RESEARCH QUICK TAKES

4.1: Potential hearing aid fitting misconceptions: When is a “fit-to-target” a “fit-to-target”?

Brian Taylor & Gus Mueller

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In the everyday practice of fitting hearing aids, we develop many beliefs, about both the technology and the fitting procedures. These beliefs often are based on:

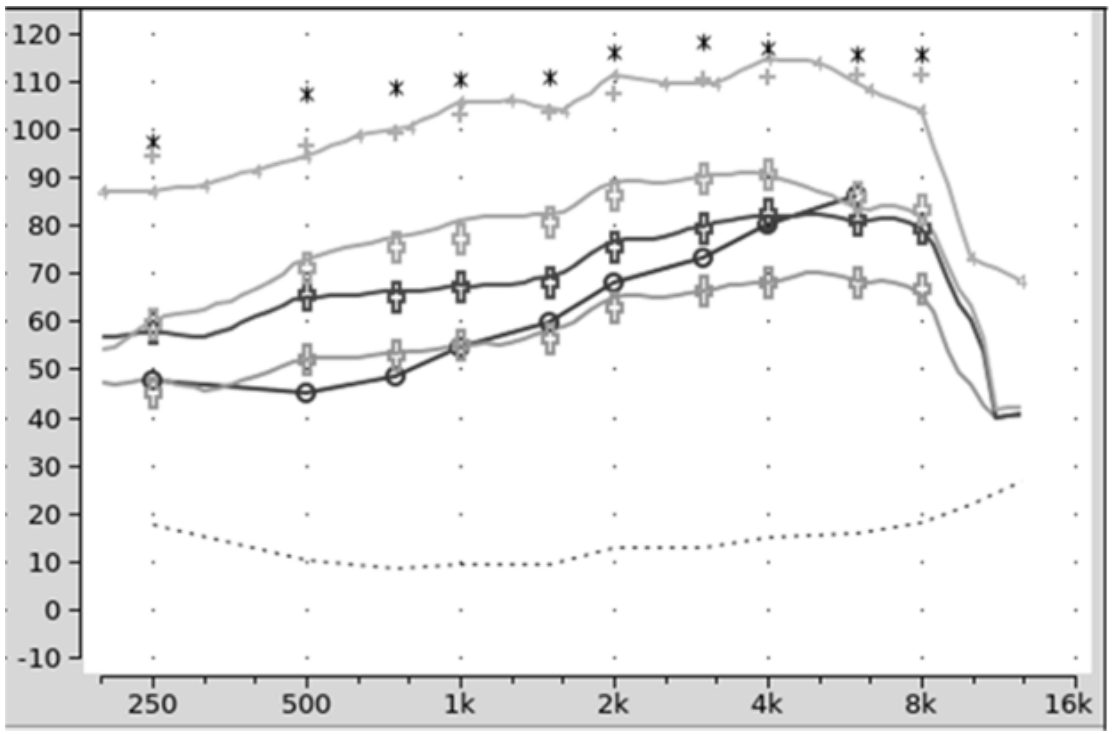
- Things we think we learned in school
- Things we might have read
- Things we have heard from a rep
- Things from our fitting experiences
- Things we just believe to be true because we always have.

But for most of us, not all of them really are true.

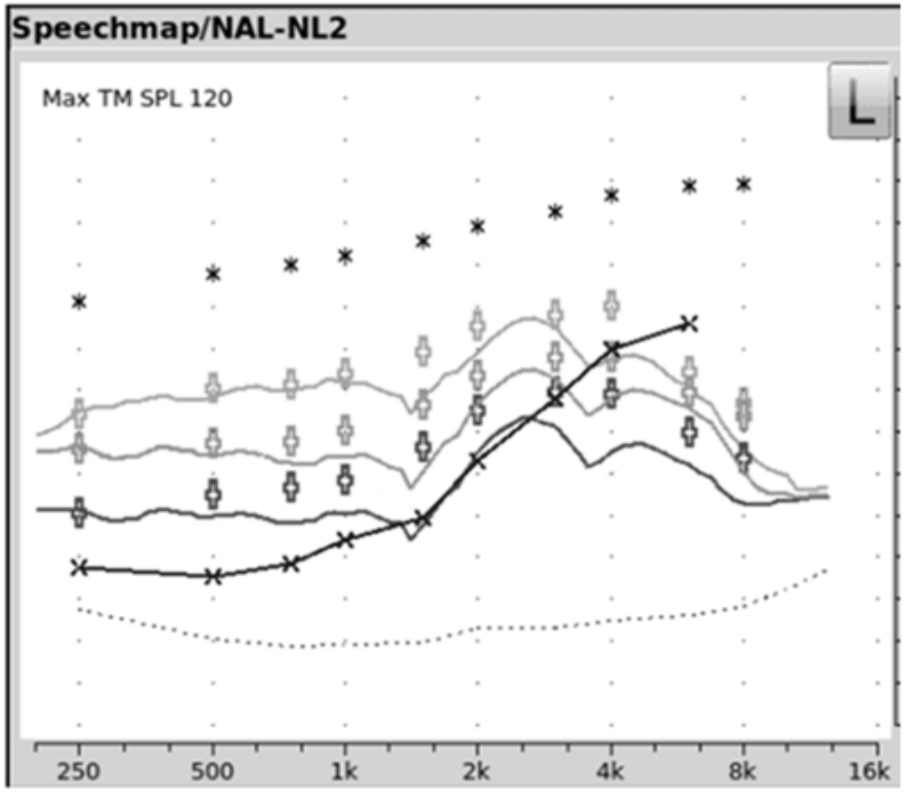
In past Quick Takes, we've emphased the importance of verifying real-ear prescriptive targets with probe-mic measures . . .

- BUT, how close is close enough?
- When is a target match, a target match?
- Can someone be too concerned about obtaining a precise match?

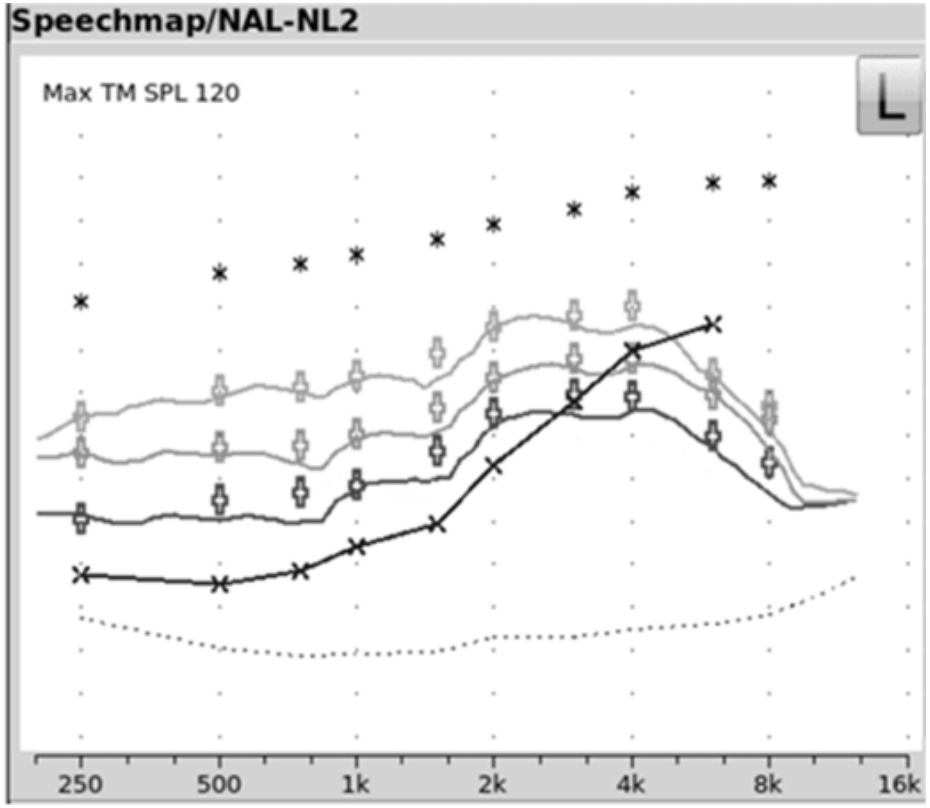
We’d probably all agree that this is a good match, right?



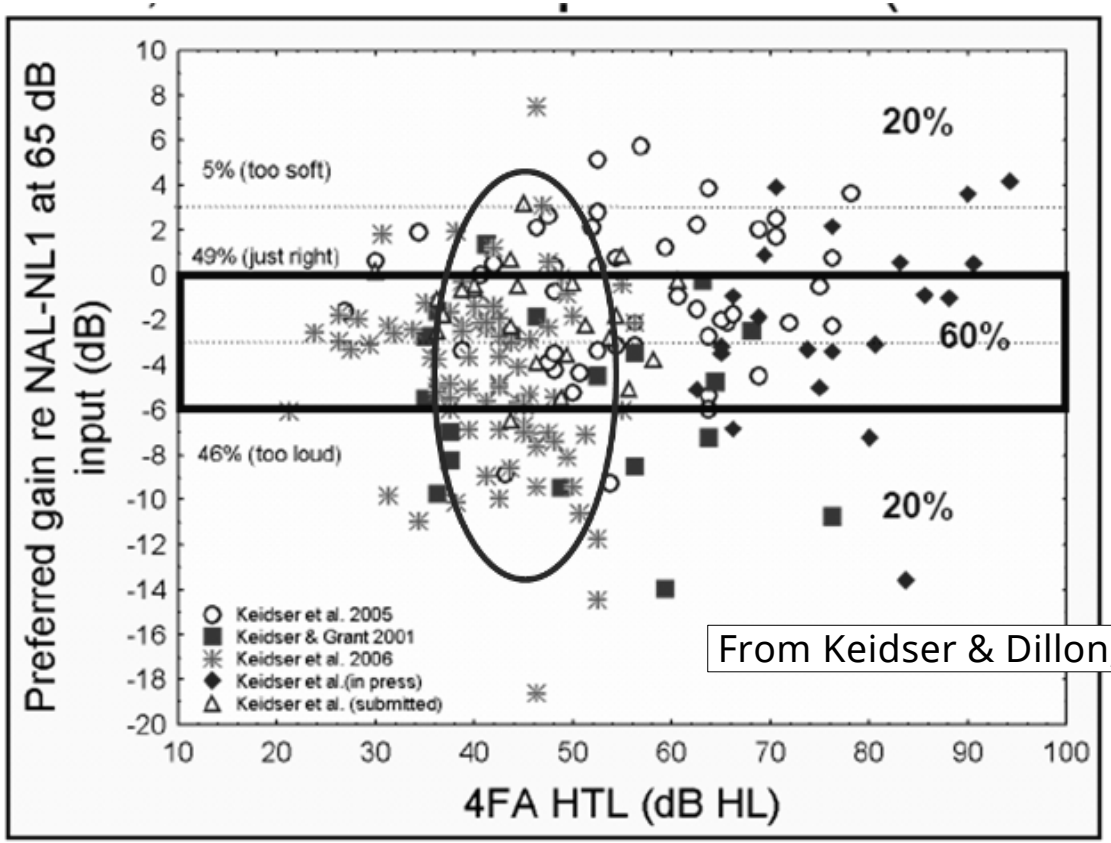
And, we'd probably all agree that this is *NOT* a good match?



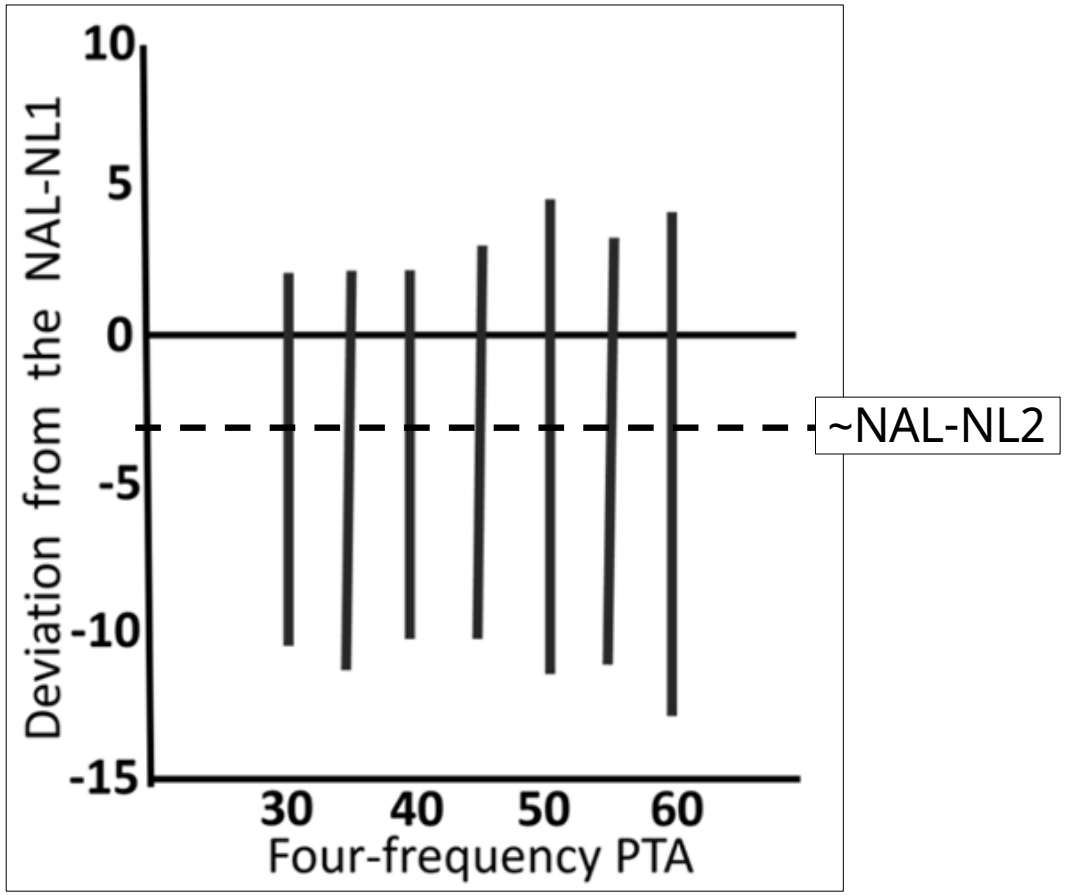
But what about this? Good? Acceptable?



NAL-NL1 data used for the development of NAL-NL2



From Keidser & Dillon, 2006



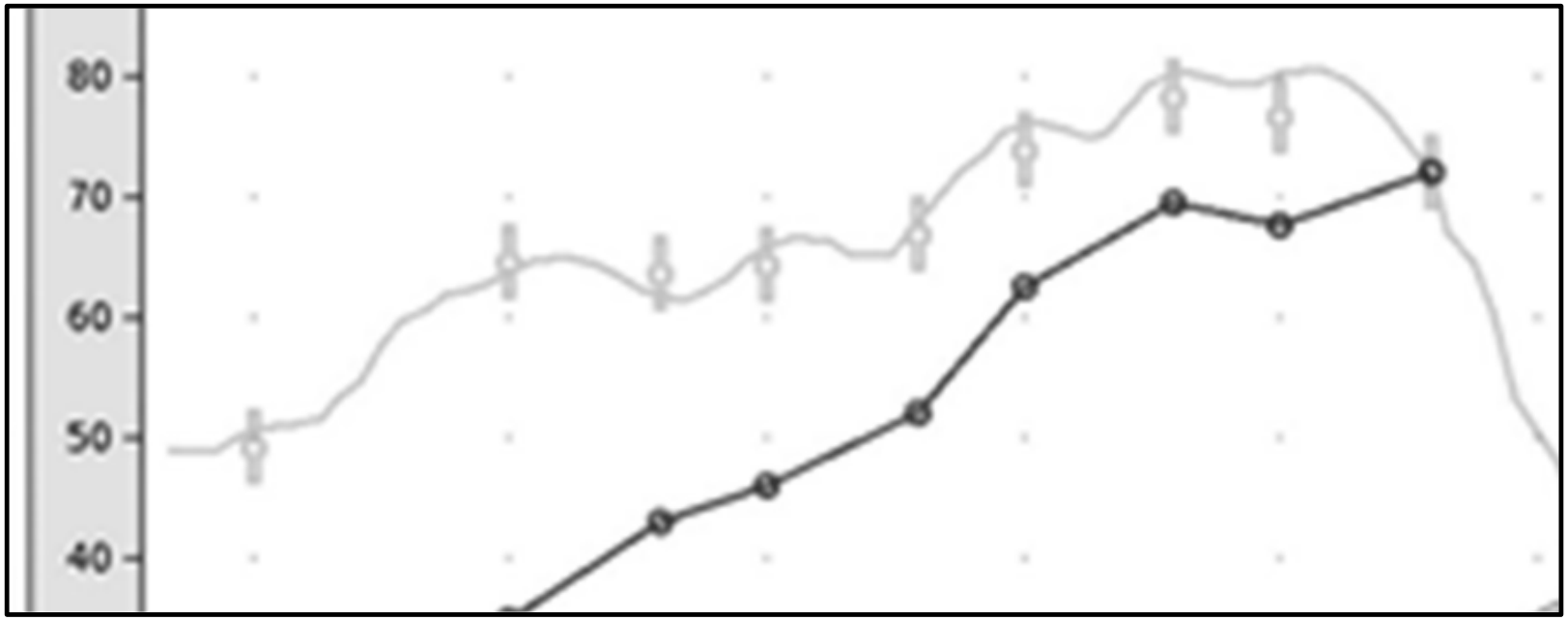
Simplified version of chart

- Note the range of preferred listening for the different hearing loss groups.
- The target simply is the average, but we can't forget about the range.
- Reasonable is +/- 5 dB, so think of the "target" as a 10 dB window

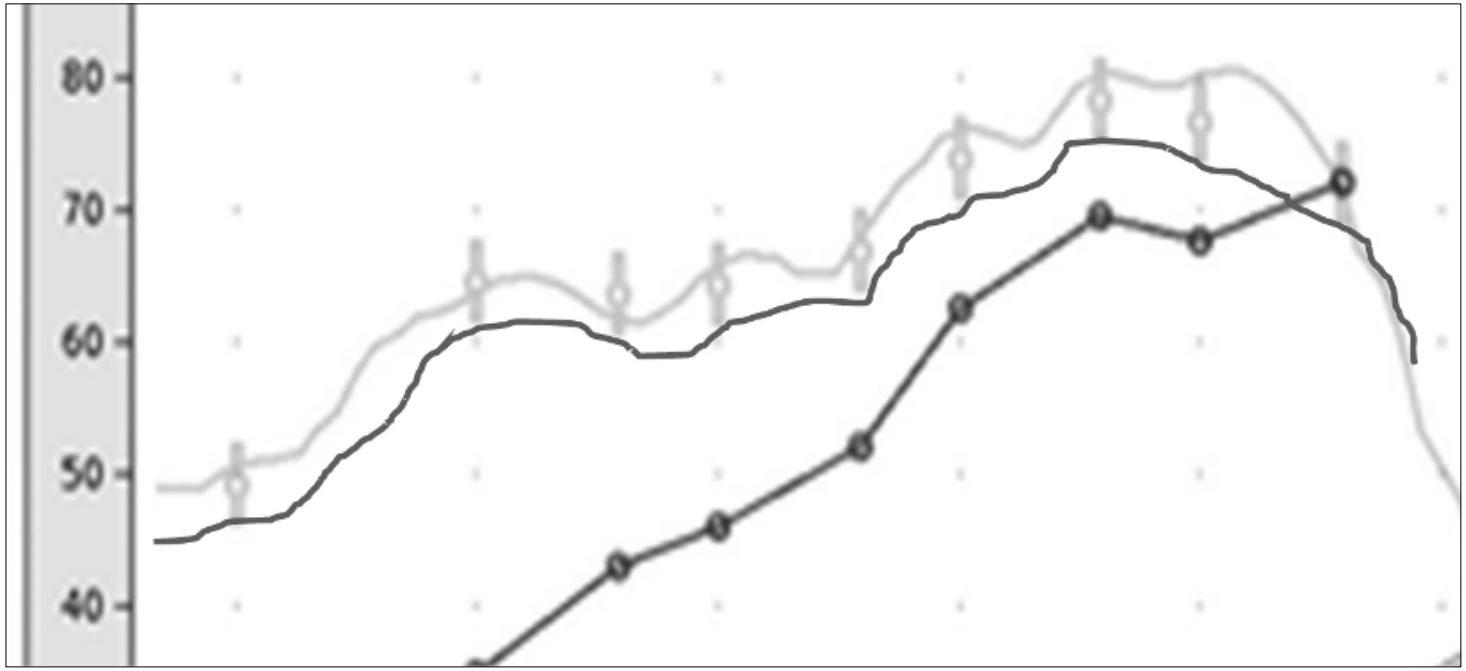
Research to support for the +/- 5 dB thinking:

- NAL-NL2 data predicted deviation from target would be standard deviation of ~5 dB
- Previous research with the NAL found that benefit and satisfaction was not significantly reduced until the rms error (at 1000, 2000, and 4000 Hz) reached 6 dB or more.
- Cox and Alexander found, that differences among prescriptions were preserved if the rms error for the match to target was 5 dB or less.

