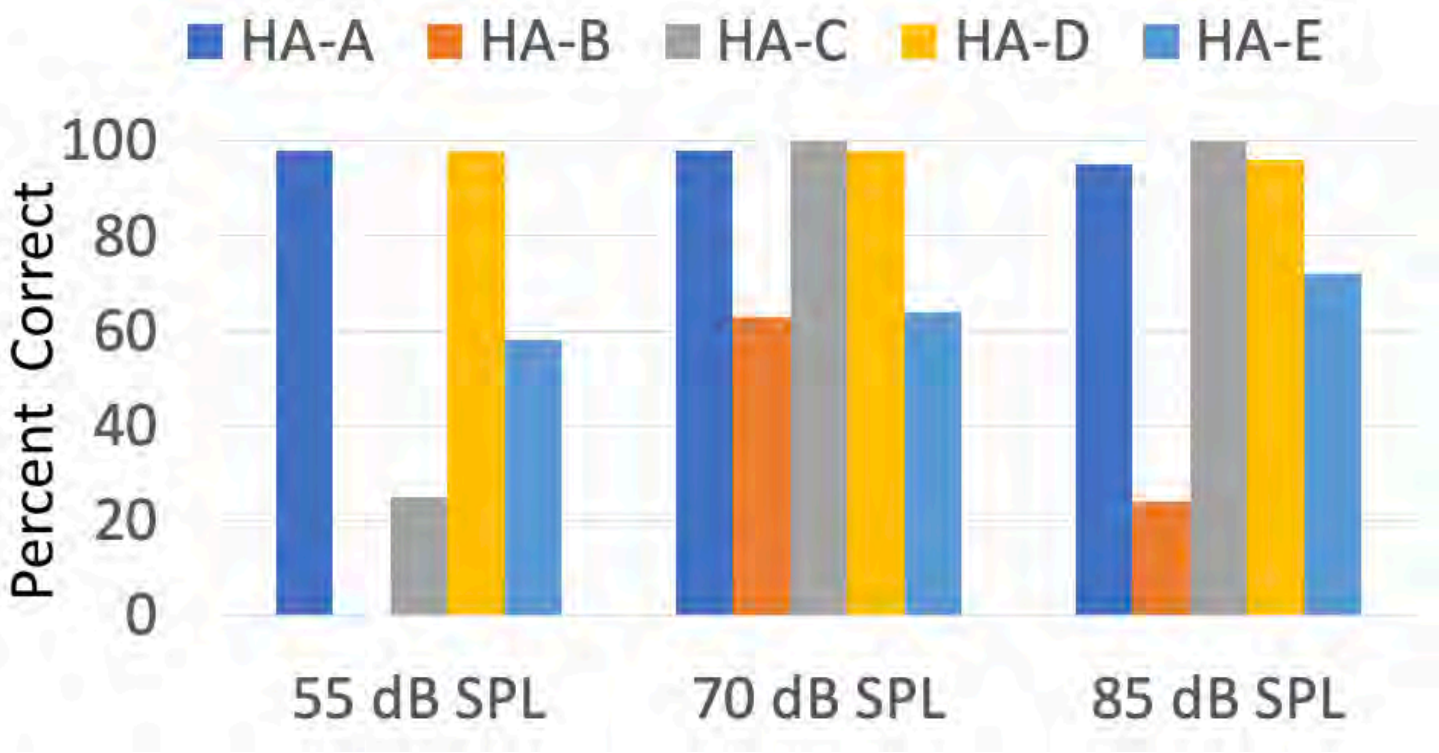
Back and forth conversation between a man and a woman in quiet



Male and female conversation at noisy food court: SNR +5 dB (@ at 3 different SPL levels)



Jazz Music With Vocal



And, the Clinical Nugget is . . .

When a patient has a complaint about not receiving appropriate benefit from directional technology or noise reduction—consider that it simply may be because the hearing aids are not classifying signals correctly.

Four general areas:

- Pre-fitting Considerations
- Signal Processing and Features
- Verification
- Post-Fitting/Validation

Using autoREMfit for Hearing Aid Fitting and Verification: Evidence of Accuracy and Reliability

By JOHN PUMFORD, AuD, and H. GUSTAV MUELLER, PhD

This clinical study examines the new autoREMfit application of Audioscan VerifitLINK as integrated into Signia Connexx hearing aid fitting software. The results reveal good fit-to-target accuracy (RMSE ~2 dB; 65 dB SPL input) for two different audiograms and coupling systems. Test-retest reliability was excellent with no value greater than 1 dB at any frequency. Clinical benefits of this autoREMfit collaboration are discussed.

Certainly one of the most critical aspects related to the fitting and dispensing of hearing aids (HA) is ensuring that the gain and output have been optimized for a given user across frequencies. While to some extent, this is patient-specific, we do know that on average, the best starting point is a validated prescriptive fitting method, such as the NAL-NL2[1] or the DSLv5.0.[2] Research has shown that a verified fitting to either of these validated generic fitting formulas will provide increased benefit when compared to alternative choices, such as the manufacturers' proprietary fittings in both adults and pediatrics (see Mueller, Ricketts, and Bentler[3] for a review). Clinical studies have also shown that the manufacturers' versions of these validated generic fitting formulas typically do not result in targeted behavior in the real-ear (including when there is a perfect match to target displayed by the software simulated output).[4,5]

John Pumford, AuD, is Director of Audiology and Education at Audioscan Dorchester, Ontario, and **H. Gustav (Gus) Mueller, PhD**, has faculty appointments at Vanderbilt, Rush, and Northern Colorado Universities, and is Contributing Editor at AudiologyOnline. His home office is in Bismarck, ND.

This evidence leads to the logical conclusion that real-ear probe-microphone verification is necessary for all hearing aid fittings.

Probe-microphone (aka real-ear) measures, as we know them today, have been clinically available for 35 years. The use of this verification approach has been part of all clinical guidelines from professional organizations that have been written since that time. Some documents, in fact, go so far as to state what frequency-specific dB deviations from prescriptive targets are allowable.[6,7] Despite the logical need for real-ear verification, and the support from professional organizations, many hearing care providers (HCPs) do not conduct this testing at all, or do not use it to verify prescriptive targets. Surveys from past years indicate that probably no more than 30-40% of HCPs fitting hearing aids routinely conduct probe-mic measures, and many who do, do not use them for validating prescriptive targets.[8,9]

There are many reasons why verification to prescriptive targets is not a routine practice (see Mueller et al[3] for discussion). It is tempting to think that ownership of the equipment is a major factor. This doesn't appear to be true, as examined in the Mueller and Picou survey.[4] We can, however, come up with several possible reasons why these disparate findings exist, including: the perceived complexity of the hearing aid programming that would be involved, the HCP is not skilled in probe-mic techniques and procedures, and/or the real-ear fit-to-target process is perceived as too time consuming.

To address in part these issues, hearing aid and real-ear equipment manufacturers have partnered to develop an automated method for fitting to prescriptive targets, which we'll refer to as autoREMfit (each company tends to have their own name for the procedure; see Mueller and Ricketts for a review[10]). AutoREMfit isn't something new; it has been around for 20 years,[11] but there recently has been an increased interest.

In principle, with autoREMfits, the hearing aid manufacturers' software exchanges measurement and control data with the verification equipment, assessing the difference between the real-time measured output and the desired (target) output to make HA programming adjustments until a match to target is obtained. The HCP still has to make some pre-fitting decisions in the HA fitting software, ensure that the patient is seated correctly and the probe tube placement is appropriate, but the fit-to-target itself is automatic. Today, there are at least five different verification equipment companies that have partnered with four leading hearing aid manufacturers (and their affiliates) to develop an autoREMfit option.[12] Overall, research with these different autoREMfit approaches has shown them to be reasonably accurate and reliable.[13-18]

As reviewed by Mueller,[12] there are several potential advantages to using autoREMfit. First, the fit-to-target most likely is faster than that accomplished with traditional HCP programming, even for an experienced provider.[14,15] For someone who is new to programming hearing aids, the autoREMfit is likely more accurate and consistent than the HCP-fit. The procedure also comes in handy when the need arises to program hearing aids that the HCP normally doesn't work with. Finally, the automated procedure is indeed impressive, and could be used as a sales tool, helping to ensure patient confidence in the fitting.

There are, however, some potential concerns.[18] Some autoREMfit implementations fit only to the REIG, not to output targets (ie, the REAR), some systems only fit to average-level inputs, and several autoREMfit systems use the prescriptive targets from the HA fitting software, not those of the verification

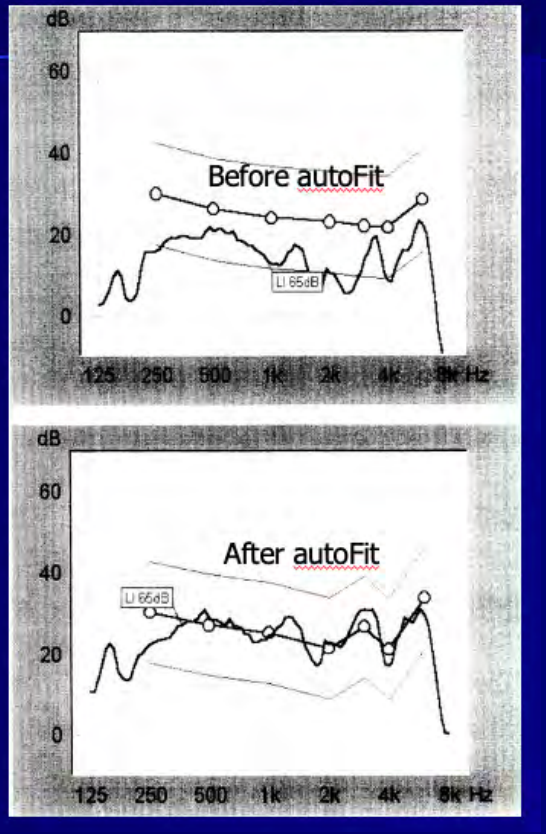
Studied autoREMfit for:

- Validity (NAL-NL2)
- Reliability
- For different fittings (open vs. closed)
- For different audiograms

What is autoREMfit?

