RESEARCH QUICK TAKES

2.1: After the fitting—What post-fitting problems are common

Brian Taylor & Gus Mueller

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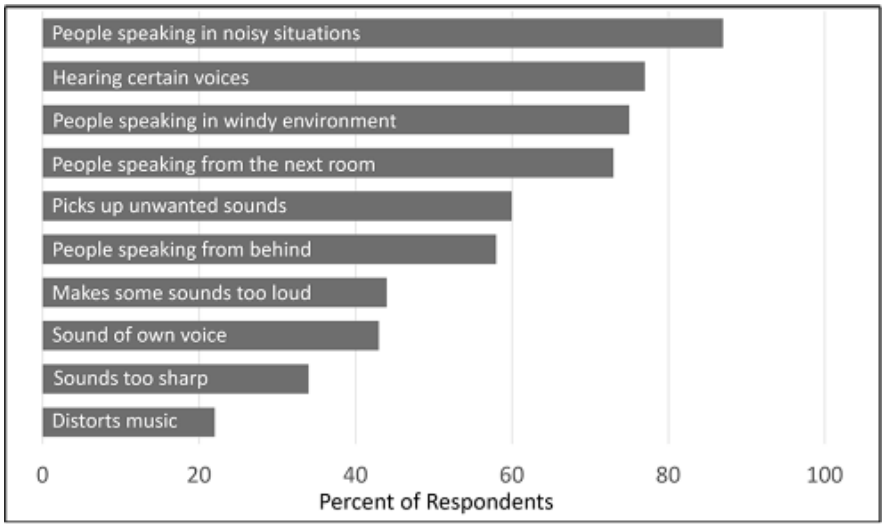
Problems reported by hearing aid users
(From Bennett et al, 2020)



- Based on previous pilot work by the authors, a list of 26 potential post-fitting problems were presented to hearing aid users, who then selected which of these problems applied to them.
- The mean response was 10 of the identified problems were experienced by the average user. The top ten problems identified are shown in the Figure.
- As expected, there was a correlation with number of problems and hearing aid benefit and satisfaction

This survey tends to make things look worse than they are: The MarkeTrack 10 data revealed that 76% of hearing aid owners (those with relatively new hearing aids) are "satisfied" with their ability to follow conversations in background noise.

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Problems in background noise: Counseling or "try to fix it with programming?"

Conduct a QuickSIN (or other SRT-50 speech test) using earphones, to determine patient's optimum performance in background noise.

Make an educated estimate of the SNR for the listening situation that is causing the problem (+5 dB is common, can be 0 dB in noisy restaurants).

Determine if it's possible for the patient to do well in this situation.

Note: Levitt and Flexer reported that the SNR can be improved by 6-9 dB by changing the fitting from the default proprietary program to the NAL.

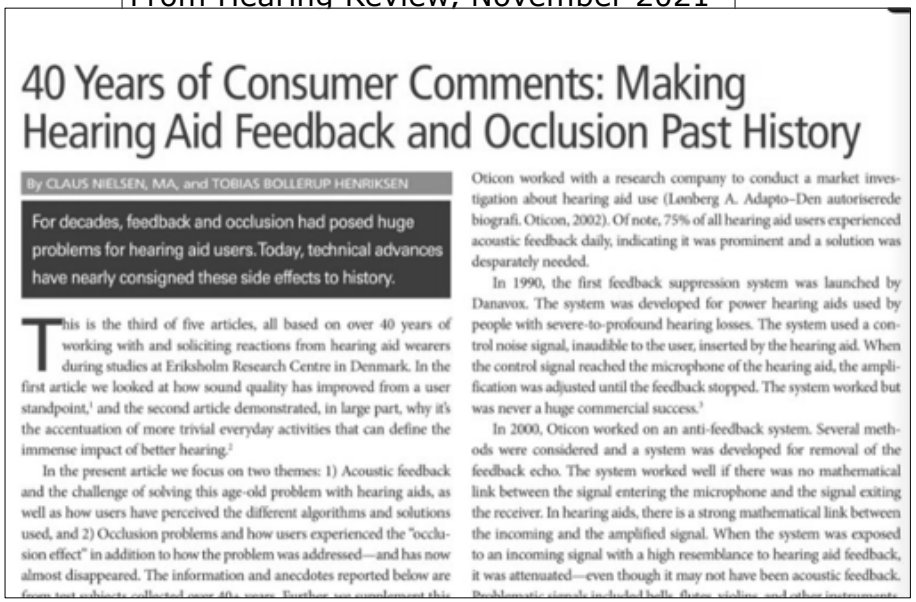
Patient post fitting problems: Reports from audiologists (Jenstad et al, 2003)

Too loud	797
Whistle (acoustic feedback)	479
Speech not clear	391
Fitting painful	303
Sounds like in barrel, tunnel	276
Sounds tinny	237
Environmental sounds too loud	177
Not loud enough	172
Sounds sharp	165
Too soft	165

- Clinical audiologists fitting hearing aids were presented 16 different potential post-fitting problems. The audiologists (n=>300) then reported what they believed the patient would say if these problems existed.
- The top ten comments are shown in the Table. The same complaint could be expressed for different fitting problems.
- These are not necessarily the top 10 complaints, as the responses were somewhat driven by the fitting problems that were used as examples.

Frequency of some of the problems probably have changed since this survey was conducted:

From Hearing Review, November 2021



40 Years of Consumer Comments: Making Hearing Aid Feedback and Occlusion Past History

By CLAUS NIELSEN, MA, and TOBIAS BOLLERUP HENRIKSEN

For decades, feedback and occlusion had posed huge problems for hearing aid users. Today, technical advances have nearly consigned these side effects to history.

This is the third of five articles, all based on over 40 years of working with and soliciting reactions from hearing aid wearers during studies at Eriksholm Research Centre in Denmark. In the first article we looked at how sound quality has improved from a user standpoint,[1] and the second article demonstrated, in large part, why it's the accentuation of more trivial everyday activities that can define the immense impact of better hearing.[2]

In the present article we focus on two themes: 1) Acoustic feedback and the challenge of solving this age-old problem with hearing aids, as well as how users have perceived the different algorithms and solutions used, and 2) Occlusion problems and how users experienced the "occlusion effect" in addition to how the problem was addressed—and has now almost disappeared. The information and anecdotes reported below are

Oticon worked with a research company to conduct a market investigation about hearing aid use (Lønberg A. Adapto–Den autoriserede biografi. Oticon, 2002). Of note, 75% of all hearing aid users experienced acoustic feedback daily, indicating it was prominent and a solution was desparately needed.