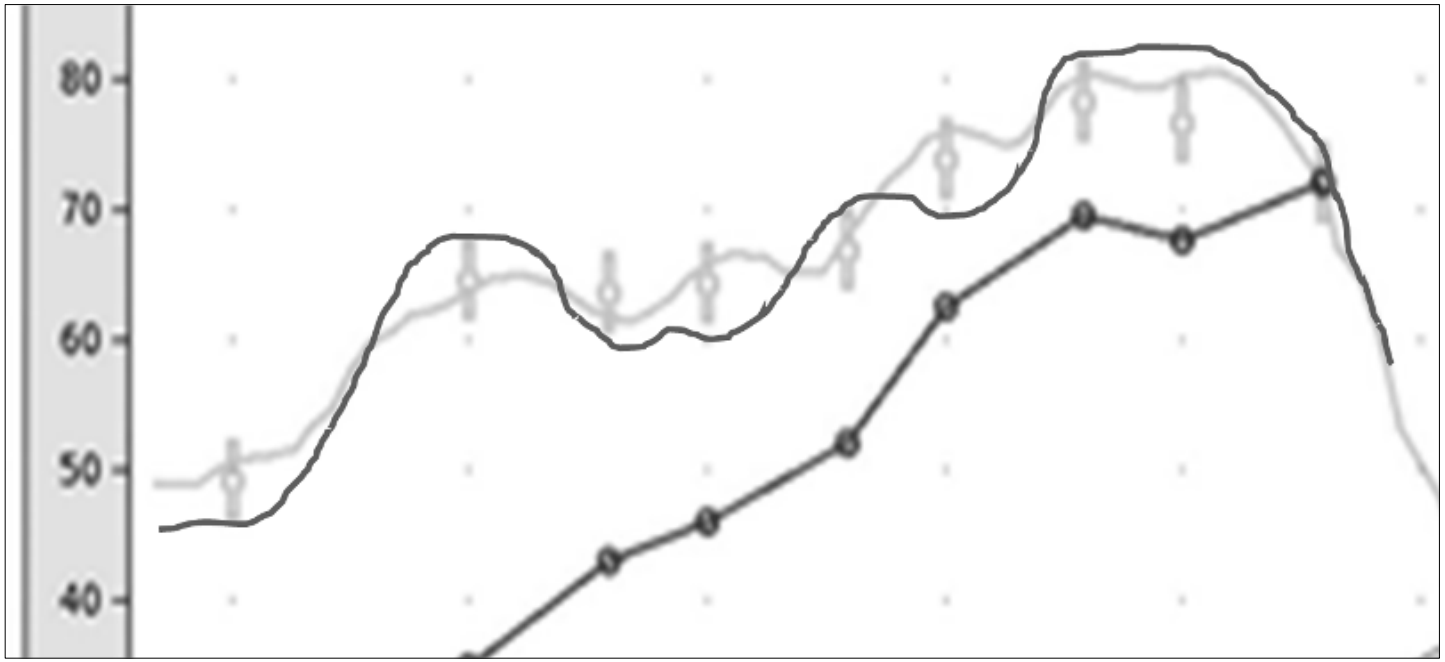
Of course, in a perfect world,
all our fittings will be this good . . .



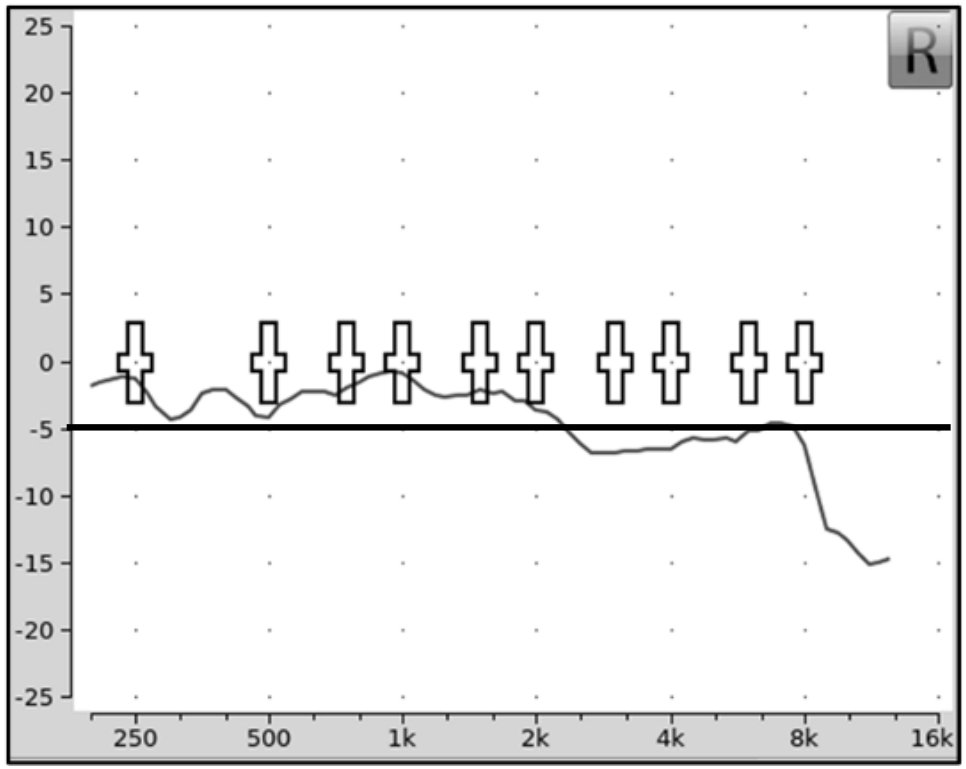
Even with the 5 dB rule, you still have to do a little thinking—this “within 5 dB” fitting looks okay.



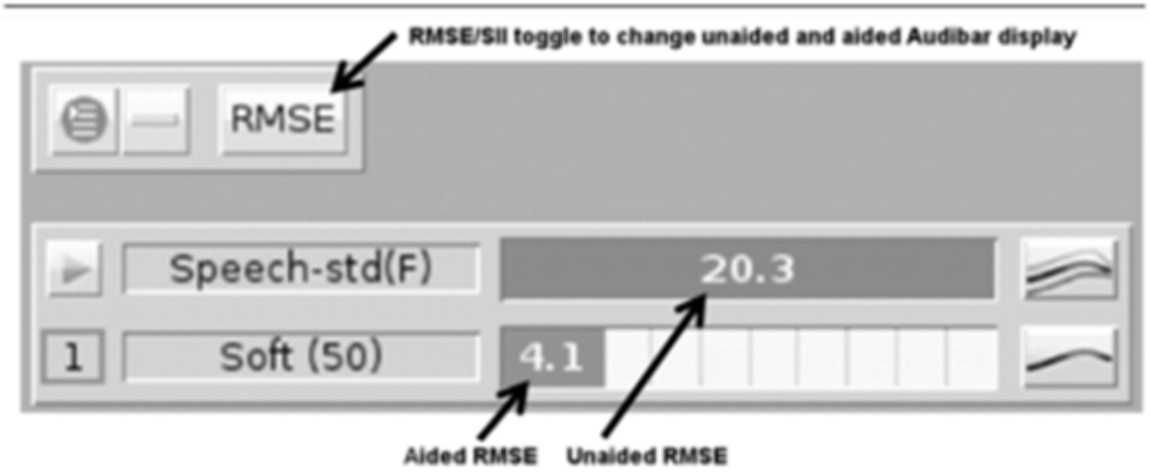
This fitting, however, also within +/- 5 dB, needs some work



Probe-mic manufacturer’s have tools to assist in determining the “goodness” of the fitting:

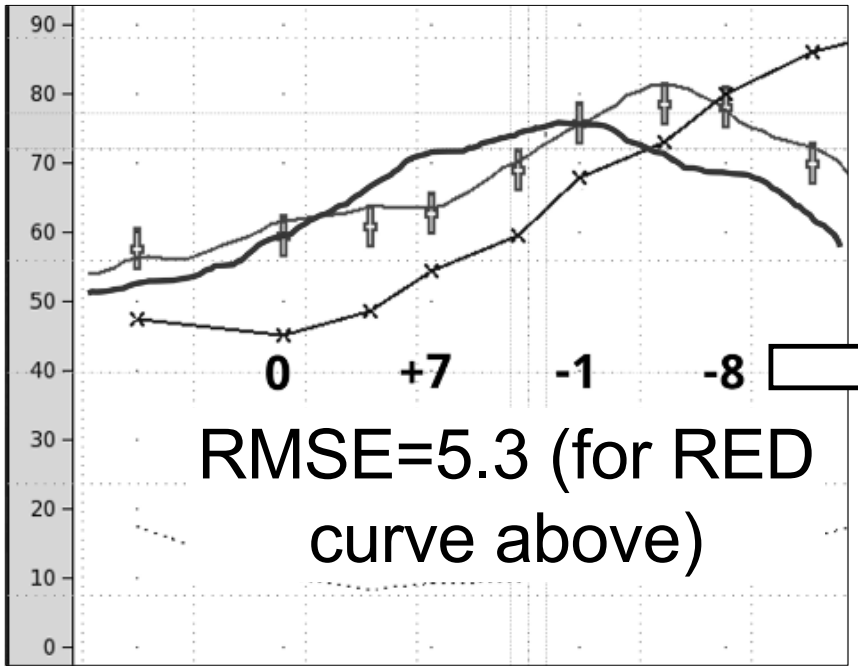


Some probe-mic equipment will calculate RMSE (< 5 dB normally used as “okay” criterion)



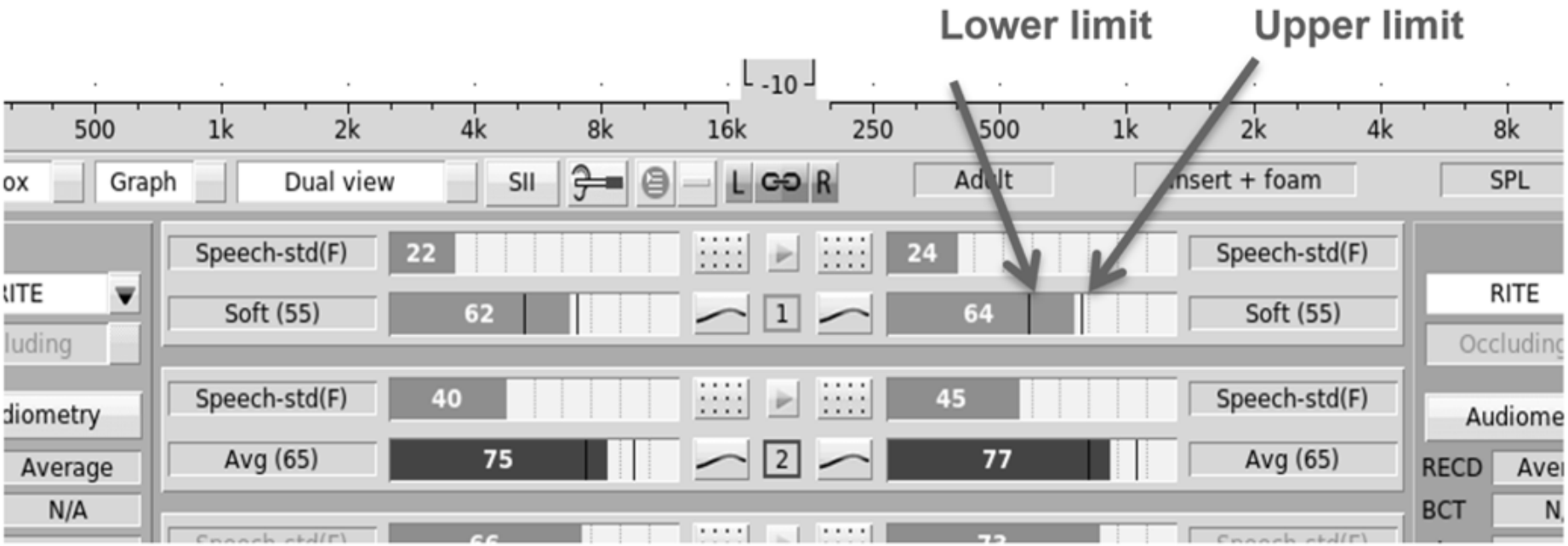
Common to use 500, 1000, 2000 and 4000 Hz for the RMSE calculation (but can be changed to other frequencies, or more frequencies can be added).

Again, sometimes you still might have to think a little:
RMSE sort-of okay, but . . .



$$RMSE = \sqrt{\frac{\sum_{i=1}^{N} (Predicted_i - Actual_i)^2}{N}}$$

And, SII values also can help evaluate the fitting goodness . . .



MISCONCEPTION

The fitting target is not a dot on the screen—it’s a 10 dB window to allow for individual variance in preferred loudness levels.

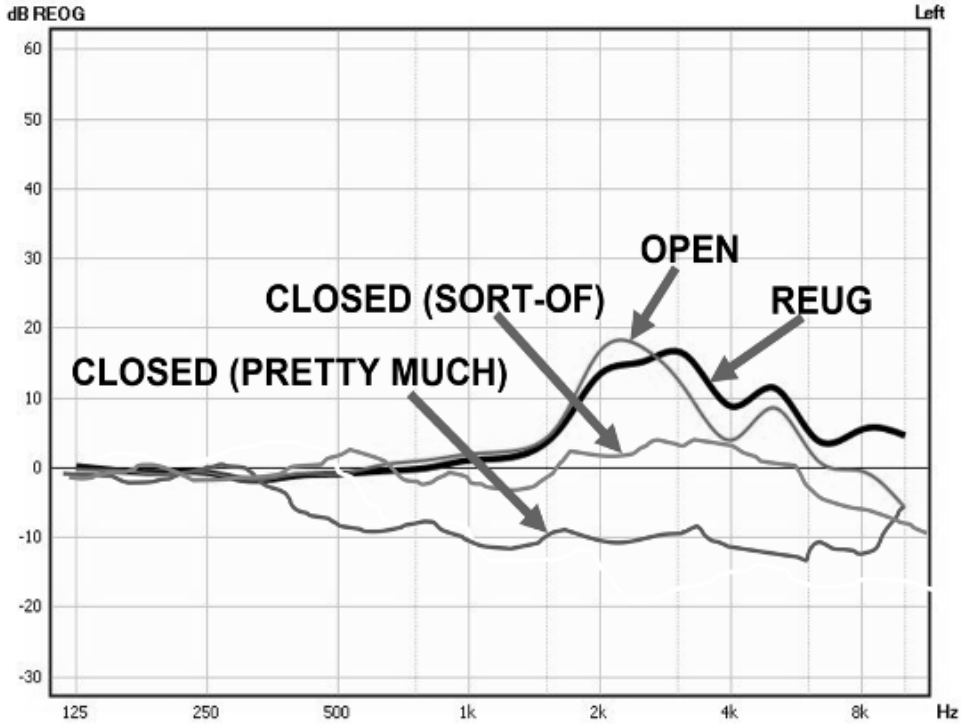
RESEARCH QUICK TAKES

4.2: Potential hearing aid fitting misconceptions: Venting considerations when using instant-fit tips and domes.

Brian Taylor & Gus Mueller

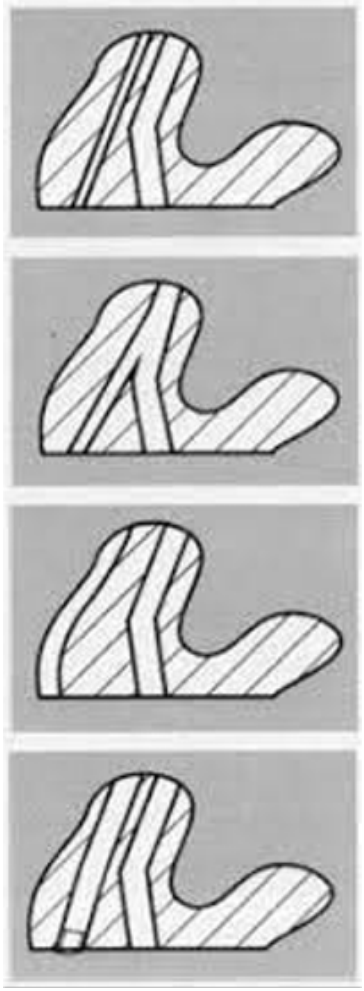
How do we know if the venting is what we want?

Easy . . . Conduct an REOG measure:



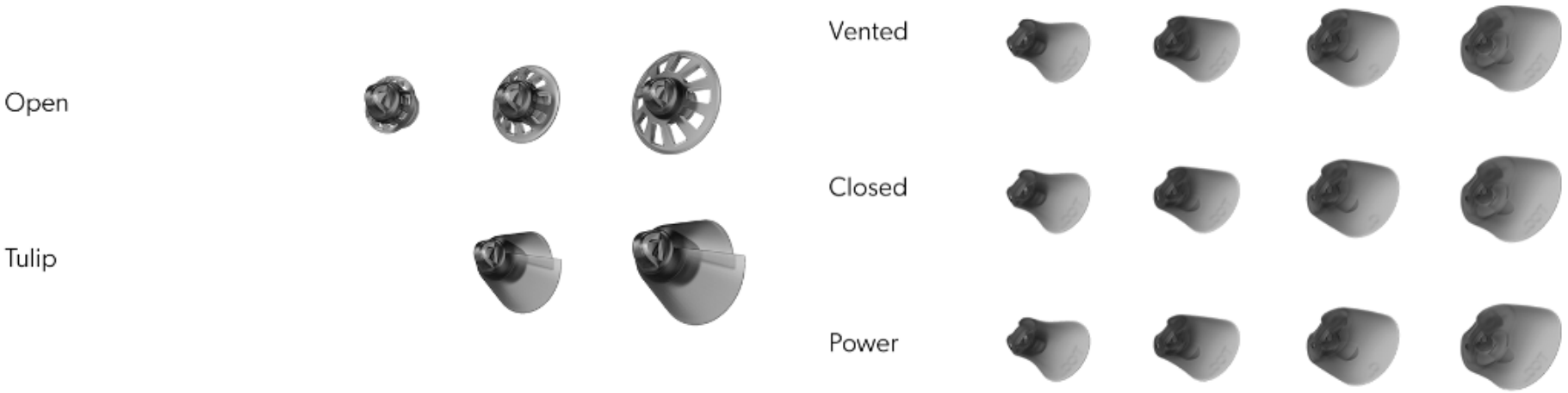
Does everyone routinely conduct an REOR measure?

NO!



Historically, considerable research has been conducted regarding different types of venting—diagonal, parallel, trench, etc, . . . Acoustic effects related to the length of the vent . . . and the diameter of the vent . . . pressure relief, 1mm, 2mm, 3mm, CROS, etc.

Today, instant fit domes and tips are popular: some instant-fit choices . . .