- It's a method of integrated/automated verification.
- Either the fitting software borrows information from the probe-mic equipment, or the probe-mic equipment borrows information from the fitting software. Most systems will fit to both NAL and DSL and maybe even . . . Gasp . . . Proprietary.
- The audiologist must make the background decisions in the fitting software, ensure that the patient and the probe tube are positioned correctly, and make a few mouse clicks to go through the autoREMfit software.
- The actual programming of the hearing aids, however, is conducted automatically

Is autoREMfit something new?



From: *Trends in Hearing*. Probe-Microphone Measurements: 20 Years of Progress?

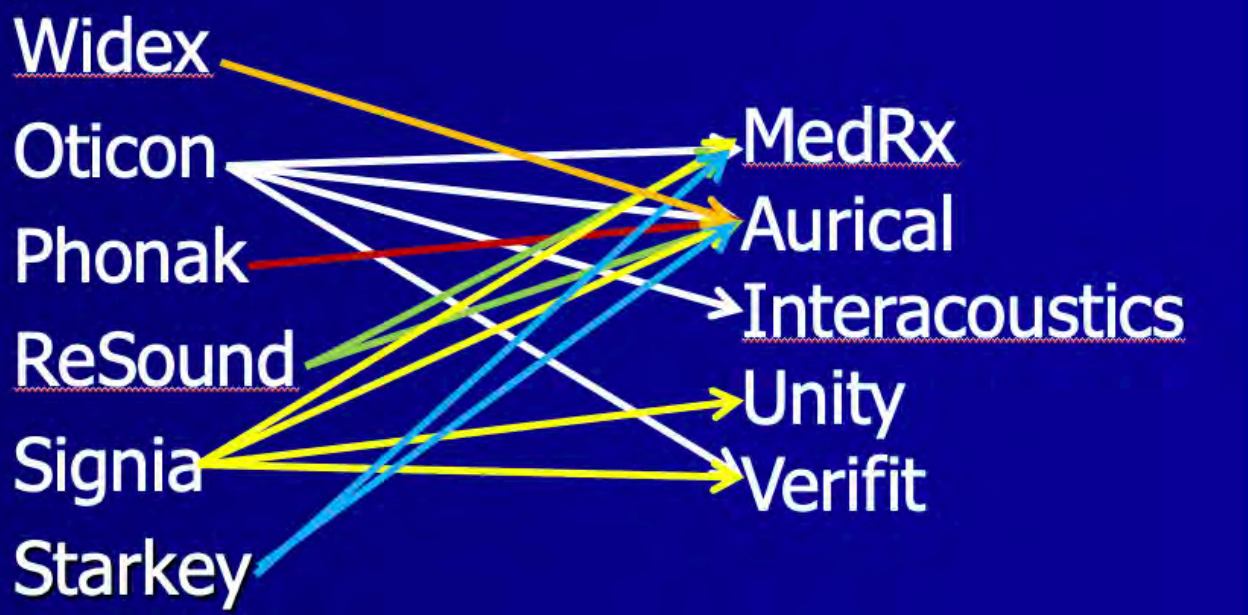
Mueller (2001)

To put that date into perspective

A cell phone with a camera was not available until 2002

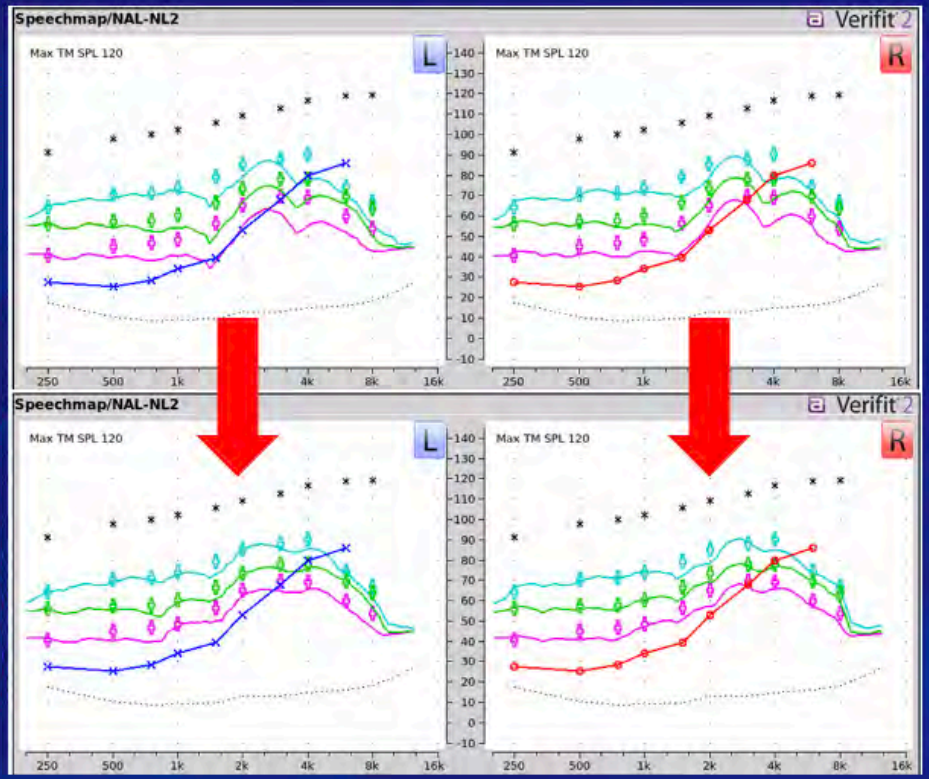
(640 x 480 pixels!)

AutoREMfit: Who is integrated with whom?

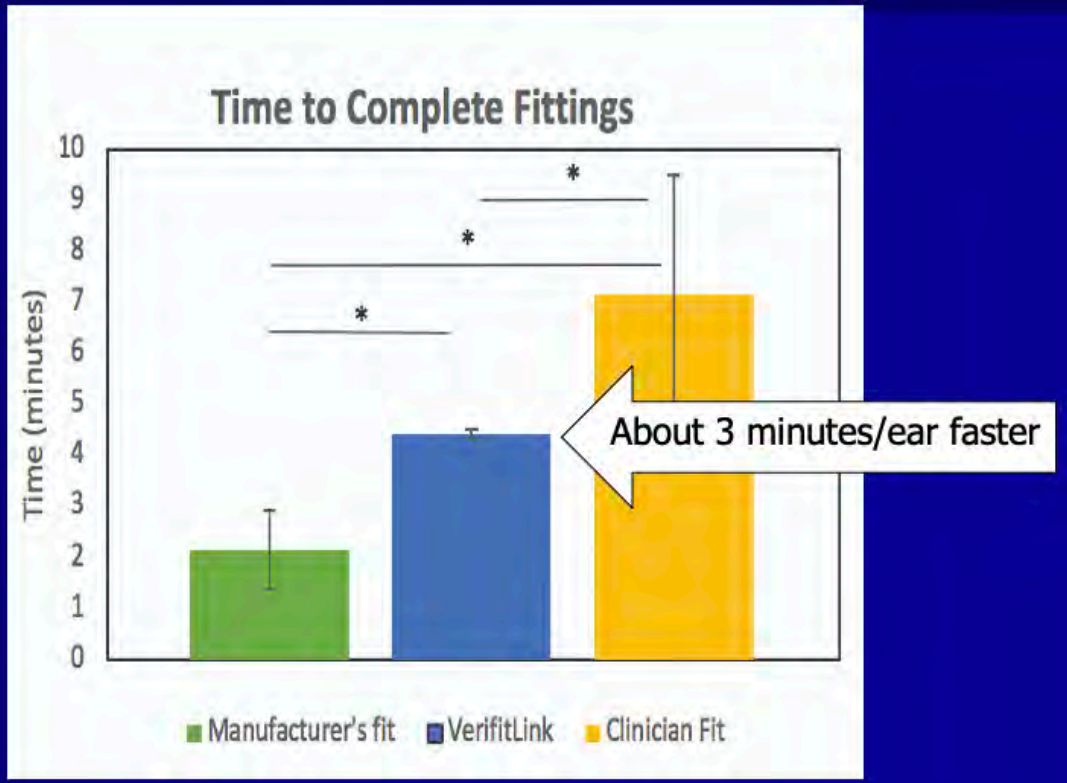


Downstream brands might also be integrated

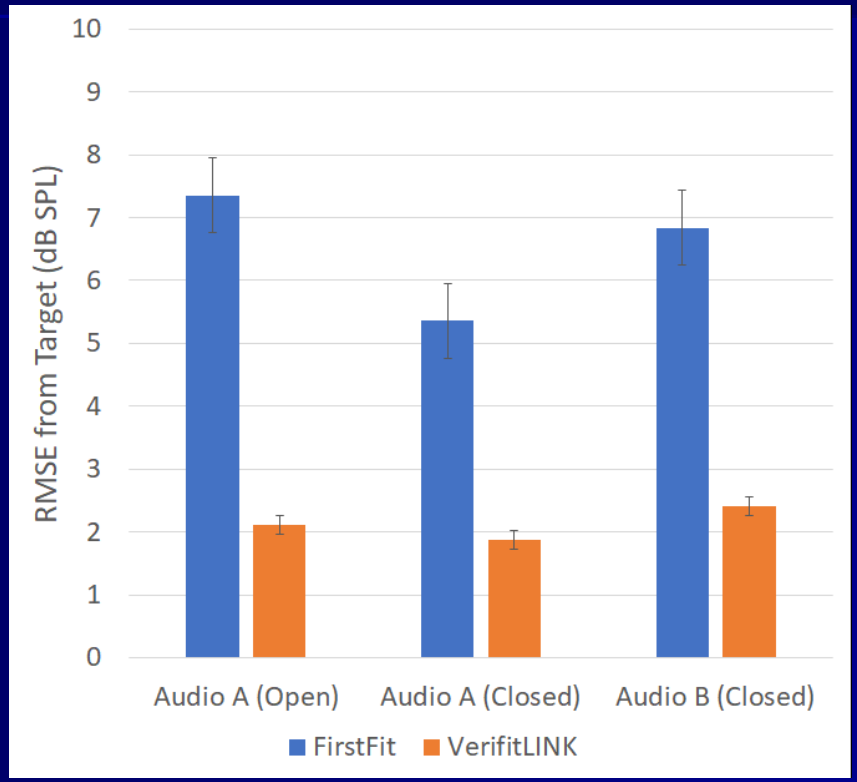
“Before” (top) and “After” (bottom) example of autoREMfit