In 1990, the first feedback suppression system was launched by Danavox. The system was developed for power hearing aids used by people with severe-to-profound hearing losses. The system used a control noise signal, inaudible to the user, inserted by the hearing aid. When the control signal reached the microphone of the hearing aid, the amplification was adjusted until the feedback stopped. The system worked but was never a huge commercial success.[3]

In 2000, Oticon worked on an anti-feedback system. Several methods were considered and a system was developed for removal of the feedback echo. The system worked well if there was no mathematical link between the signal entering the microphone and the signal exiting the receiver. In hearing aids, there is a strong mathematical link between the incoming and the amplified signal. When the system was exposed to an incoming signal with a high resemblance to hearing aid feedback, it was attenuated—even though it may not have been acoustic feedback.

- **FEEDBACK**
- **OCCLUSION EFFECT**
- **WIND NOISE**
- **COMFORT**

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What post-fitting issues can (should) be fixed?

Is this a problem that can be fixed through follow-up programming, or is it a counseling issue?

Will fixing the problem create a new problem?

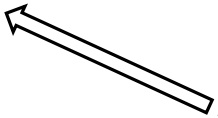
Does the patient know what is best for them?

Will the problem solve itself over time through acclimatization?

Typical Case

A patient who had just been fitted to the NAL-NL2 returns to the clinic and says that in her home, soft environmental sounds are just too loud. Easy to fix, right?

But what about the research that shows that the #1 audiologic factor for benefit and satisfaction is matching NAL targets for soft inputs?



And stay tuned: These two factors will be discussed in future Quick Takes!

If you are going to alter the programming—how much change is a noticeable change?

Original Articles

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

Benjamin Caswell-Midwinter & William M. Whitmer

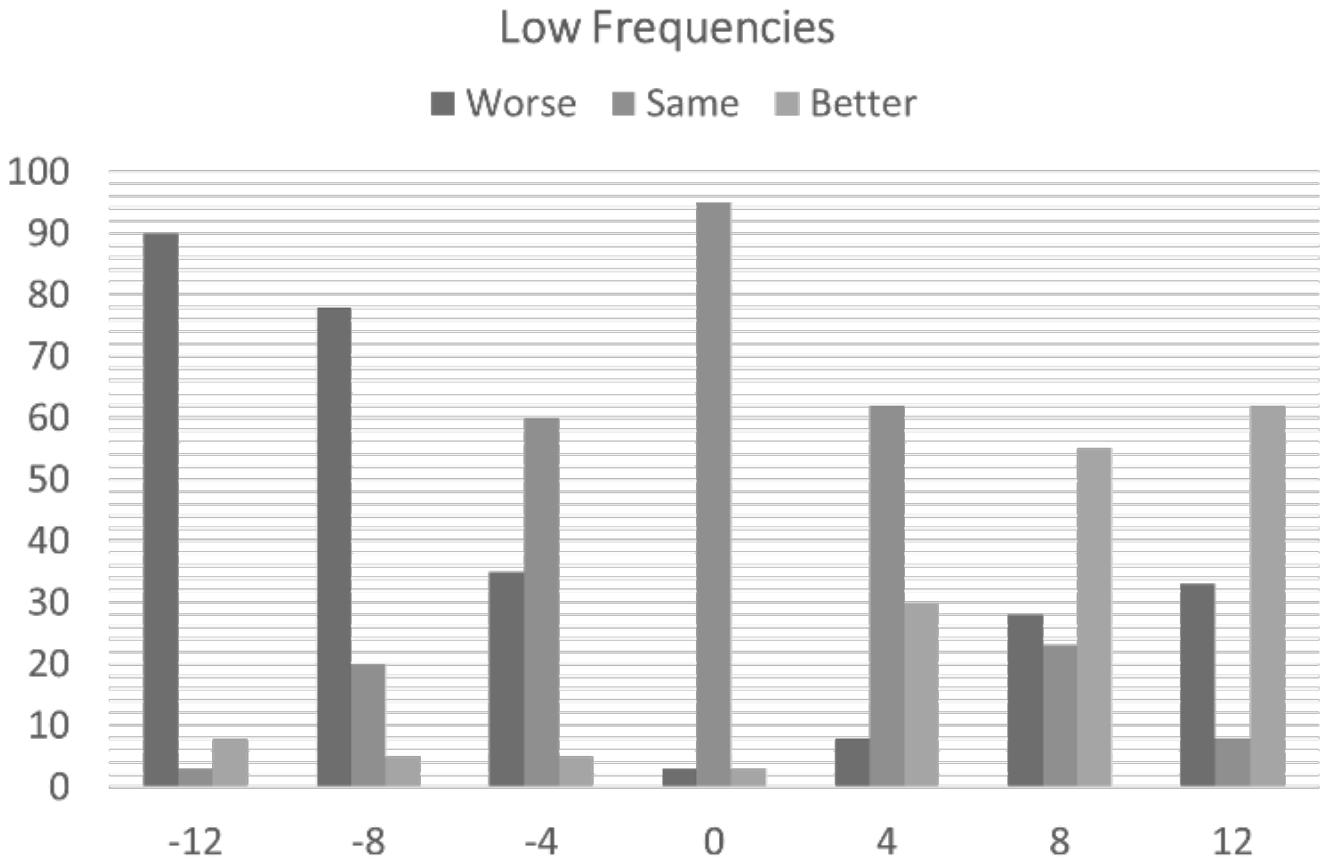
Pages 427-437 | Received 25 May 2020, Accepted 13 Oct 2020, Published online: 11 Nov 2020

Download citation https://doi.org/10.1080/14992027.2020.1839679 Check for updates

Experienced hearing aid users, listening to speech, made judgements (better, worse, or the same) regarding changes in gain in the speech signal, relative to their 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 fitting 10 times, totaling 210 comparisons.



