Revealing the Potential of Aided Cortical Testing: What Audiologists Should Know

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Learning Objectives

- Understand Aided Cortical Testing
- Explain the need for Aided Cortical Testing
- Identify the Target Population for Aided Cortical Testing
- Demonstrate the Process for Aided Cortical Testing
- Interpret Cortical Testing Waveforms

What is Aided Cortical Testing

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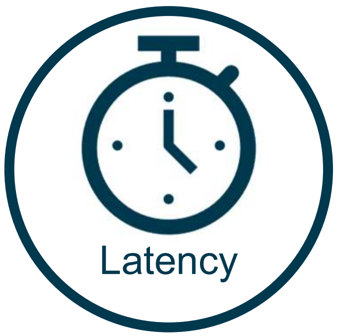
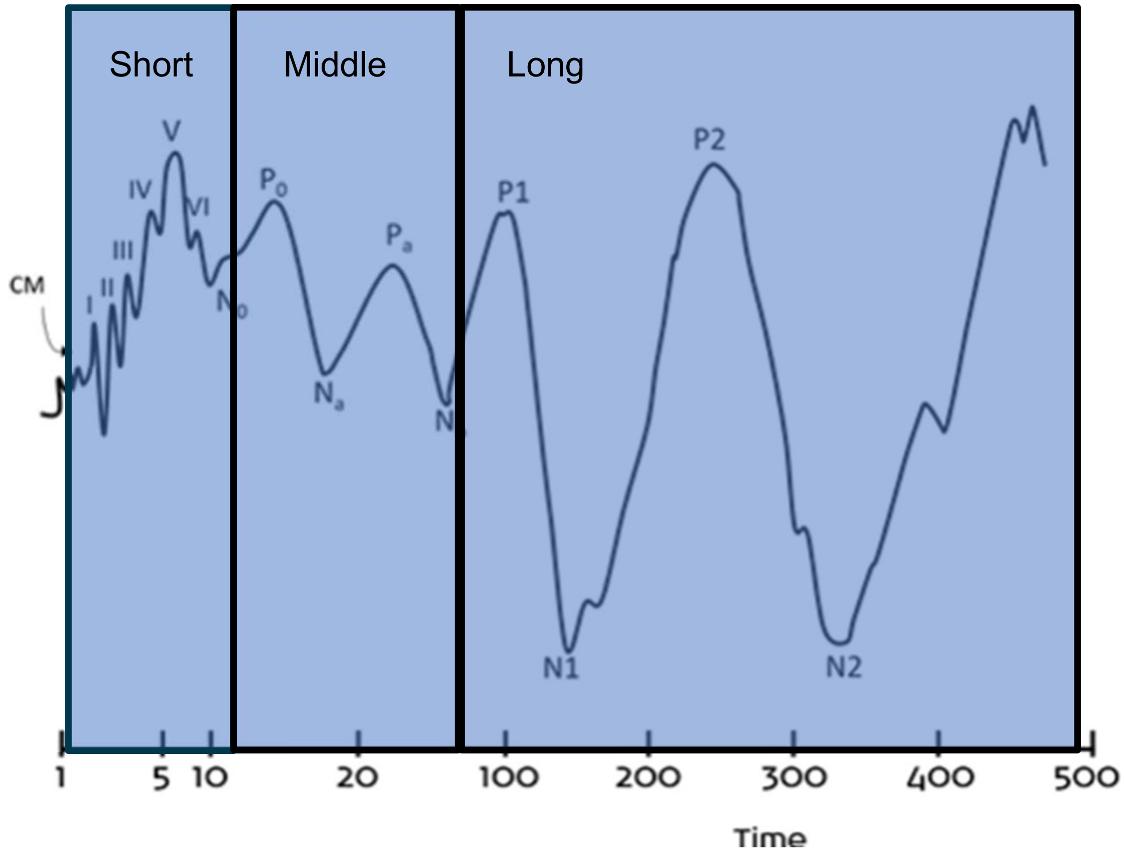
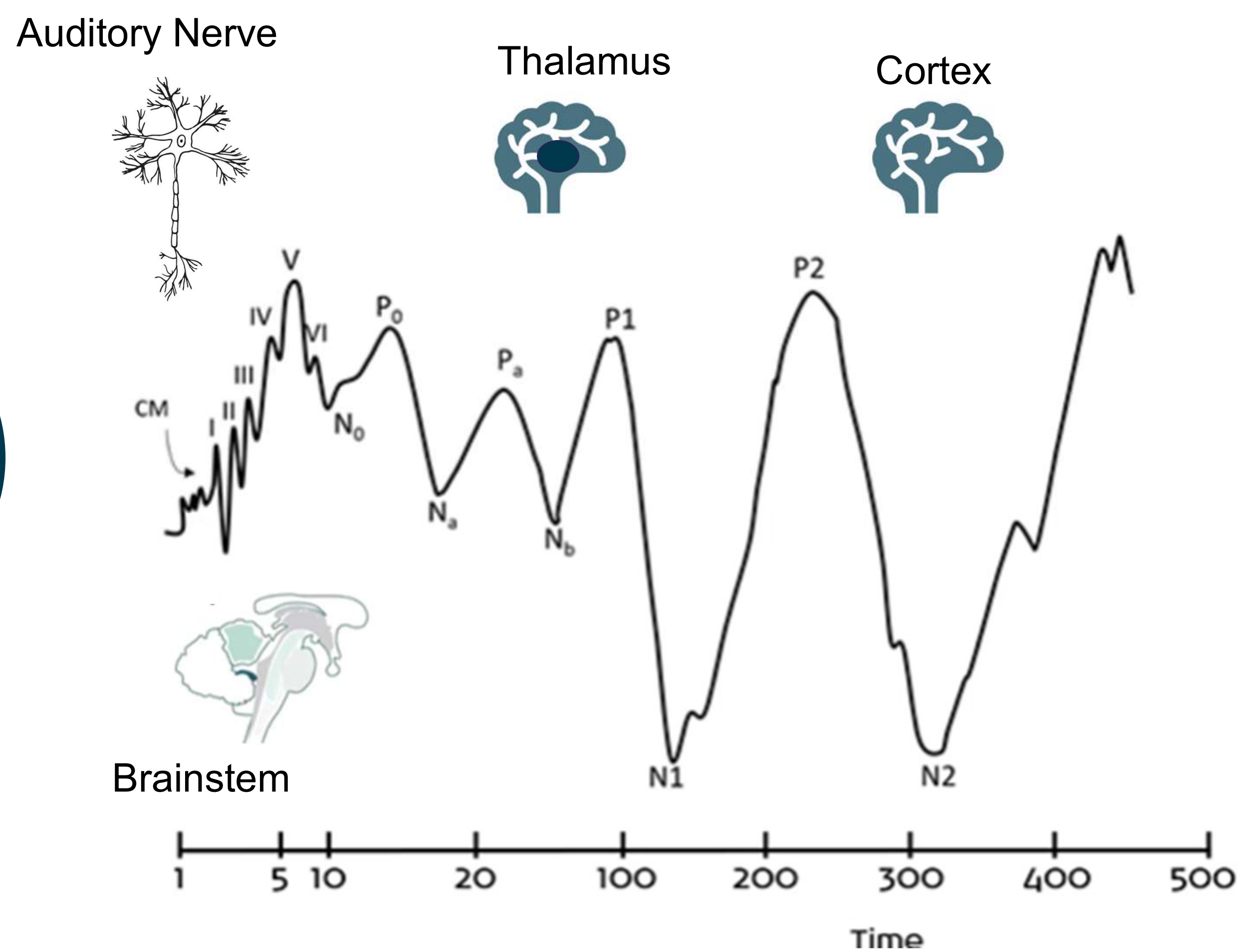