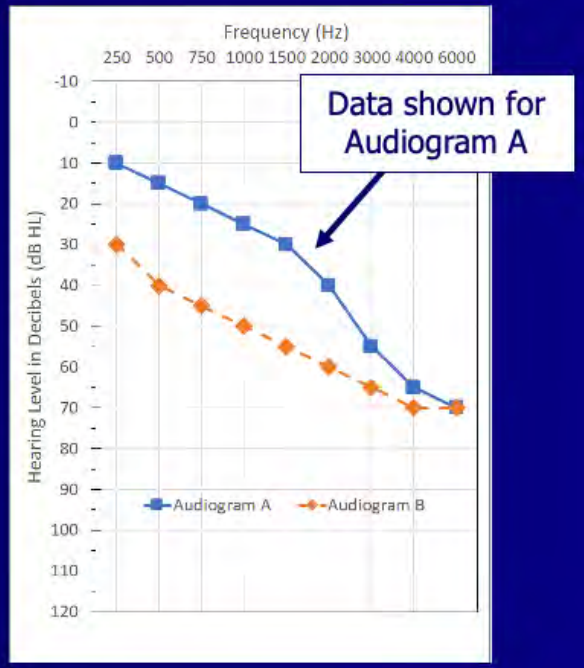
AutoREMfit does save time . . .

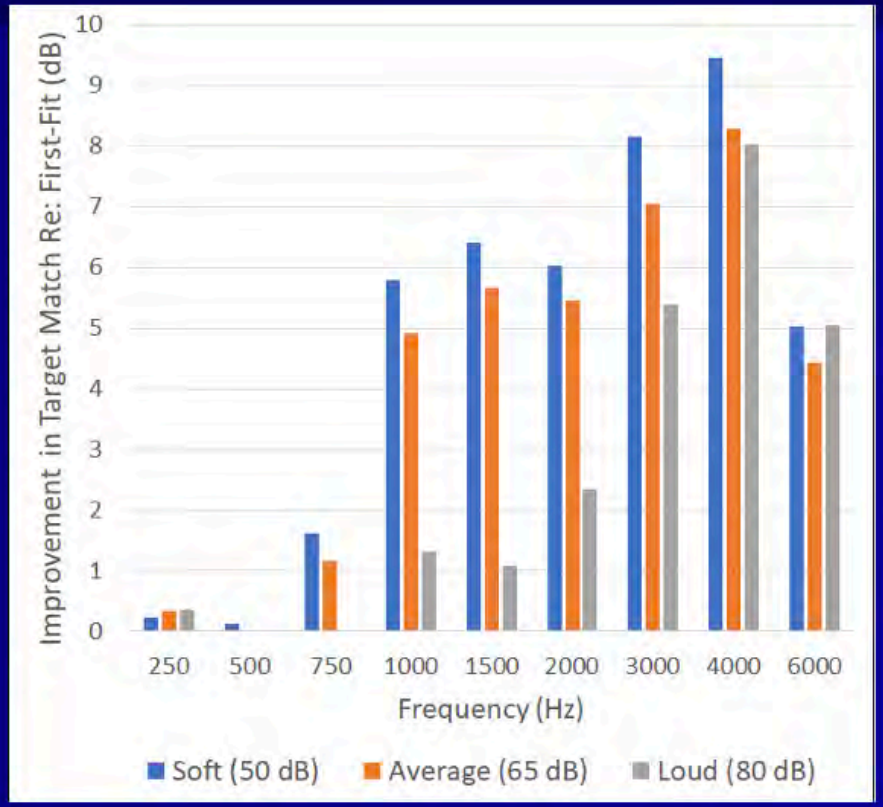


RMS error for autoREMfit (65 dB input) was very good—about 2 dB—as good as "clinician fit"



Degree of improvement in match-to-target compared to default NAL-NL2 fitting when autoREMfit was used



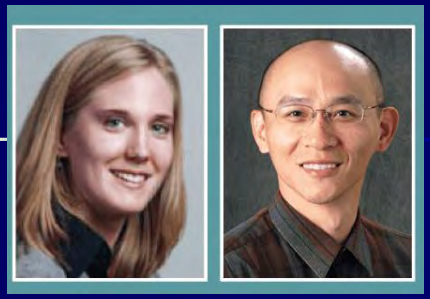


BUT . . .Two issues to consider with autoREMfit

- Some autoREMfit procedures only fit to the 65-dB input. If a match to soft targets doesn't happen, and you have to "fix" soft, you'll probably mess up average, which will need to be re-programmed, which negates the reason for doing autoREMfit.
- Who is the "boss" of the autoREMfit procedure—the fitting software or the software of the probe-mic equipment? If the targets of the hearing aid software are used, which we already know are not correct, the result will not be an autoREMfit, but an auto-REM-no-fit!

And, the Clinical Nugget is . . .

If the manufacturer's NAL-NL2 or DSL is not the "true" prescription, and the software is driving the fitting, the automatic fit-to-target might not be a fit-to-target.

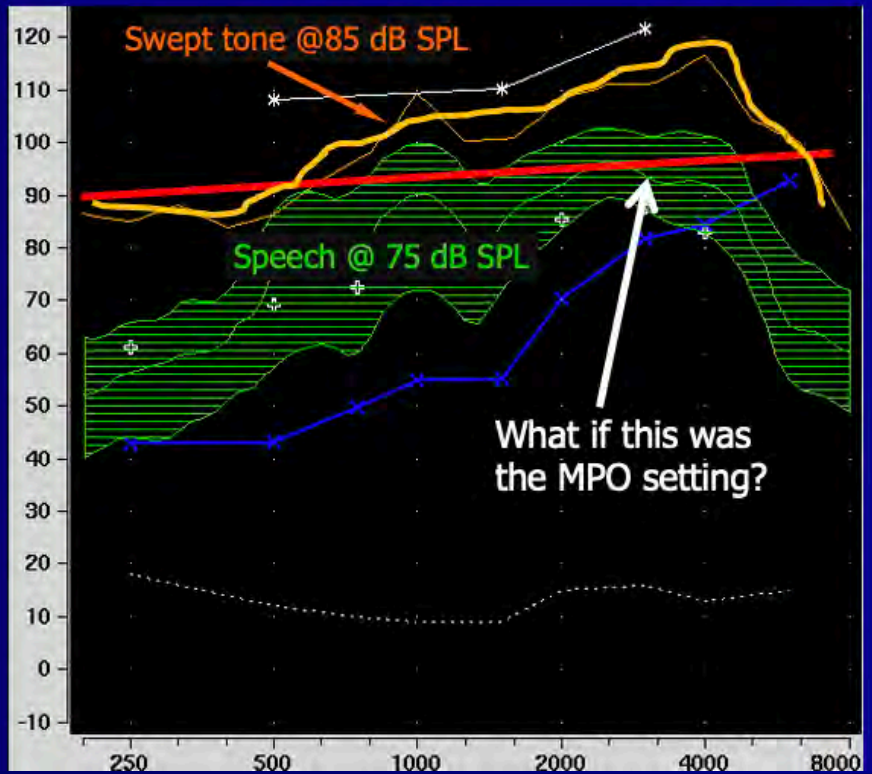


Comparing MPOs from six different hearing aid manufacturers: Headroom considerations.

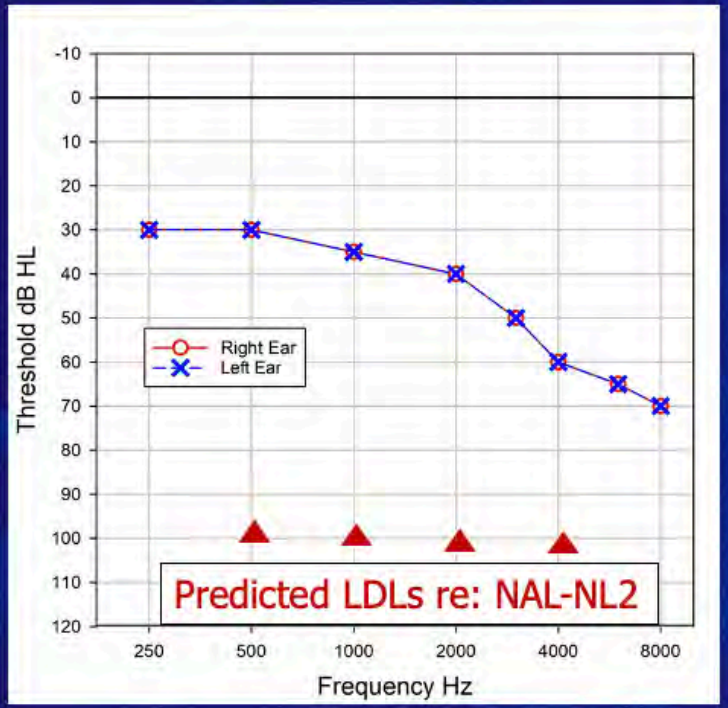
Mueller G, Stangl E, Wu Y-H.
Hearing Review. 2021
28(4):10-16.

