

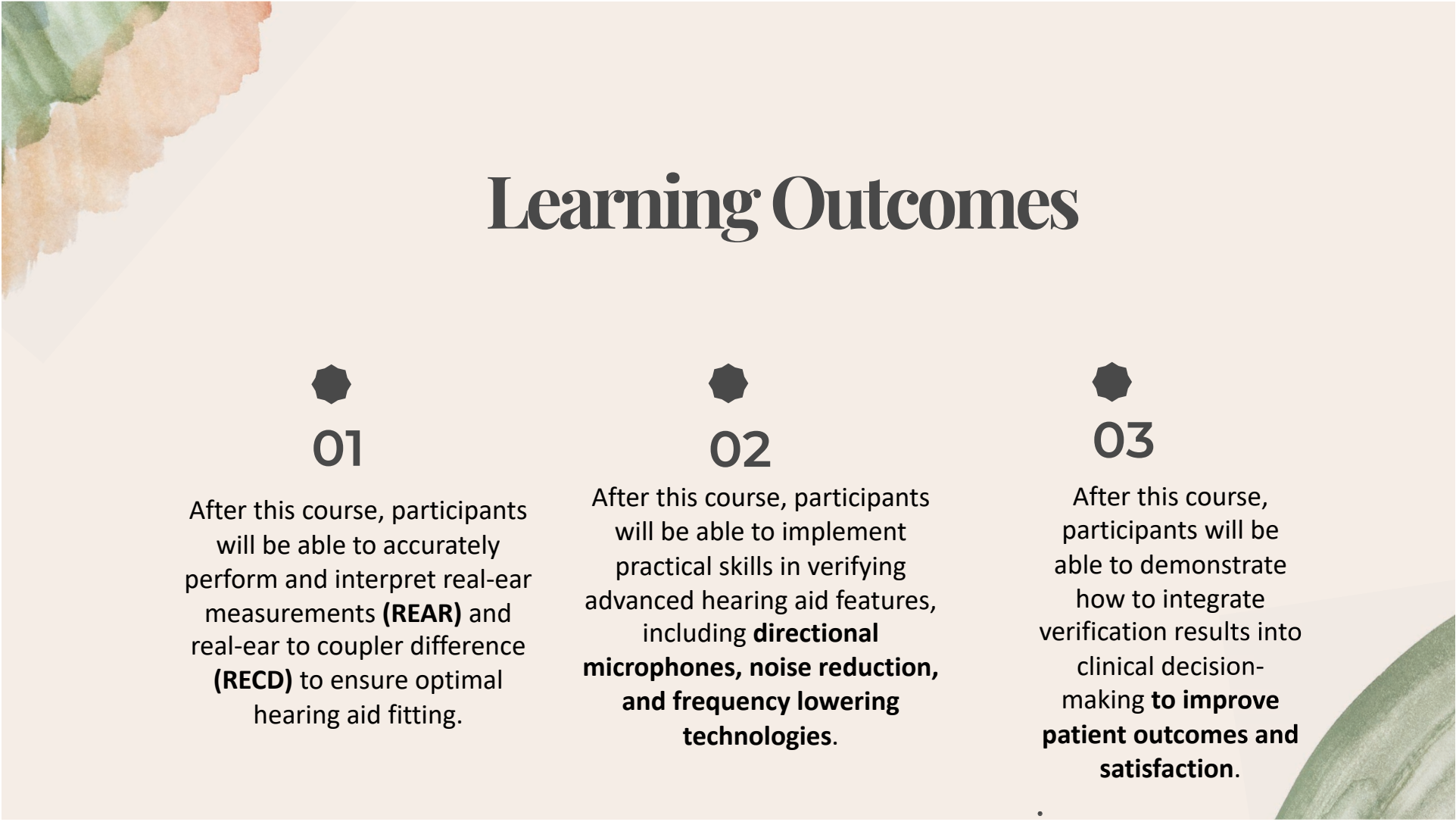
From Ears to Algorithms: Demystifying REAR, RECD, and Other Hearing Aid Feature Verification

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Professor

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Learning Outcomes



01

After this course, participants will be able to accurately perform and interpret real-ear measurements (**REAR**) and real-ear to coupler difference (**RECD**) to ensure optimal hearing aid fitting.