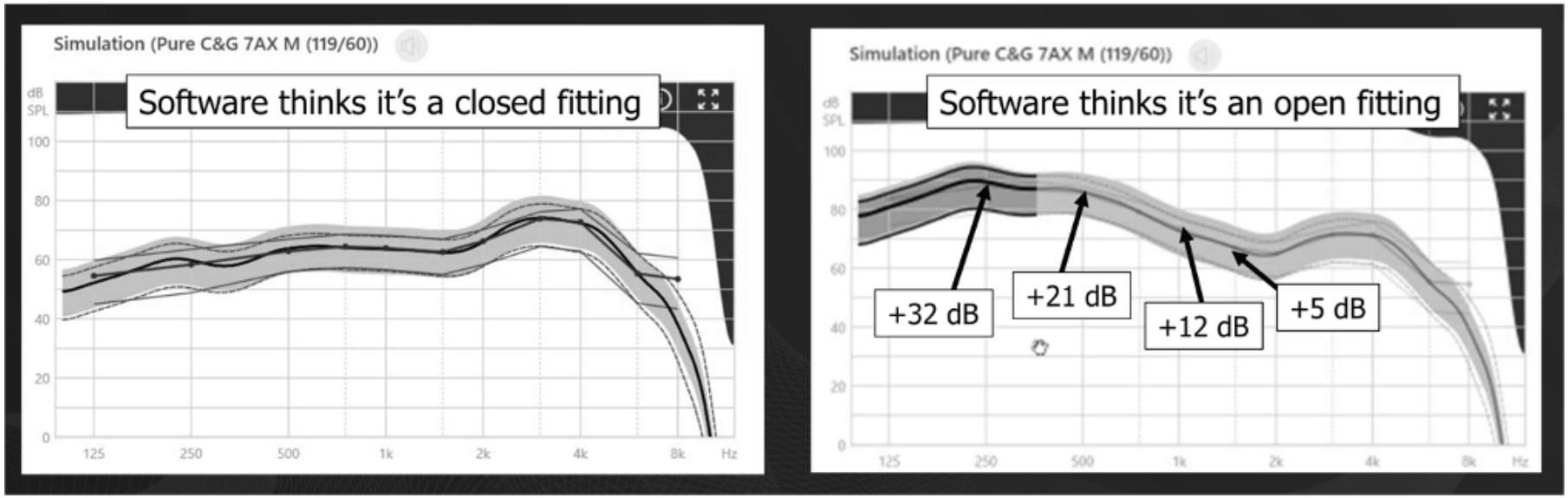


The venting that we often don’t think about, common with all “closed” instant fit tips and domes . . .

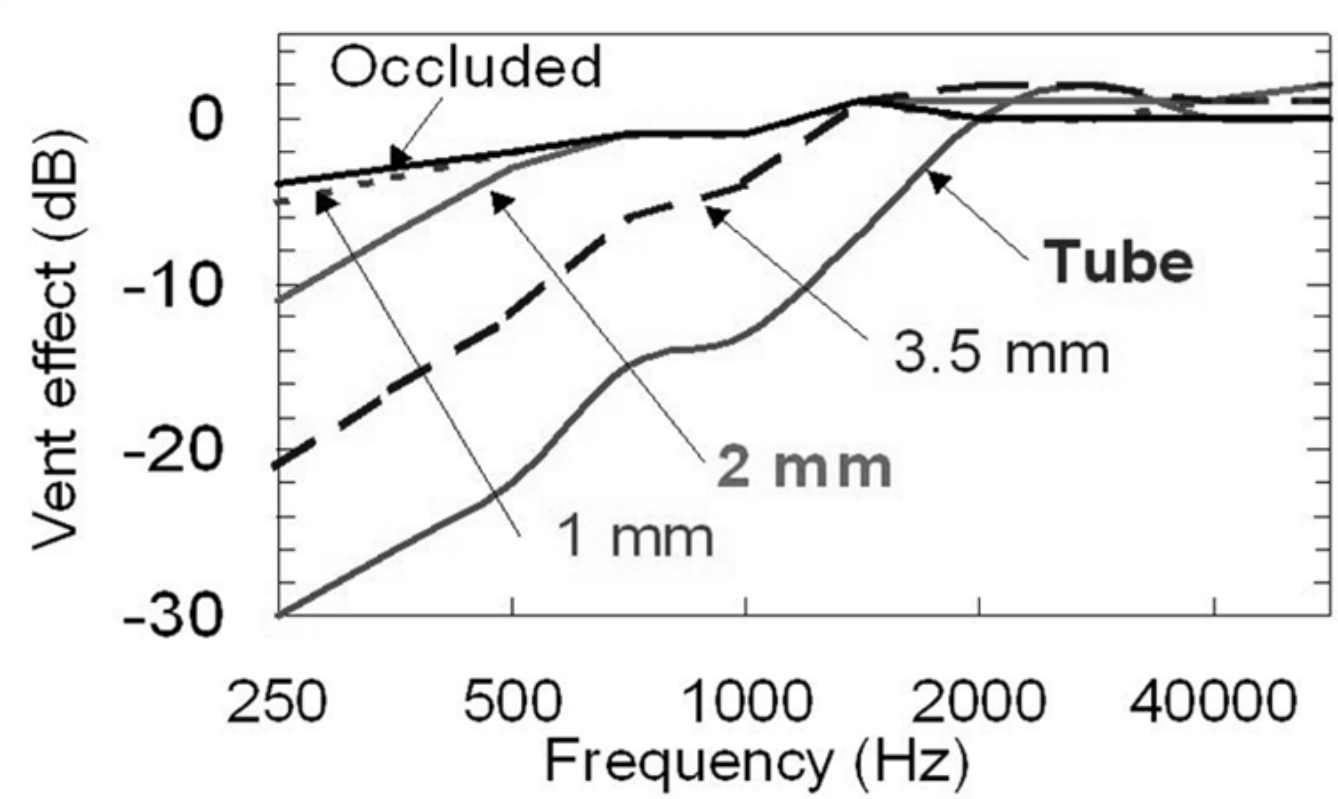
“Slit leak venting”

- Sounds that leak around the circumference of the dome—where the dome meets the ear canal.
- The shorter the distance of contact (medial to lateral) the greater the effect.

This can have a huge effect for initial programming:

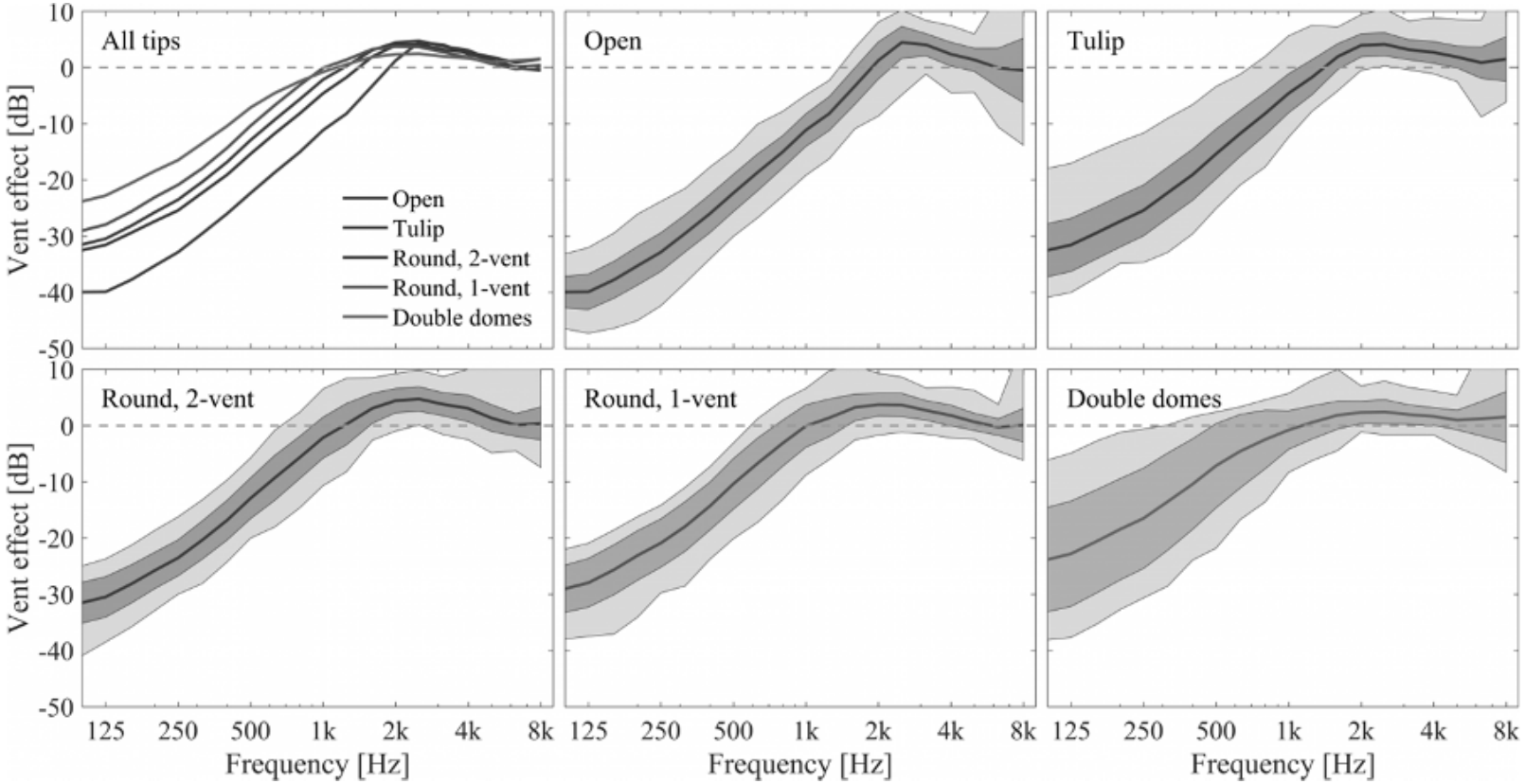


Venting data that you'll find in most textbooks, and what most of us recall (from Dillon, 1985):

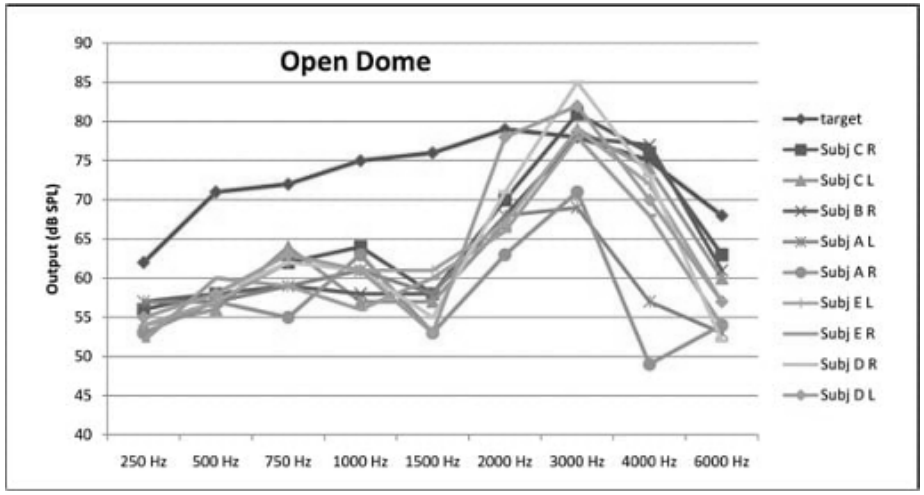


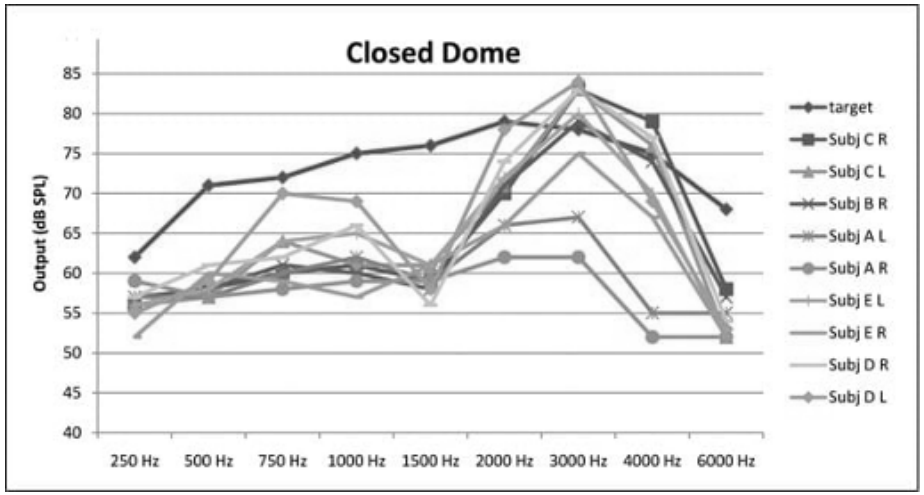
What we see from instant-fit tips is quite different

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



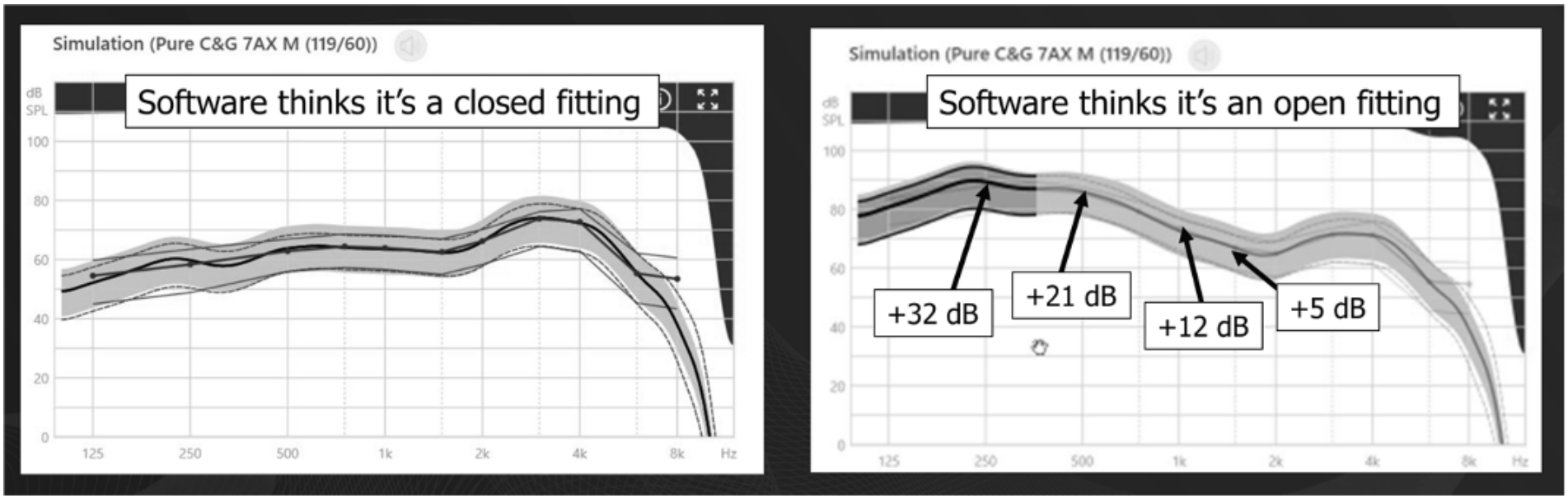
Instant fitting tips: The “openness of closed” should not be a secret—here are data from 2009!





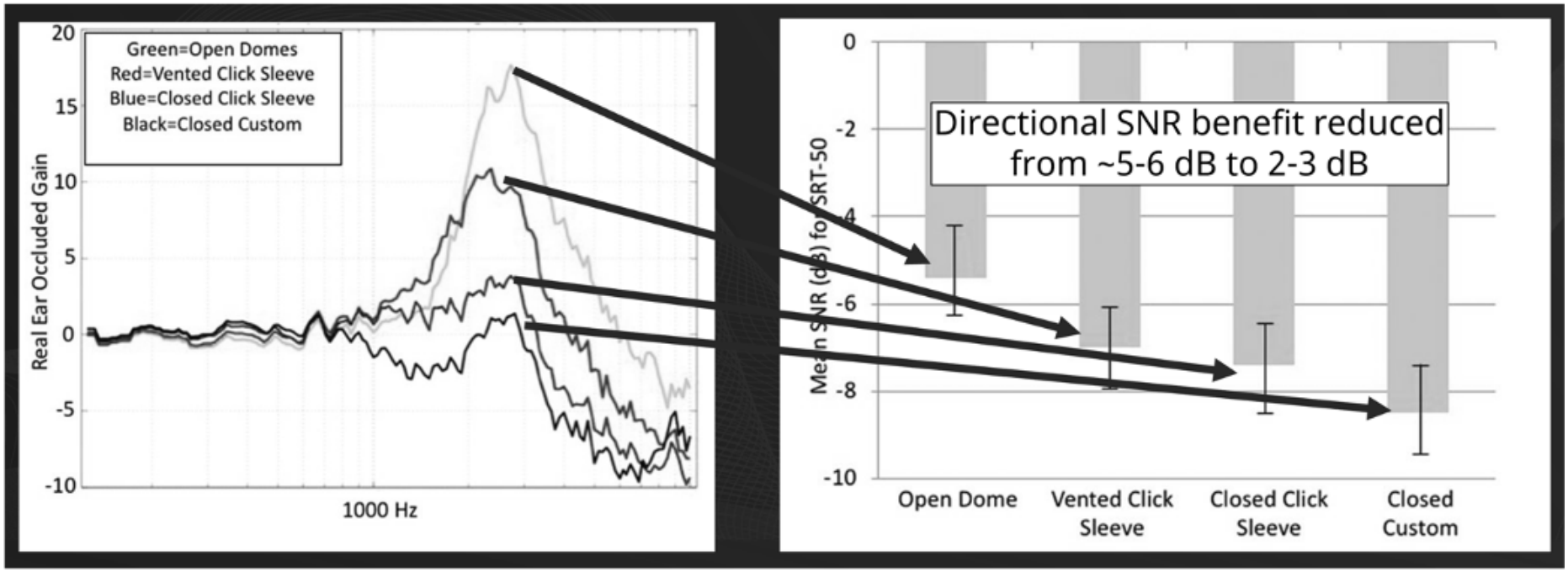
Real-ear output for hearing aids programmed to manufacturer-default NAL-NL2 using both an open and a closed instant fitting tip (From Teie [2009] *Hearing Review*)

What if . . . Real-ear verification never was conducted, and a fitting believed to be closed, really was open?



Closed vs. Open: Also can have a huge impact on directional processing

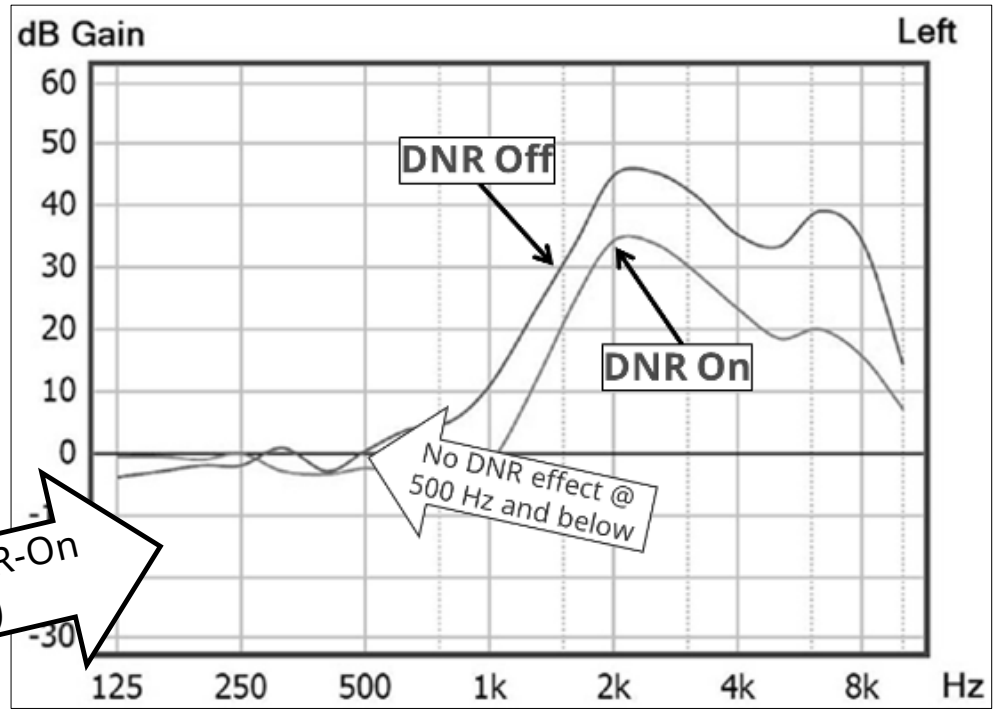
(From Froehlich & Littmann, 2019)



Openness also will impact effectiveness of DNR processing

No gain to “squash”—patient will not hear difference.