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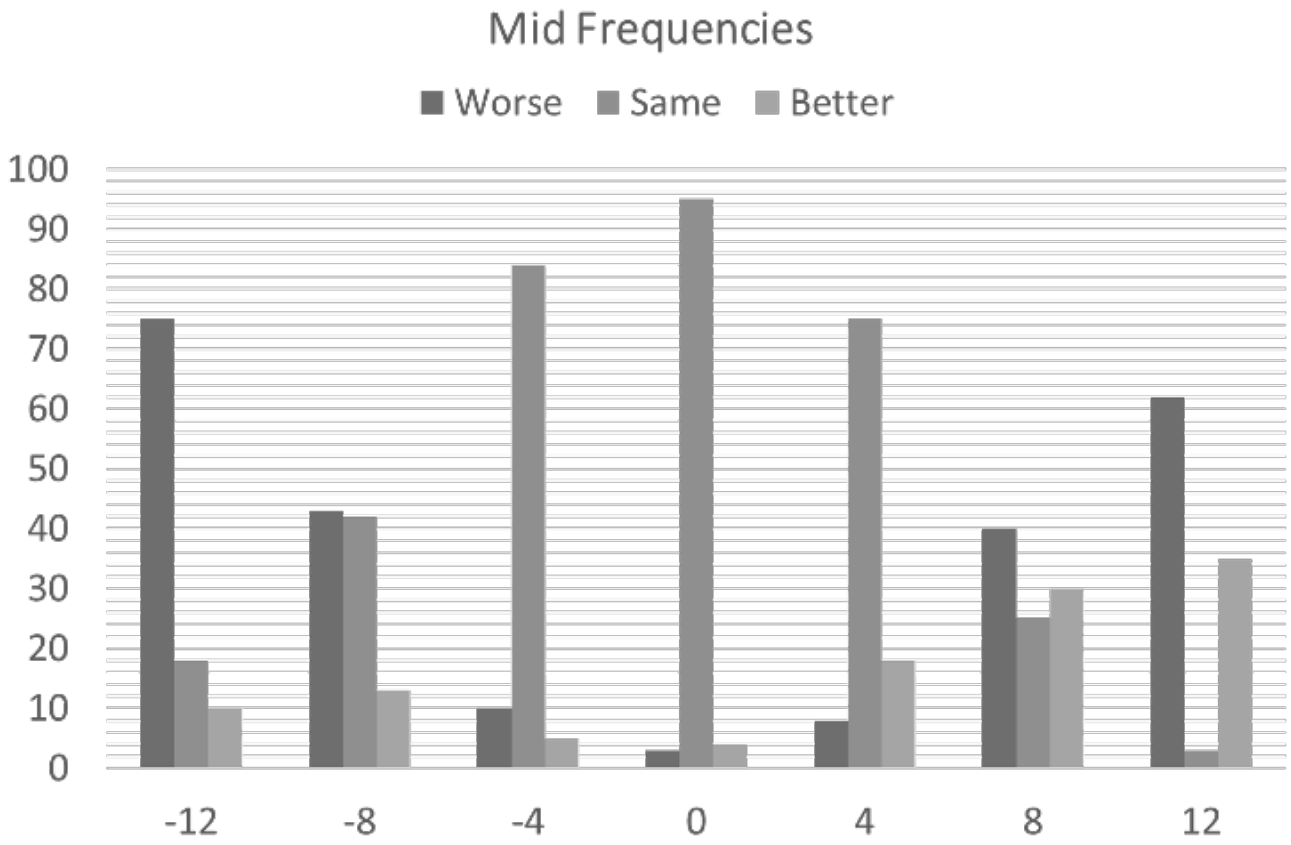

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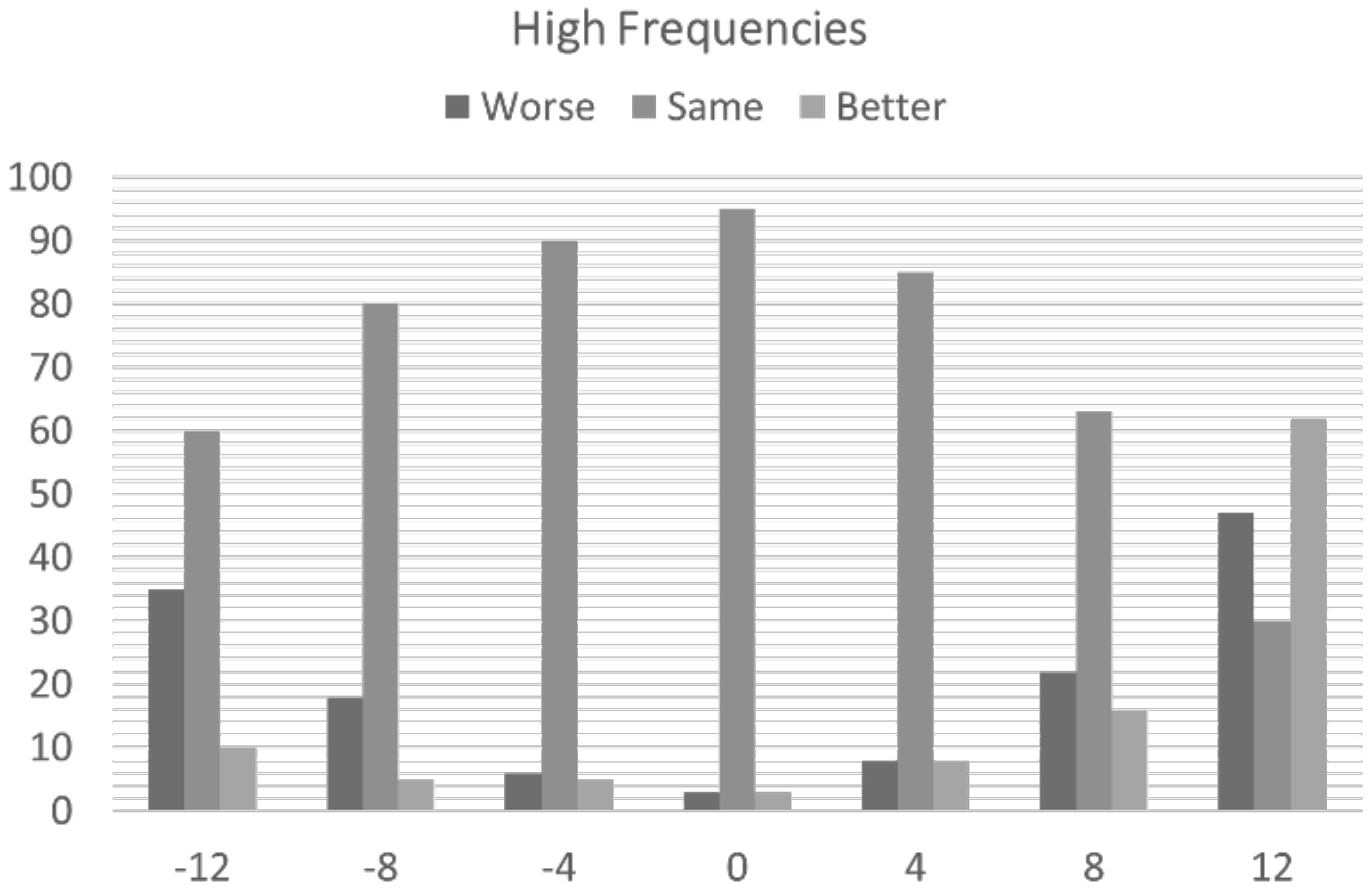

