Richard Seewald

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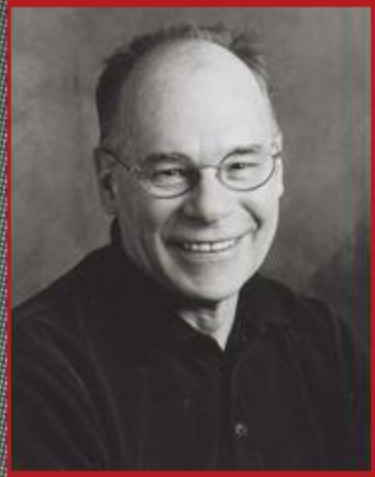

Protocolo de adaptación de audífonos en niños de 3 a 18 meses: adaptación y verificación

Hearing instrument fitting protocole in infants from 3 to 18 months of age: fitting and verification procedures

Hearing Instrument Fitting Protocol in Infants 3 to 18 Months of Age:

Fitting and Verification Considerations

Richard Seewald, Ph.D.

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National Centre for Audiology

The University of Western Ontario

London Ontario Canada

The Fitting Process

ASSESSMENT

SELECTION AND FITTING

VERIFICATION

VALIDATION

Presentation Outline

- *Preselection Considerations*
- *Electroacoustic Selection and Fitting*

Pediatric Hearing Instrument Selection and Fitting

- ***Preselection Considerations***

Hearing instrument features

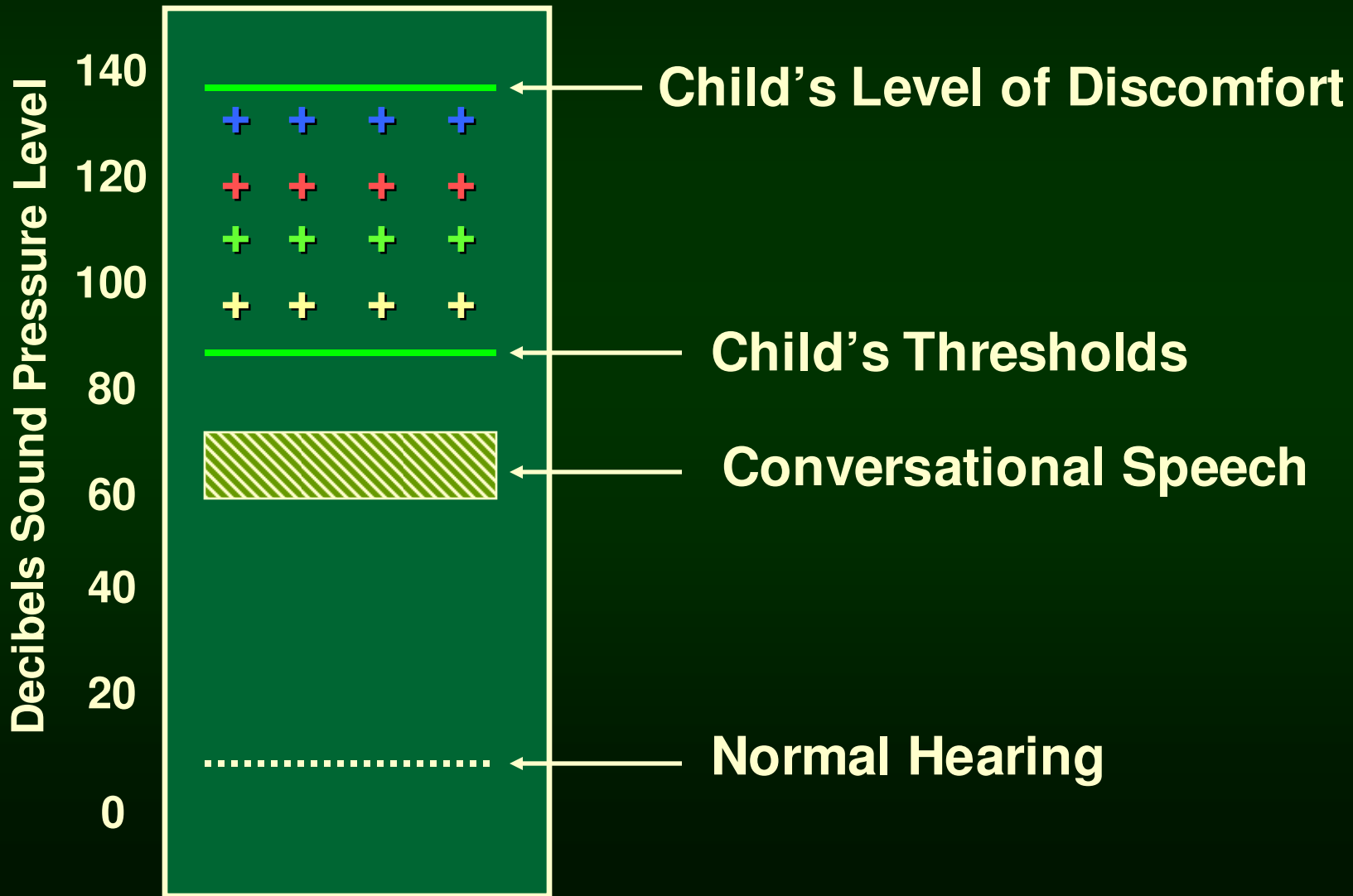
Physical characteristics:

- BTE casing
- Pediatric sized earhook
- Filter in earhook that provides a minimum of 6 dB of attenuation at 1000 Hz.
- Tamper-proof battery doors
- A system for locking the volume control
- Direct audio input

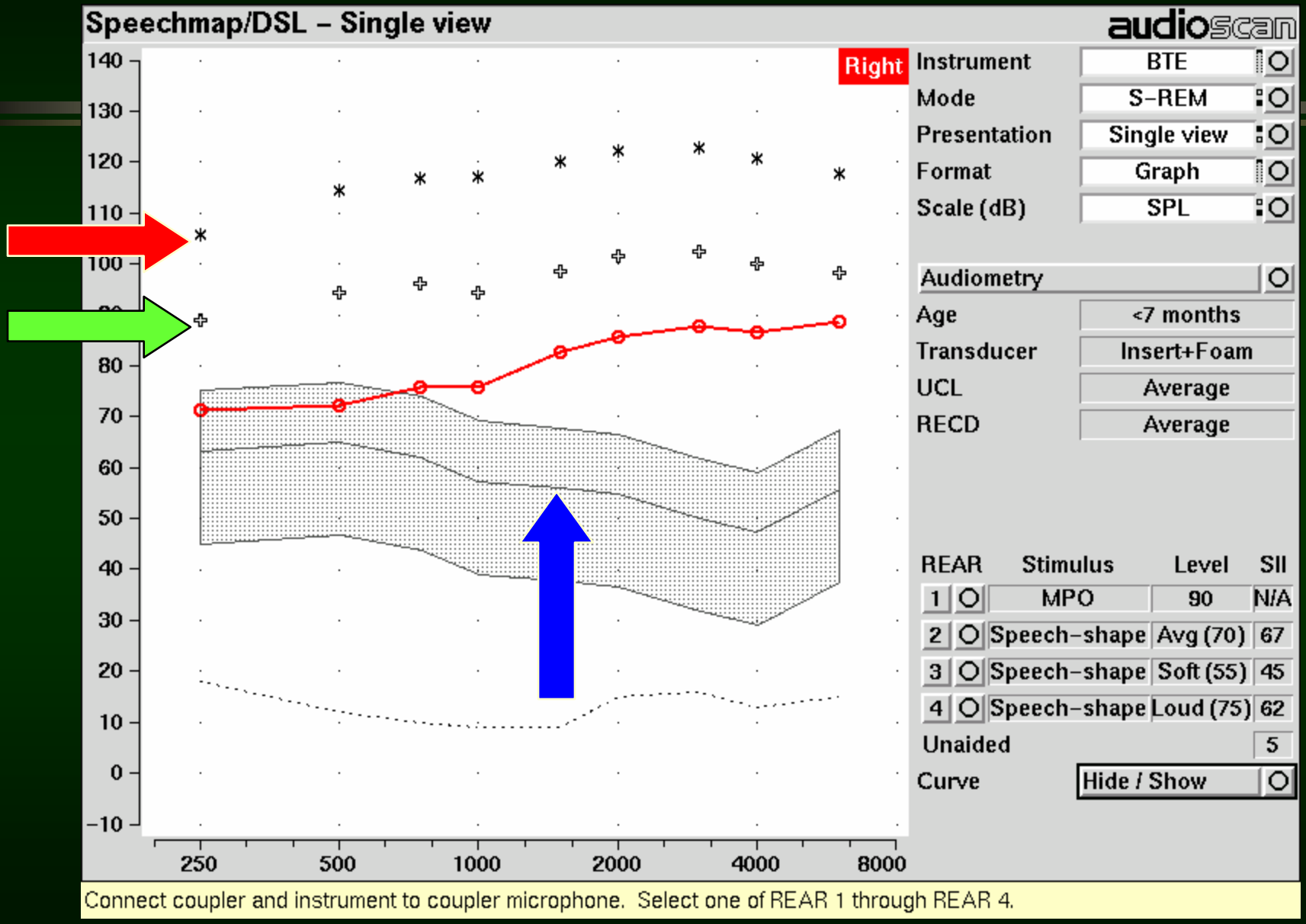
Pediatric Hearing Instrument Selection and Fitting

- *Electroacoustic Selection and Fitting*

The Electroacoustic-Based Approach to Fitting (from Erber 1973)

