Education
The Science of Hearing Aid Fitting

# How Speechmapping Can Facilitate and Guide Solution-Centric Treatment

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Kentucky Academy of Audiology
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audioscan
Hearing Instrument Fitting Systems



## Any of these been on your mind lately?

COSTCO WHOLESALE

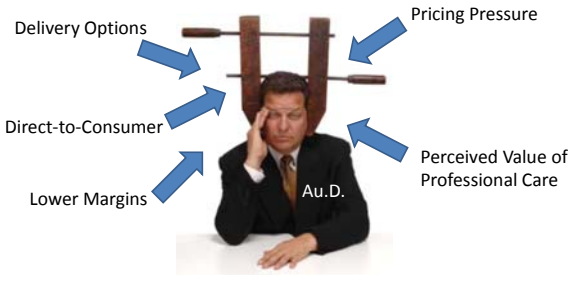
Office of Science and Technology Policy

The National Academies of SCIENCES · ENGINEERING · MEDICINE

OTC/DTC "Hearing Aids" ← FDA




## Feelin' The Squeeze?



## Key Part of NAS 12 Recommendations

- Recommendation 2:
  - Develop and promote measures to assess and improve quality of hearing health care services
    - Align and promote ***best practices*** and core competencies across the continuum of hearing health care, and implement mechanisms to insure widespread adherence
    - Research, develop and implement a set of quality metrics and measures to evaluate hearing health care services with the end goal of improving hearing and ***communication focused patient outcomes***



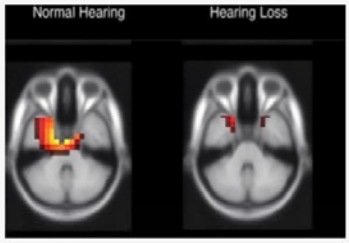
## Best Practices Guidelines – AAA 2006

(Modified by AuDNet Patient Care Excellence Program)

- Provider Guarantee
- Auditory Assessment
- Auditory Needs Assessment *
- Non-Auditory Needs Assessment
- Hearing Instrument Selection
- Fitting & Verification
- Hearing Instrument Orientation
- Counseling & Follow-Up AR
- Outcome Assessment
- Patient Care Audit

*** Communication Focused Patient Outcomes**

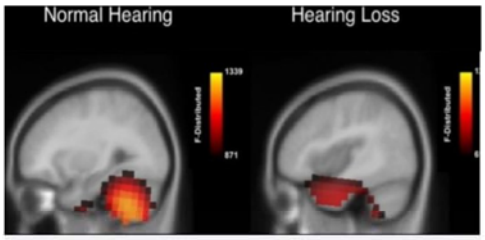





*Adults with early-stage age-related hearing loss (right) show decreased activation of the hearing portion of the brain compared with normal hearing age-matched adults (left).*

http://www.hearingreview.com/2015/05/researchers-discover-brain-reorganizes-hearing-loss/




Adults with mild age-related hearing loss (right) show brain reorganization in which hearing portions of their brain are recruited for processing visual patterns. This is not seen in age-matched adults with normal hearing (left).

*Credit: Anu Sharma*

http://www.hearingreview.com/2015/05/researchers-discover-brain-reorganizes-hearing-loss/




## Question. . .

- Can a rewired brain be rewired again?

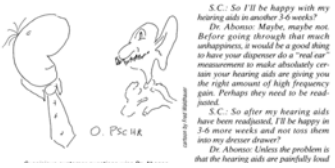
INNOVATIVE APPROACHS

The brain's habit of rewiring itself takes time, an important concern in good fittings.

## HABRAT: *Hearing Aid Brain Rewiring Accommodation Time*

STUART GATEHOUSE, PHD, AND MEAD C. KILLION, PHD

Every practicing dispenser knows that it may take a considerable amount of time for the listener to "get used to" new hearing aids. But do fundamental and beneficial changes in the wiring of the brain itself help the auditory rehabilitation process? Data presented here indicate it is sometimes impossible to properly evaluate the benefit of a particular hearing aid fitting for weeks or even months, which in turn implies that extraordinary judgment is required when the "wear it awhile and you'll get used to it" vs. "let me readjust the hearing aid" decision must be made by the dispenser.