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It pretty much goes back to these four points . . .

Is this a problem that can be fixed through follow-up programming, or is it a counseling issue?

Will fixing the problem create a new problem?

Does the patient know what is best for them?

Will the problem solve itself over time through acclimatization?

RESEARCH QUICK TAKES

2.2: After the fitting—Reliance on patient judgments

Brian Taylor & Gus Mueller

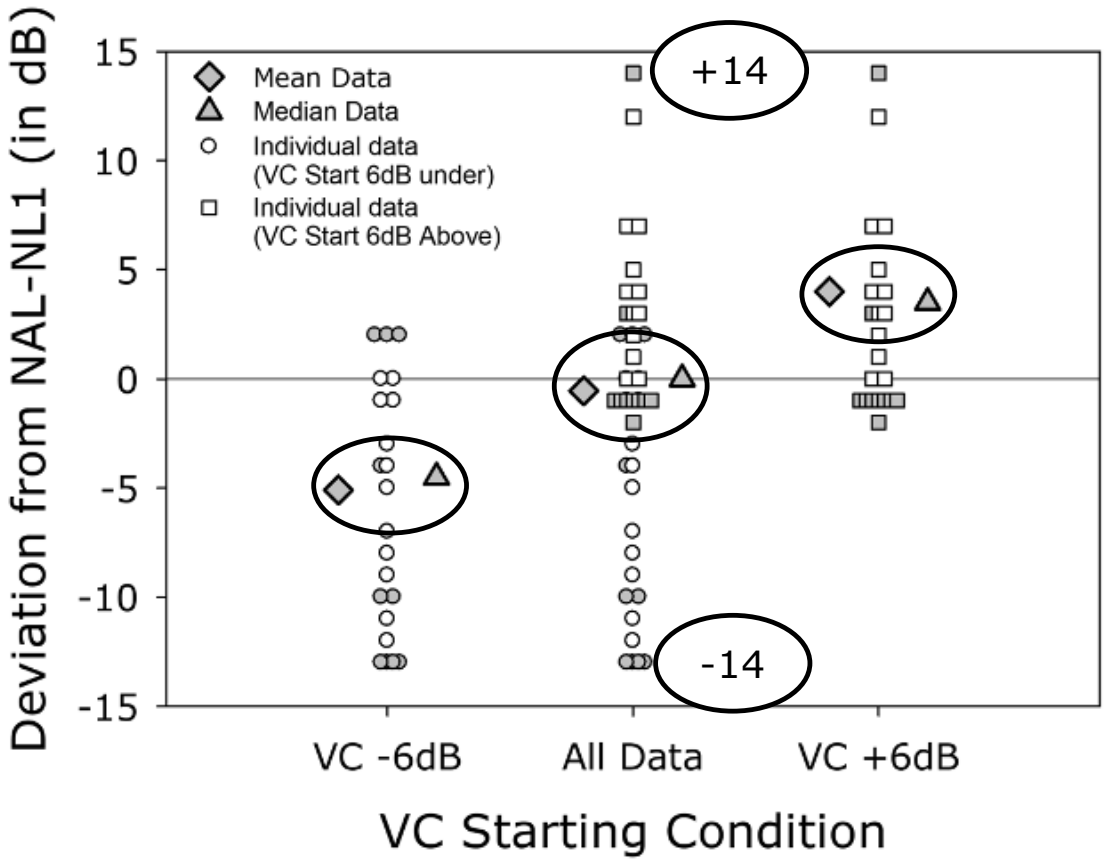
Patient's complaints following the fitting. What do you do?

- If the patient was initially fitted correctly, try to make the problem go away through counseling?
- Assume the patient knows what is best, and make changes until there is a smile on his or her face (or at least a partial smile)?
- Or some compromise: Make a small change and try to counsel away the rest.

An important question to consider: Is the patient a good judge of what is best for him or her?

Some results from studies using trainable hearing aids

- Individuals were fitted with hearing aids that had automatic gain training of +/- 8 dB. All participants were experienced full-time users of bilateral hearing aids and were satisfied users.
- In a cross-over study (all participants had both conditions) the hearing aids were programmed to either 6 dB above NAL targets, or 6 dB below NAL targets
- For each condition, the participants used their hearing aids for 2-3 weeks in their everyday listening environment.
- Use instructions were given to encourage use in a variety of listening environments.
- Data logging was used to ensure that the hearing aids were used in different situations, and that gain adjustments were made.