We need the MPO set not too “hot” and not too “cold”—but “Just Right”

Important to consider the relationship between the MPO setting and the peaks of speech:



Recent study of MPO in premier hearing aids
(Mueller et al, 2021)

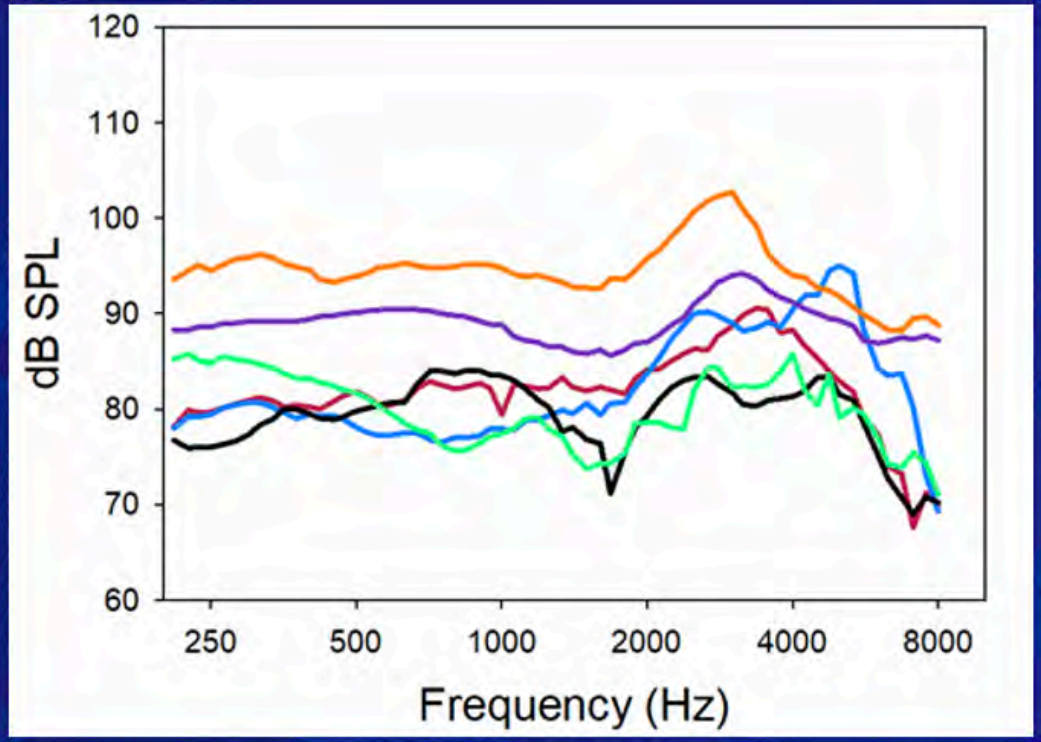


Using this audiogram we:

- Programmed the premier hearing aid from the six major manufacturers to NAL-NL2.
- In a 2-cc coupler, the MPO for each product was assessed (swept tone of 90-dB-SPL)
- The MPO indicated in each manufacturer's fitting software was compared to that prescribed by the NAL (stand-alone software)

Is the MPO controlled by the WDRC or the AGCo?

Note that for four of the six products, the output is limited to 75-85 dB SPL, unnecessarily limiting useful headroom by ~10 to 15 dB.



Noisy restaurant outing: Background noise is ~75 dB SPL (not uncommon)

She raises her voice to 80 dB SPL to overcome background noise (as people will do)

Wearing poorly-fit hearing aids with the max output set to ~75 dB SPL

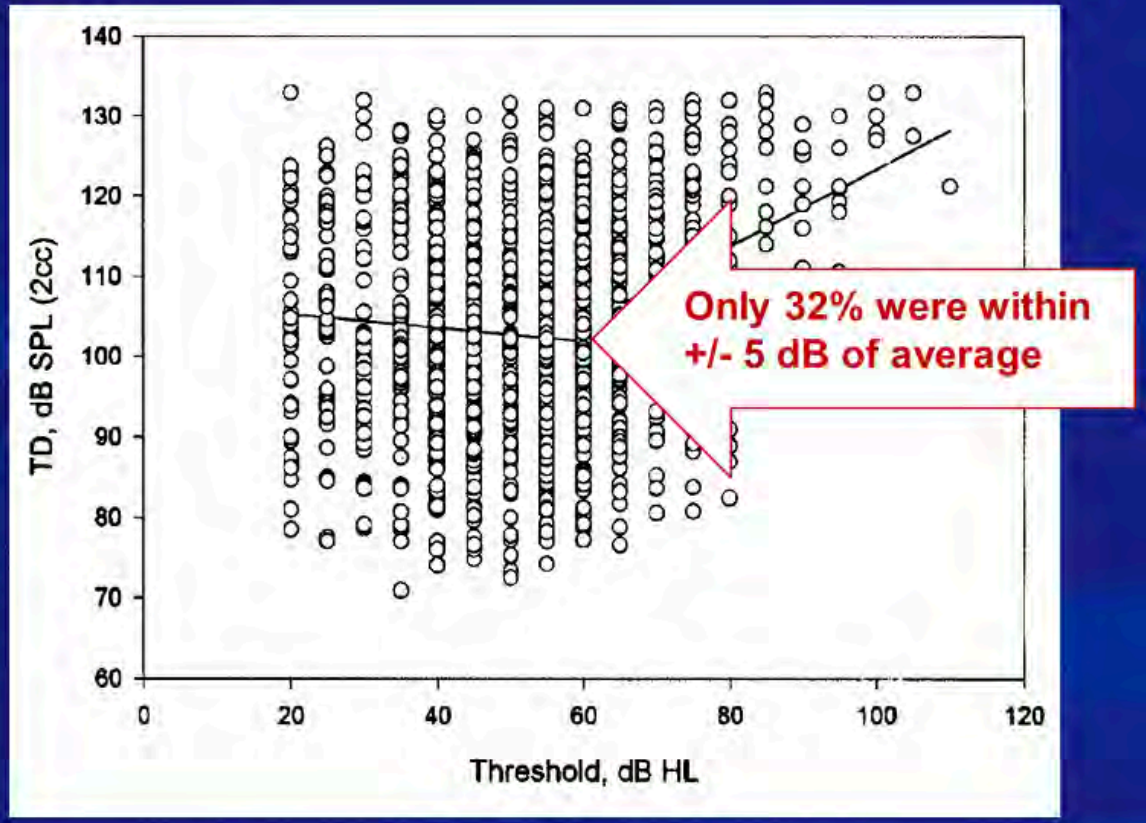
And, the Clinical Nugget is . . .

Setting the MPO too low can have several negative consequences—one of them is reduced speech understanding in background noise.

So how do we ensure that the MPO is set “Just Right?”

Why it is very risky to rely on average values

(From Bentler and Cooley, 2001)



Preferred method for the pre-verification setting of the MPOs (AGCo kneepoints) for a given patient

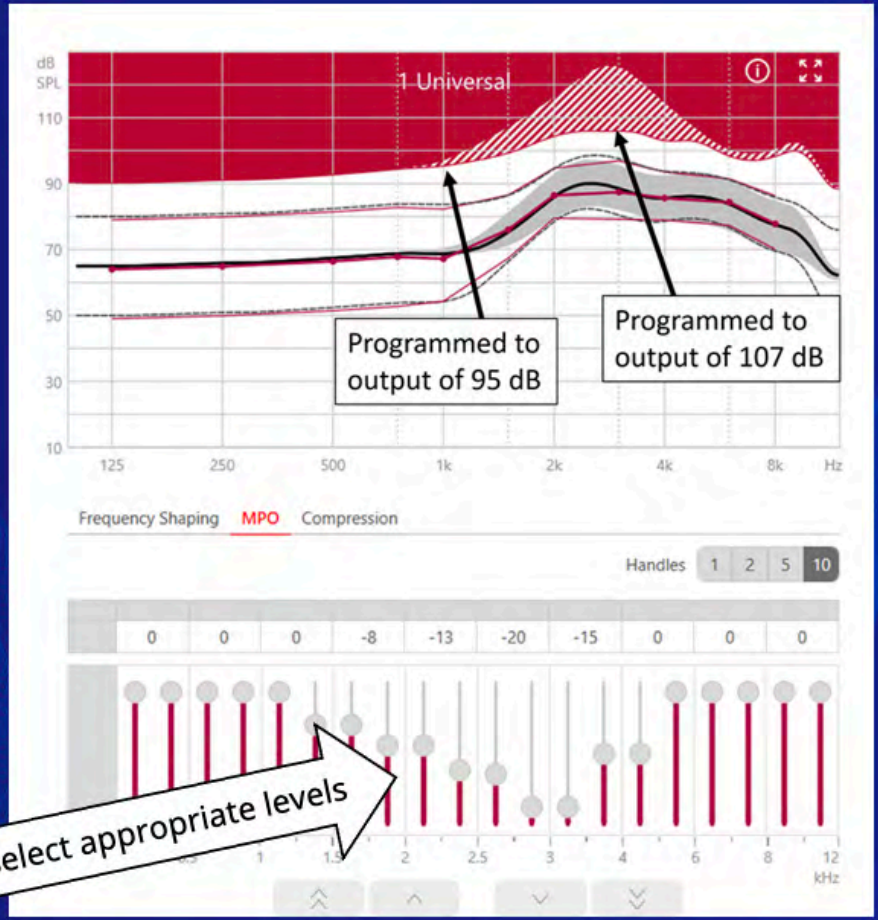
- Step 1: Determine frequency-specific LDLs for 2-3 key frequencies for each ear
- Step 2: Convert these HL values to 2-cc coupler values using RETSPLs. RETSPLs (insert earphones): 500 Hz=8 dB, 1000 Hz=3 dB, 2000 Hz=5 dB, 3000 Hz=3 dB, and 4000 Hz=7 dB.
- Step 3: Go to the output controls in the fitting software, and use these 2-cc values to set the frequency-specific MPOs

Example:

HL LDLs are 92 dB at 1000, 104 dB at 3000 HZ

RETSPLs for both 1K and 3K are 3 dB

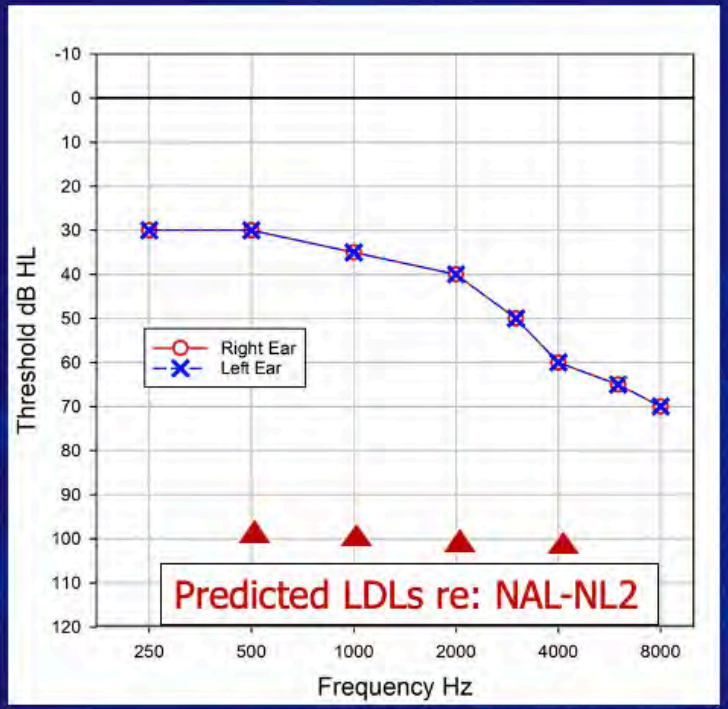
- 92 + 3 = 95
- 104 + 3 = 107



If, the pre-fitting procedure isn’t followed, the most common back-up plan is to allow the manufacturer to select the MPOs, based on . . .?

This can be very risky!

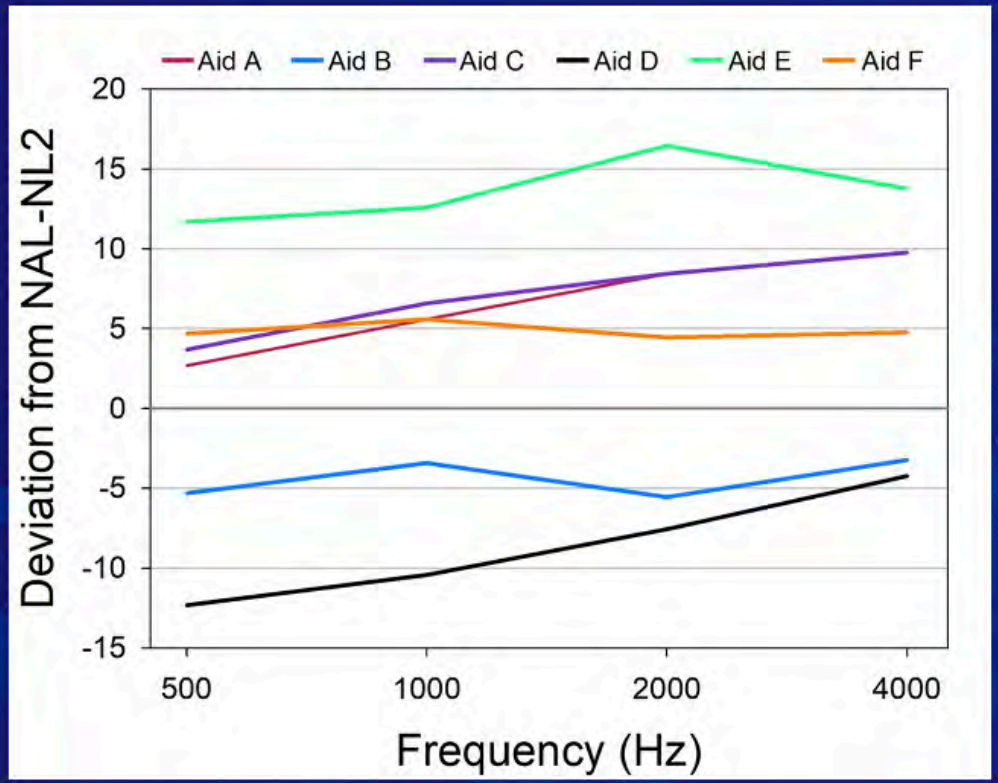
Part 2 of Mueller et al, 2021 study of MPO in premier hearing aids



Using this audiogram we:

- Programmed the premier hearing aid from the six major manufacturers to NAL-NL2.
- Examined the MPO settings shown in the software by each manufacturer.

NAL-NL2 prescribed MPO vs. that selected in the manufacturer's fitting software:



Differences of 12-15 dB from the NAL.

Differences of ~25 dB among manufacturers!

Something just isn’t right in the world!

But a strong message why the world needs us!

And, the Clinical Nugget is . . .

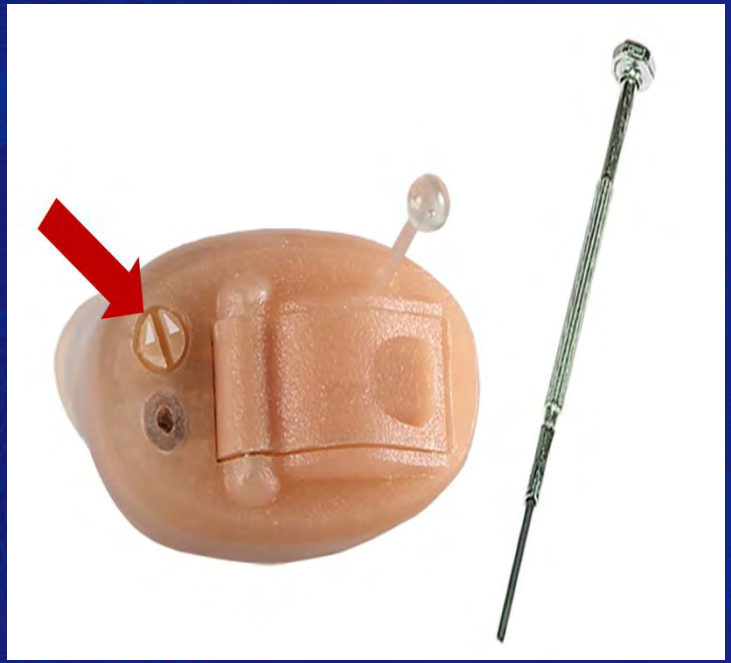
Four general areas:

- Pre-fitting Considerations
- Signal Processing and Features
- Verification
- Post-Fitting/Validation

Remember the year?

The Supergroup Traveling Wilburys Vol. 1 album went certified triple platinum.

And how were we adjusting hearing aids back then?



Has the effectiveness of post-fitting adjustments gotten better?

This research may have the answer…

The perceptual limitations of troubleshooting hearing-aids based on patients' descriptions

Benjamin Caswell-Midwinter & William Whitmer (2021)
Int J Audiol, 60(6):427-437.

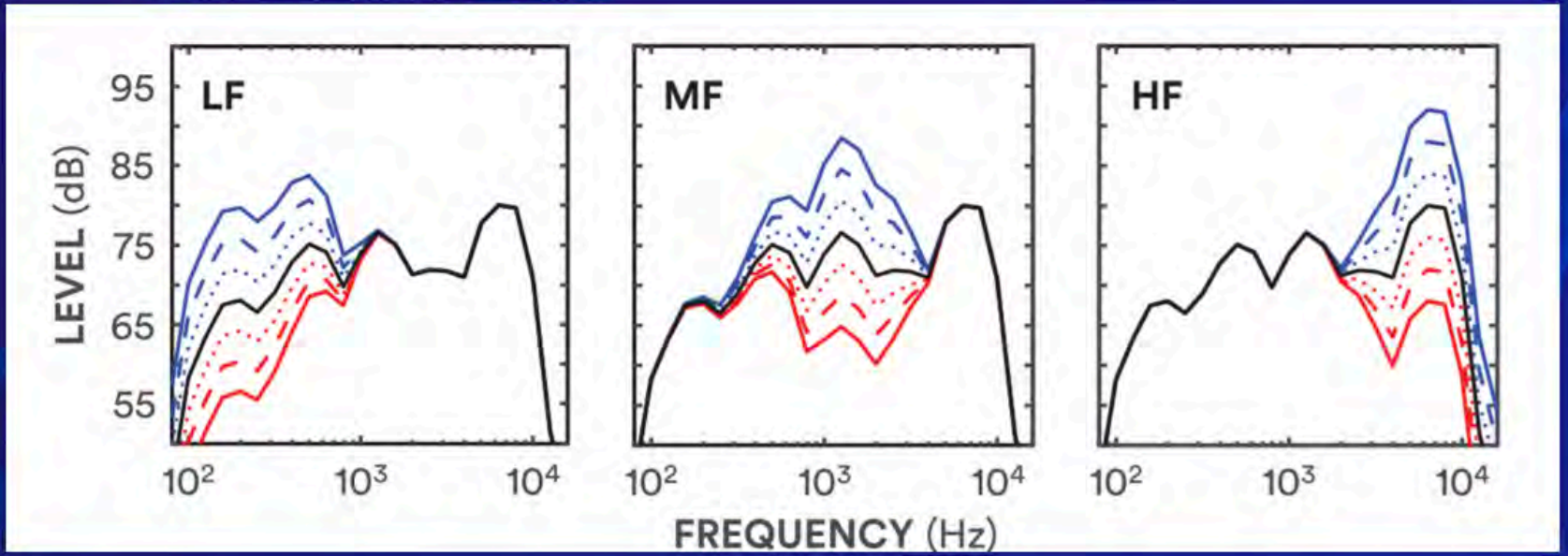
A recent study that address the effects of making post-fitting changes:

Experienced hearing aid users (n=32), listening to speech, made judgements (better, worse, or the same) regarding changes in gain in the filtered speech signal, relative to their programmed target-prescribed gain.