02

After this course, participants will be able to implement practical skills in verifying advanced hearing aid features, including **directional microphones, noise reduction, and frequency lowering technologies.**



03

After this course, participants will be able to demonstrate how to integrate verification results into clinical decision-making **to improve patient outcomes and satisfaction.**

Limitations and Risk

- Please review these bullets and make any revisions/additions as applicable for your course.
- The applicability and accuracy of the course content may vary by the clinical, geographical, and cultural context; you should evaluate the course accordingly.
- As healthcare is rapidly evolving, new findings may change the validity of the information presented in this course. Providers should always consult the latest research and guidelines from professional associations.
- The interventions discussed in this course may be limited in generalizability, requiring practitioners to consider specific individual and population factors.
- The course may not cover all possible risk factors, diagnostic methods, or treatment options, and complex cases may require additional considerations.
- Healthcare providers should apply cultural competence and sensitivity to ensure effective and respectful care based on their patients' diverse needs.
- Providers should always evaluate the limitations of diagnostic and screening tools, considering their potential for false results as well as any ethical implications.
- It is the responsibility of course participants to critically evaluate the evidence from multiple sources to guide professional practice.

Who am I?

Professor

Audiologist

Researcher

Department Chair

Clinical Director

Wife

Mom

Organizer of all things



Disclosures

The content is that of the author and not the:

- Department of Veterans Affairs
 - US Government
 - State of South Dakota
 - South Dakota Board of Regents
-
- I have various relationships with hearing aid manufacturers and verification system manufacturers for research.

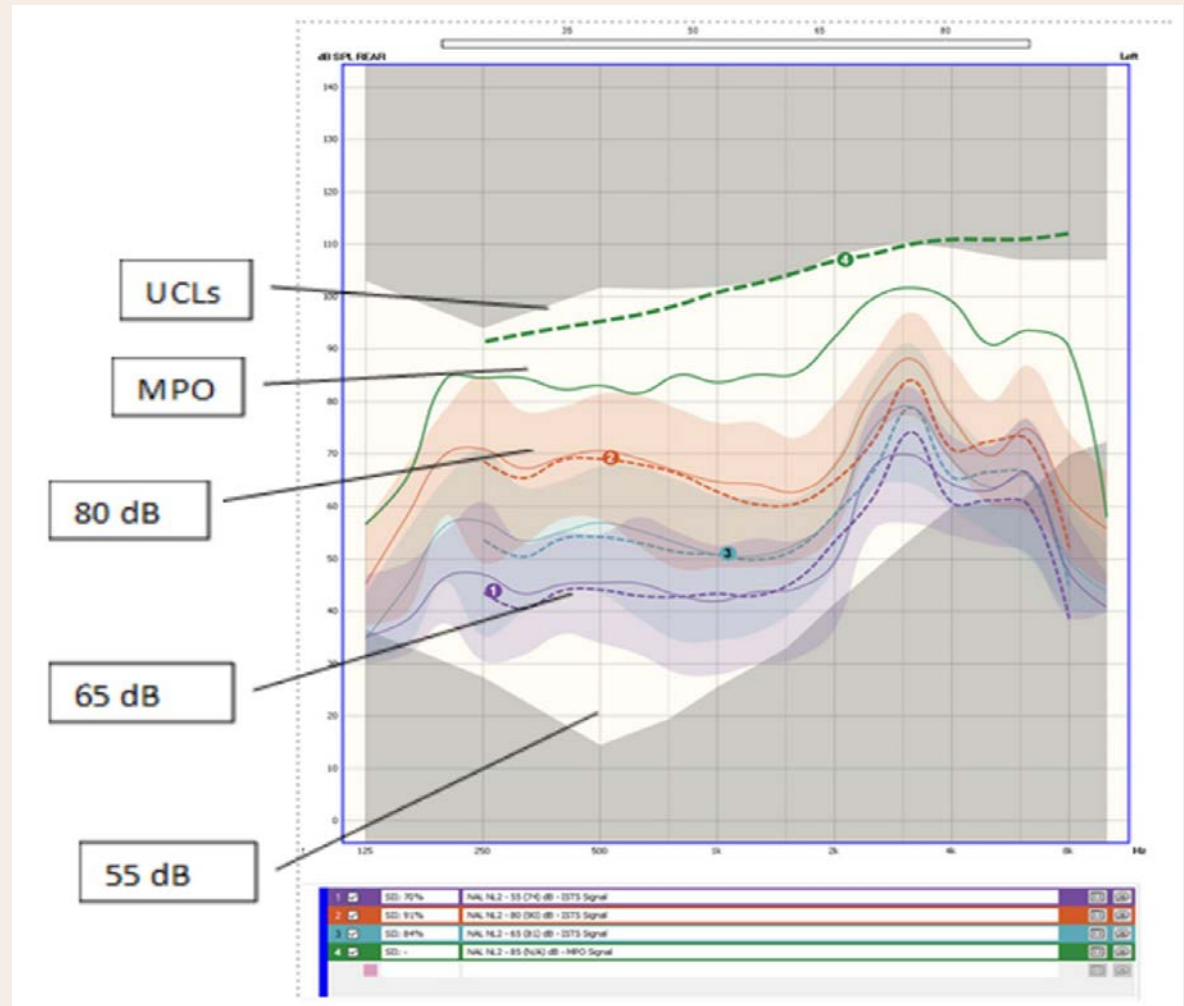
A FEW COMMENTS ABOUT PROBE MICROPHONE MEASURES