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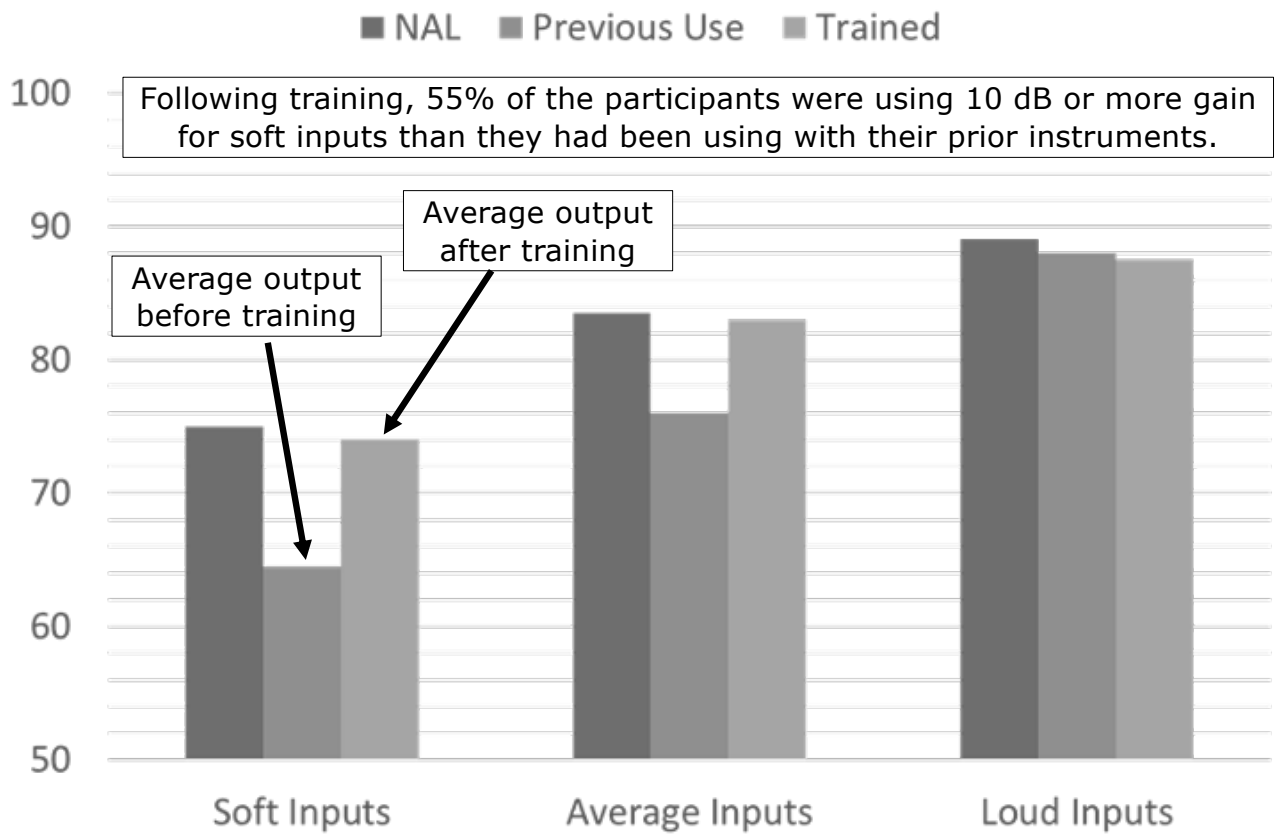
Other findings from this study:

- Average use time/home trial was 135 hours (range 49 to 226).
- What setting each subject had first (+6 dB versus -6 dB) did not influence trained gain.
- There was no correlation between use time and degree of gain learning.
- There was no correlation between use time and deviation from NAL target
- There was no correlation between time spent in different listening situations and deviation from NAL target.

A second study using trainable hearing aids

- Individuals were fitted with hearing aids that had automatic gain training of +/- 16 dB. Compression training: Independent training for different input levels (e.g., training gain louder for soft inputs would not impact trained gain for loud inputs).
- All participants were experienced full-time users of bilateral hearing aids (> 2 years) and were satisfied users. All participants initially had been "under-fit" to NAL targets (clinic used manufacturer's proprietary fitting).
- Individuals were fitted to the NAL, and used their hearing aids for 2-3 weeks in their everyday listening environment.
- Use instructions were given to encourage use in a variety of listening environments.
- Data logging was used to ensure that the hearing aids were used in different situations, and that gain adjustments were made.



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

N ACCESS | **EDITOR'S AWARD** | American Journal of Audiology | Research
| 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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2017

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Revised: Jan 10, 2017

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
- 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)

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%

A related 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.

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The classic poison ivy study from the 1960s:

Thirteen boys known to be sensitive to poison ivy had a leaf rubbed on each arm. On one arm, they were told it was poison ivy, but it really was a harmless leaf. On the other arm they were told it was a harmless leaf, but it really was poison ivy.

All 13 boys broke out with a rash on the arm that they were told had been rubbed with poison ivy. Only two had a rash on the arm that really was rubbed with poison ivy.

The poison ivy results are a little extreme, but many studies have been conducted with similar finings, leading researchers to conclude: *"Patient beliefs regarding treatment may have a stronger association with clinical outcome than the actual treatment received."*

And how this relates to hearing aids?

- 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 had a preference for "digital."

- In a similar study, paraticpants 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 (70.9% versus 66.8%) and sound quality ratings (8.1 versus 7.4). A significant proportion of participants (75%) expressed an overall preference for the "new" hearing aids.

- And . . Don't forget about the placebo group from the Humes et al, 2017 study!

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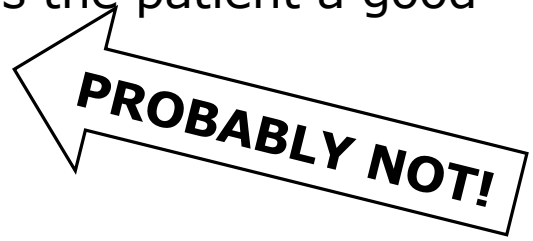
An important question to consider: Is the patient a good judge of what is best for him or her?



RESEARCH QUICK TAKES

2.2: After the fitting—Reliance on patient judgments

Brian Taylor & Gus Mueller

RESEARCH QUICK TAKES

2.3: After the fitting—The role of acclimatization

Brian Taylor & Gus Mueller

Let's start with some terminology:

- Acclimatization: Adapting to a new environment, in this case, auditory. This seems to be a reasonable term, as it is also used to describe how the human body acclimates to temperature, altitude, and other environmental conditions.

- Adaptation: The process of adapting to something, such as environmental conditions (in this case, auditory); the responsive adjustment of a sense organ. This, too, is a reasonable term, and some believe more descriptive of what is happening than calling it acclimatization. It has long been used in reference to the eye—for example, adaptation to varying light conditions.