Latency


Short
Middle
Long
CM
I
II
III
IV
V
VI
P1
P2
N1
N2
1
5
10
20
100
200
300
400
500
Time

Anatomical origin



Slow vertex response (SVR)

N1-P2 Response

Cortical evoked response audiometry (CERA)

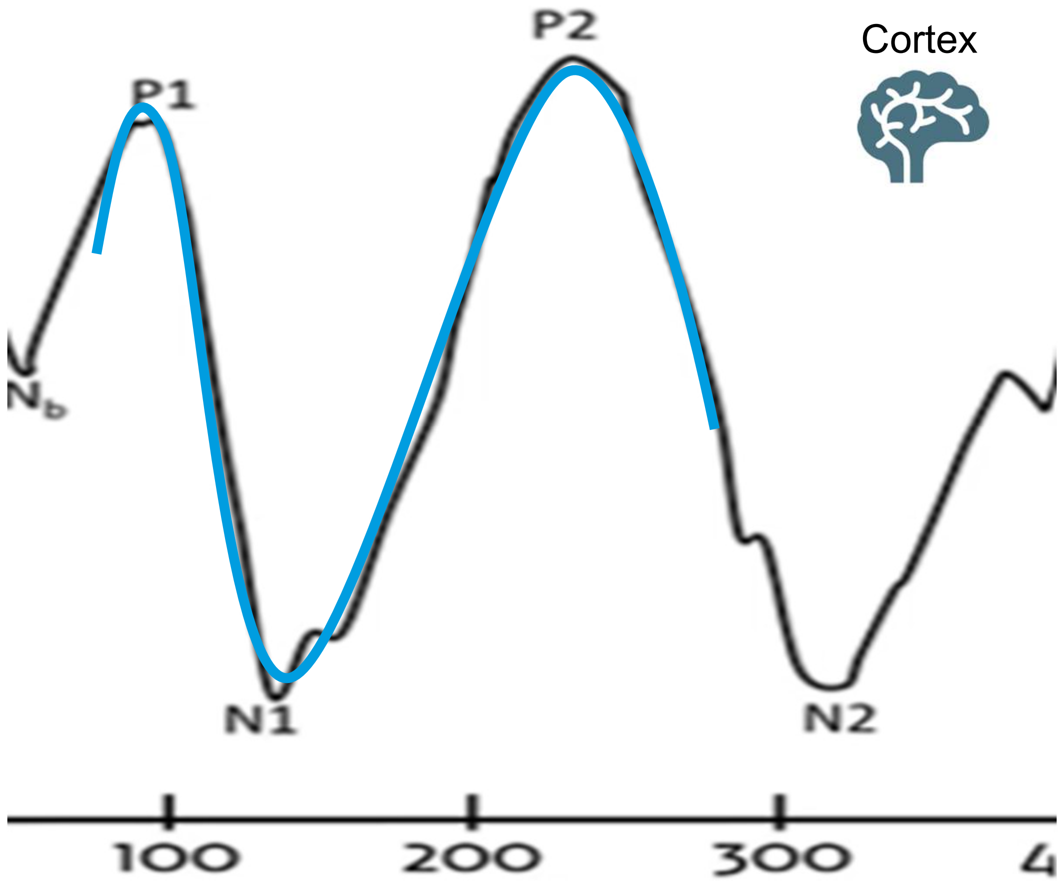
Cortical auditory evoked potential (CAEP)

Auditory late response (ALR)