*S.C.: So I'll be happy with my hearing aids in another 3-6 weeks?*

*Dr. Abonso: Maybe, maybe not. Before going through that much unhappiness, it would be a good thing to have your dispenser do a "real ear" measurement to make absolutely certain your hearing aids are giving you the right amount of high frequency gain. Perhaps they need to be readjusted.*

*S.C.: So after my hearing aids have been readjusted, I'll be happy in 3-6 more weeks and not toss them into my dresser drawer?*

*Dr. Abonso: Unless the problem is that the hearing aids are painfully loud*





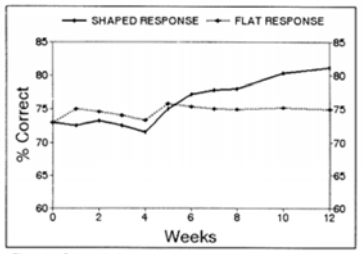



*Fig. 1. Speech-identification-in-noise scores from Gatehouse[5] in the fitted ears for flat amplification and a rising frequency response.*

5. Gatehouse S: The time course and magnitude of peripheral acclimatization to frequency responses: Evidence from monaural fitting of hearing aids. *J Acoust Soc Am* 92:1256-1268, 1992.




## Michael Merzenich on plasticity:

- Plasticity exists from cradle to grave
- Radical improvements in cognitive function are possible even in the elderly
- ***Practicing a new skill under the right conditions*** can change millions if not billions of connections between nerve cells in our brain maps

Doidge, N., "The Brain That Changes Itself" Penguin Books, 2007

## Kevin Munro's work

*studying plasticity and acclimatization*

- The ABR amplitude has been found to be greater in ears that had been aided, than in ears with the same degree of hearing impairment that had not been aided.
- The brain will only reorganize if speech is amplified to new, higher levels than the person previously experienced.

Aud THE HEARING JOURNAL SEPTEMBER 2010 • VOL. 63 • NO. 9



## Two Key Take-aways

- The brain will only reorganize if speech is amplified to new, higher levels than the person previously experienced. (Munro)
- Practicing a new skill under the right conditions is required to change our brain maps. (Merzenich)





## Aural Rehabilitation (AR)

". . . the reduction of hearing-loss-induced deficits of function, activity, participation, and quality of life through sensory management, instruction, perceptual training and counseling."

Boothroyd, A., "Aural Rehabilitation: What is it and Does it Work?" Trends in Amplification, 2007 Jun; 11(2): 63-71

*Treatment*

It's a matter of perspective

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## Today's Techno-centric Model


Jessen, D., Altidis, P., "ADA and IAA: Aural Rehabilitation in Private Practice" ADA webinar recording at http://audiologist.org/ada-and-iaa-aural-rehabilitation-in-private-practice

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## Proposed Solution-centric Model


Jessen, D., Altidis, P., "ADA and IAA: Aural Rehabilitation in Private Practice" ADA webinar recording at http://audiologist.org/ada-and-iaa-aural-rehabilitation-in-private-practice

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*How Speechmapping Can Facilitate and Guide Solution-centric Treatment*

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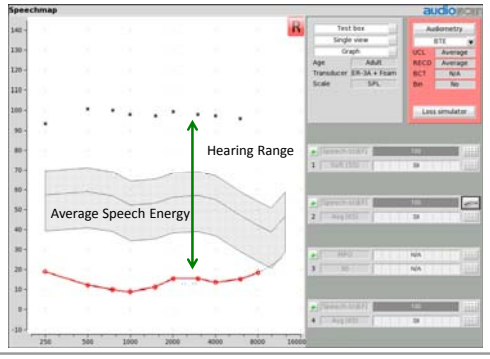
## The Basic Speechmap Screen - Verifit