- Adjustment: Making or becoming suitable; adjusting or accommodating to circumstances. This term also describes the process quite well; however, we make so many adjustments to hearing aids that it might be best to avoid this term just to reduce confusion.

- Auditory learning: Acquiring new auditory skills or abilities related to perception, cognition, and memory. Although learning does not account for all the factors of hearing aid adaptation, stimulus learning probably is related to some of the acclimatization effects.

Forms of acclimatization that could assist in a successful fitting:

- Acclimatize to soft sounds: More accepting of soft sounds means more gain for soft, more audibility nearly always means better acousitic scene awareness and improved speech understanding
- Acclimatize to newly restored high-frequency speech signals: More gain in the highs usually means better speech understanding
- Acclimatize to loud sounds: If LDLs go up, the dynamic range becomes bigger and it becomes easier to place the speech signal within the boundaries.
- Acclimatize to sound of own voice: Not necessary to turn down gain when own voice is not acceptable
- And the big one—acclimatization involves brain plasticity, allowing for better processing, and an improvement in speech understanding.

Patients often complain that soft sounds are too loud—Do they acclimatize to this?

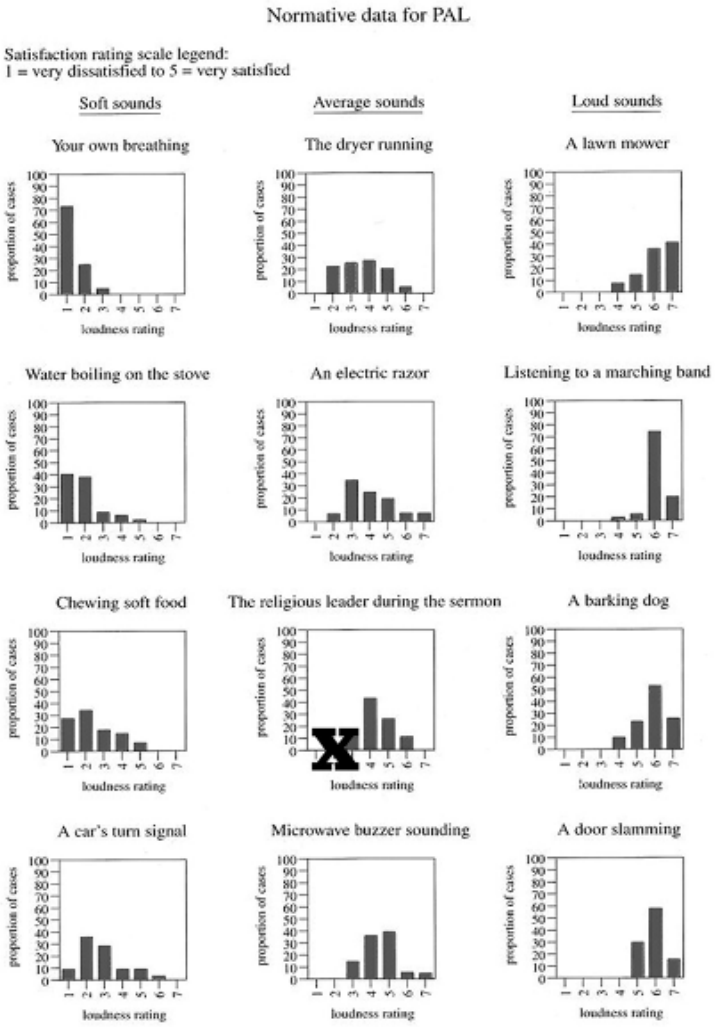
- The Profile of Aided Loudness (PAL) has been used to study this.
- The PAL consists of 12 different sounds that all patients have heard at one time or another. Four sounds for soft, four for average, and four for loud.
- The scale can be given to patients before and after the fitting of hearing aids
- The sounds were selected from a pool of over 100, and were placed in respective categories based on ratings (1 to 7 loudness scale) from individuals with normal hearing. Only sounds that were consistently rated a given value were included.

Interesting tidbits: In the development the PAL, when over 100 sounds were rated by normal hearing individuals, the sound that had the greatest variability (and was not used on the form) was the "clinking of glasses." It was rated #2 by some and #6 by others. The sound that had the most consistent rating, a #6 for >90% of participants was "galloping horses" (also not used).