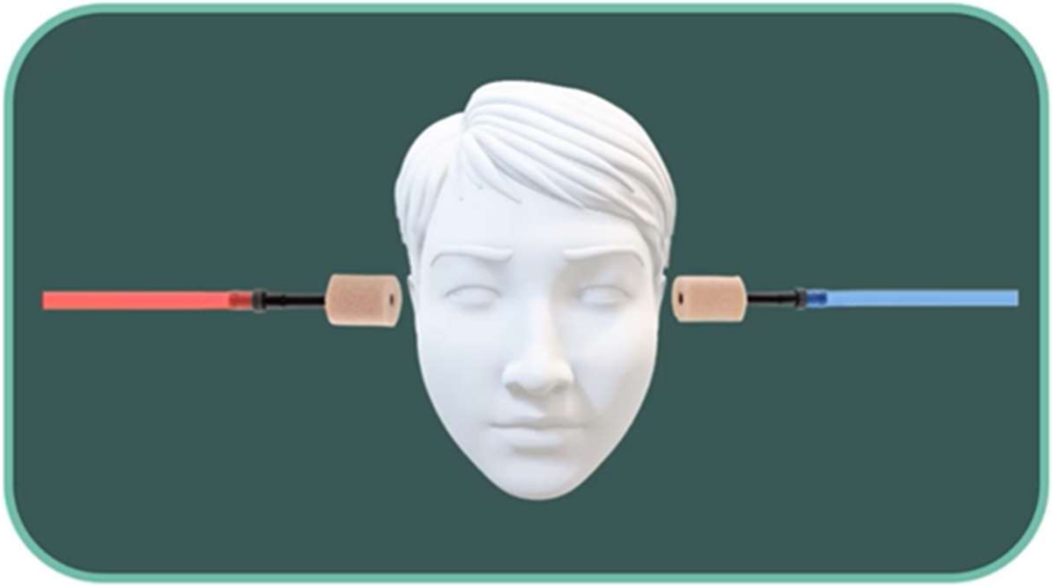
Auditory cortical response (ACR)

Mismatch negativity (MMN)

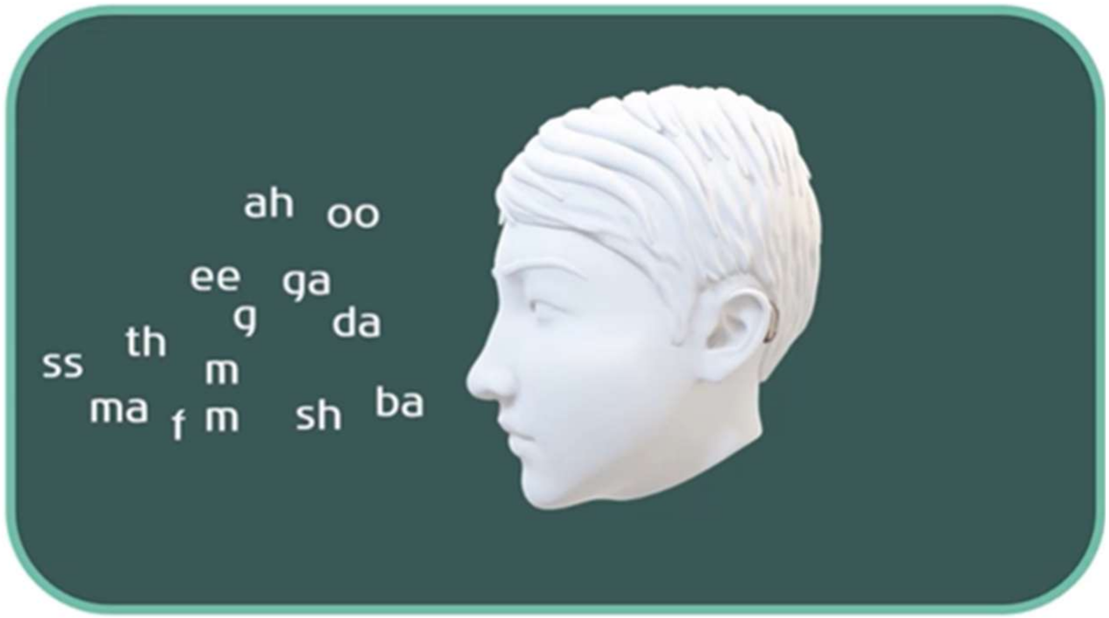
P300



Threshold CAEP



Aided Cortical Test



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Why perform aided cortical testing

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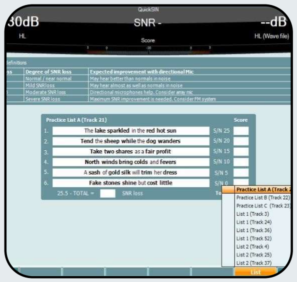
Audiogram



Speech in Noise Testing

Hearing Aid Selection

Test Box Measures

Real Ear Measures

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How do we know if the hearing aid is doing the job properly?

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Outcome measures

- Self-reporting measures
- Validated questionnaires
- Input of other people in patient's life
- Direct speech testing with the patient, and speech-in-noise testing with the hearing aids
- But what if the patient can't do any of these outcome measures?

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Aided cortical – an objective validation

- An objective method to validate the benefit of a fitted hearing aid or cochlear implant in patients who cannot subjectively respond to a hearing test, by measuring a patients cortical responses to speech-like sounds

Who is suitable for Aided Cortical testing?