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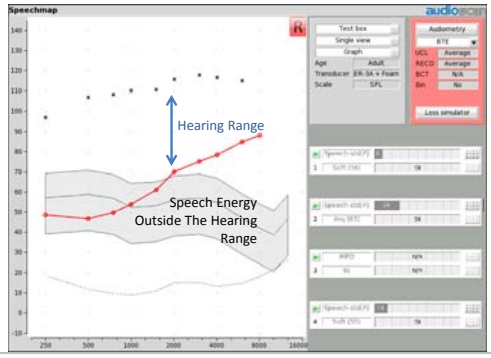
## The Basic Speechmap Screen - Verifit

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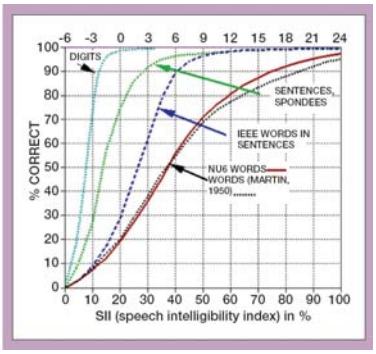
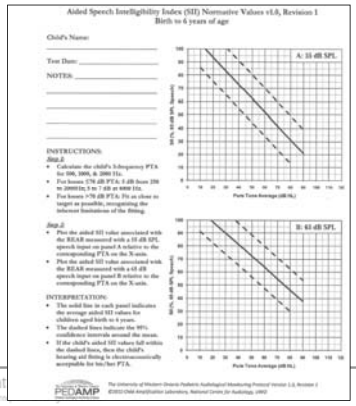



Killion, M., Mueller, H.G., "Twenty Years Later: The New Count-The-Dots Method", Hearing Journal, January 2010, pp 10-15

From "PedAMP" @ www.dslio.com




## A Bit About Rules

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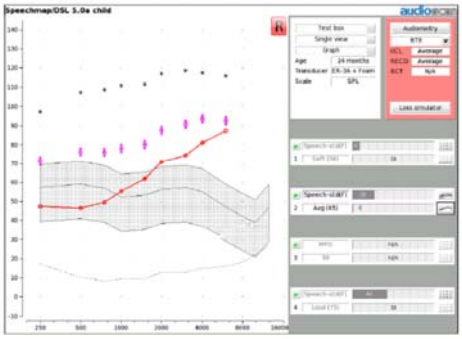
## DSL Child – 24 Months



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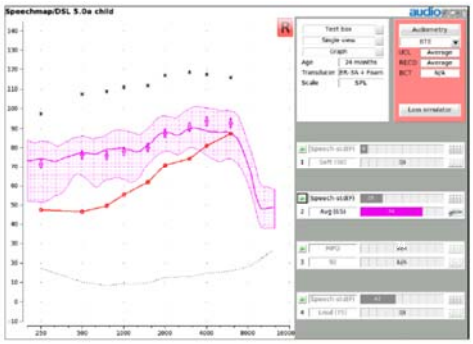
## DSL Child – 24 Months



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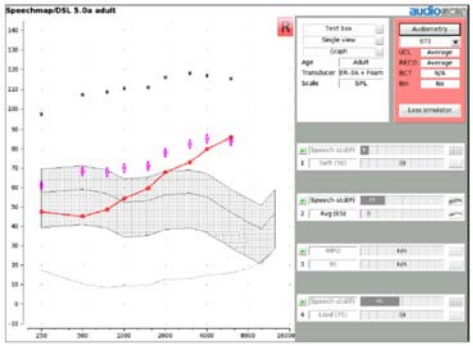
## DSL Adult