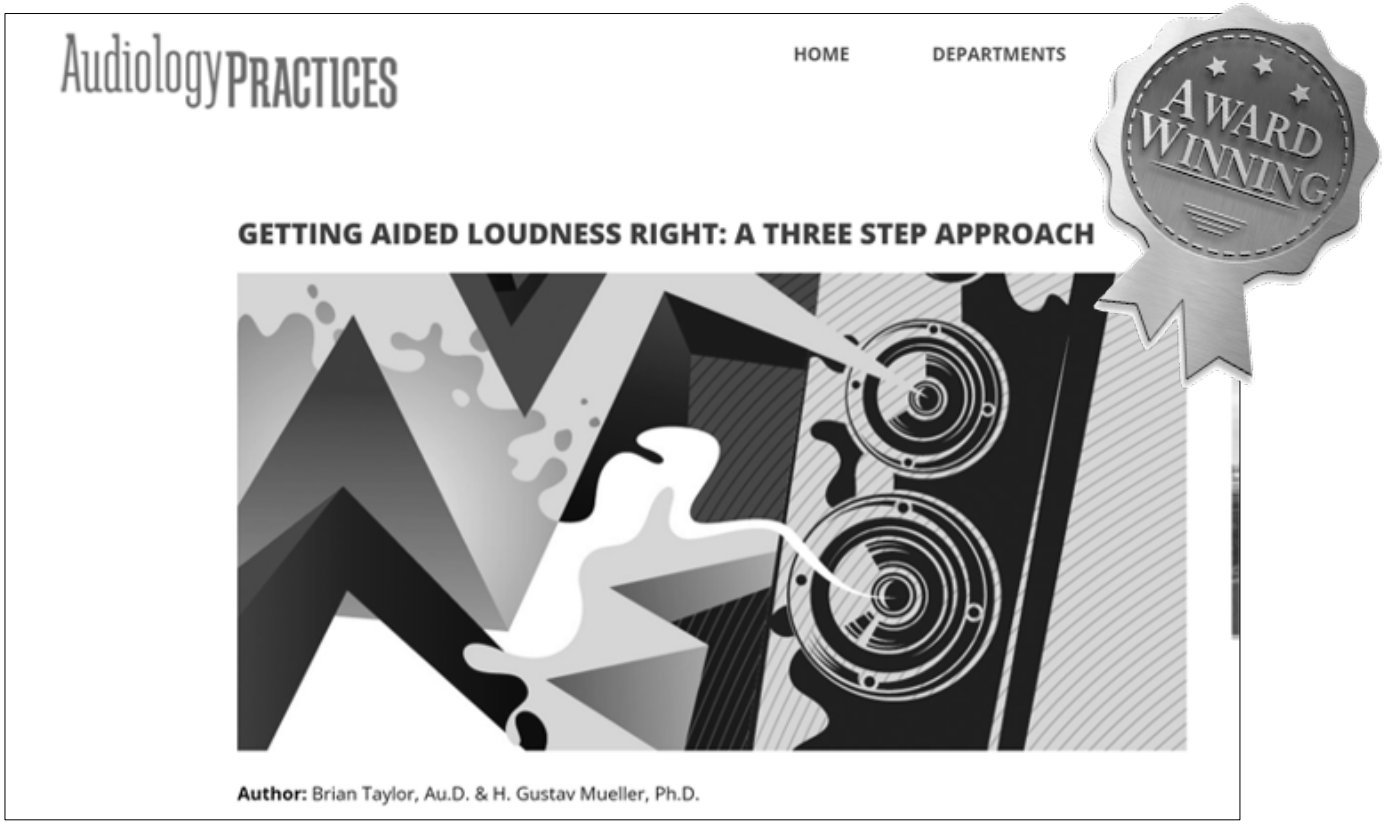
Cox Loudness Anchors used for ratings

Loudness Categories

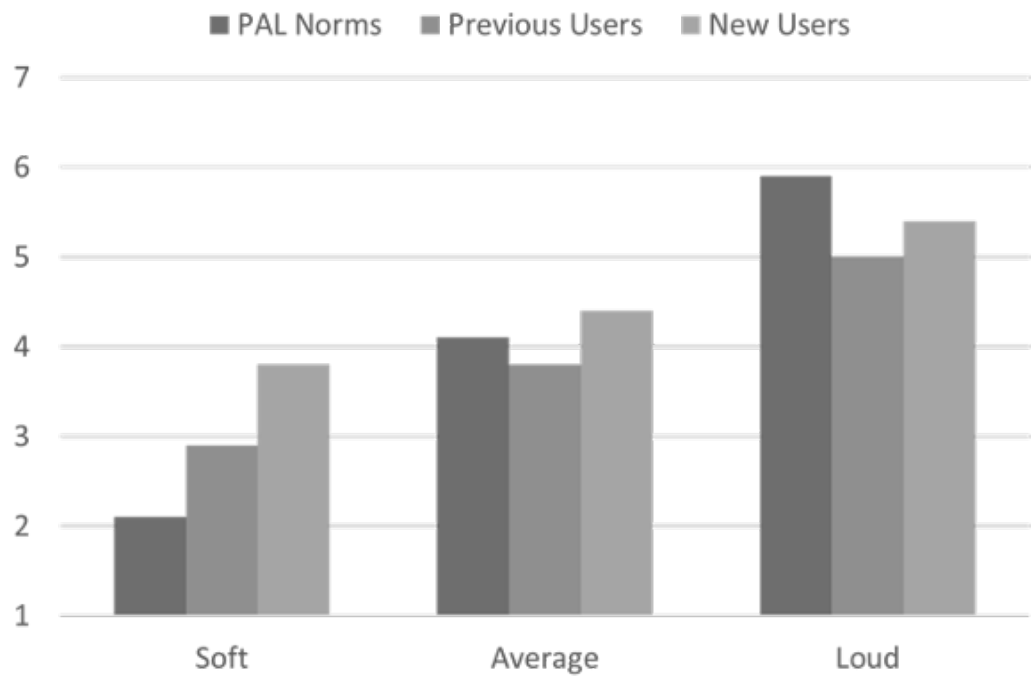
7. Uncomfortably loud
6. Loud, but o.k.
5. Comfortable, but slightly loud
4. Comfortable
3. Comfortable, but slightly soft
2. Soft
1. Very soft



Everything you want to know about the PAL (and other loudness measures)



Loudness ratings for PAL following 2-weeks of hearing aid use after being fitted with new hearing aids



New and experienced users fitted with new hearing aids programmed to the NAL. Ratings obtained after two weeks of hearing aid use.

Norms for the PAL (Blue Bar): Soft=#2, Average=#4 and Loud=#6

Note: The new hearing aids users are rating soft inputs as ~#4. That is, they are being perviedved as average-level sounds.