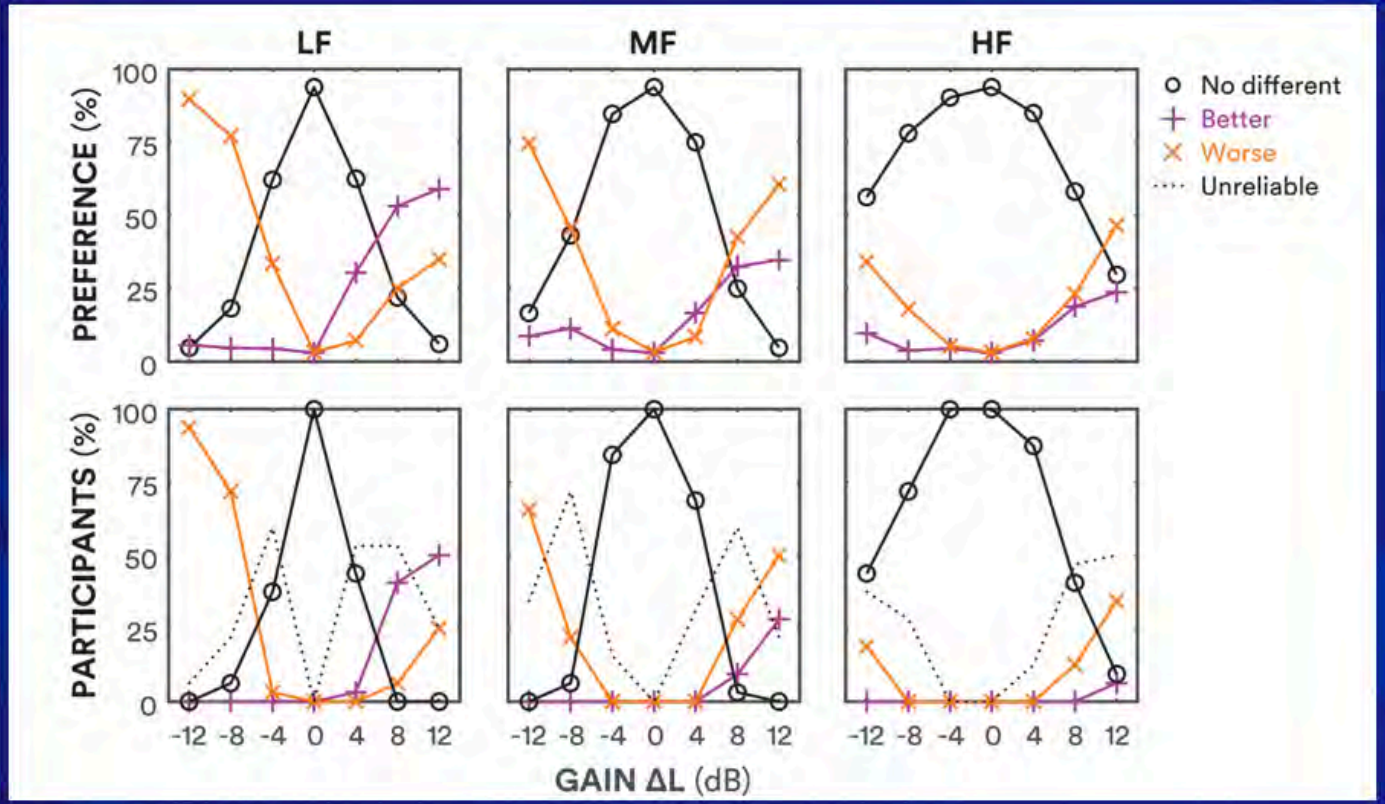
There were 18 experimental adjustments. These were both increments and decrements of 4 dB, 8 dB and 12 dB for three different frequency bands: low frequency, mid-frequency and high frequency.

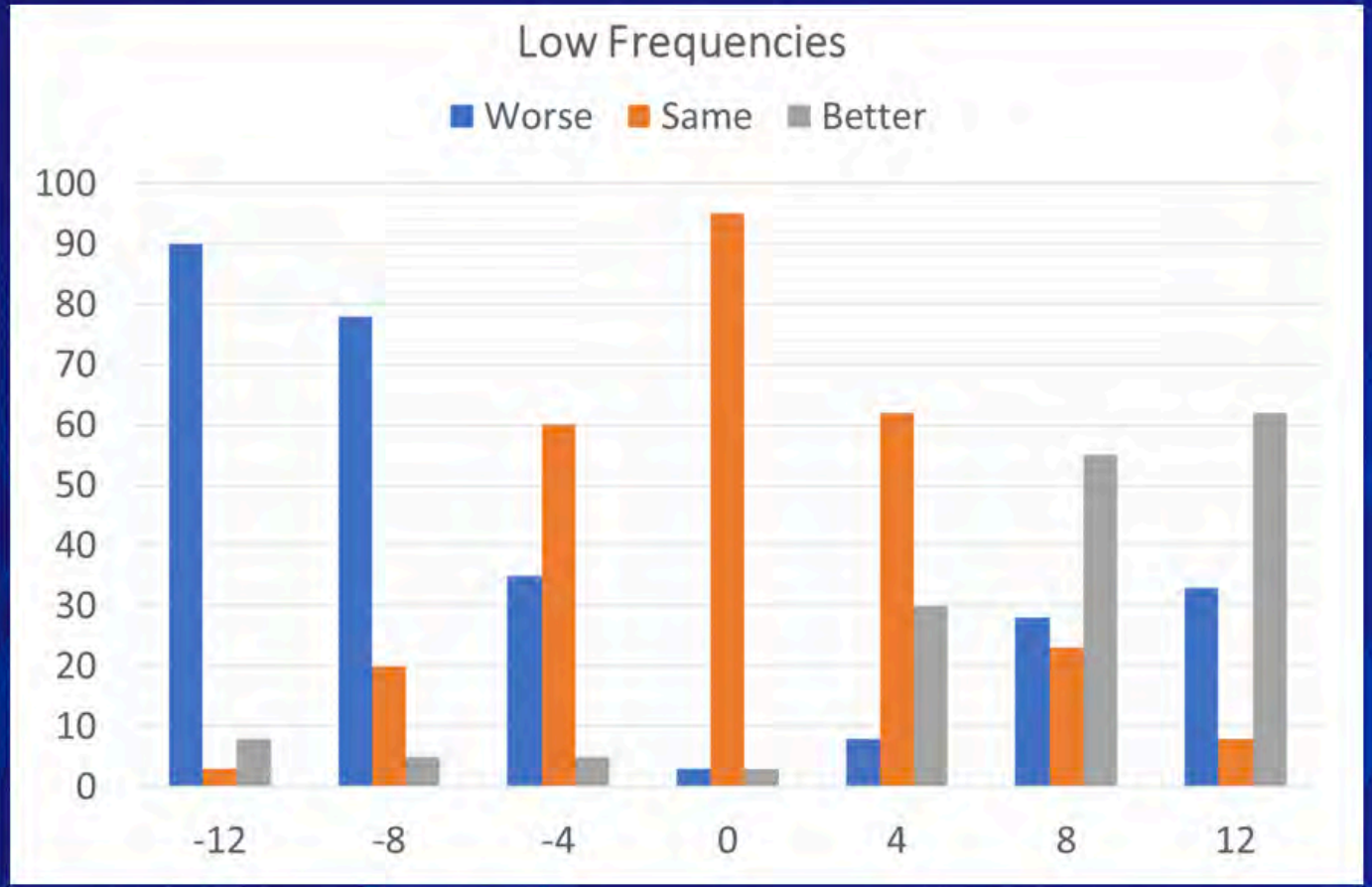
There also were three “control” adjustments, where the speech signal was not changed (0 dB for all three bands). Participants compared each adjustment to their standard target fitting 10 times, totaling 210 comparisons.

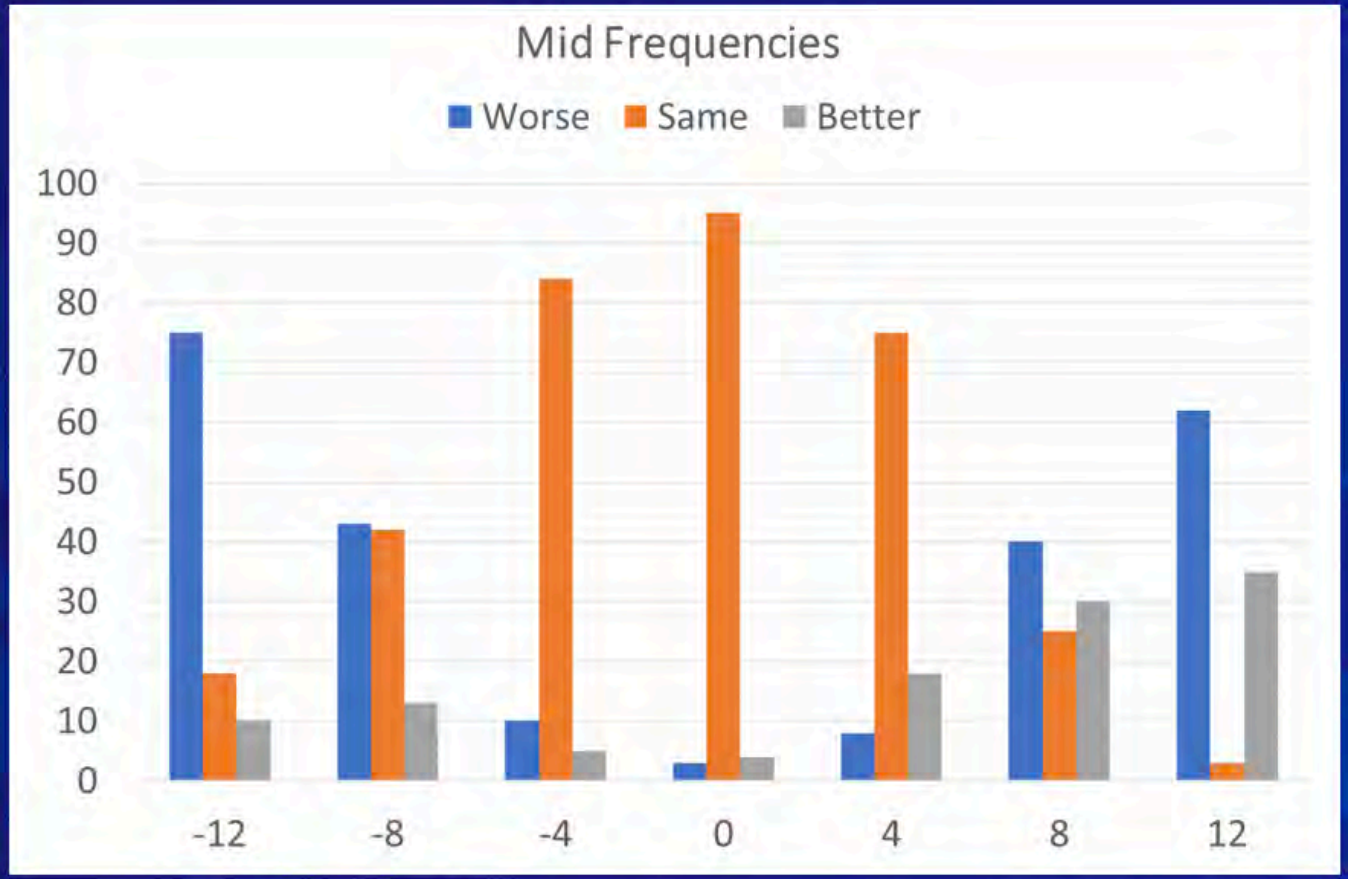
Examples of the changes made for the three different bands:

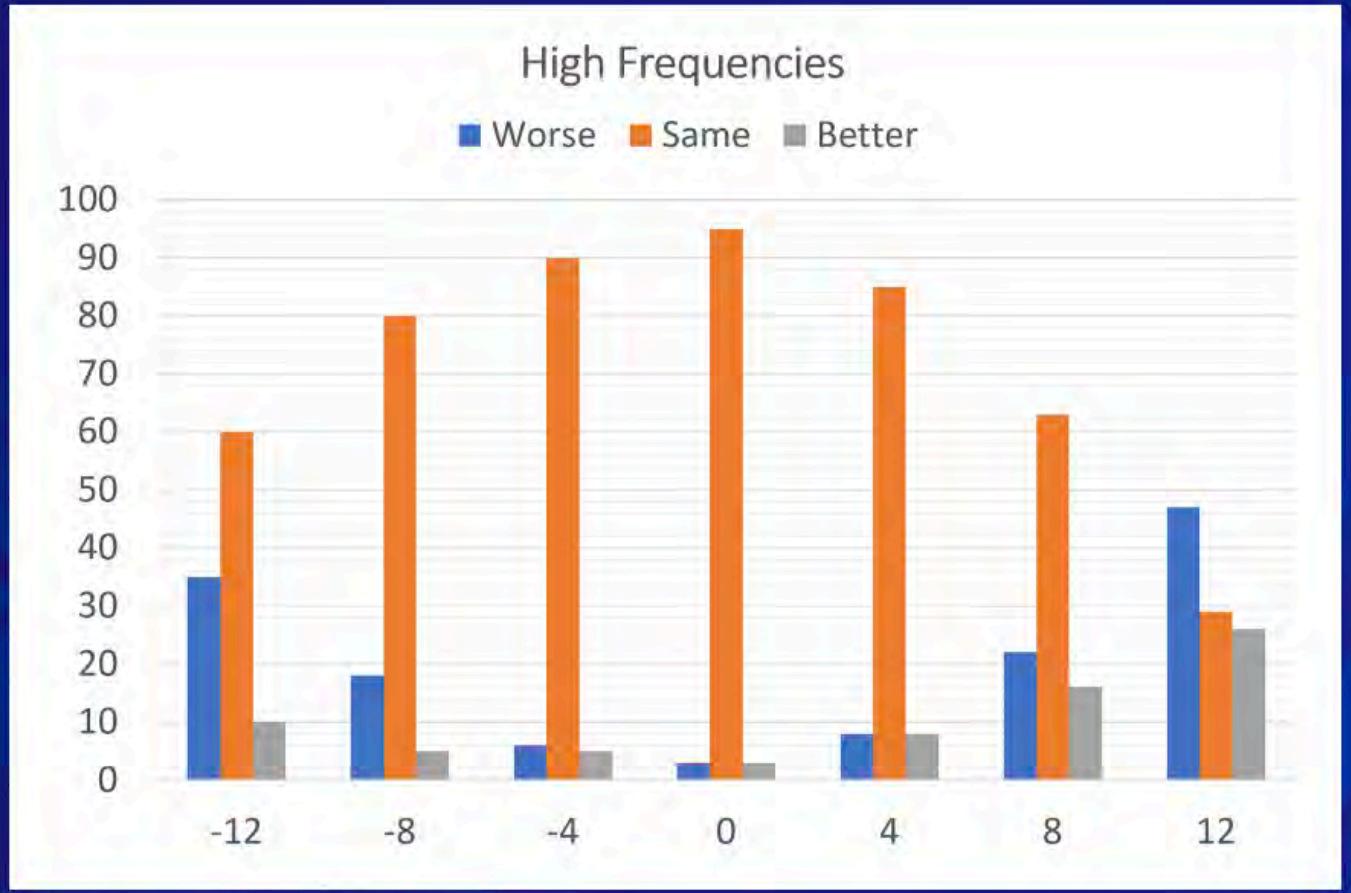


Results displayed in article:




Low Frequencies
Worse
Same
Better
100
90
80
70
60
50
40
30
20
10
0
-12
-8
-4
0
4
8
12


Mid Frequencies
Worse
Same
Better
100
90
80
70
60
50
40
30
20
10
0
-12
-8
-4
0
4
8
12

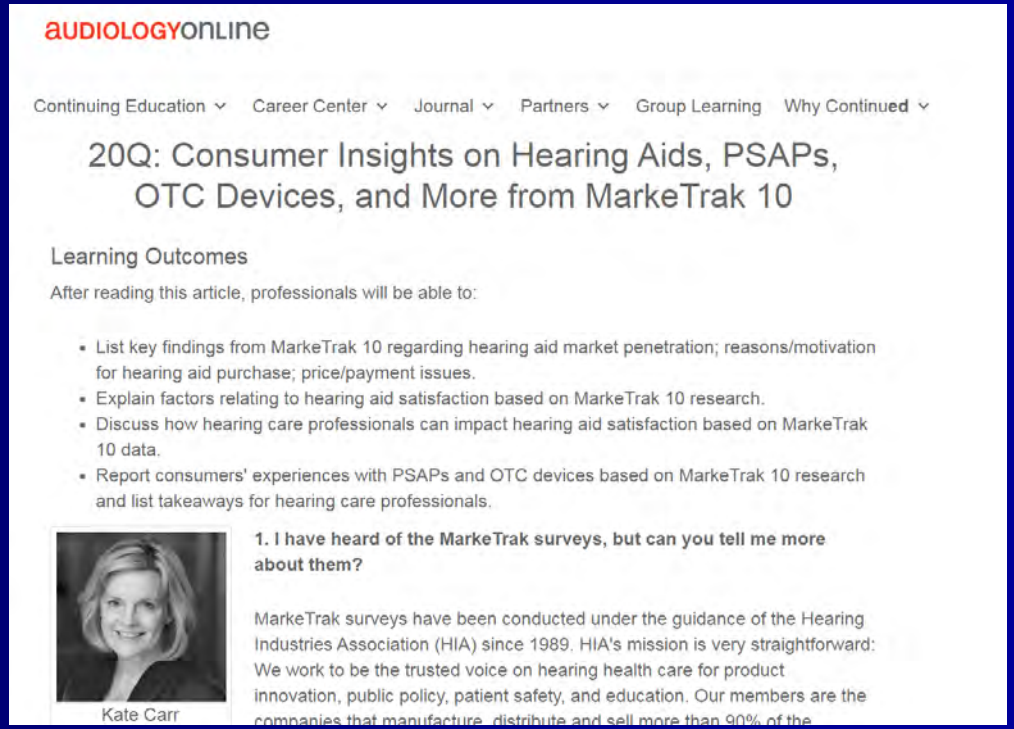

High Frequencies
Worse
Same
Better
100
90
80
70
60
50
40
30
20
10
0
-12
-8
-4
0
4
8
12

And, the Clinical Nugget is . . .

The smile that you put on the patient's face during post-fitting tweaking, simply may be due to a "Placebo Effect", a "Halo Effect," or random luck, and not at all reflective of a true perceptual improvement in the processing of the hearing aids.

Good news from MarkeTrak10!