- Equipment
- How will it “fit” on a not average pinna
- Signal available
- Upgrades you may need
- Placement

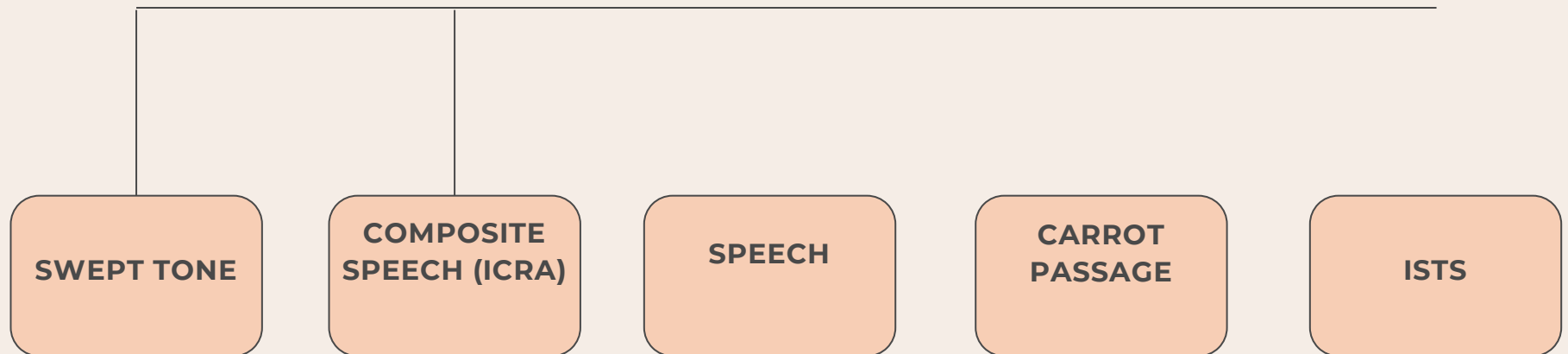
REAR... is essential for hearing aid fitting

- Goals of hearing aid fitting:
- Audibility
- Normal loudness perception
- Comfort
- Safety
- Better speech understanding