No attenuation—noise signals will go directly to the ear drum.



Good reason to conduct real-ear DNR-On vs. DNR-Off (using noise signal)

MISCONCEPTIONS

- Instant-fit tips are much more open than commonly believed. Don’t be led astray by the label of “closed.”

- With an open mold, today’s sophisticated directional products will have an SNR advantage no better than a directional product of 50 years ago!

RESEARCH QUICK TAKES

4.3: Potential hearing aid fitting misconceptions: Does the default fitting software get the MPO setting right?

Brian Taylor & Gus Mueller

We need the MPO set “not too hot” and “not too cold” but just right!

What happens when MPO is “too hot?”

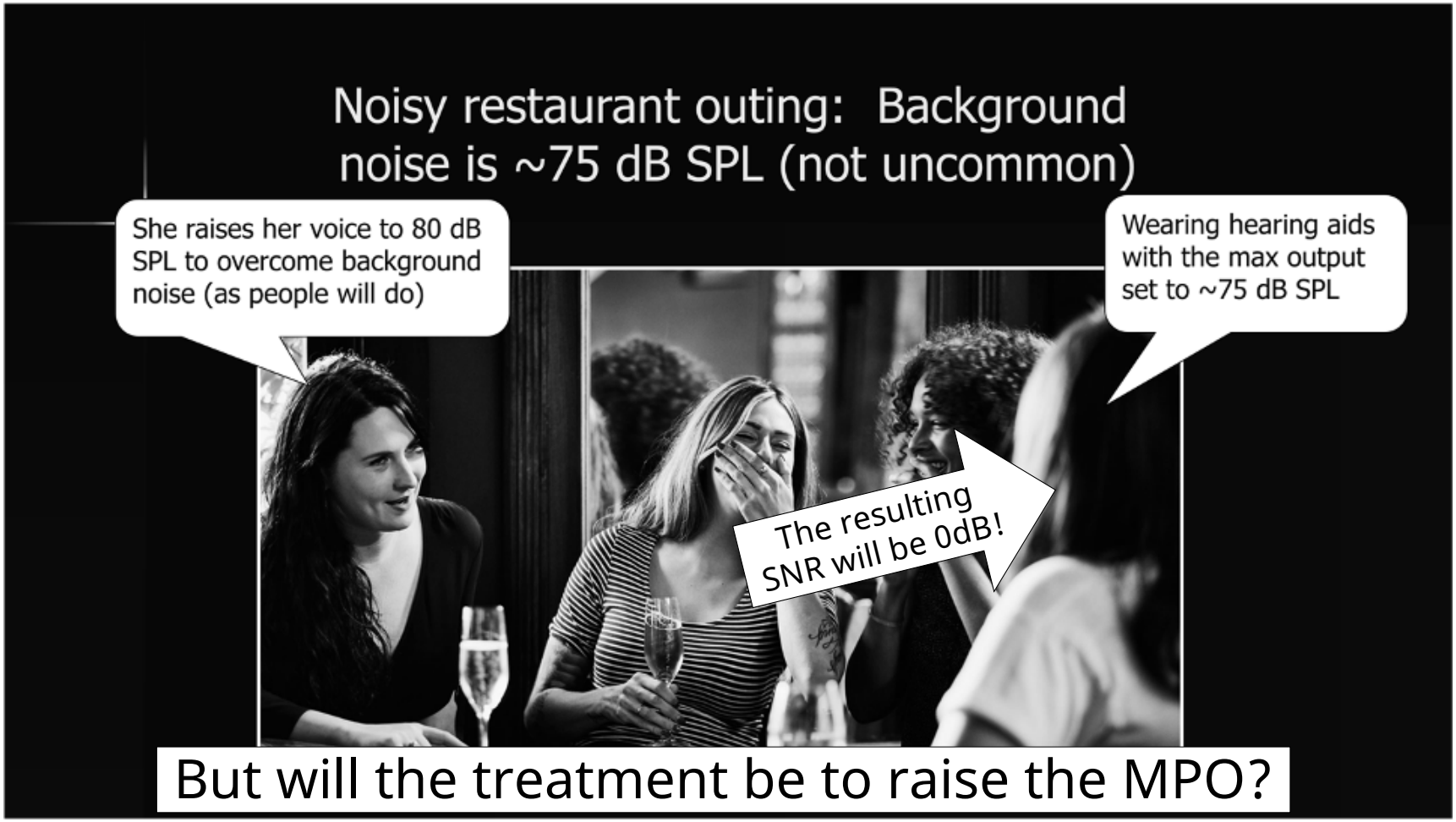
- Patients will turn down gain. They will then not have appropriate audibility for soft and average inputs, and will conclude that hearing aids don’t work very well.

- Patients only will use their hearing aids when they know no loud sounds will exist, missing out on amplification for the majority of listening situations, and will conclude that maybe hearing aids are not needed at all.

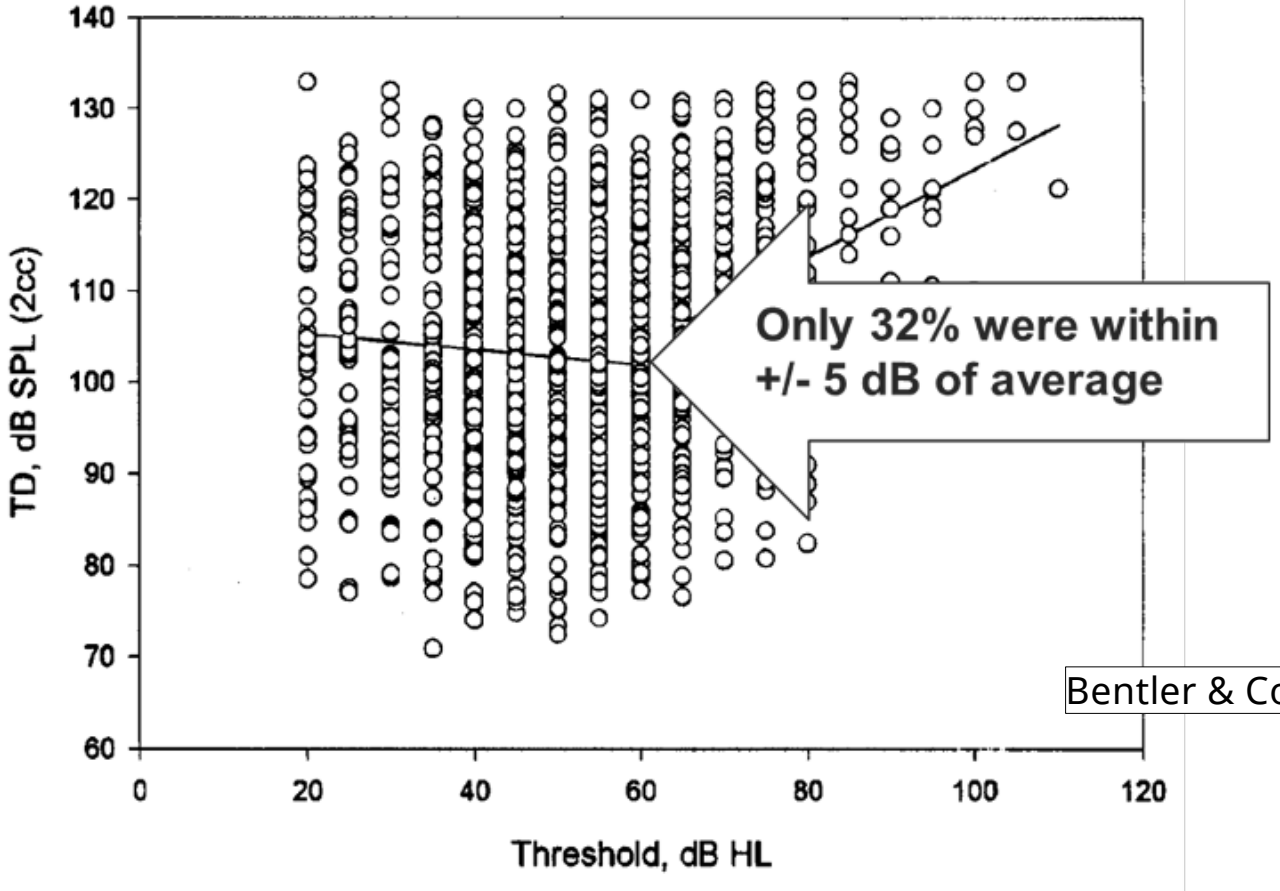
- Patients will have some initial negative experiences, and simply stop using their hearing aids.

What happens when MPO is “too cold?”

- Speech may sound distorted, as it often will be at the maximum output level.
- Speech may not have the necessary dynamics, as the peaks will be “clipped.” Music will sound “dull.”
- The range of loudness perceptions will be limited—average and loud inputs may only differ by a few dB following processing.
- For some speech-in-noise listening situations (where the input is a positive SNR), a low output setting could make the real-world SNR more adverse.


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 hearing aids with the max output set to ~75 dB SPL
The resulting SNR will be 0dB!
But will the treatment be to raise the MPO?

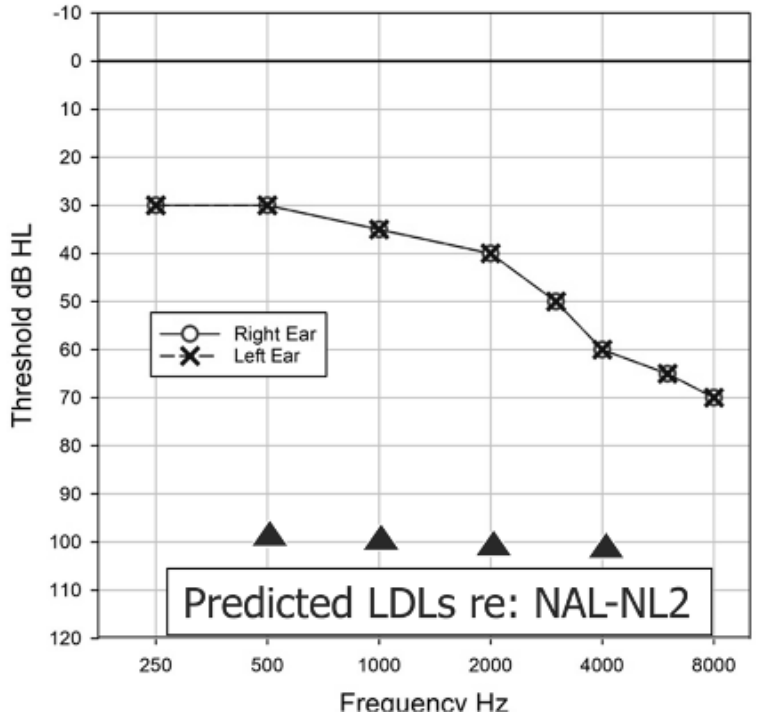
A reminder from Quick Takes v3.4: Why “average” doesn’t work very well



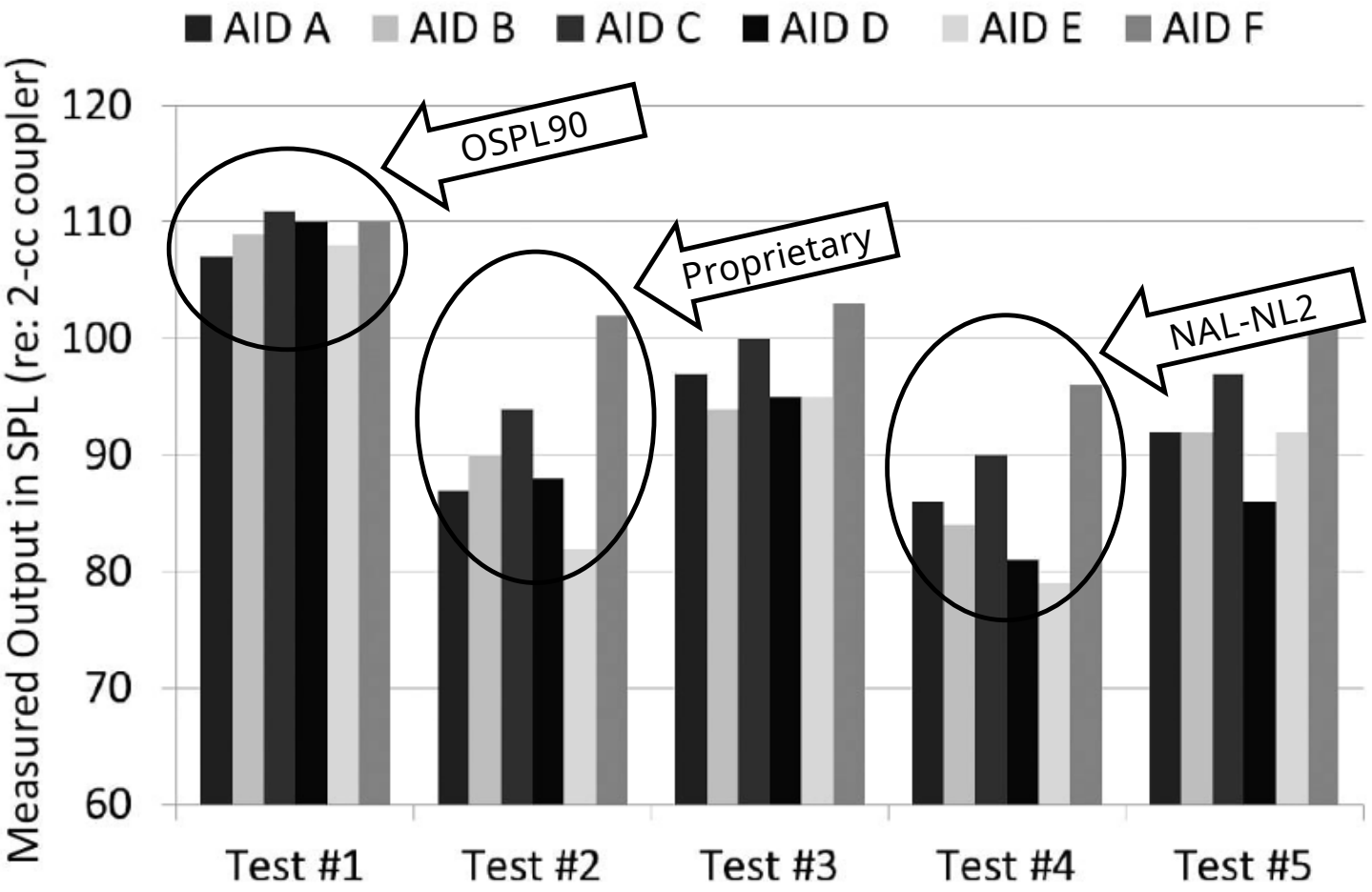
Bentler & Cooley, 2003

BUT . . . The problem is even bigger than fitting to average:

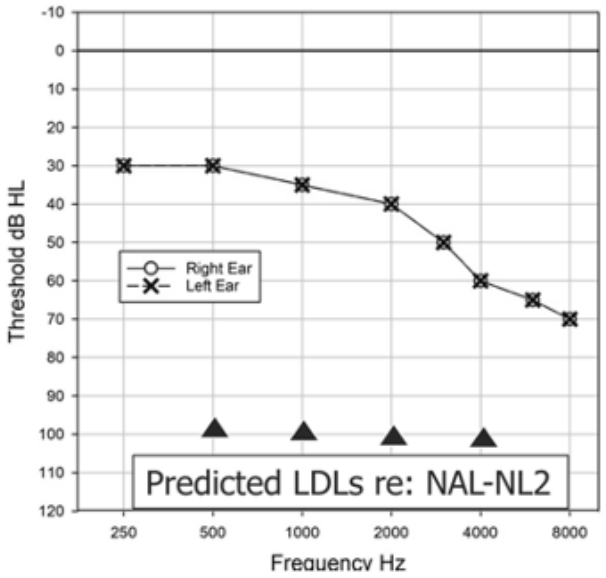
(Mueller, Stangl & Wu, 2021)

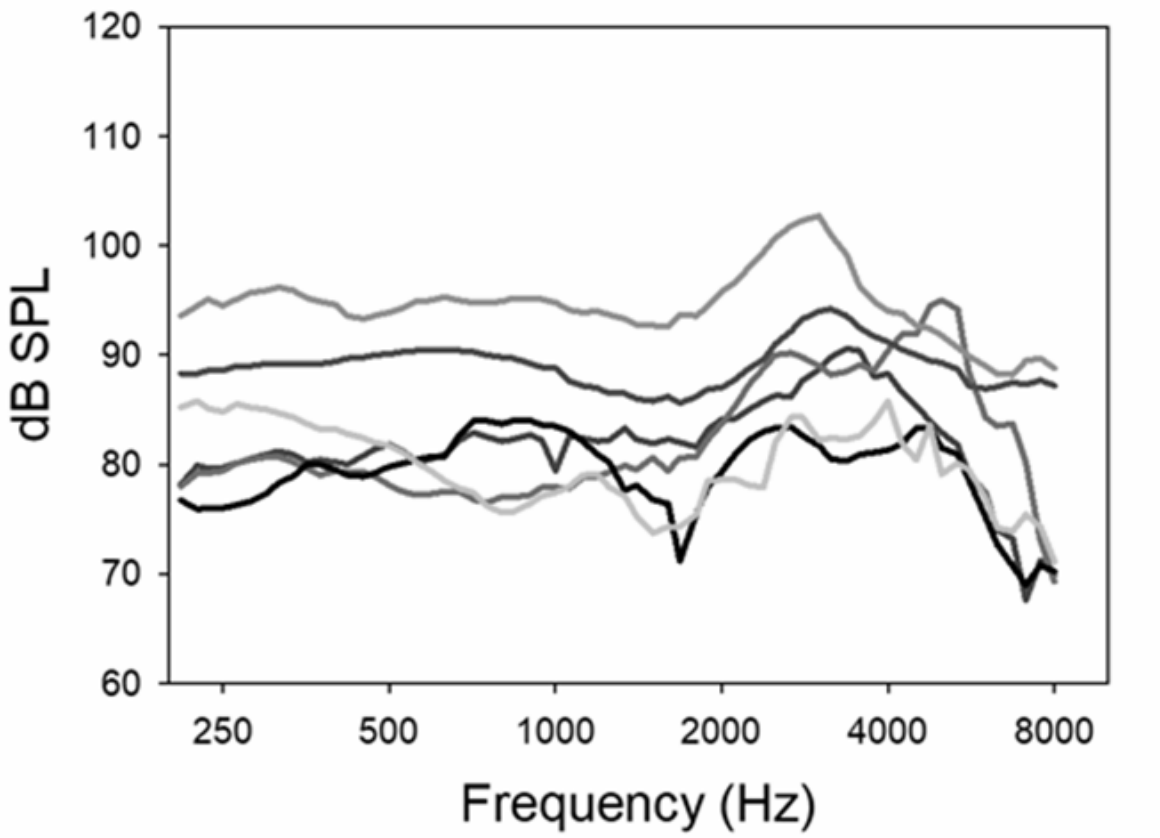


- Conducted OPSPL90 and MPO testing on premier hearing aids of Big Six
- Measures obtained via 2-cc coupler.
- As part of study, hearing aids were programmed to typical audiogram for both proprietary and for NAL-NL2
- Comparisons also were made to presriberd output vs. MPO shown in fitting software.