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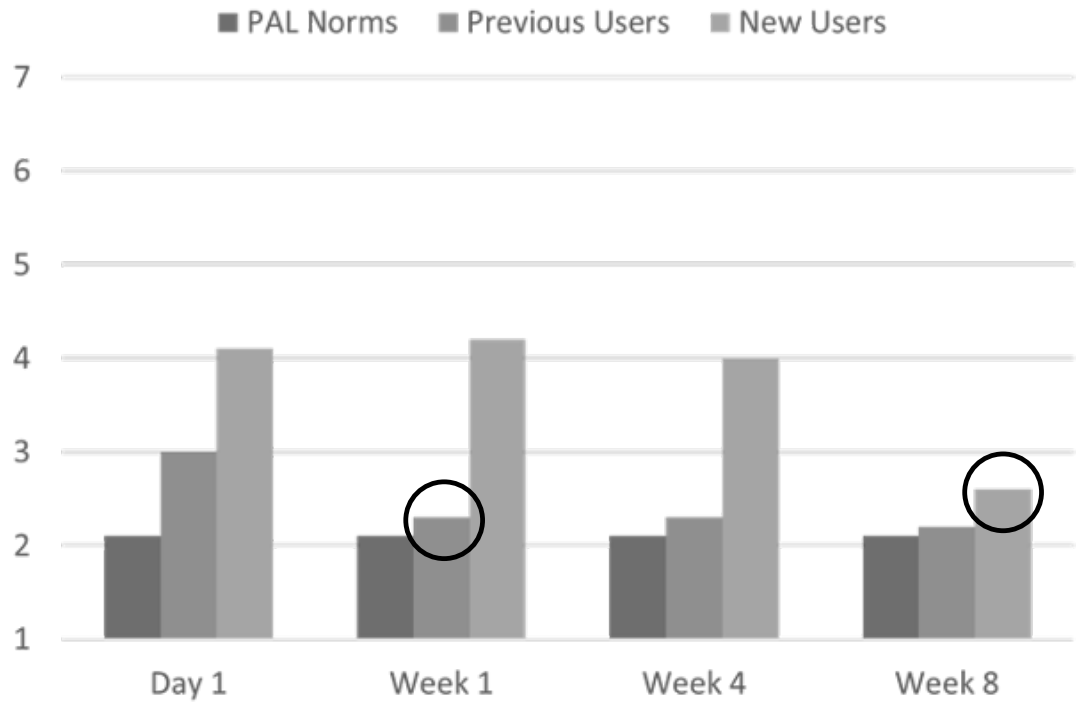
Different (but related) study: Loudness ratings for PAL over 8-week period



New and experienced users fitted with new hearing aids programmed to the NAL. Ratings obtained for soft inputs at 4 intervals after the fitting.

Norms for the soft inputs of the PAL (Blue Bar): Soft=#2

Note 1: The experienced users were rating soft sounds correctly after only one week of hearing aid use.

Note 2: The new users did not rate soft correctly until 8 weeks of hearing aid use.

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Do LDLs change over time for individuas wearing hearing aids?

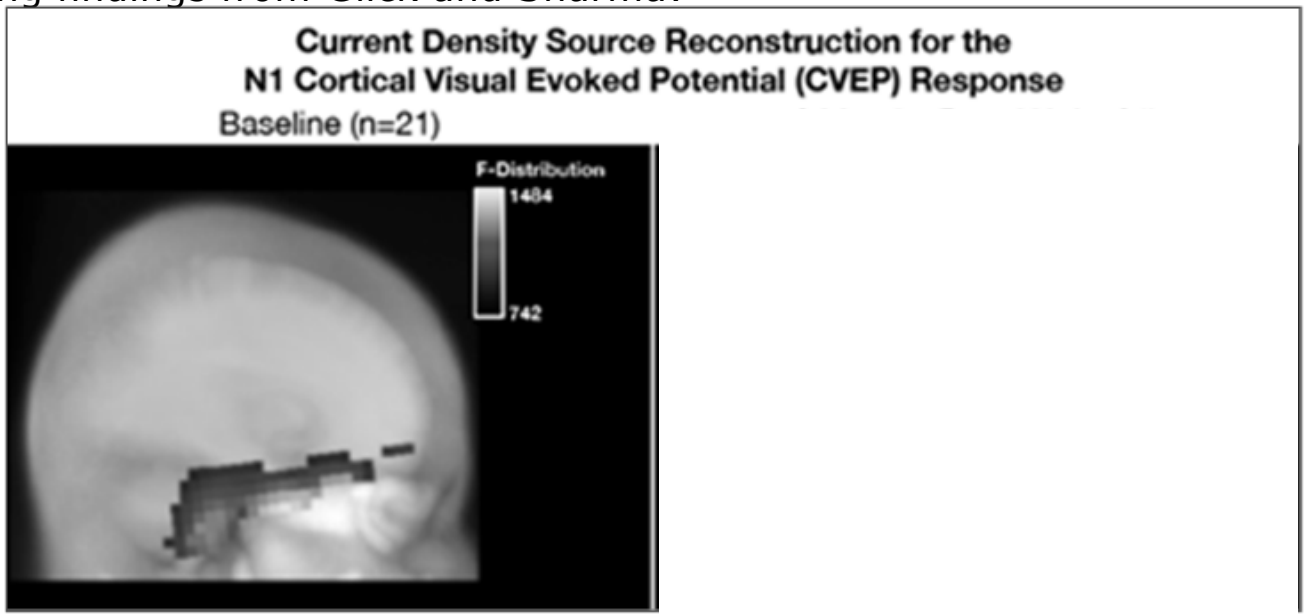
Two large studies, which followed patients for a year or more, say "NO." In both studies, patients were initially fitted with MPO corresponding to their measures LDLs.

It's possible that if the patients were forced to use an output above their LDLs, that over time, their LDL might increase—but why woud we do this?

The lack of change of LDLs is good news for clinicians, as it means that repeat LDL testing probably isn't necessary for annual follow-up visits following the fitting of hearing aids.

And the big question: Does acclimztization lead to imporved speech understanding following extended hearing aids use?

Interesting findings from Glick and Sharma:



In addition to the changes in neuroplasticity shown above, the authors also found significant improvements in the QuickSIN scores and cognitive function at 6-month follow-up.

A couple *well-designed* studies suggesting that acclimatization for speech understanding exists:

If studies are not well designed, you might find that:

- The improvement is simply because the patients are using more gain (which is why gain must be fixed)
- The improvement is simply because of a practice/learning effect for the speech material used (which is why there must be a control group)

- Dawes P. & Munro K. (2017): At the end of 30 days, a subset of new users with moderate hearing loss who wore their hearing aids at least 6 hr/day had significantly improved speech in noise recognition (~3-dB SNR) compared with the control group. Improvements were associated with more consistent hearing aid use, more severe hearing loss, and self-report of background sounds being less distracting.

- Wright D, Gagné JP. (2020): In this research, as with the other studies, a group of new users and a group of experienced users (controls) were fitted with new hearing aids. Speech recognition in noise and listening effort were assessed on eight different occasions during a 10-month field trial. The new hearing aid users showed improvement over time in speech in noise performances (~2 dB SNR)—this effect was observed following only one month of hearing aid use. There was no improvement for the previous users, and no significant change over time for either group for listening effort.

THE FINAL WORD . . .

Acclimatization is real, and can assist in solving post-fitting problems. It does take time, however, and also often requires that the patient understands and trusts the process.