REAR: Real Ear Aided Response



Test Stimulus



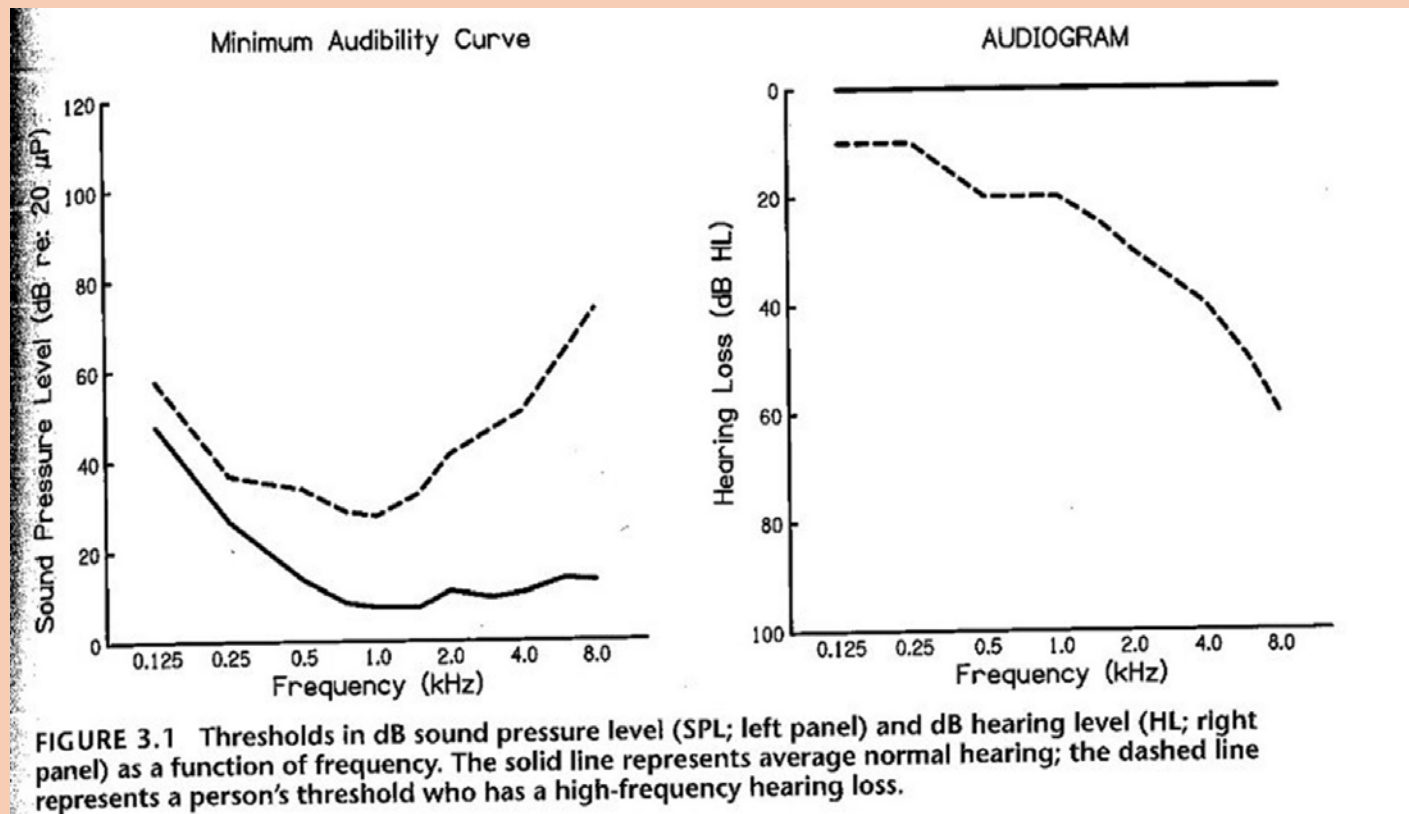
What else can be verified using REM?

- Directional mic feature
- Frequency lowering feature
- Measuring feedback
- Hearing Protection
- Noise reduction
- Occlusion effect
- Voice audibility

Order in our clinic

- Fit
- Feedback
- RECD
- REAR
 - Soft, Moderate, Loud, MPO?
 - What order?
- Validate

dB SPL and dB HL



We order or validate a hearing aid based on coupler data (2cc, SPL)

- TDH-50 in HL
- Insert in HL
- Insert in SPL
- 6cc, HL
- 2cc, HL
- 2cc, SPL (but it's still not perfect)

Real Ear to Coupler Difference

What is it

When is it important, useful

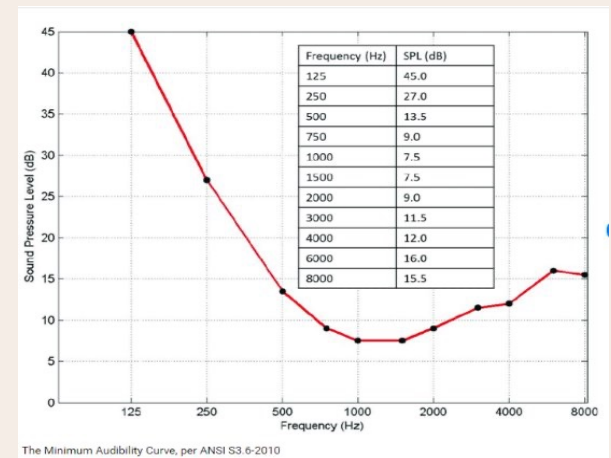
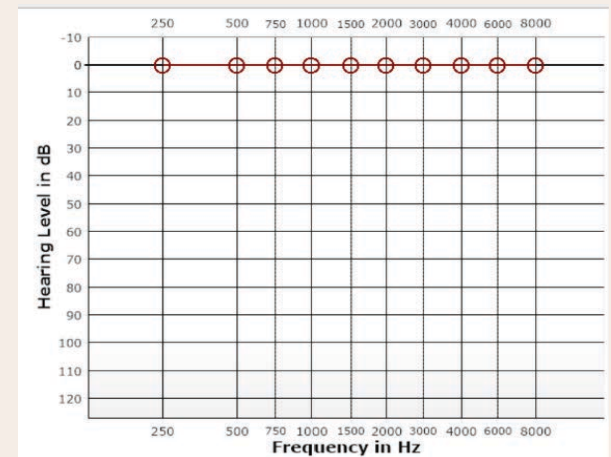
Examples