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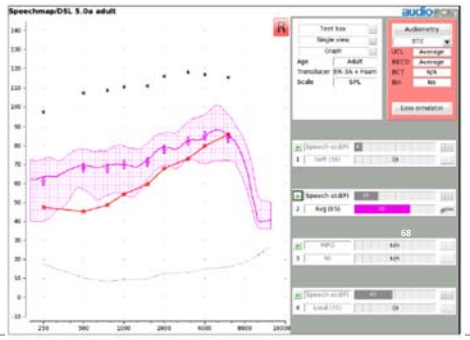
## DSL - Adult



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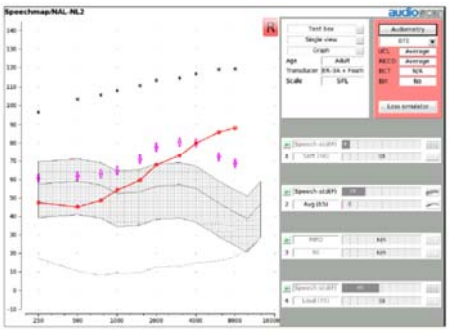
## NAL-NL2



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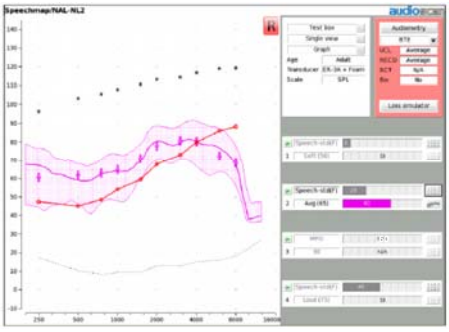
## NAL-NL2



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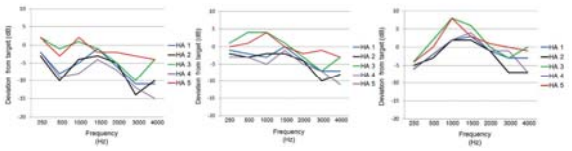
## NAL-NL2 REAR Results Using 5 Different Manufacturers' Programming Software



55dB 65dB 75dB

Sanders, J., Stoody, T., Weber, J., Meuller, H., "Manufacturers' NAL-NL2 Fittings Fail Real Ear Verification" Hearing Review, March 2015 24-32



## *Pre-Fitting in the Test Box*

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## RECD Applications - Reminder

- Convert audiometry (e.g., threshold and UCL) from HL to SPL near the eardrum
- Convert test box measurements of hearing aid output to estimated real-ear aided response (S-REM)

## RECD Key Points

- For infants and children, RECD values vary from child to child and over time
- Measured RECD values can be different than average RECD values, even if average values are age specific – including adults



## WRECD

*Wideband Real-ear-to-coupler difference*

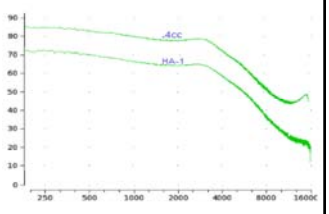
- Difference in dB [across **200 - 12500** Hz] between SPL measured in real-ear and in a **0.4cc** coupler, produced by transducer generating same wideband input signal.



## WRECD

2cc coupler issue: Signals beyond 8KHz get buried in microphone noise floor

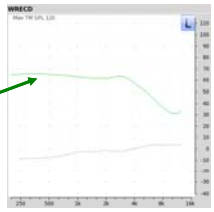
- ~ 14 dB greater output in 0.4cc coupler than 2cc coupler due to smaller volume
- Brings output above the measurement mic noise floor in HFs
- System automatically converts 0.4cc RECD to HA-1 RECD when required



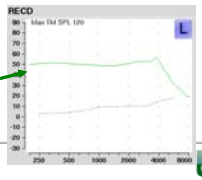
## How do we measure RECD/WRECD ?