Infants and young children

- Infants aged 3 to 7 months
- Young children not doing aided VRA for whatever reason, to assess aided benefit
- ANSD children post ABR / pre-behavioural. What can they hear?
- Severe to profound losses. Is the hearing aid working or do they need a CI?
- CI users, with some limitations

Older children

- Not performing reliable behavioural testing
- Complex needs, developmental delay, disabilities
- Non-organic hearing losses

Consider:
ABR
ASSR
Threshold
Cortical

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Adults

- Adults with complex needs who cannot perform traditional behavioural testing – aided or unaided
- Cochlear implant candidates – deriving benefit from their hearing aids?
  - Cross-check for behvaioural testing
- CI users, with some limitations

Consider:
ABR
ASSR
Threshold
Cortical

How Do I Perform Aided Cortical Testing

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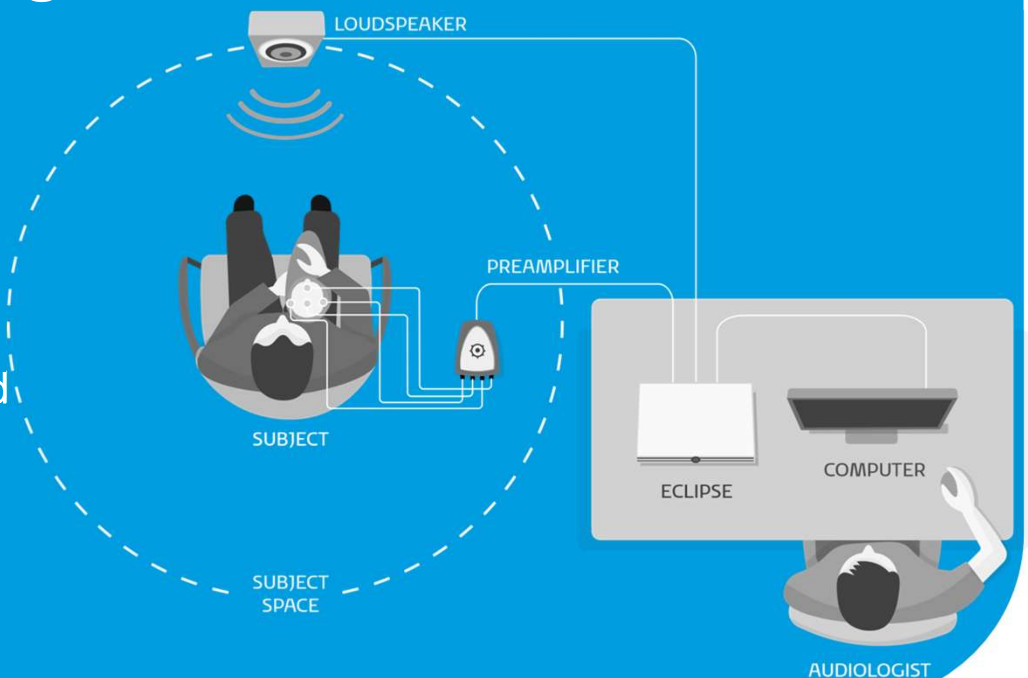
How to perform Aided Cortical testing

- Field speaker delivers signal/stimuli
- Electrodes place on patient to measure the cortical response
- Awake patient activated with movie, toys, etc.



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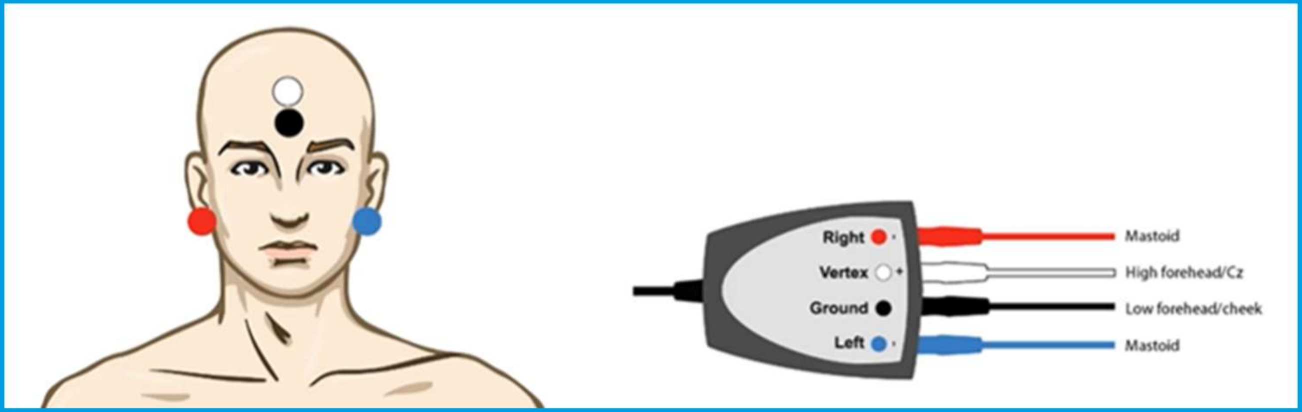
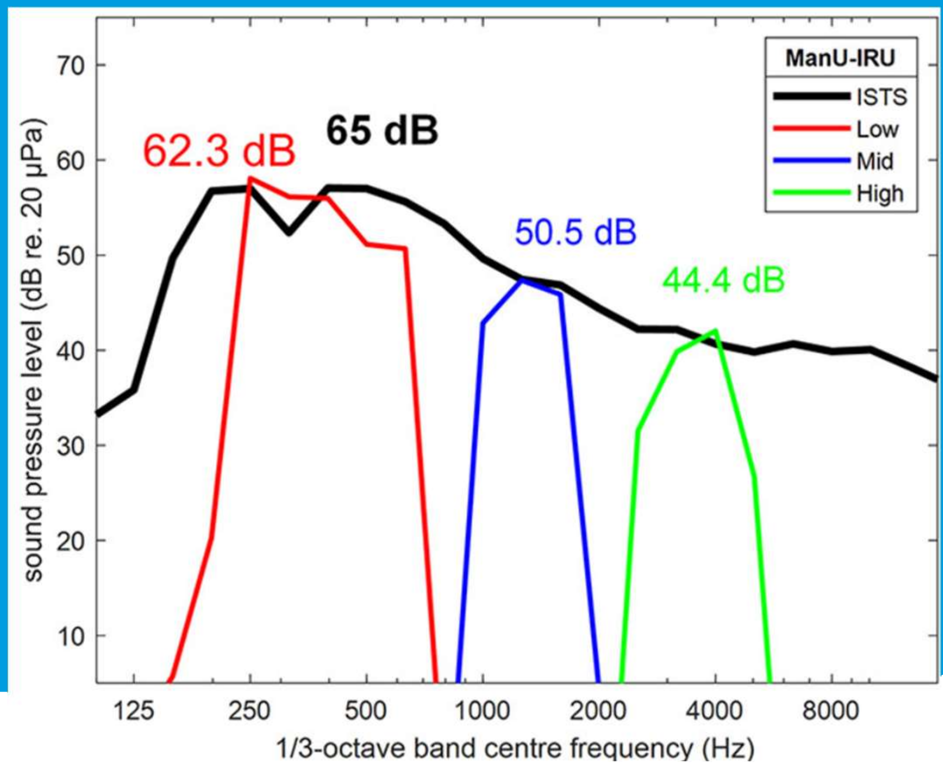
Electrode Placement