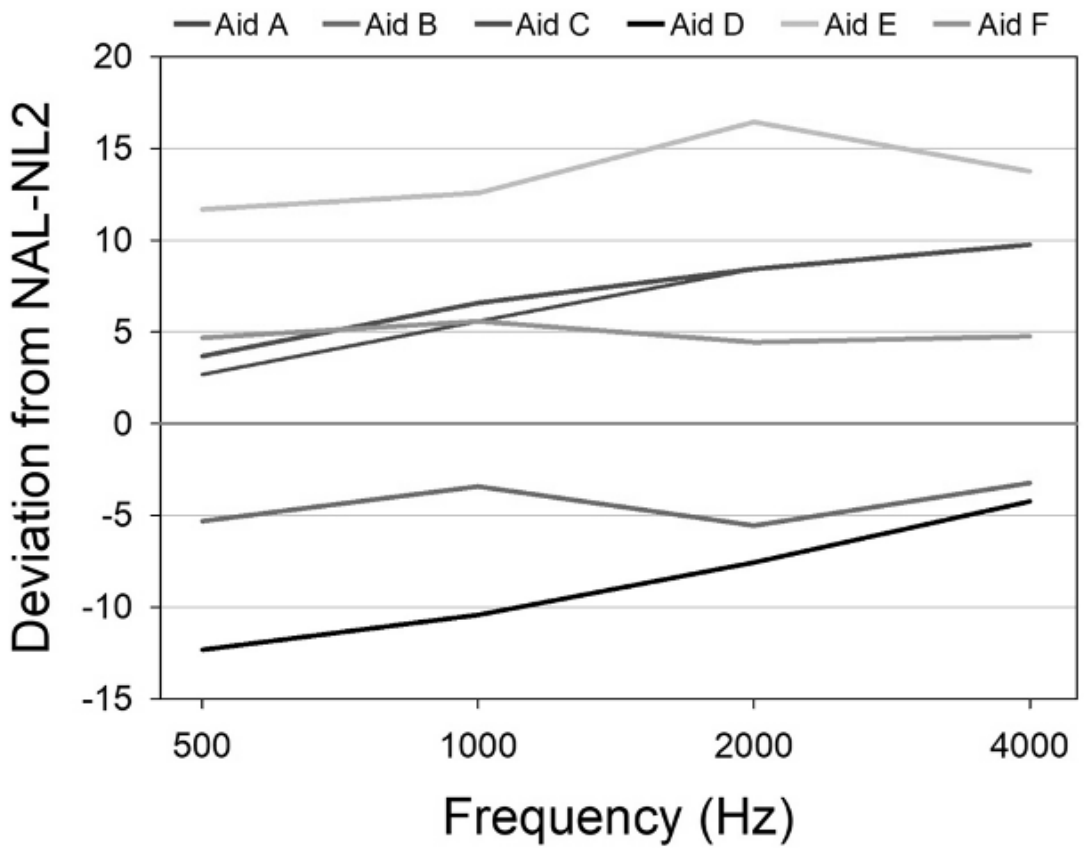

AID A
AID B
AID C
AID D
AID E
AID F
Measured Output in SPL (re: 2-cc coupler)
120
110
100
90
80
70
60
OSPL90
Proprietary
NAL-NL2
Test #1
Test #2
Test #3
Test #4
Test #5

MPOs for the NAL-NL2 fittings





MPO shown in the software vs. NAL-NL2



Variance from the NAL of ~12-15 dB

Variance among manufacturers of ~20-25 dB

MISCONCEPTION

For most products, the fitting software does not select the best MPO for the patient.

RESEARCH QUICK TAKES

4.3: Potential hearing aid fitting misconceptions: Does the default fitting software get the MPO setting right?

Brian Taylor & Gus Mueller

RESEARCH QUICK TAKES

4.4: Potential hearing aid fitting misconceptions: How accurate are hearing aid environmental classification systems?

Brian Taylor & Gus Mueller

signia | Audiology

A little history: It has been believed for many years that different processing is needed for different listening situations:

- Less gain in lows when noise is present (1947)
- Manual switching from omni to directional (~1975)
- Analog “Noise reduction”: Zeta noise blocker, BILL processing (~1980s)
- Multiple programs (e.g., Widex Quatro ~1989)
- Automatic switching from omni to directional (~2001)

And then, in the late 1990s we had digital hearing aids, that had “automatic signal classification systems.”

Assessing the game:

- The score?
- What down?
- Yards needed?
- Where on field?
- Game time left?
- Time outs left?

Who to send in?

- Blocking fullback?
- Speedy running back?
- Big tight end?
- Sure-handed receiver
- Kicker?

Signal classification works a lot like a football coach

Like the coach, the hearing aids need to assess the "game" situation (the listening environment):

- Both overall level and band-specific level
- Spectral peaks and spectral location of base envelope modulation rates
- Channel specific amplitude depth and rate; co-modulations
- Spectral and temporal signature of both lower and higher level portions of the input signal
- Relative amplitude of portion of the input signal estimated to be speech versus that estimated to be noise (i.e., the SNR of the input signal)

And then decide who (what) to send into the game:

- Directional processing?
- Noise reduction?
- Sound Smoothing?
- Echo Blocker?
- Wind reduction?
- Own Voice Processing?
- Feedback reduction?

Today’s hearing aids can classify sounds into as many as seven different categories:

- Quiet
- Speech-in-quiet
- Speech-in-noise
- Noise
- Music
- In car
- Own voice

BUT . . . How accurate are they?

Research comparing signal classification systems of premier hearing aids of Big Six (Cui & Groth, 2017):

- All products were good at identifying quiet, and speech-in-quiet.
- Noise (a hand mixer) was identified as noise by 5 of the 6 instruments, and 5 of the 6 also were accurate in identifying speech babble.
- Speech-in-noise was identified correctly by two products (~90%), but the other four had accuracy of only ~40-60%.
- Four of the six products had music as one of the classification categories. Two of these instruments were quite accurate in identifying both pop and classical music (~90% or better). One product was 95% accurate for pop music, but only 35% for classical. And the fourth product had a 5% accuracy for pop, and 55% for classical.

This article gives us a glimpse of how good current 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

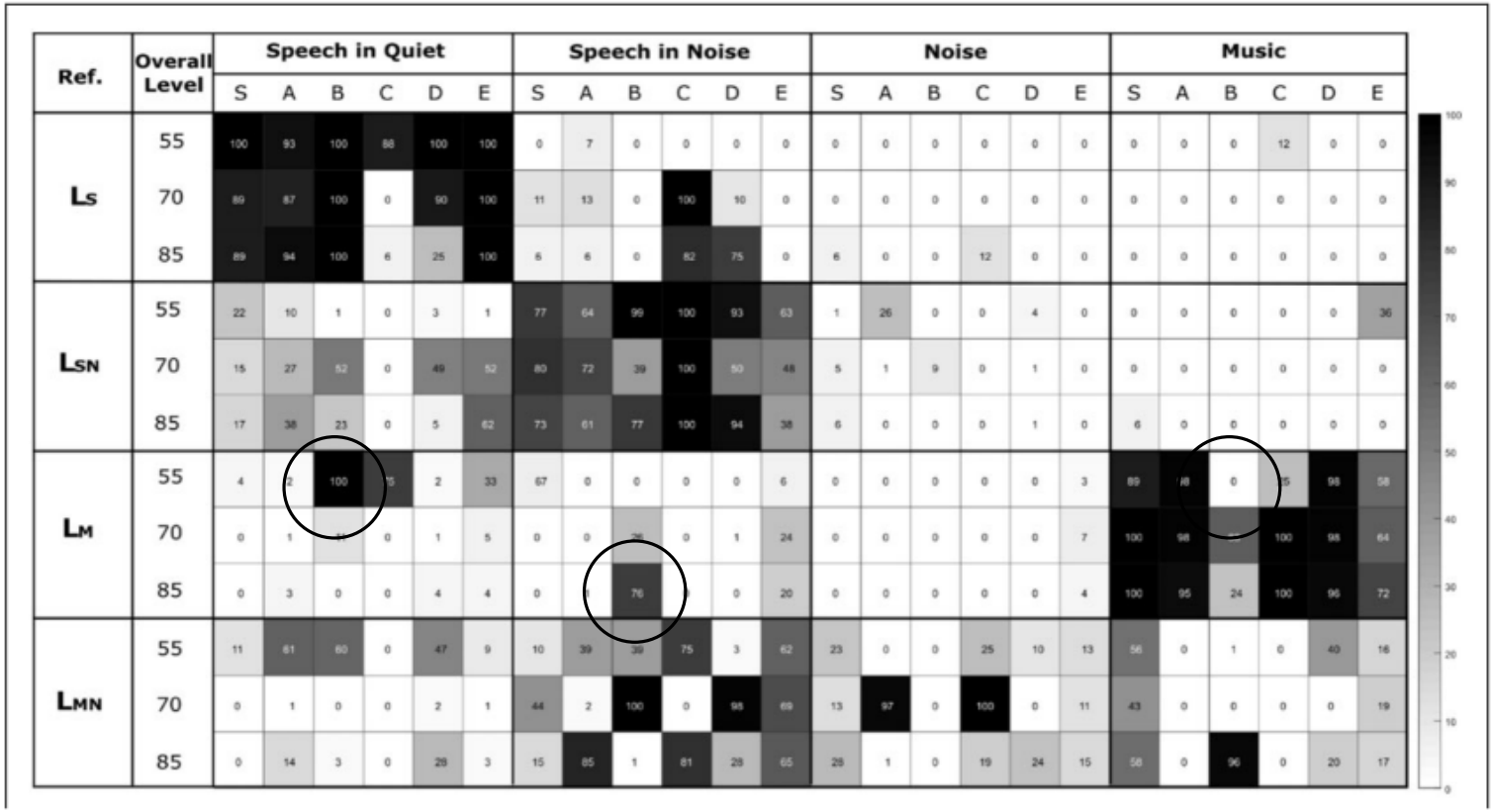
What they did . . .

- Compared the classification schemes among five premium hearing instruments. Instruments programmed to each companies default proprietary algorithm.

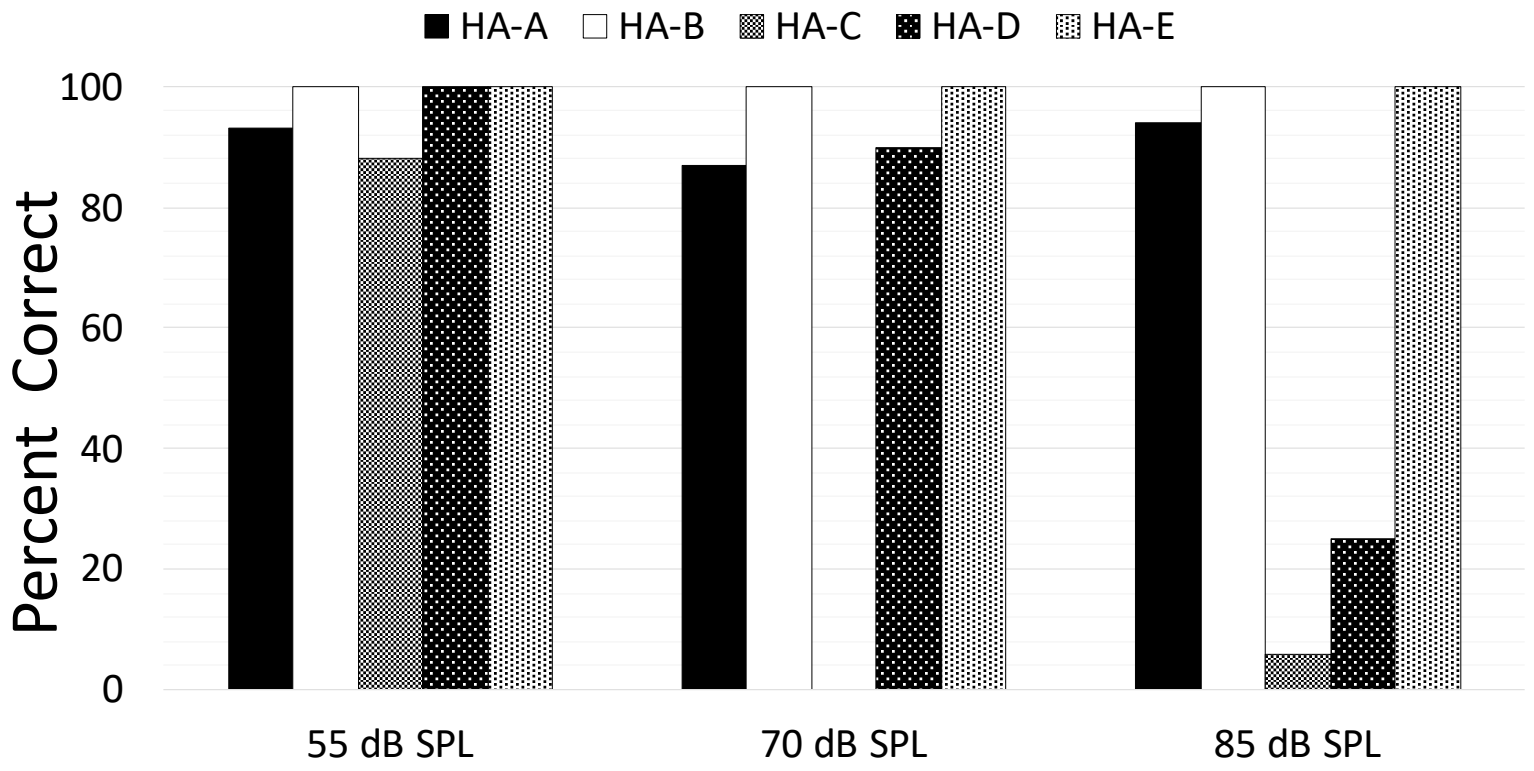
- Twenty-eight acoustic scenes representing various prototypical environments were presented to the five devices mounted on an acoustic manikin. The scenes varied in content, overall SPL and SNR.

The ratings (as displayed in the article):

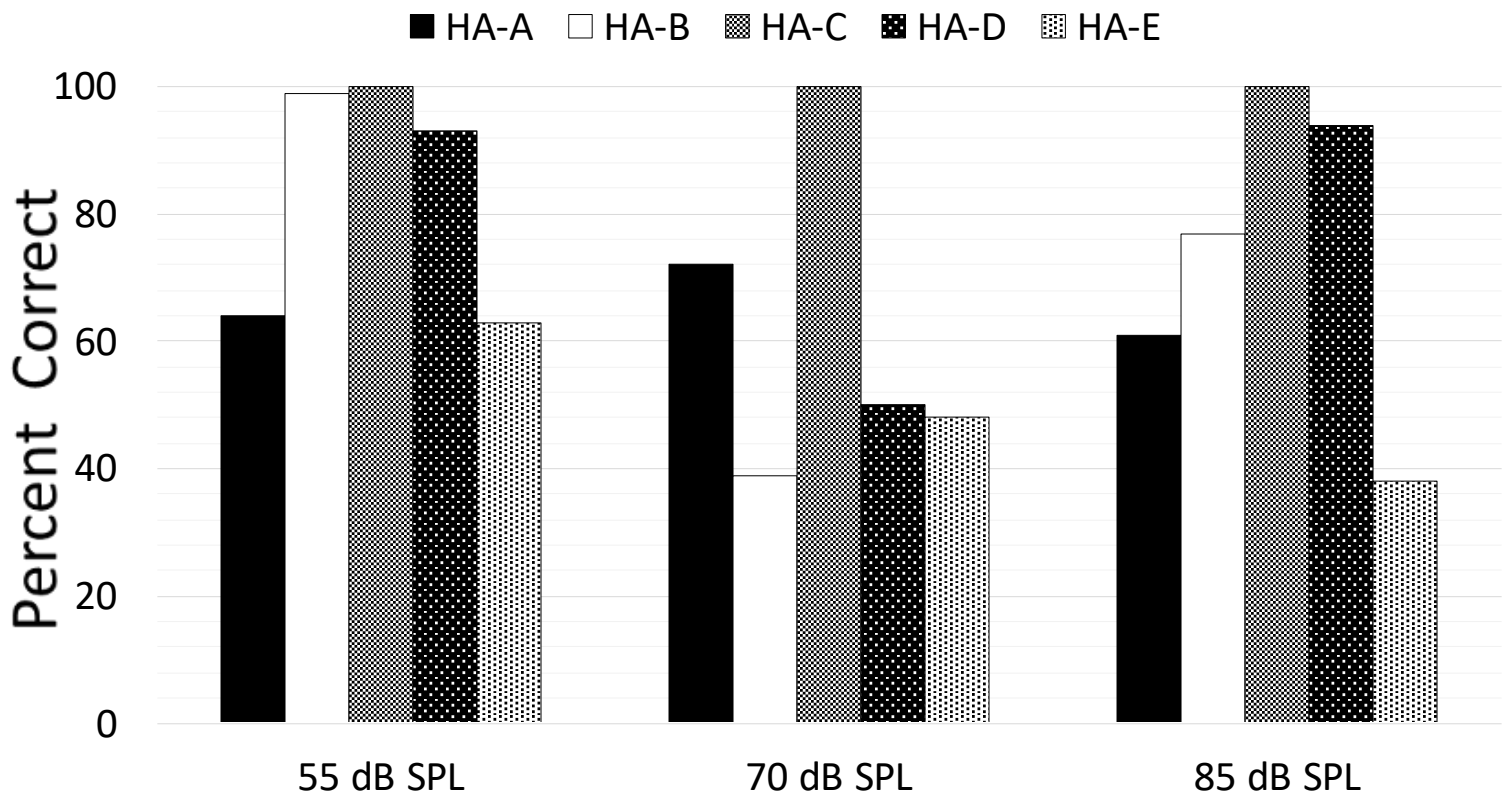
The darker the square, the more frequent the classifier selected that category