Check out the special issue of *Seminars* devoted to MarkeTrak10 findings



AUDIOLOGYONLINE

Continuing Education | Career Center | Journal | Partners | Group Learning | Why Continued

20Q: Consumer Insights on Hearing Aids, PSAPs, OTC Devices, and More from MarkeTrak 10

Learning Outcomes

After reading this article, professionals will be able to:

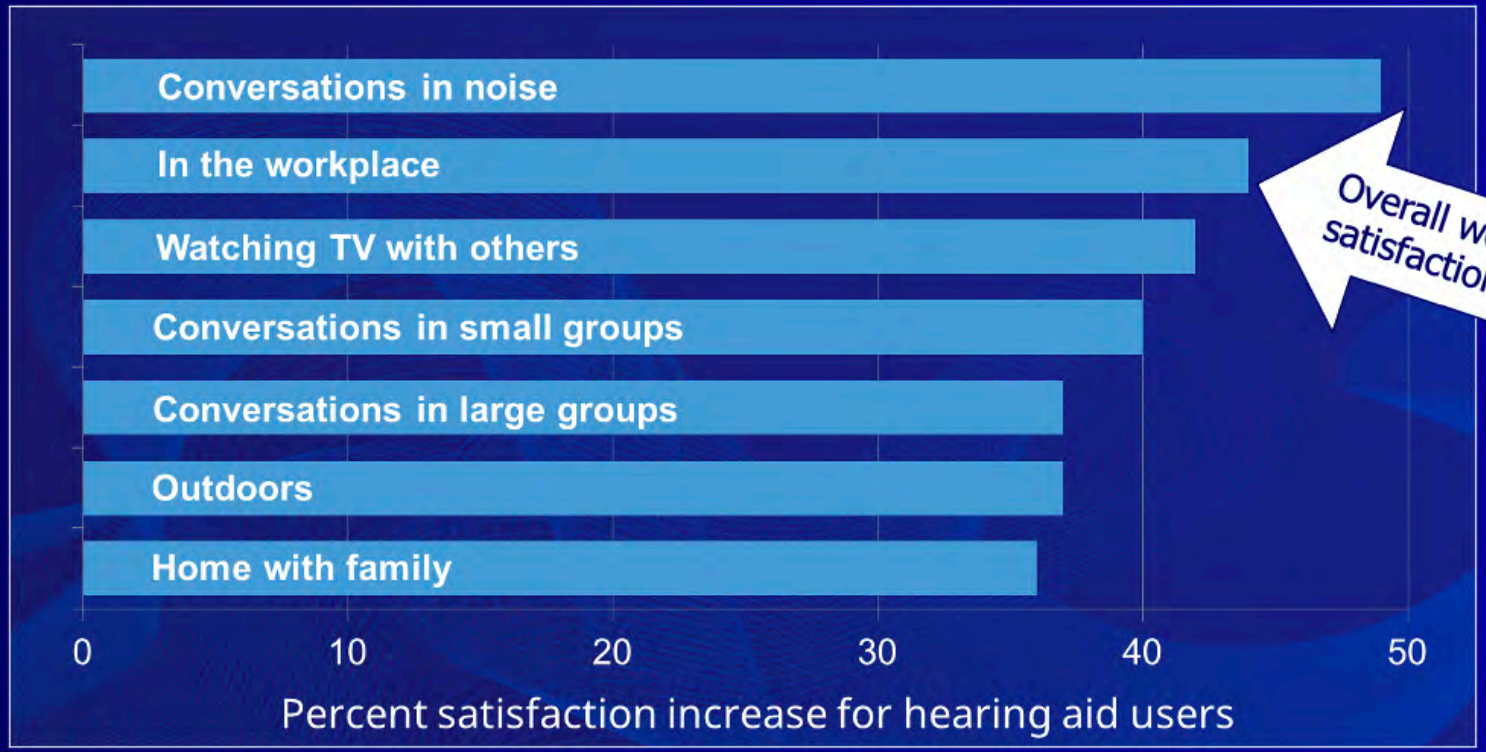
- List key findings from MarkeTrak 10 regarding hearing aid market penetration; reasons/motivation for hearing aid purchase; price/payment issues.
- Explain factors relating to hearing aid satisfaction based on MarkeTrak 10 research.
- Discuss how hearing care professionals can impact hearing aid satisfaction based on MarkeTrak 10 data.
- Report consumers' experiences with PSAPs and OTC devices based on MarkeTrak 10 research and list takeaways for hearing care professionals.

Kate Carr

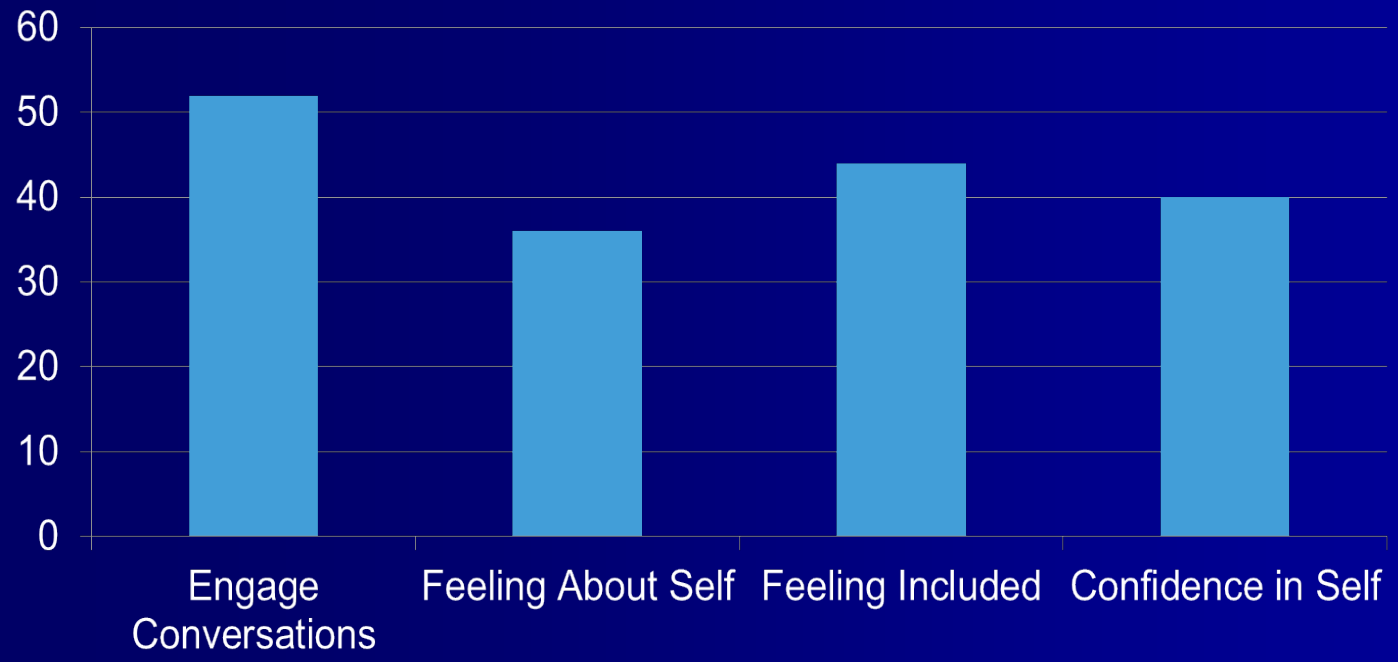
1. I have heard of the MarkeTrak surveys, but can you tell me more about them?

MarkeTrak surveys have been conducted under the guidance of the Hearing Industries Association (HIA) since 1989. HIA's mission is very straightforward: We work to be the trusted voice on hearing health care for product innovation, public policy, patient safety, and education. Our members are the companies that manufacture, distribute and sell more than 90% of the

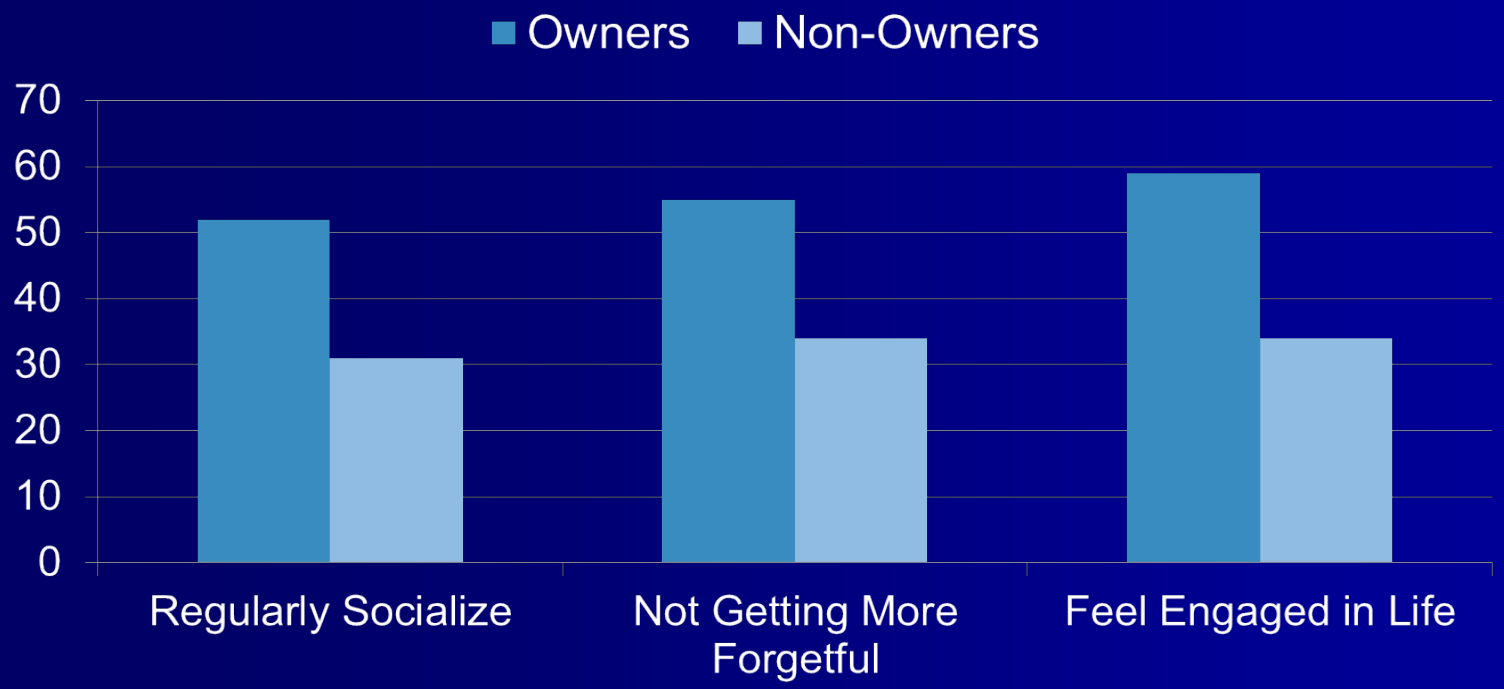
Percent satisfaction increase for owners vs. non-owners



Percent user's reporting "Better" or "Much Better" after obtaining hearing aids



Important QoL Factors



And, the Clinical Nugget is . . .

Hearing aids work pretty darn well!

SigniaUSA
800-766-4500

AUDIOLOGYONLINE