Speech sounds

- ManU-IRU
- HD-Sounds
- Ling 6



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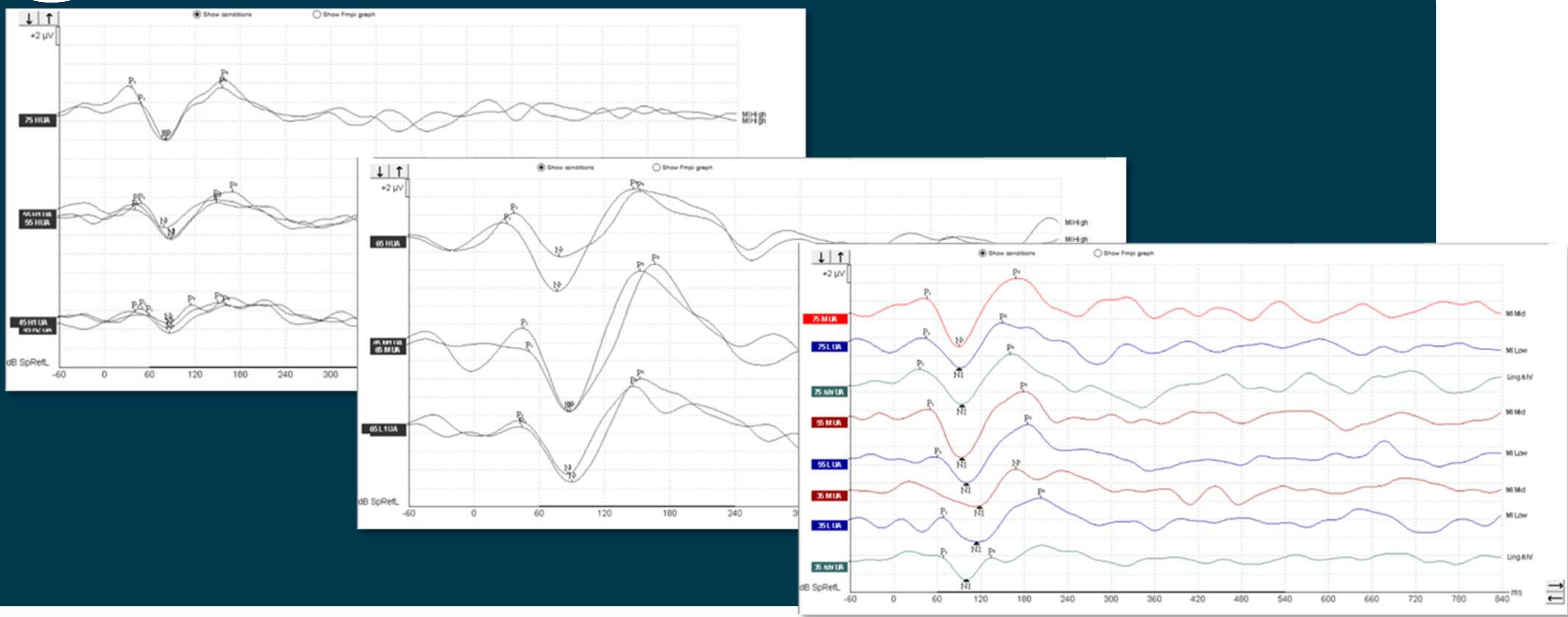
How do we identify cortical responses?