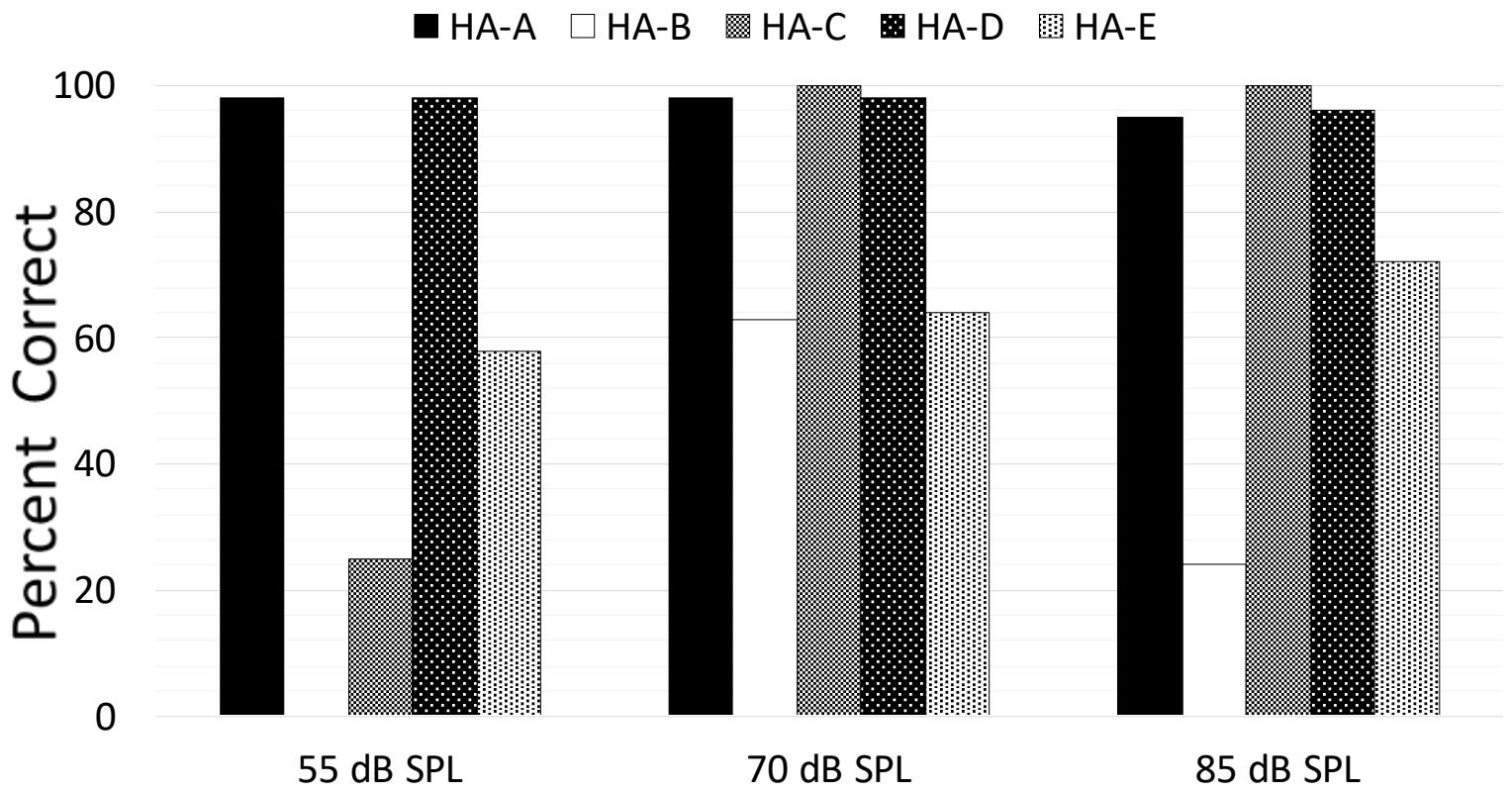
Back and forth conversation between a man and a woman in quiet



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



Jazz Music With Vocal



MISCONCEPTION

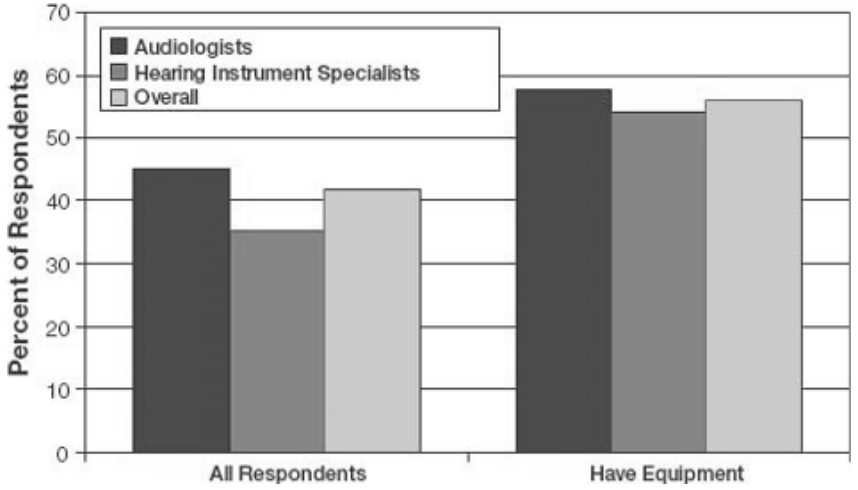
For several situations, the signal classification might not be correct—important for post-fitting counseleing.

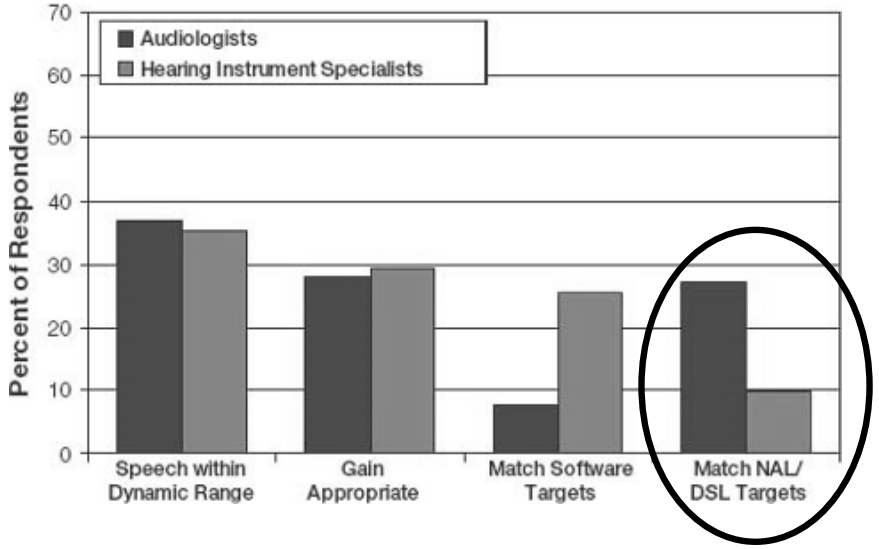
RESEARCH QUICK TAKES

4.5: Potential hearing aid fitting misconceptions: Are there reasonable alternatives to a verified prescriptive fitting?

Brian Taylor & Gus Mueller

Some results from the Mueller & Picou survey . . .





The results of the survey suggest that at least one of these three misconceptions must be true:

- The NAL-NL2 algorithm is not a very good starting point for the average patient.
- The manufacturer’s default proprietary algorithm is better than the NAL.
- When the manufacturer’s NAL is selected in the software, you have the NAL fitting in the real ear.

The NAL-NL2 algorithm is not a very good starting point for the average patient.

As described by Earl Johnson in his 20Q article on the NAL-NL2 and DSLv5: “You have to start someplace.”

Consider this (for a 16 channel hearing aid):

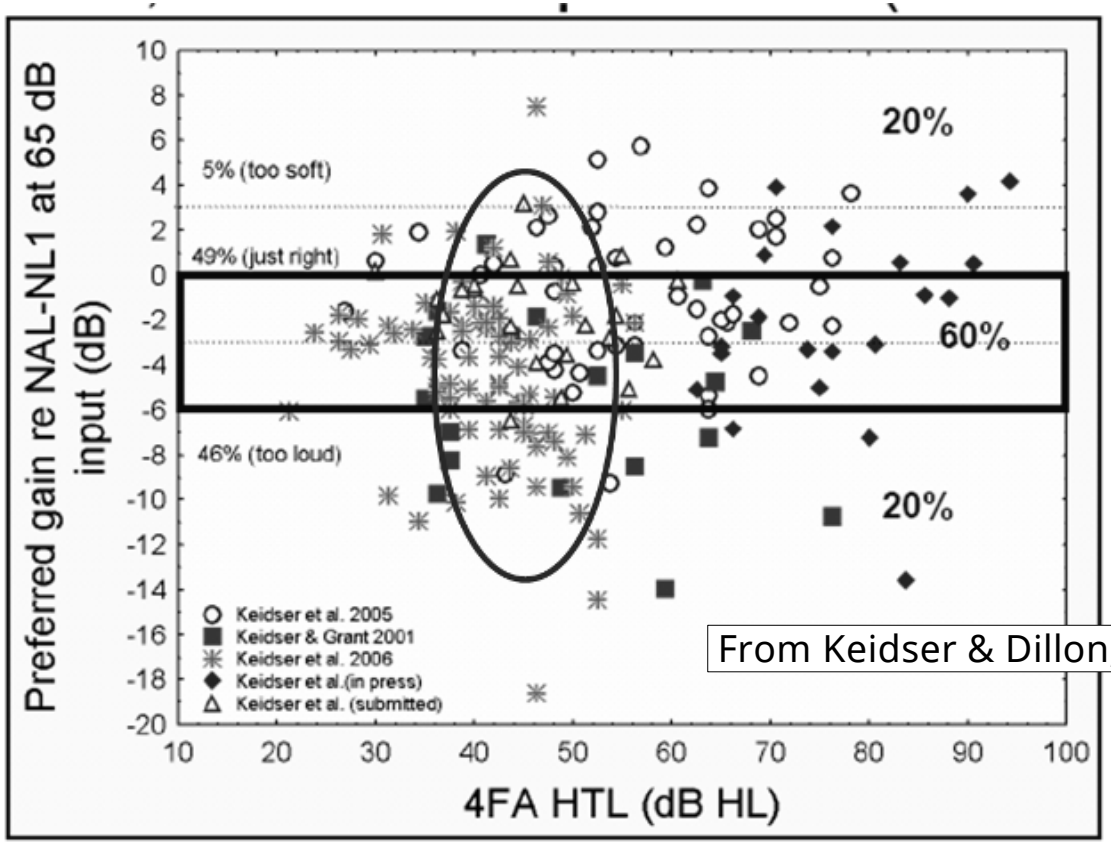
- An experienced HCP probably could limit the range of appropriate gain to 20 dB for each frequency.
- And would know that gain could no change too drastically from channel to channel.
- And would know that a smooth frequency response is necessary.
- And would know that the same response would not provide the best loudness, quality and intelligibility

After all of which, there would still be **1430** possible frequency responses from which to choose for any particular patient!
And that’s just for on input level.

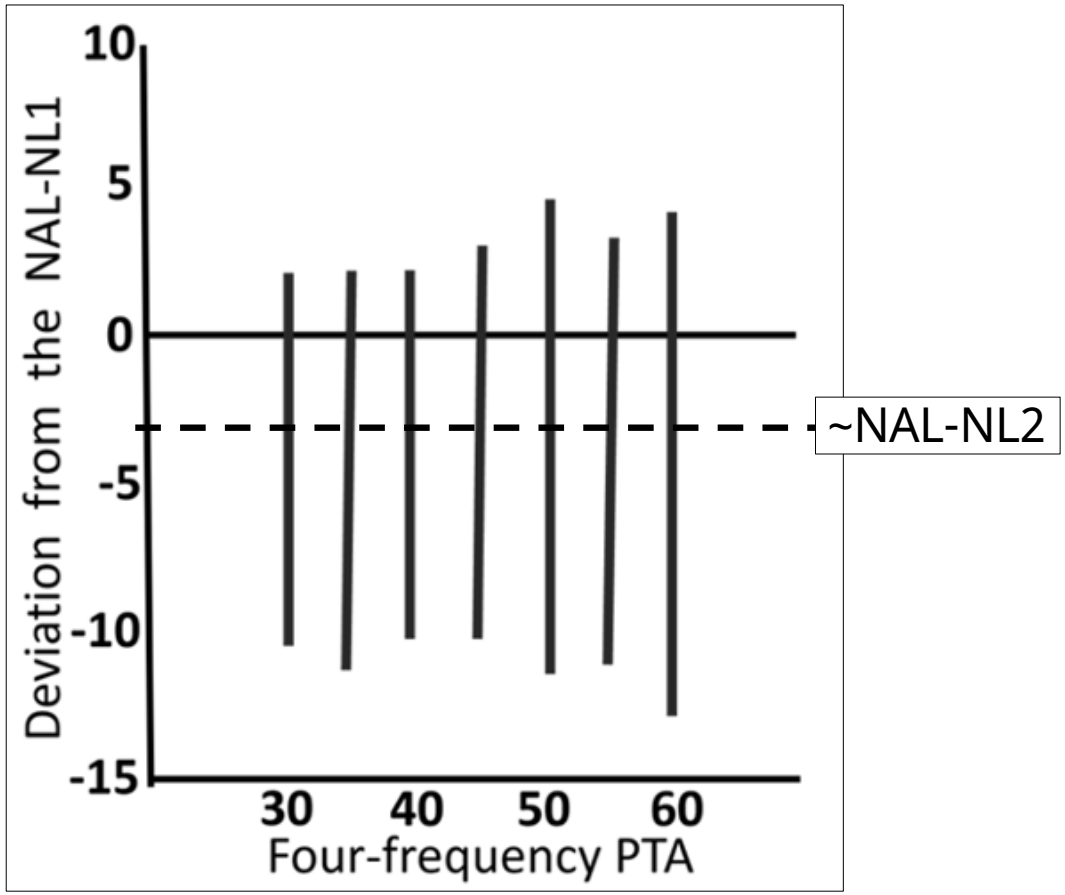
A little history:

- Original NAL ~1977
- Revised NAL (NAL-R) ~1986
- Non-Linear Version (NAL-NL1) ~1999
- Revised Non-Linear Version (NAL-NL2) ~2011

NAL-NL1 data used for the development of NAL-NL2



From Keidser & Dillon, 2006



Simplified version of chart

- Range of preferred listening for the different hearing loss groups.
- Change from NAL-NL1 when NAL-NL2 was introduced.

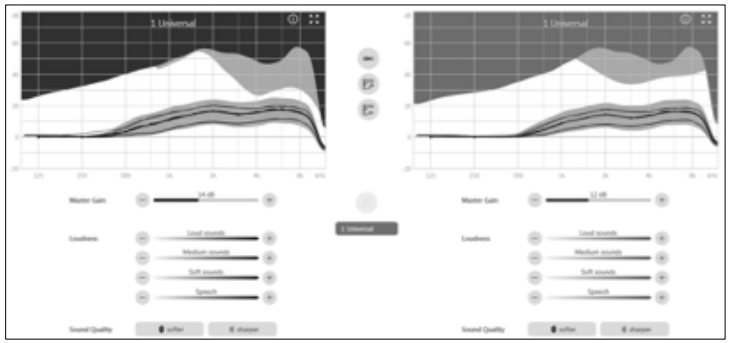
Support for the NAL-NL2 algorithm . . .

Following three weeks of training, researchers examined the new trained settings for both low and high frequencies, for six different listening situations:

- Participants trained down from the NAL-NL2 for all six situations, but only by a minimal amount.
- For the speech in quiet condition for the high frequencies, the average value was a gain reduction of 1.5 dB (range = 0 to –4 dB).
- For the speech in noise condition, there was an average gain reduction of only 2 dB (range =+0 .5 to –4.5 dB).

Researchers evaluated the outcomes of self-fitting hearing aids initially set to 0 dB REIG:

- The real-world effectiveness of the self-fitting approach was evaluated via a month-long field trial.
- Following the trial, there was a strong correlation between user-selected and audiologist NAL-programmed gain.
- On average, the user-selected gains were only 1.8 dB lower than those selected by the audiologists, based on the NAL-NL2 prescription.

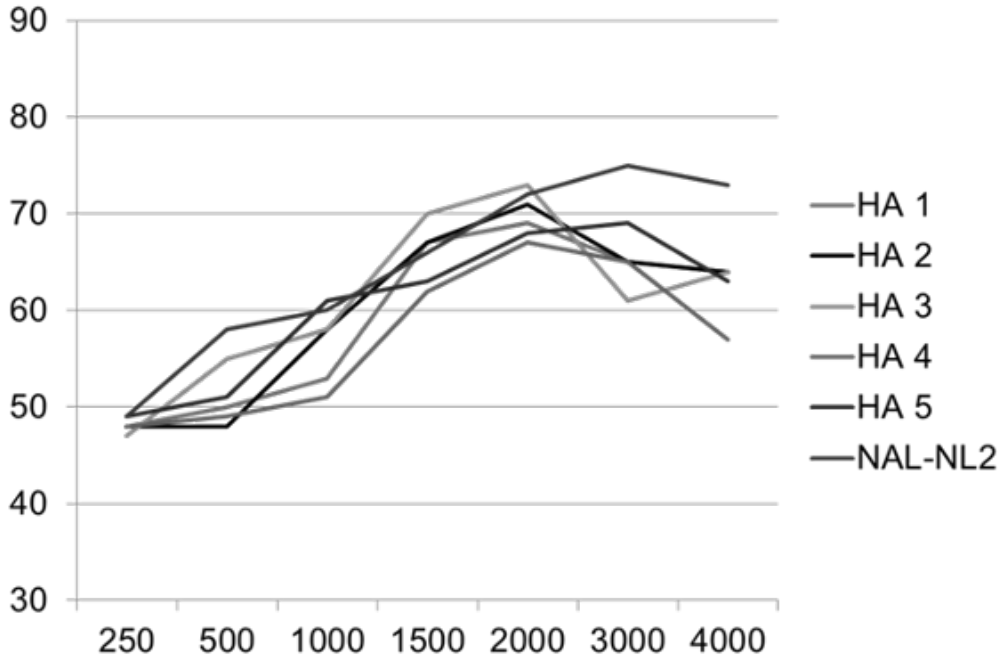


The manufacturer’s default proprietary fitting is a better starting point than the NAL-NL2.

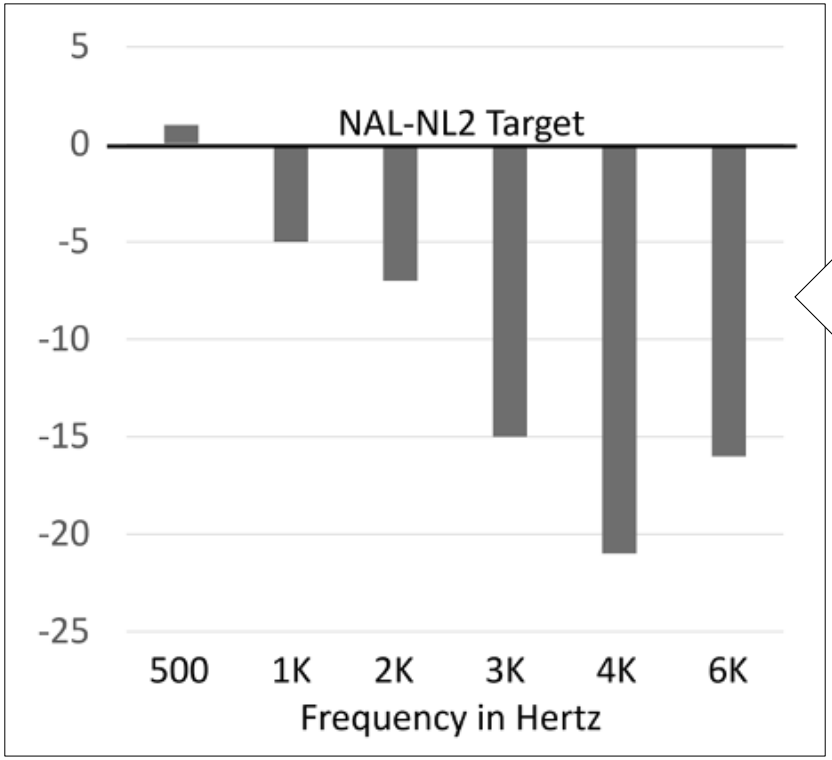
One might ask . . . Why do manufacturers have proprietary fittings?

- Having a “proprietary” fitting makes a given product sound more unique and a little mystical.
- Less gain in the highs means less feedback problems—the feedback reduction algorithm does not need to be as good as if you are fitting to the NAL-NL2.
- HCPs in different countries have different styles, procedures and sales techniques.
- New hearing aids users generally prefer hearing aids that don’t sound like hearing aids. The best way to accomplish this is to provide very little gain.