Probe microphone measures allow you to account for RECD and/or REUR

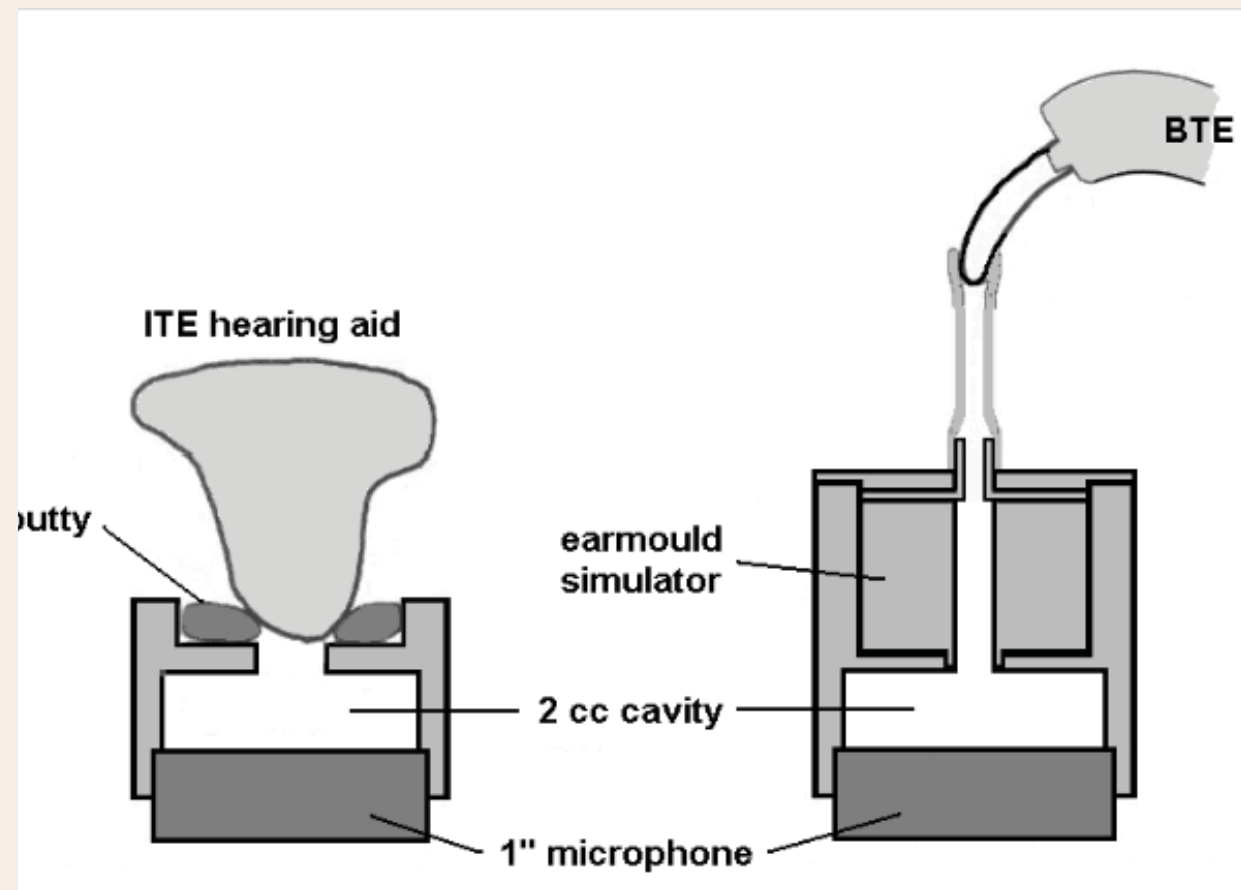
- 1. RECD** makes sense whenever you are dealing with couplers and want to be exact and/or know that your patient is very different from a coupler
- 2. REUR** makes sense when you are dealing with insertion gain or when all you have is sound field thresholds

We order or validate a hearing aid based on coupler data (2cc, SPL)