1. Calibrate the RECD transducer

WRECD: Verifit 2



RECD: Verifit VF-1, Axiom, RM500SL

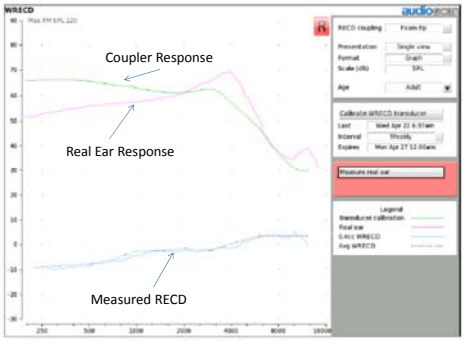





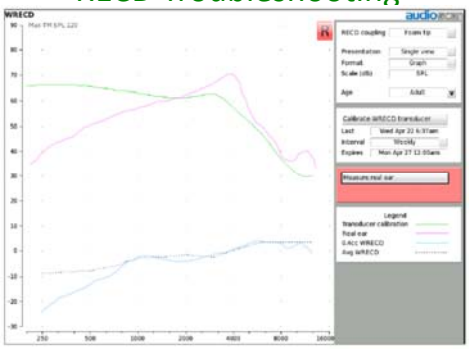
You are ready to measure the real ear response!



## Ideal End Result – VF2



## RECD Troubleshooting



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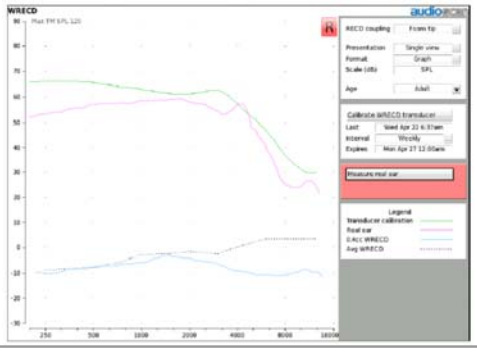
## RECD Troubleshooting



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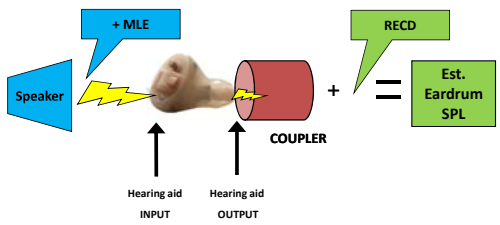
*How are RECDs used??*

*In Hearing Instrument Fitting*

**To predict real-ear hearing aid performance**

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## Binaural test box

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## New couplers and TRIC adapter

- New putty-less coupling for RIC instruments
- Slide-on couplers for increased speed.

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## Binaural test box

- Run simultaneous tests to compare programming or to test for binaural features.
- Instruments now positioned as worn on ear.


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## Binaural Speechmap®

- Symmetrical, controlled acoustic space allows us to ensure same stimulus applied to each hearing instrument
- Use to test pairs, or to compare two different instruments!

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## Binaural Speechmap®

- Choose L+R link button in Speechmap dual view screen
- Tests will run simultaneously using one set of test parameters.


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## Calibrated Speech Signal Fitting Options

- Speech Standard 1 (the “Carrot Passage”)
- Speech Standard 2
- ISTS

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A Speechmapping/Auditory Training Strategy

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## The Notion of "Goal" Fitting & "Starter" Fitting

- Definition of "Goal" Fitting:
  - Brings speech sounds back into the listening range for as broad a range of frequencies as possible:
  - Delivers an acceptable SII result
- Definition of "Starter" Fitting:
  - Settings that the patient feels comfortable enough with to start their new listening experience
- Difference between the two:
  - Practice!