General pattern of proprietary fittings compared to the NAL-NL2



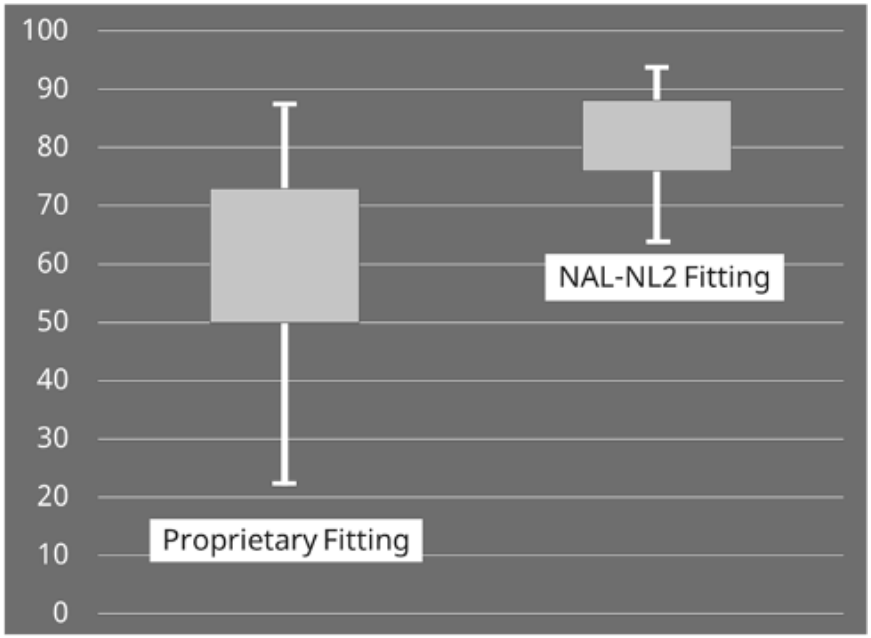
Recent Valente et al (2018) study comparing NAL fitting to proprietary:



Average under-fitting for the proprietary

Some Valente et al data:

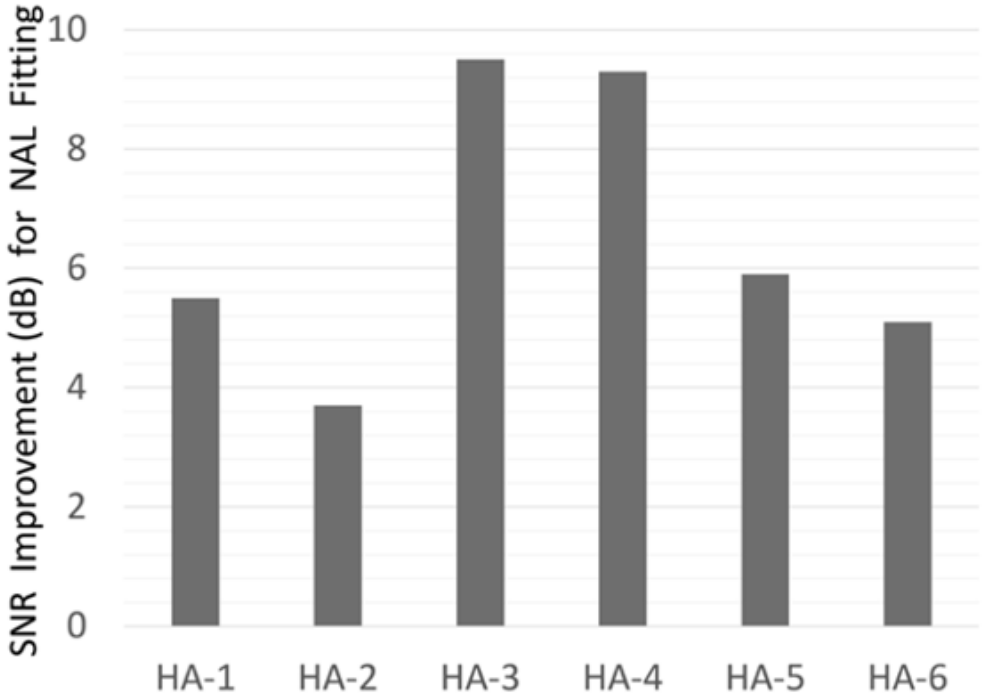
Not surprisingly, patients performed much worse for speech understanding with the proprietary fitting



Following the month-long field trial with both types of fittings (cross-over design):

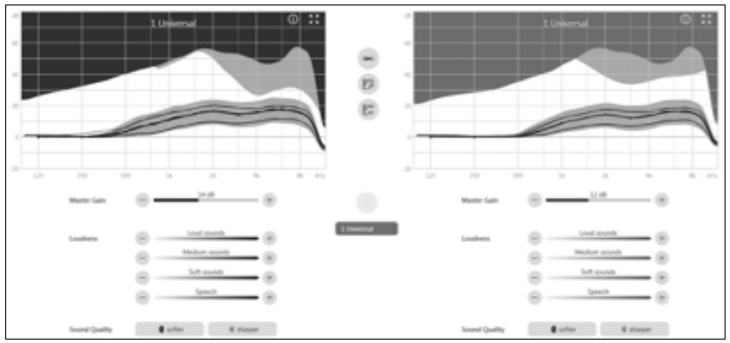
- Performance on the APHAB was significantly better for the NAL-NL2
- Of the 24 participants, 19 preferred the NAL-NL2 fitting

The minimal gain provided by proprietary fittings has an even greater effect on speech understanding in background noise (From Leavitt and Flexer)



Mean SNR improvement when participants were fitted to the NAL vs. proprietary fitting.

Hearing aids were the premier model of the Big 6.



Selecting the manufacturer’s default NAL-NL2 in the fitting software will result in the NAL-NL2 in the real ear.

A little history:

2003: Research showed that real-ear gain for 2000-4000 Hz was an average of 7-12 dB below simulated target-match gain.

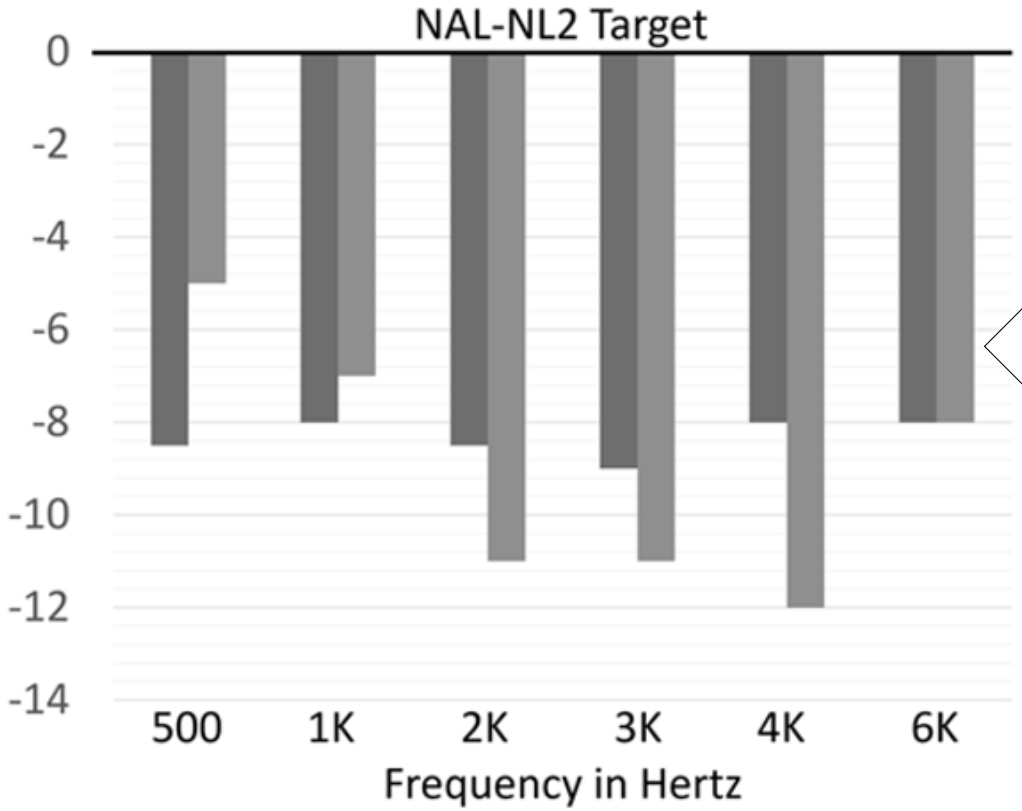
2007: Probe-mic testing on 42 ears showed that hearing aids programmed to default NAL failed to match targets by >10 dB in 64% of cases.

2012: Probe-mic testing on 51 ears showed that hearing aids programmed to default NAL failed to match targets by >10 dB in 71% of cases.

2015: Hearing aids programmed to four different manufacturer's NAL-NL2 fell below target by an average of 8-12 dB in the high frequencies.

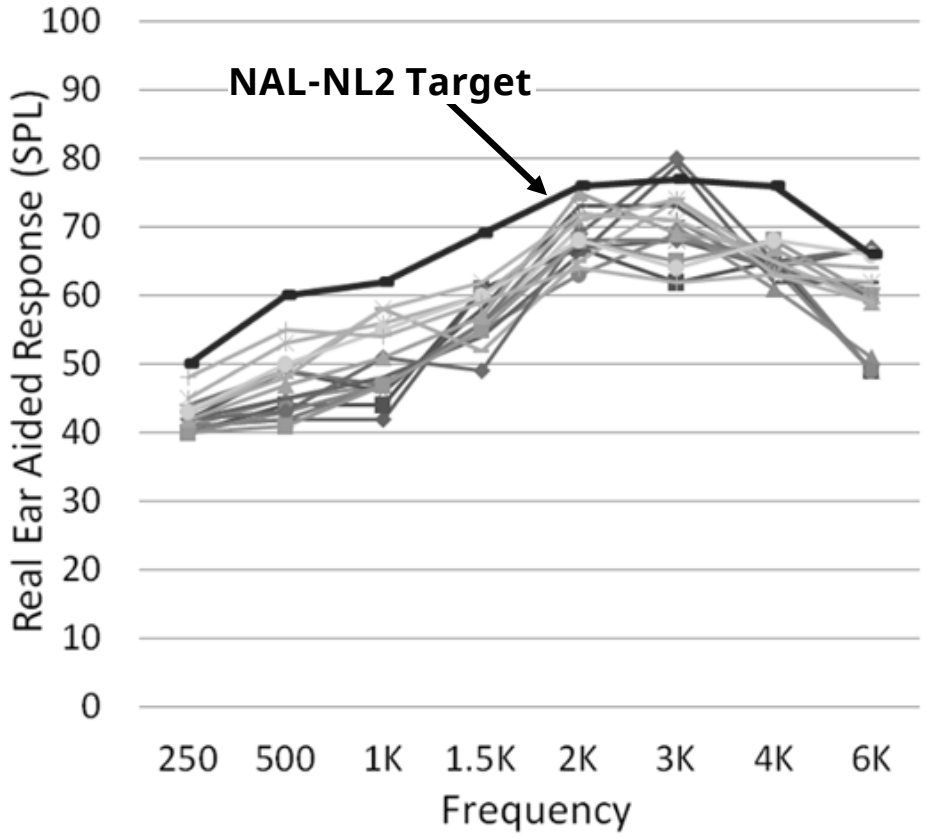
Mismatch to target observed in two recent studies

(Amlani et al, Pumford & Mueller)



Average under-fitting for the NAL-NL2 in the real ear

The mistake appears to be the greatest for soft inputs:



Real-ear findings (n=16) for soft inputs. In all cases, near-perfect match to target was displayed on the software fitting screen.

MISCONCEPTIONS

The NAL-NL2 algorithm is not a very good starting point for the average patient. **WRONG, IT IS**

The manufacturer's default proprietary algorithm is better than the NAL. **NO WAY!**

When the manufacturer's NAL is selected in the software, you have the NAL fitting in the real ear. **VERY UNLIKELY**

RESEARCH QUICK TAKES

4.6: Potential hearing aid fitting misconceptions: Are there other ways to verify the “best” fitting?

Brian Taylor & Gus Mueller

In QuickTakes 4.5 we concluded that real-ear verification of a validated prescriptive method is the gold standard.

But are there alternative methods of verification?

- Speech recognition measures?
- Function gain/aided sound field measures?
- In situ testing?
- AutoREMfit?
- Patient preference?

A look at the alternative methods:

- Speech recognition measures?
- Function gain/aided sound field measures?
- In situ testing?
- AutoREMfit?
- Patient preference?

How speech could be used . . .

Comparative testing with different programmed settings. Fit the patient with the setting that results in the best performance.

The problem:

- Need to avoid ceiling effects
- When do you stop the testing? There are oodles (scientific word) of programmable possibilities.
- The probability of one score being better than another is unlikely, due to the variability of speech material.

How speech could be used . . .

Conduct testing with different programmed settings until the patient's optimum performance is obtained.

The problem:

- Need to avoid ceiling effects
- When do you stop the testing? How do you know what is optimum for a given patient?
- The probability of one score being better than another is unlikely, due to the variability of speech material.

Variability of speech material

Score %	N = 50	N = 25		Score %	N = 50	N = 25
0	0-4	0-8		52	34-70	28-76
2	0-10			54	36-72	
4	0-14	0-20		56	38-74	32-80
6	2-18			58	40-76	
8	2-22	0-28		60	42-78	36-84
10	2-24			62	44-78	
12	4-26	4-32		64	46-80	40-84
14	4-30			66	48-82	
16	6-32	4-40		68	50-84	44-88
18	6-34			70	52-86	
20	8-36	4-44		72	54-86	48-92
22	8-40			74	56-88	
24	10-42	8-48		76	58-90	52-92
26	12-44			78	60-92	
28	14-46	8-52		80	64-92	56-96
30	14-48			82	66-94	
32	16-50	12-56		84	68-94	60-96
34	18-52			86	70-96	
36	20-54	16-60		88	74-96	68-96
38	22-56			90	76-98	
40	22-58	16-64		92	78-98	72-100
42	24-60			94	82-98	
44	26-62	20-68		96	86-100	80-100
46	28-64			98	90-100	
48	30-66	24-72		100	96-100	92-100
50	32-68					

QuickSIN

	Lists per Condition		
	1	2	3
95% C.D. (dB)	3.9	2.7	2.2
90% C.D. (dB)	3.2	2.2	1.8

A look at the alternative methods:

- ~~Speech recognition measures?~~
- Function gain/aided sound field measures?
- In situ testing?
- AutoREMfit?
- Patient preference?

Easy to eliminate this alternative:

- The sound field must be calibrated correctly (many are not).
- The non-test ear must be masked using an earphone.
- The expansion circuit of the hearing aid might suppress the tones the patient is trying to hear.
- The ambient noise of the room (amplified by the hearing aid) might mask the tones that the patient is trying to hear.

Easy to eliminate this alternative:

- The WDRC of the hearing aid might suppress the tones that the patient is trying to hear.
- The feedback reduction feature of the hearing aid might suppress the tones that the patient is trying to hear.
- Test-retest reliability is poor.

Note on test-retest: To be significantly different at the .05 level, the differences would have to be greater than 15 dB. If hearing aid Programming A resulted in an aided threshold of 20 dB, Programming B would have to result in aided thresholds of 0 dB or 40 dB to be different from Programming A.

A look at the alternative methods:

- ~~Speech recognition measures?~~
- ~~Function gain/aided sound field measures?~~
- In situ testing?
- AutoREMfit?
- Patient preference?

Hearing aid in situ measures

What are they?

Frequency-specific signals are produced by the hearing aid, and thresholds are obtained. These thresholds are then used for programming the hearing aid, rather than the threshold obtained via traditional audiometry.

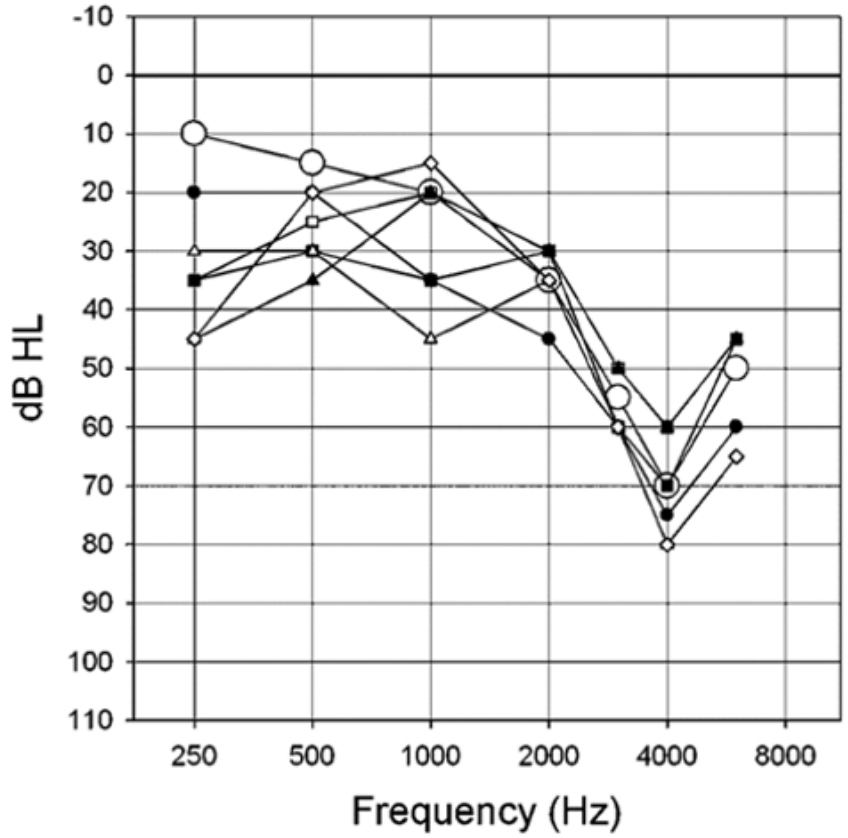
And why is this better?

The notion is that because the hearing aid/earmold are in place, variations in ventng and individual ear acoustics will be accounted for (e.g., RECD).