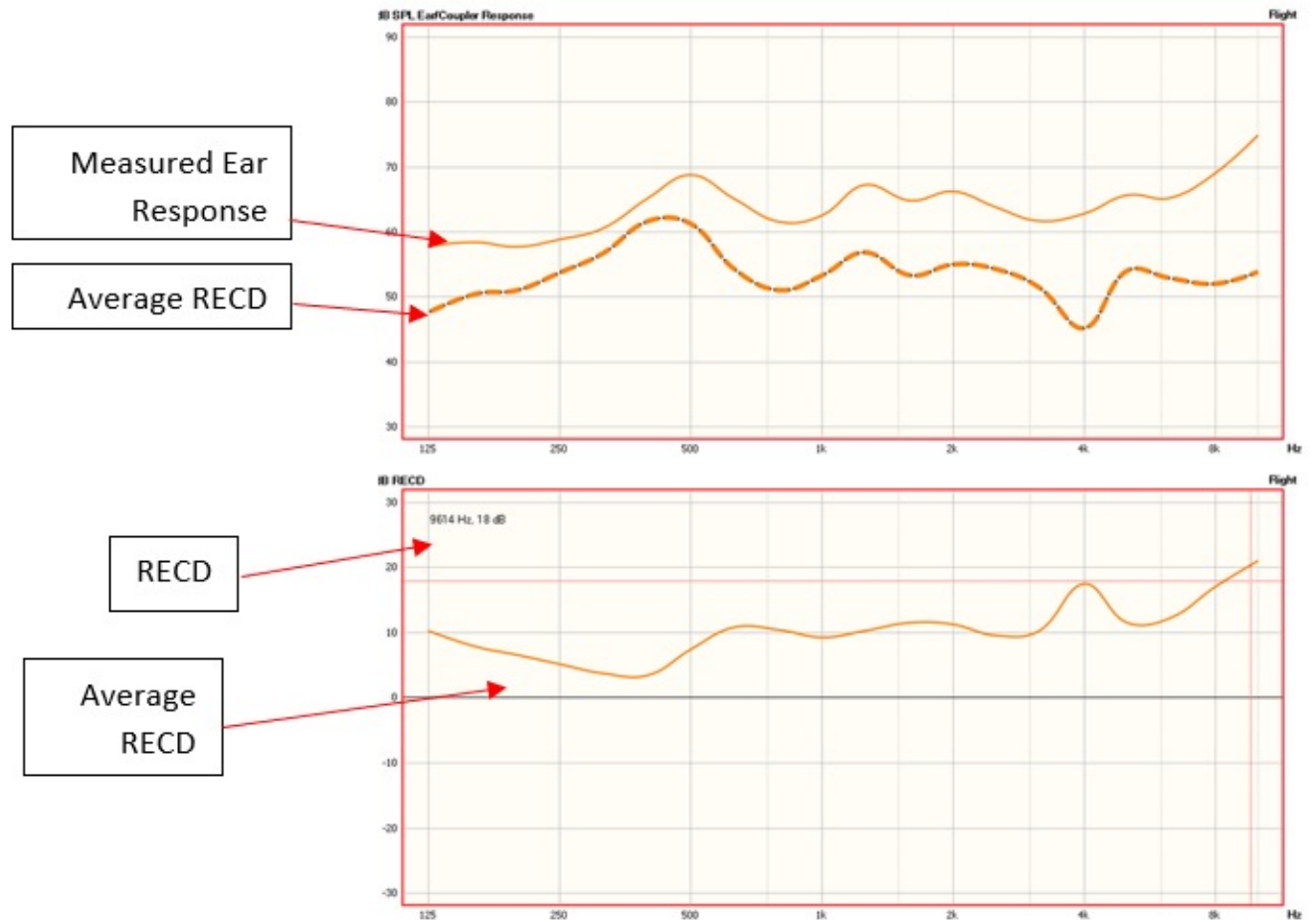
- Audiogram = dB HL
- Hearing aid = dB SPL
- Need to convert HL to dB SPL for hearing aid
- How??
- Average conversion = 2cc coupler
 - Adult white male
- **Problem?? Not all ears are 2cc**







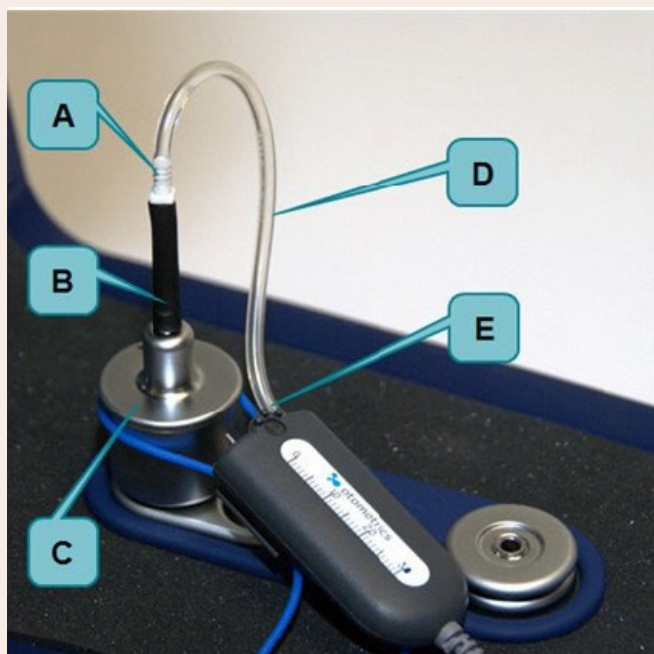
Real Ear Acoustics



Ideally you would account for...