Adults



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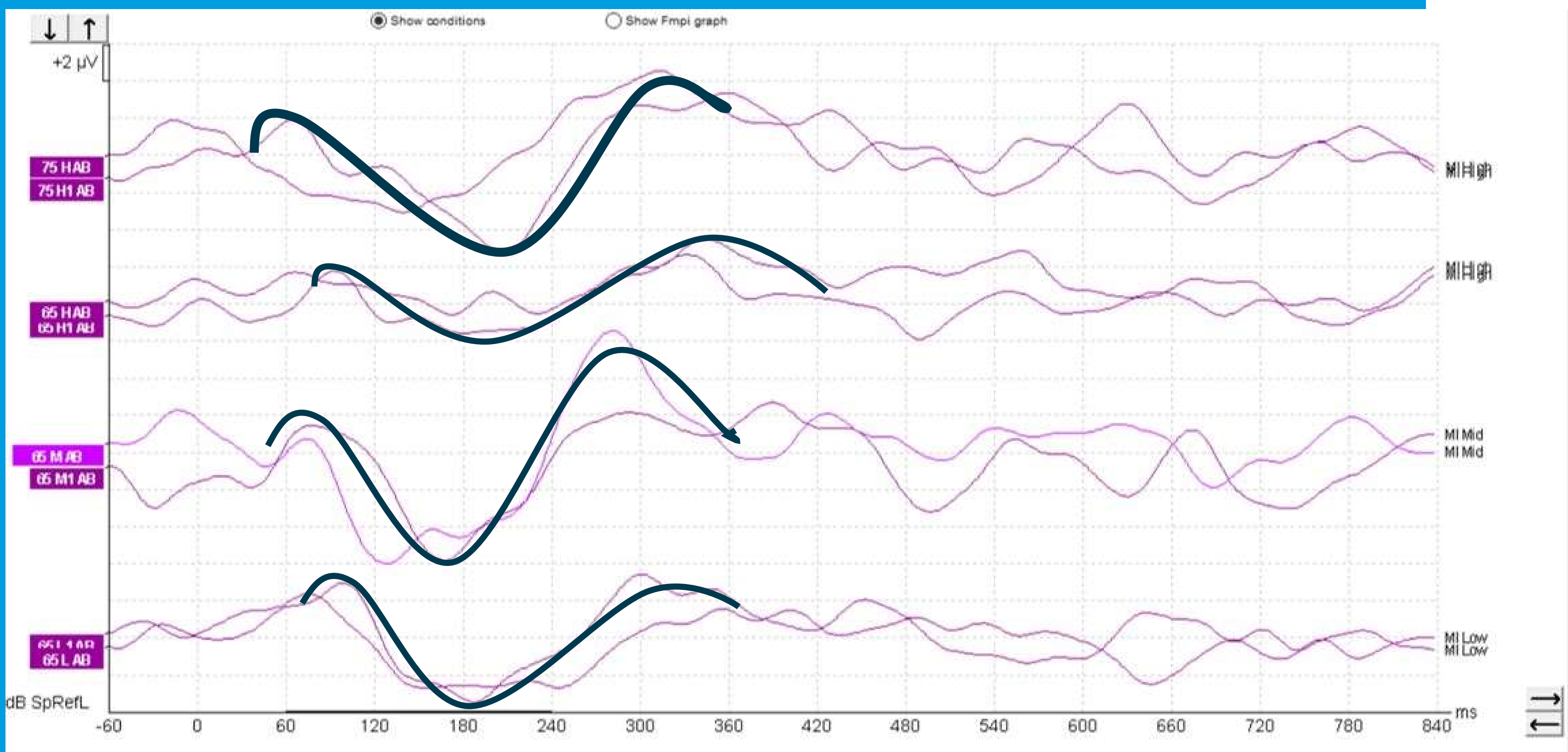

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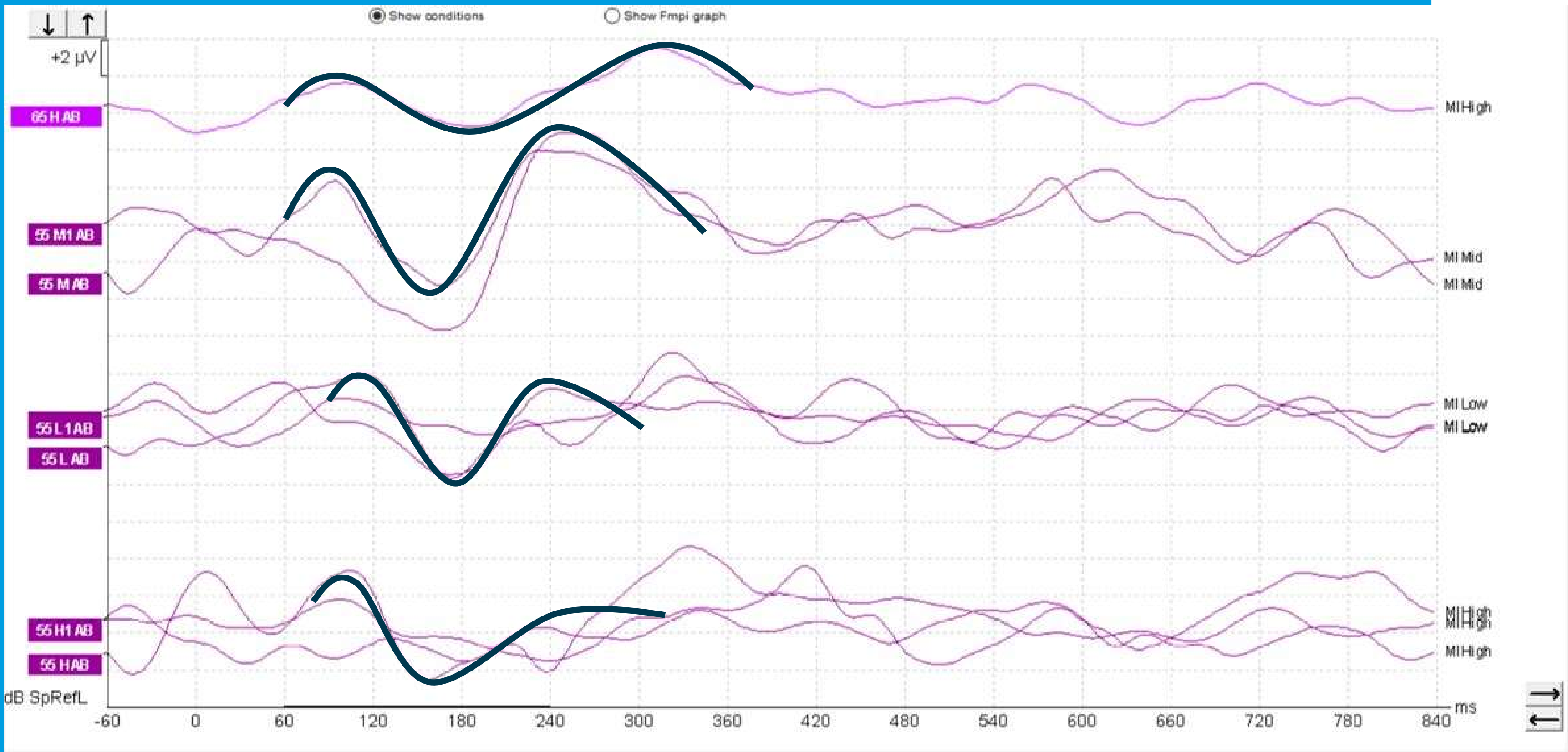