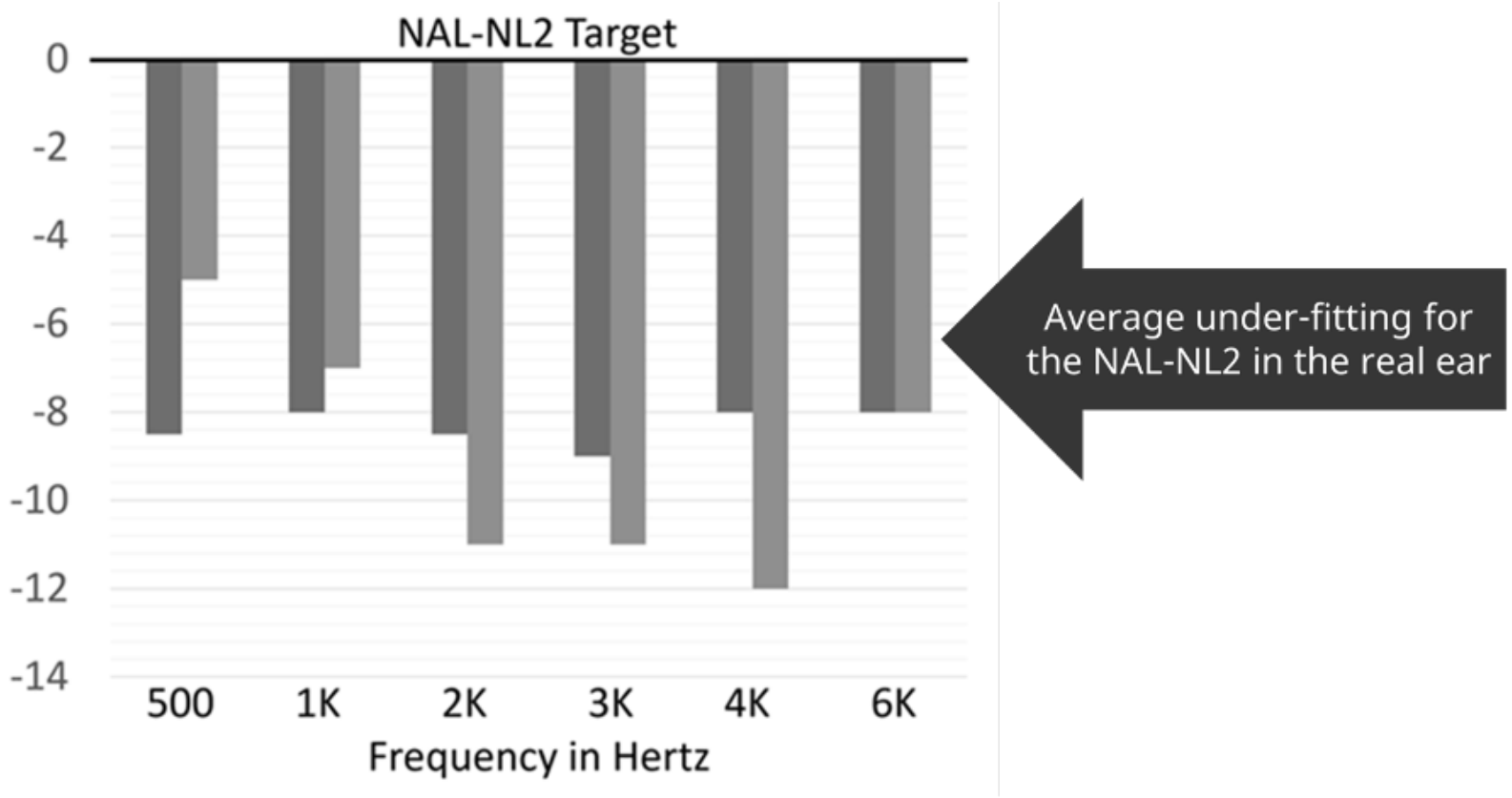
Hearing aid in situ measures

What you sometimes hear from manufacturer reps

Reason #1 why this isn’t true:



Reason #2 (most important) why this isn't true:



A look at the alternative methods:

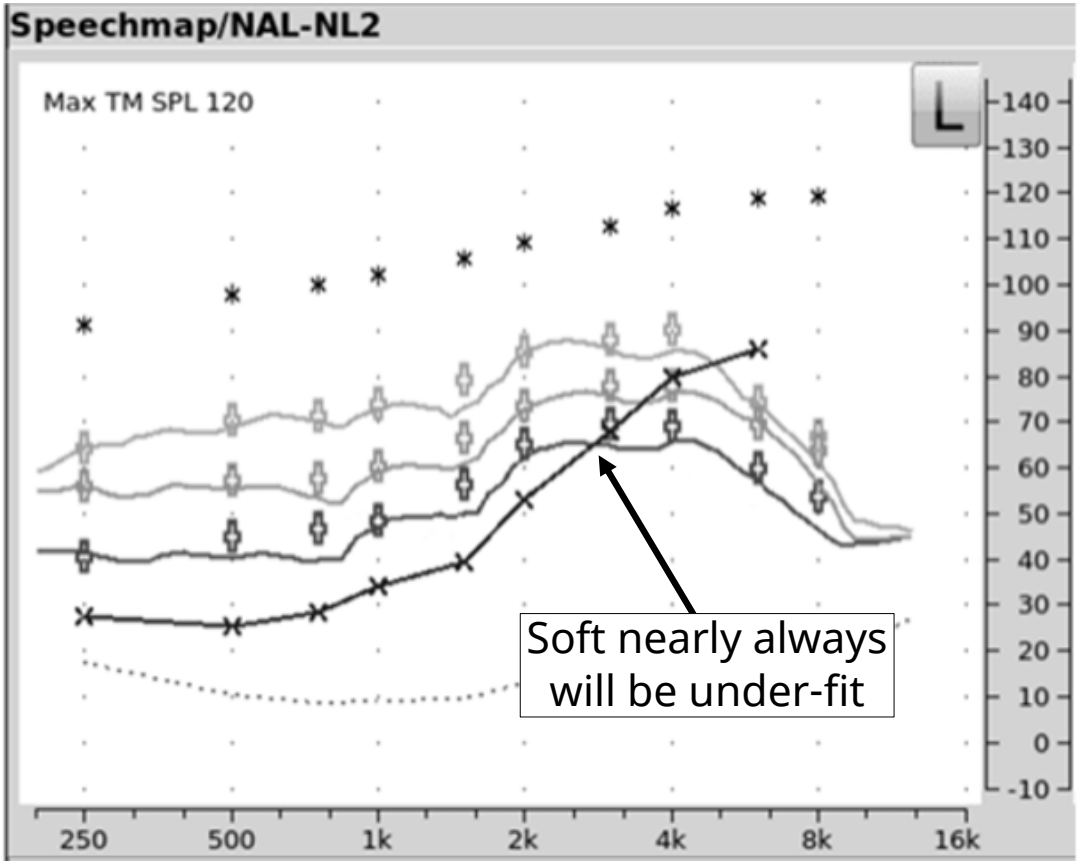
- ~~Speech recognition measures?~~
- ~~Function gain/aided sound field measures?~~
- ~~In situ testing?~~
- AutoREMfit?
- Patient preference?

What is autoREMfit?

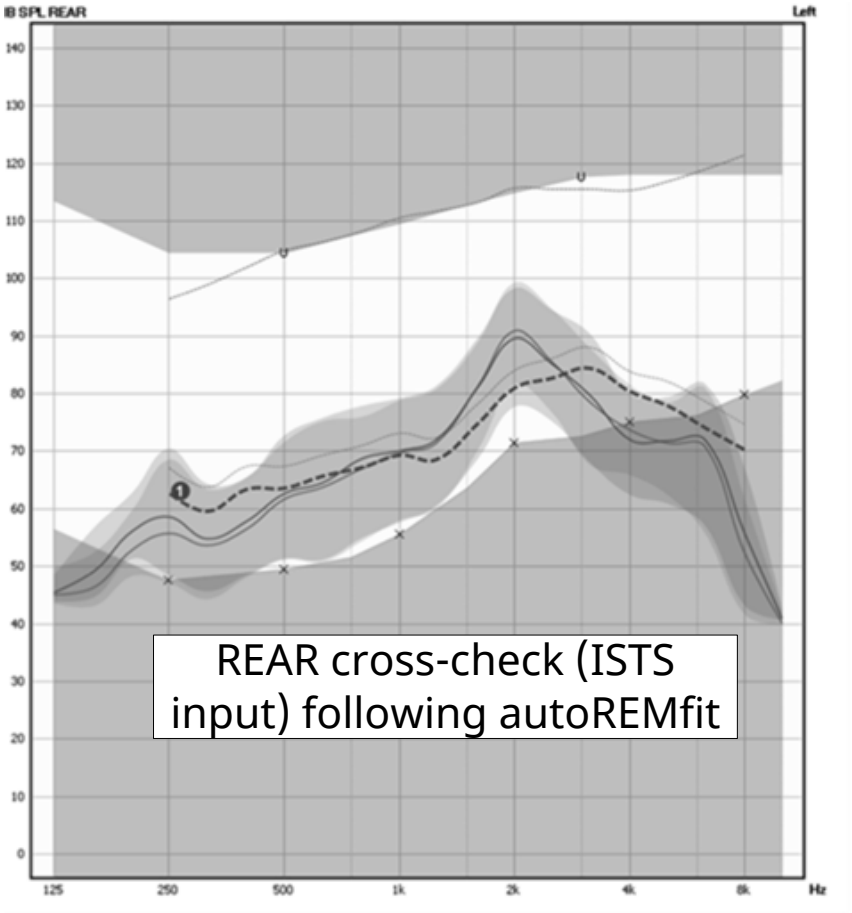
- It’s a method of integrated/automated verification.
- Either the fitting software borrows information from the probe-mic equipment, or the probe-mic equipment borrows information from the fitting software. Most systems will fit to both NAL and DSL.
- The examiner must make some background decisions 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

All sounds great . . . BUT . . .

Some autoREMfits only fit to 65 dB input—how good is the match for soft inputs?

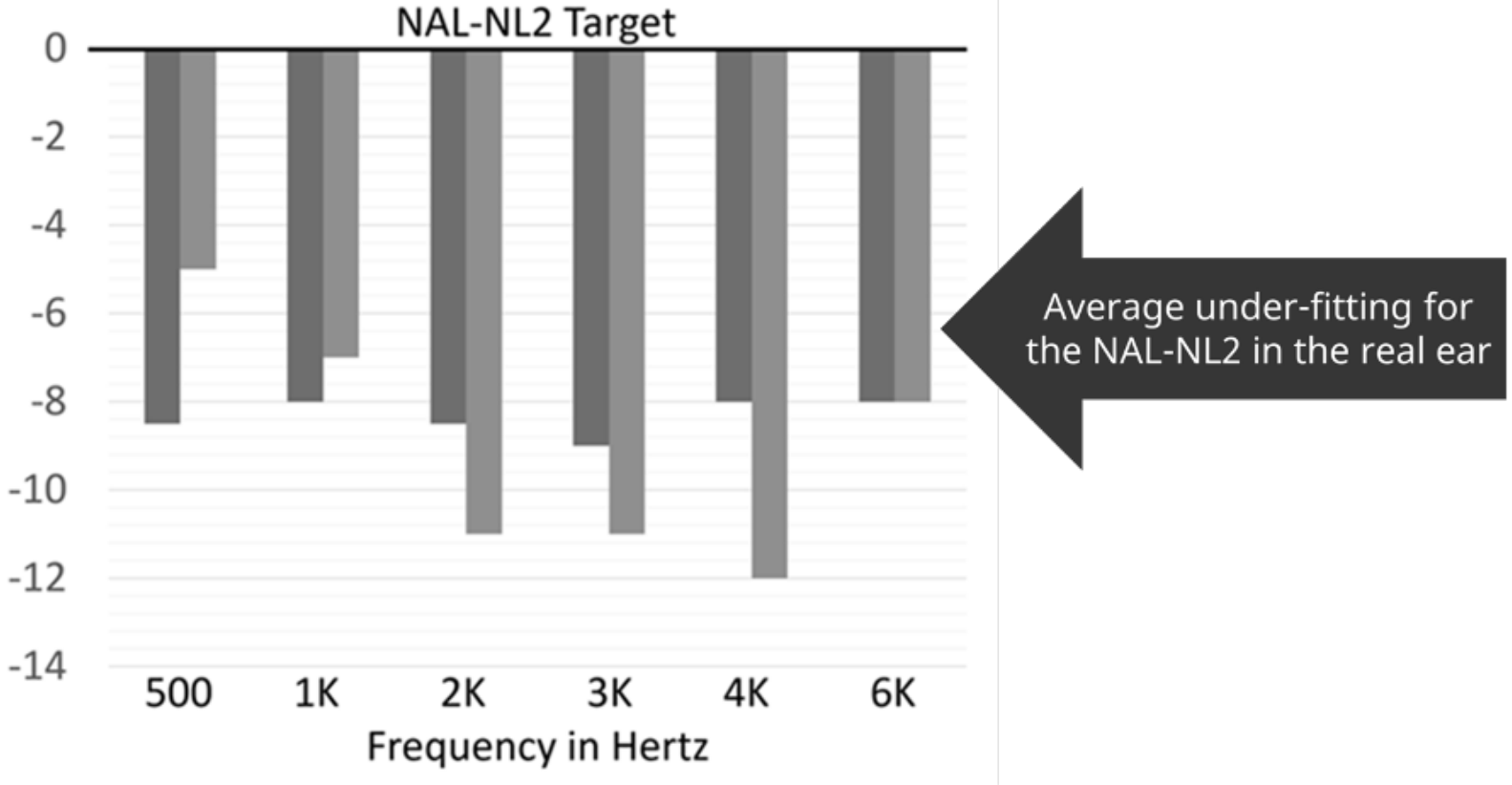


Some autoREMfits use the patient’s REUG—this can lead to a poor REAR match to target:



REAR cross-check (ISTS input) following autoREMfit

And most importantly, many autoREMfits use the manufacturer's NAL-NL2 targets, not the true targets of the probe-mic equipment



A look at the alternative methods:

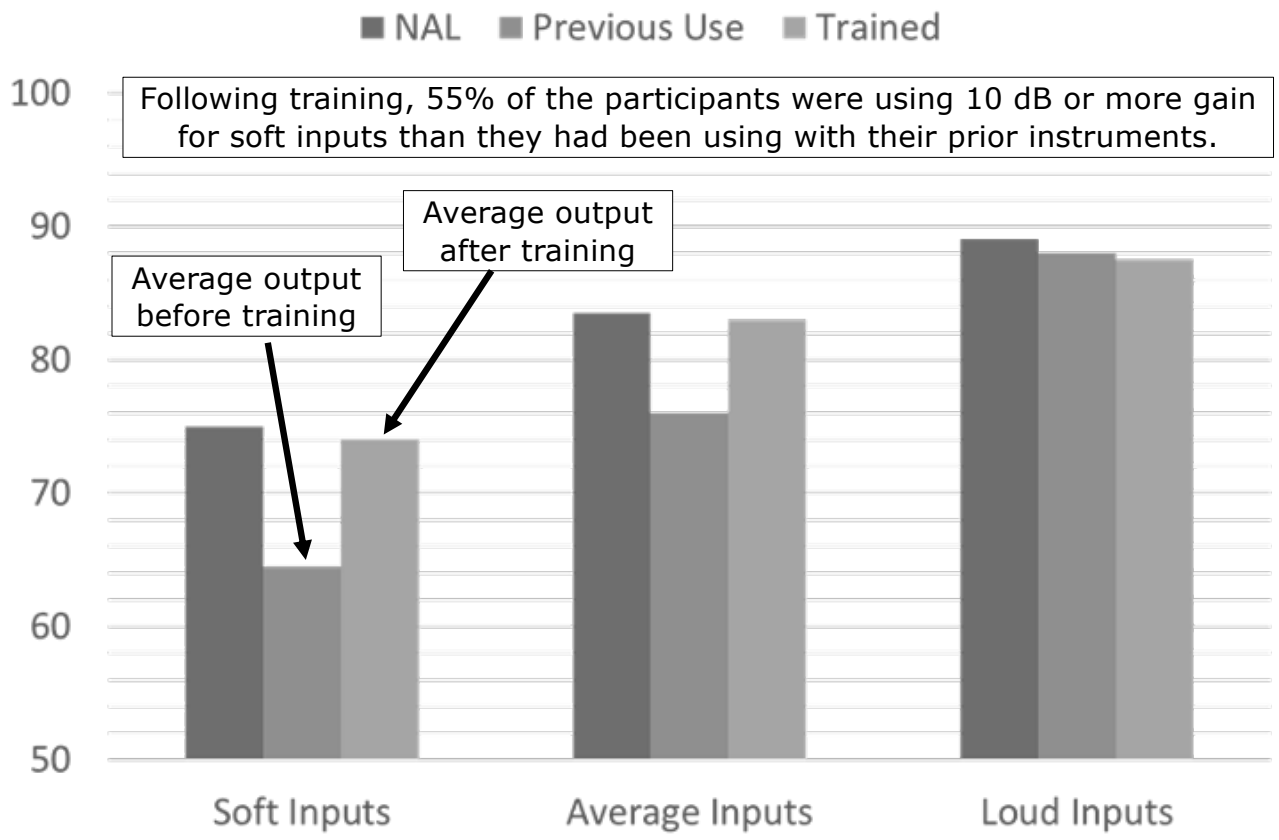
- ~~Speech recognition measures?~~
- ~~Function gain/aided sound field measures?~~
- ~~In situ testing?~~
- ~~AutoREMfit?~~
- Patient preference?

We talked about the risk of using “patient preference” as a verification tool back in QuickTakes 2.2. We’ll review a few of the highlights:

First—A study with trainable hearing aids:

A group of 24 individuals who had been under-fitted for over two years, but were “happy,” were re-fitted to the NAL-NL2 using trainable hearing aids--automatic compression gain training of +/- 16 dB.

Used their hearing aids for 2-3 weeks in their everyday listening environment with the new programming. Instructed to make VC adjustments to maximize comfort, quality and audibility.



signia | Audiology

A couple finding from the large (much discussed) Humes et al. research published in 2017:

OPEN ACCESS | EDITOR'S AWARD | American Journal of Audiology | Research Article | 1 Mar 2017

The Effects of Service-Delivery Model and Purchase Price on Hearing-Aid Outcomes in Older Adults: A Randomized Double-Blind Placebo-Controlled Clinical Trial

is corrected by

Larry E. Humes, Sara E. Rogers, Tera M. Quigley, Anna K. Main, Dana L. Kinney and Christine Herring

FIGURES REFERENCES RELATED DETAILS

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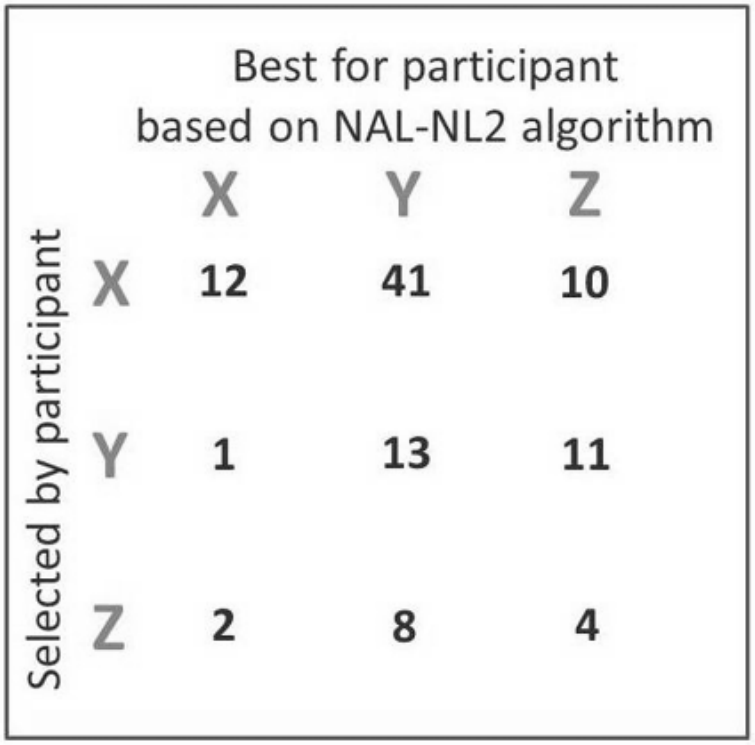
To refresh your memory, three different groups (~50/group, all blinded; very similar hearing losses) were fitted bilaterally and then used their hearing aids for 6-weeks in the real world (no access to change gain):

- Audiologist Best Practice: Fitted by an audiologist to NAL-NL2 prescriptive targets (with some tweaking)
- Patient Decides: Patient decided through listening examples to three different pairs of hearing aids that varied in gain.
- Placebo: Hearing aids were fitted so that they had 0 dB gain for average speech inputs (e.g., REAR=REUR)

A finding from the Humes et al (2017) study (for the group that picked their own hearing aids):



Selected by participant	Best for participant based on NAL-NL2 algorithm: X	Y	Z
X	12	41	10
Y	1	13	11
Z	2	8	4

- Note that based on the validated NAL-NL2 method, hearing aid "Y" would have been the choice for 62 (61%) of the 102 ears fitted. Hearing aid "Y" was only selected 25% by the consumers.
- The participants, favored hearing aid "X"—selected 62% of the time.
- Overall, the consumers selected the "wrong" hearing aid fitting ~70% of the time.

At the end of the 6-week trial, patients were told that they could have a full refund of their purchase price, or they could keep their hearing aids.

Any guesses on what percent of each group chose to keep the instruments?

Audiologist Best Practice: 81%

Patient Decides: 53%

Placebo (No Gain): 36%

How reliable are patient judgements?

- When digital hearing aids first came out, Ruth Bentler and colleagues did a cross-over study with hearing aids labeled digital and aids labeled "conventional" (all were conventional, fitted identically). In month-long real-world trials, participants had higher APHAB scores for the digital product, and 33 of 40 (83%) had a preference for "digital."

- In a similar study, participants were fitted with the same pair of hearing aids twice, but they were either labled "new" or "conventional. "The results revealed that when using the "new" hearing aids, participants had significantly better mean speech-in-noise performance and sound quality ratings. A significant proportion of participants (75%) expressed an overall preference for the "new" hearing aids.

A look at the alternative methods:

- ~~Speech recognition measures?~~
- ~~Function gain/aided sound field measures?~~
- ~~In situ testing?~~
- ~~AutoREMfit?~~
- ~~Patient preference?~~

MISCONCEPTIONS

The only verification method is real-ear measures—there is no alternative approach.

RESEARCH QUICK TAKES

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