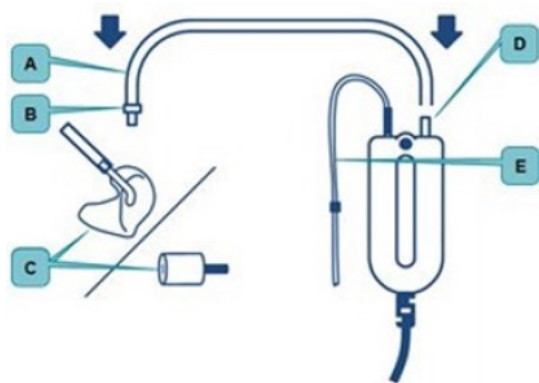
- Residual volume
- Earmold effects
- Microphone placement
- Eardrum impedance
- Loss of natural ear canal resonance

Measure the Coupler



- A. RECD coupling
- B. BTE adapter tube
- C. BTE (HA2) adapter
- D. Transducer tubing
- E. Transducer tube port

Measure the Ear

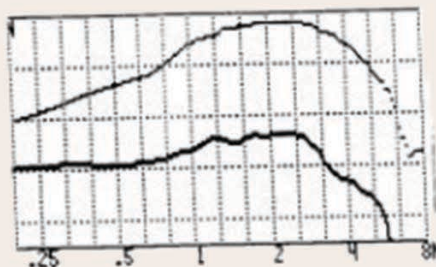


- A. Transducer tubing
- B. RECD coupling
- C. Earmold or foam insert tip
- D. Transducer tube port
- E. Probe tube

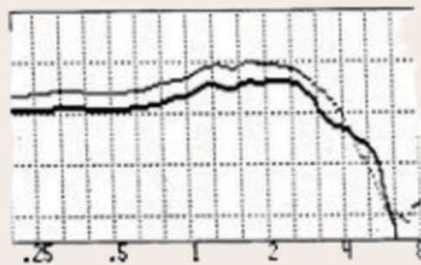


But what if their ear is not average?

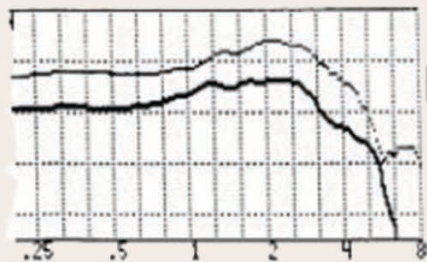
- Response is "louder" = ear is smaller
- So, the 7 dB conversion is not accurate?
- Present 60 dB HL at 1000 Hz
- Convert to 67 dB SPL?
- In this case there is an additional 8 dB, so it is 75 dB SPL



4 YOA



2 YOA



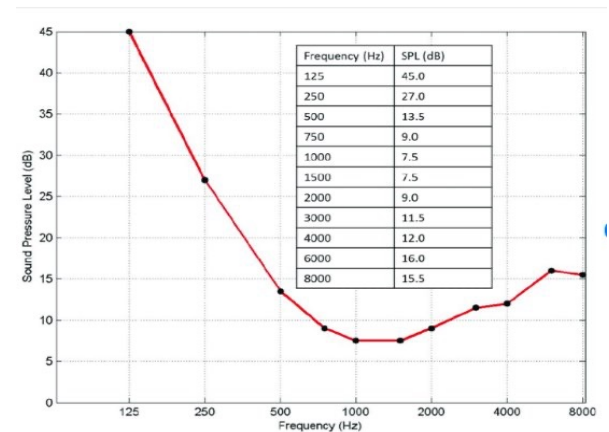
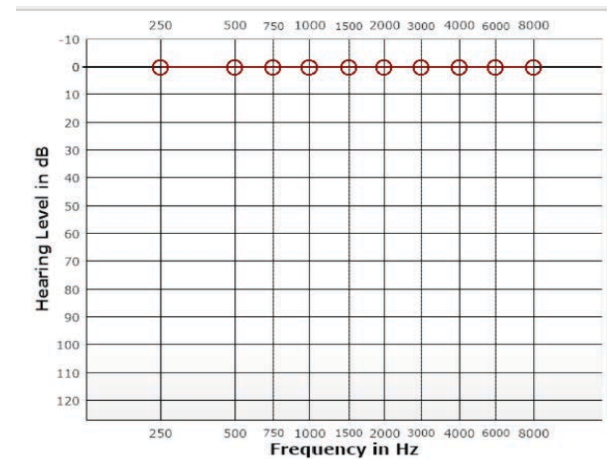
33 YOA

Consequences...