## Calibrated Speech Signal Fitting Options

- Speech Standard 1 (the "Carrot Passage")
- Speech Standard 2
- ISTS

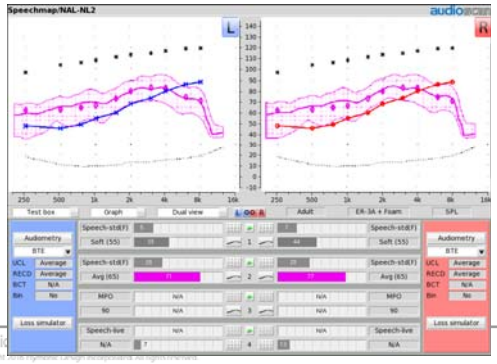
## Initial Aided Audibility Verification

**Yes or No – Is This A "Goal" Fitting?**

- Set instrument to the most experienced user setting with the fitting software
- Select the fitting formula you wish to use
- Program the hearing instrument (First Fit)
- Place pre-programmed hearing instrument in the test box:
  - Session is re-loaded with RECD if available
- Run Speechmap at 65dB input in TEST 2 and obtain long-term average
  - Did you hit the target? Yes or No
  - Do you have an acceptable aided SII? Yes or No



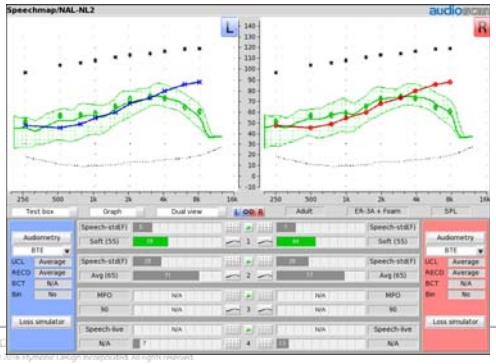
## Example of an Initial Aided Audibility Result




## Speechmap® fitting protocol

- Test 1:
  - Set input to 50dB STD speech
    - This will show you a new target for that input level
  - Goal: To adjust the overall gain of the aid so that the middle line of the aided speech banana hits the target values indicated

## Fitting Test One: Soft Speech

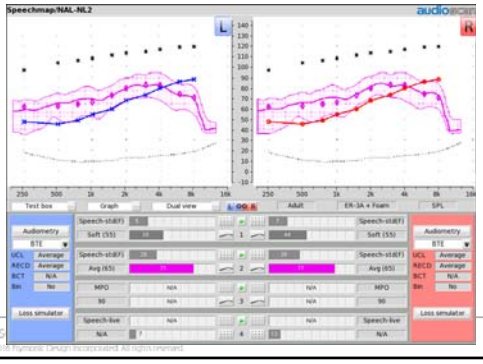



## Speechmap Fitting Protocol

- Test 2:
  - Input: 65dB STD speech
  - Goal: To verify that the gain adjustments made in Test 1 deliver target results for dots and SII
    - If not, use compression settings to make adjustments as necessary
      - Adjust gain values for Loud and/or Moderate inputs, while leaving gain for Soft inputs as set in Test 1



## Fitting Test Two: Conversational Speech

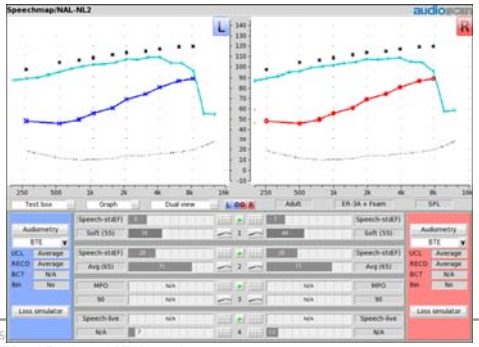


## Speechmap Fitting Protocol

- Test 3:
  - Input: MPO Sweep
  - Goal: To adjust the MPO of the aid so that the blue dots hit the output target, or are about 3dB below the UCL asterisks