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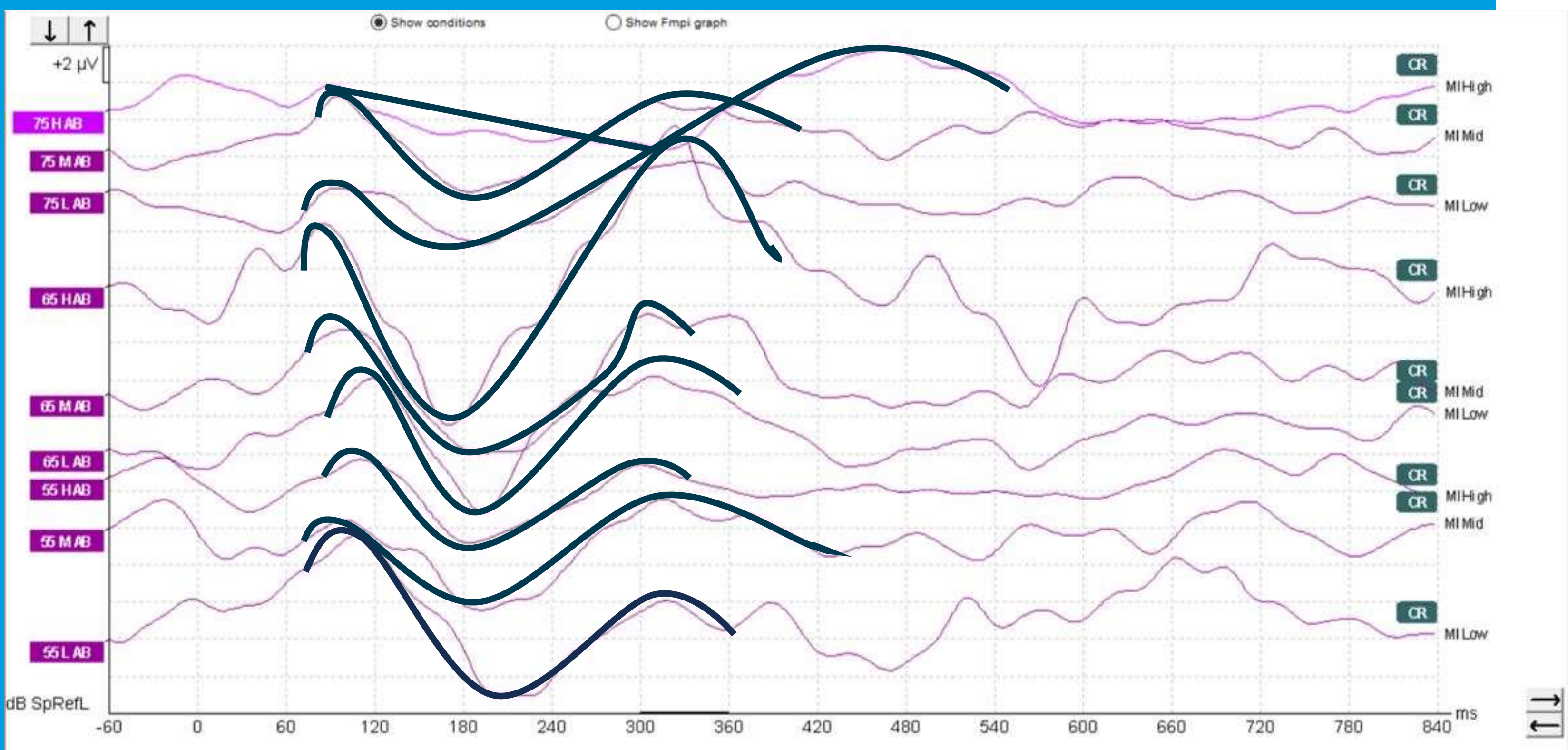