- Where do targets come from?
- Where do we fit the aid to?
- So... we would have overfit the hearing aid...
- What is the complaint of our patients?
 - It is too loud!!

We order or validate a hearing aid based on coupler data (2cc, SPL)

- Audiogram = dB HL
- Hearing aid = dB SPL
- Need to convert HL to dB SPL for hearing aid
- How??
- Average conversion = 2cc coupler
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- **Problem?? Not all ears are 2cc**



The Minimum Audibility Curve, per ANSI S3.6-2010

So what does this mean??

Jorgensen et al (2022)

We should measure -

- If we don't measure – wrong 20%
(outside 1SD)
- Are you okay with being a "C" audiologist

Right = left

Most notably – when you measure HHIE
is improved

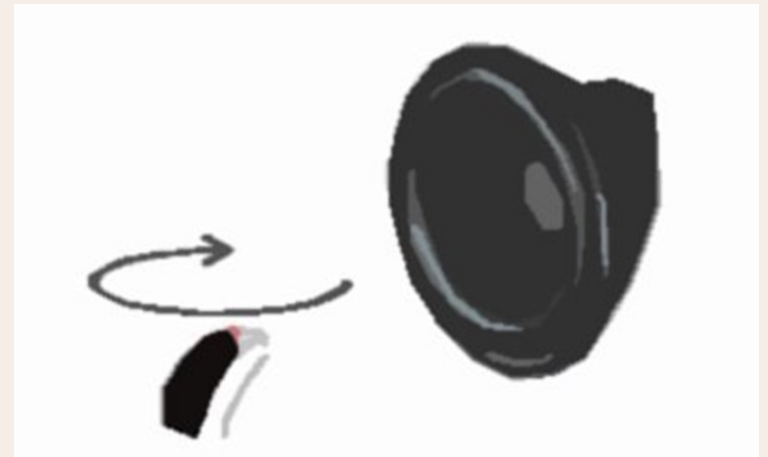
Let's talk about Directional Microphone

Why use it?

- Current technology often uses automatic processing to analyze the environment
- Allows for better performance in more complex listening environments

How do you verify this feature?

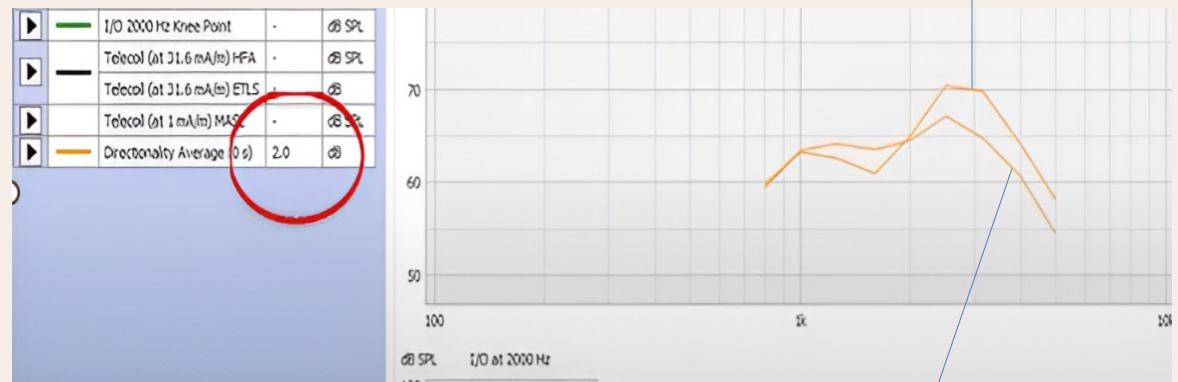
- Should we do this?
- What is different about this and traditional d-mics?
- Directional microphone curve
- Turn 45 or 90 degrees



- Should see it return to the same as the first curve after a period of time

- But for how long

- Can always ask the manufacturer?



A decorative border made of watercolor brushstrokes in shades of orange, green, and blue, framing the central text.

THANK YOU VERY MUCH!

ASK QUESTIONS – I WOULD LOVE TO ANSWER – OR FIND THE ANSWER

FOR YOU

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