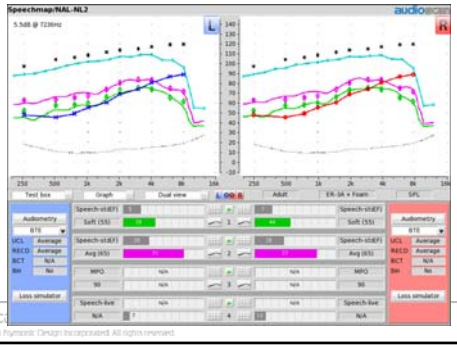


## Fitting Test Three: MPO






## Final Fitting Summary



## *FIRST-FIT COUNSELING*

ON-EAR VERIFICATION

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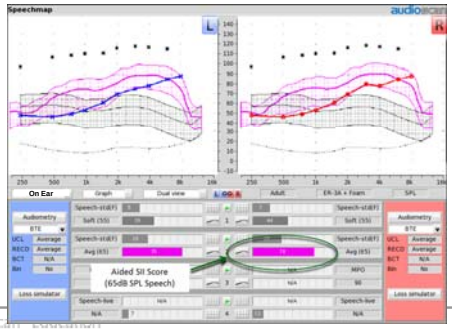
## "Goal" Fitting vs. "Starter" Fitting






## "Process" Counseling

- For first-time wearers:
  - Start with settings that the patient is comfortable to start with
  - Point out the utility that is now missing
  - Discuss the need for practice/brain training
  - Assign brain training tools
  - Outline the therapeutic process that will be undertaken to move toward "Goal" settings while still maintaining comfort.

## Some Brain Training Tools

| Computer Based | Apps | Booklet | Group |
|---|---|---|---|
| •**LACE*** (neurotone.com)<br>•**Read My Quips*** (sensesynergy.com)<br>•**Seeing & Hearing Speech #** (sensimetrics.com) | •**Hear Coach*#** (itunes.apple.com)<br>•**Music Based Mobile Auditory Training Game*#** (orca-us.info) | **Cut To The Chase*#** (cuttothechaseheaingpros.com) | •**G.R.O.U.P. AR*** (idainstitute.com)<br>•**ACE – Active Communication Enhancement*** https://shrs.uq.edu.au |

* = Adult
# = School age children



## *VERIFICATION CONSIDERATIONS*

OPEN FIT TECHNOLOGIES

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## What Is An "Open" Instrument

- "Open" should NOT be defined by hearing aid design
  - Thin Tube
  - RIC
- "Open" defined by the way ANY hearing aid is coupled to the ear:
  - If coupling does not occlude the ear, it is an "Open" fitting

## Minimal Occlusion

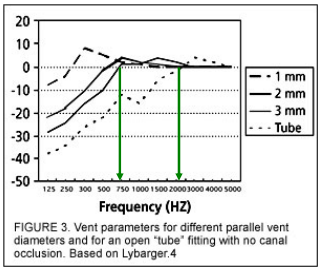



FIGURE 3. Vent parameters for different parallel vent diameters and for an open "tube" fitting with no canal occlusion. Based on Lybarger.4

Lybarger S. Earmolds. In: Katz J, ed. Handbook of Clinical Audiology, 3rd edition. Baltimore: Williams and Wilkins; 1985: 885-910.



## Method For Determining "Open" Fit

- Record 65dB Speech (Test 1) with only probe tube in ear (REUR)
- Repeat 65dB Speech (Test 2) with aid now present, but muted (REOR)
- If two results are essentially the same, it is an "Open" fitting
- If Test 2 shows occlusion (i.e., loss of ear canal resonance), it is a "BTE" fitting



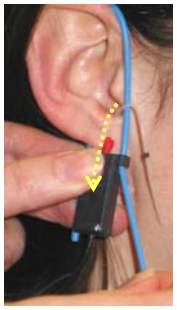
## If an Open Fitting Is Present

- Pre-fit is off the table
  - There is no such thing as an "Open" coupler
- All fitting measures need to be done on the ear
- "Concurrent" calibration (equalization) should not be used

## Impact of sound calibration method

For open fitting:

- Outflow from ear canal received by reference mic.
  - Lowers speaker output
- Resulting measured output will be reduced