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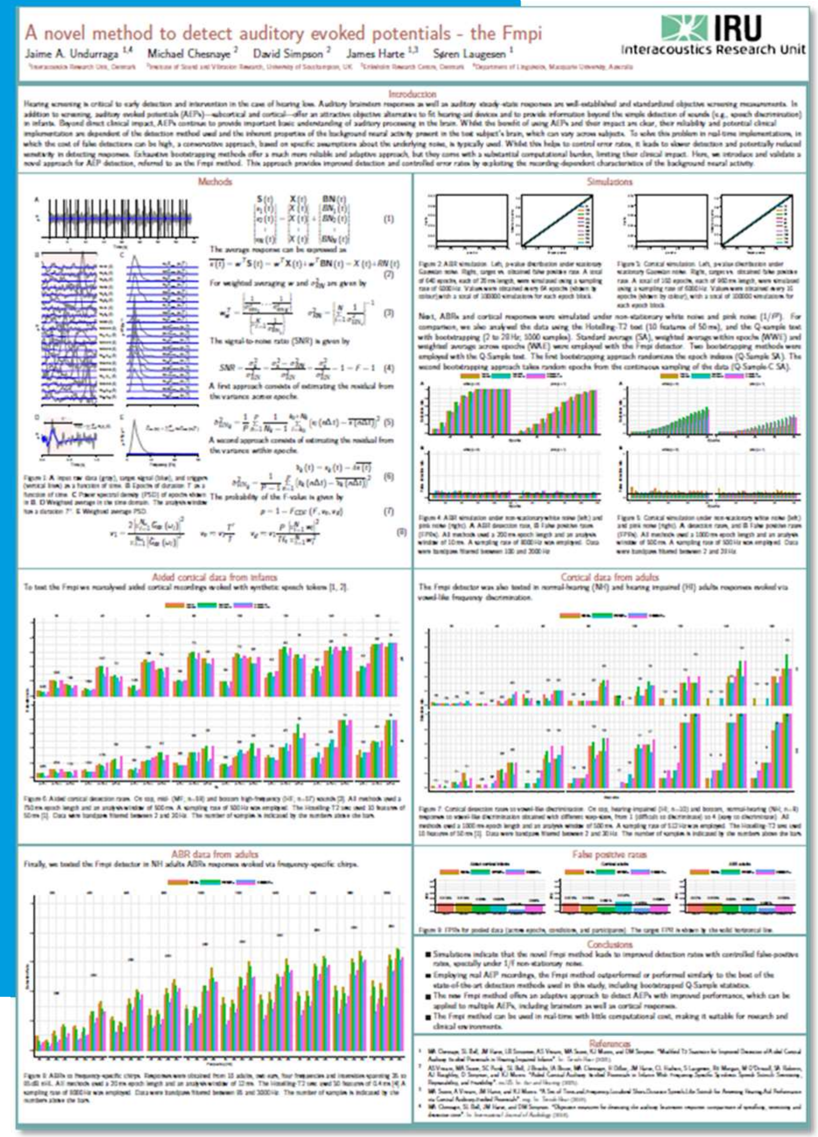
Fmpi detector

- Optimized for faster detection of responses (less recordings needed)
- Displays detector value as a percentage for clear guidance
- Stop measurement when reaching response confidence of 95% or 99%



Detection

- Morphology of the CAEP can very considerable from one infant to the next (BSA, 2022)
- Objective detection methods… are very valuable in interpreting infant CAEP responses (BSA, 2022)
- HEARLab indicates a response is present by showing a p-value smaller than 0.05)
- Eclipse module also has a detection algorithm known as fmpi

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Detection

- Look at the statistical variance of the wave form in rlation to the estimated residual noise of the waveform
- How do they estimate the residual noise
- Fsp – one single point on the waveform
- Fmp – expanded to use multiple points, 5 points of data on the waveform on ABR
- Fmpi – make sue of every point on the waveform – use 250 data points to determine the residual noise
- i = individualized, takes into account the background EEG – actually records EEG and uses it in calculation of residual noise, record more responses in less time

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Detection

For infants in a relaxed state, noise voltages are typically around 3.4 µV after 100 epochs (Carter et al, 2010)

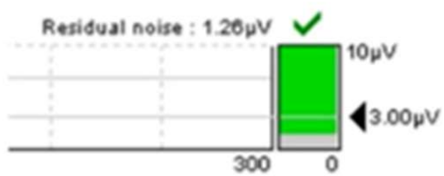
HEARLab

> 3.6 (red)

3.2 – 3.6 (yellow)

< 3.2 (green)

Eclipse



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Waveform labelling

CR

Clear Response

Fmpi >95%

RN does not matter

Acceptable morphology

Waveform labelling

RA

Response Absent

Fmpi	<95%
RN	low
Repeated waveform	
No clear waveform	

Waveform labelling

INC

Inconclusive

Fmpi	<95%
RN	high

Continue testing to reduce RN

!Single RA trace is INC!

Aided Cortical Research

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Ladies in the Van

OPEN

Aided Cortical Auditory Evoked Potentials in Infants With Frequency-Specific Synthetic Speech Stimuli: Sensitivity, Repeatability, and Feasibility

Anisa S. Visram,[1,2] Michael A. Stone,[1,2] Suzanne C. Purdy,[3] Steven L. Bell,[4] Jo Brooks,[1,2] Iain A. Bruce,[2] Michael A. Chesnaye,[4] Harvey Dillon,[1,5] James M. Harte,[6,7] Caroline L. Hudson,[1,2] Søren Laugesen,[6] Rhiannon E. Morgan,[1,2] Martin O'Driscoll,[2] Stephen A. Roberts,[1] Amber J. Roughley,[1,2] David Simpson,[4] and Kevin J. Munro[1,2]

Objectives: The cortical auditory evoked potential (CAEP) test is a candidate for supplementing clinical practice for infant hearing aid users and others who are not developmentally ready for behavioral testing. Sensitivity of the test for given sensation levels (SLs) has been reported to some degree, but further data are needed from large numbers of infants within the target age range, including repeat data where CAEPs

Conclusions: By addressing the clinical need to provide data in the target age group at different SLs, we have demonstrated that aided CAEP testing can supplement existing clinical practice when infants with hearing loss are not developmentally ready for traditional behavioral assessment. Repeat testing is valuable to increase test sensitivity. For clinical application, it is important to be aware of CAEP response variability in

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SL > 10 dB
MF | HF
94% | 79%

>99% completion

24 mins test time

Positive parental feedback

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Summary

- Objective validation of hearing aid fittings
- Reassuring
- Straightforward and easy to use
- Optimized hearing outcome
- Natural part of your clinical flow

Thank you!

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Questions

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Why perform Aided Cortical Testing?

- Bridges the gap from fitting to behavioural testing
- Validate if a hearing aid or cochlear implant provides the necessary input

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