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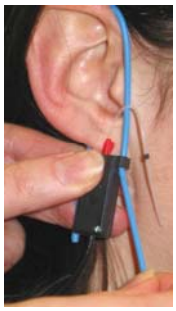
## Open Fitting Recommendation

- Use 'stored' equalization instead of 'concurrent' equalization
  - Disables reference mic.
  - Outflow from ear canal will not affect speaker level and your measurement
- If you cannot disable reference mic, move it away from ear canal



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## Effect of equalization approach

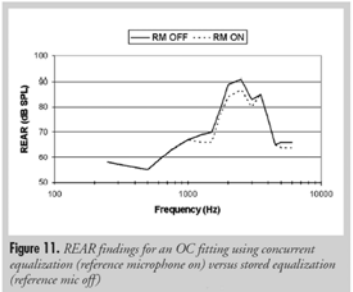


**Figure 11.** *REAR findings for an OC fitting using concurrent equalization (reference microphone on) versus stored equalization (reference mic off)*

Mueller, H.G., Ricketts, T.A., "Open Canal Fittings" Ten Take Home Tips", Hearing Journal, v9:11, Nov. 2006

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## An Open-Fit Speechmap Verification Protocol

1. Select “Open” in Instrument menu
2. Place probe tube / hearing aid on ear per typical
3. Turn OFF hearing aid.
4. Click on test signal and store ‘equalization’ when prompted
5. Turn ON hearing aid
6. Run Test 1 at 50dB calibrated speech to adjust gain
7. Run Test 2 at 65dB calibrated speech to adjust compression
8. Run Test 3 to set MPO

Optional:

1. Turn aid off and run TEST 4 at 65dB calibrated speech
2. Display Test 2 and Test 4 results as a counseling tool



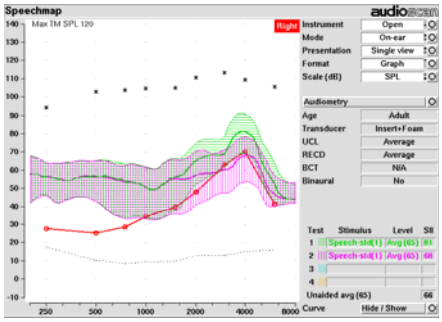


FIGURE 5: The pink shaded area is the eardrum SPL “speech banana” for 65dB speech input measured at the probe tip with the open-fit hearing aid turned OFF. The green shaded area is the eardrum SPL “speech banana” with the same hearing aid turned ON. The difference between the two indicates where amplification has reached the eardrum.



The Knowledge Clinic

*Multiple choice*

Education

**What is the core value proposition associated with an audibility-based counseling strategy?**

A. To restore normal hearing
B. To make speech sound comfortable
C. To bring speech sounds back into your listening range
D. To make things sound a little bit louder than they do now



**Define an open fitting**

A. A fitting where the physical presence of the hearing instrument changes the acoustic properties of the ear canal
B. A fitting where the physical presence of the hearing instrument does not change the acoustic properties of the ear canal
C. A thin-tube or RIC hearing aid design
D. A hearing aid or ear mold with a vent

## When should a .4cc coupler be used?

A. To test RIC products
B. To measure the gain of ITE hearing aids
C. To measure aided output
D. To effectively measure output for frequencies beyond 8KHz



*Case study discussion*

Education

## Case #1:

- *New patient*
- *Has never worn hearing aids before*
- *Hearing loss is mild-mod. S/N and symmetrical*
- *No thresholds greater than 70dBHL*

QUESTION: **What is your initial counseling going to direct the patient to expect from your treatment?**

QUESTION: **How are you going to explain this concept to your patient?**

## Case #2:

- *New patient*
- *Has never worn hearing aids before*
- *Hearing loss is mod.-severe S/N and symmetrical*
- *Thresholds of 80-85dB in the 3-8KHz range*

**QUESTION: Are you going to direct your patient to expect anything different from your treatment than the previous patient?**