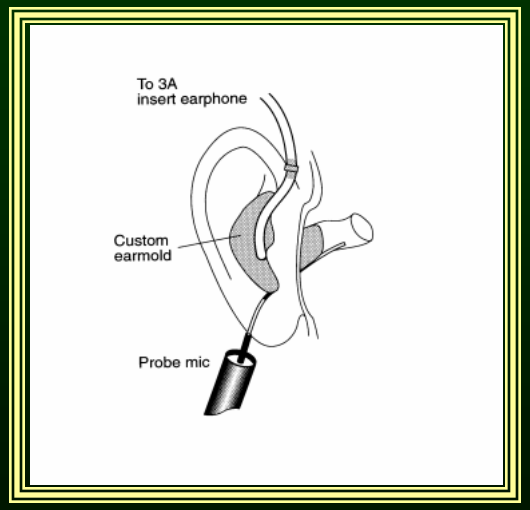


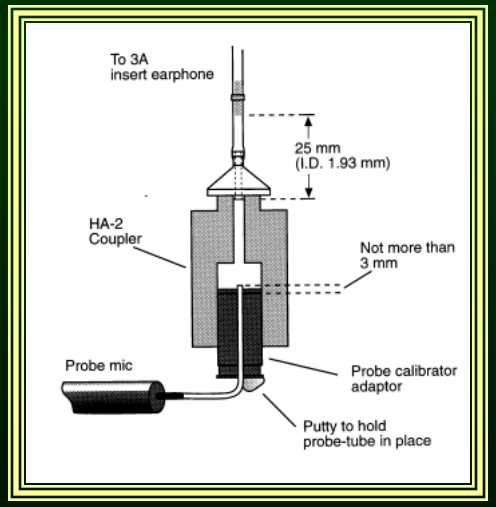
In the real-ear



From real-ear to coupler

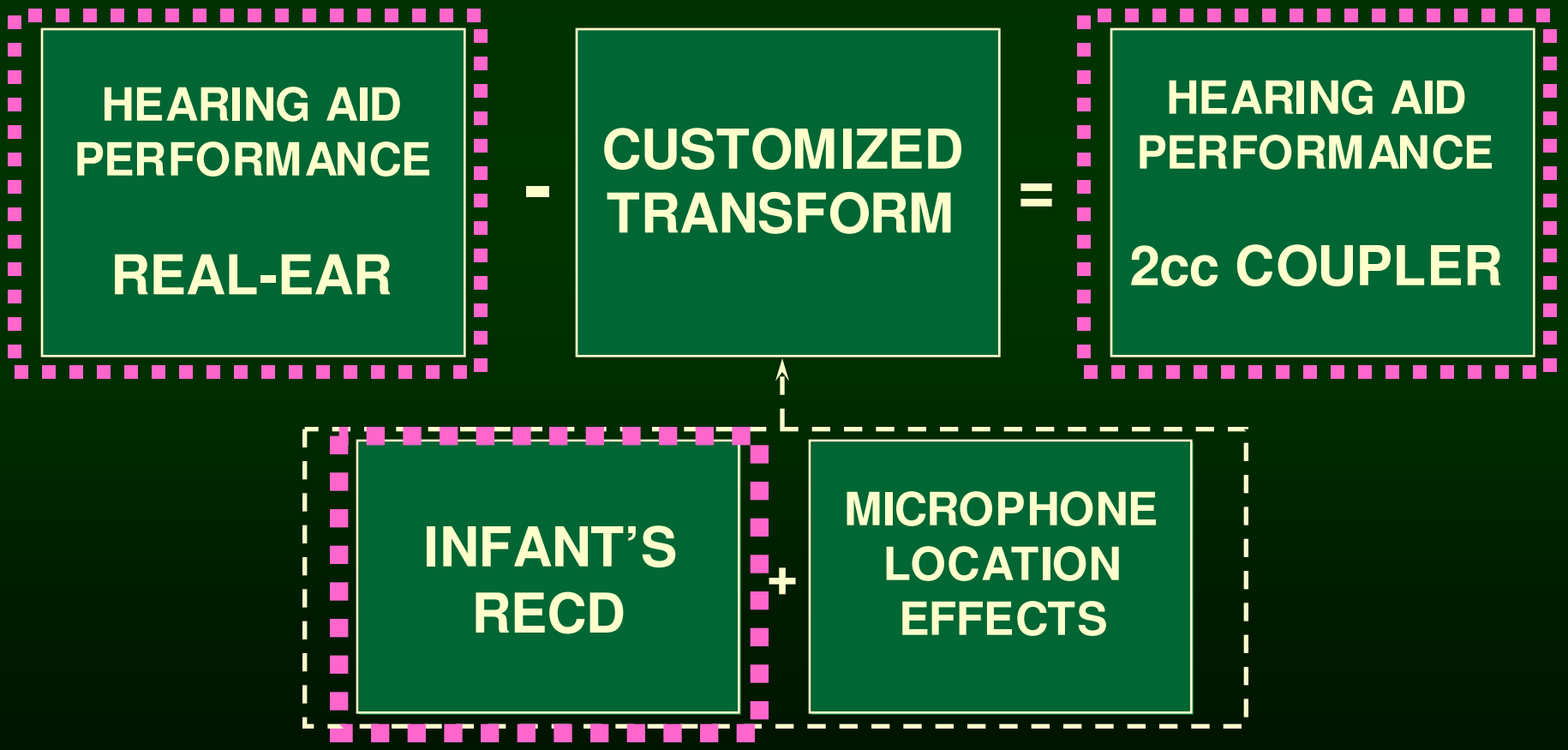
Real-ear → **Acoustic Transform** → **Coupler**



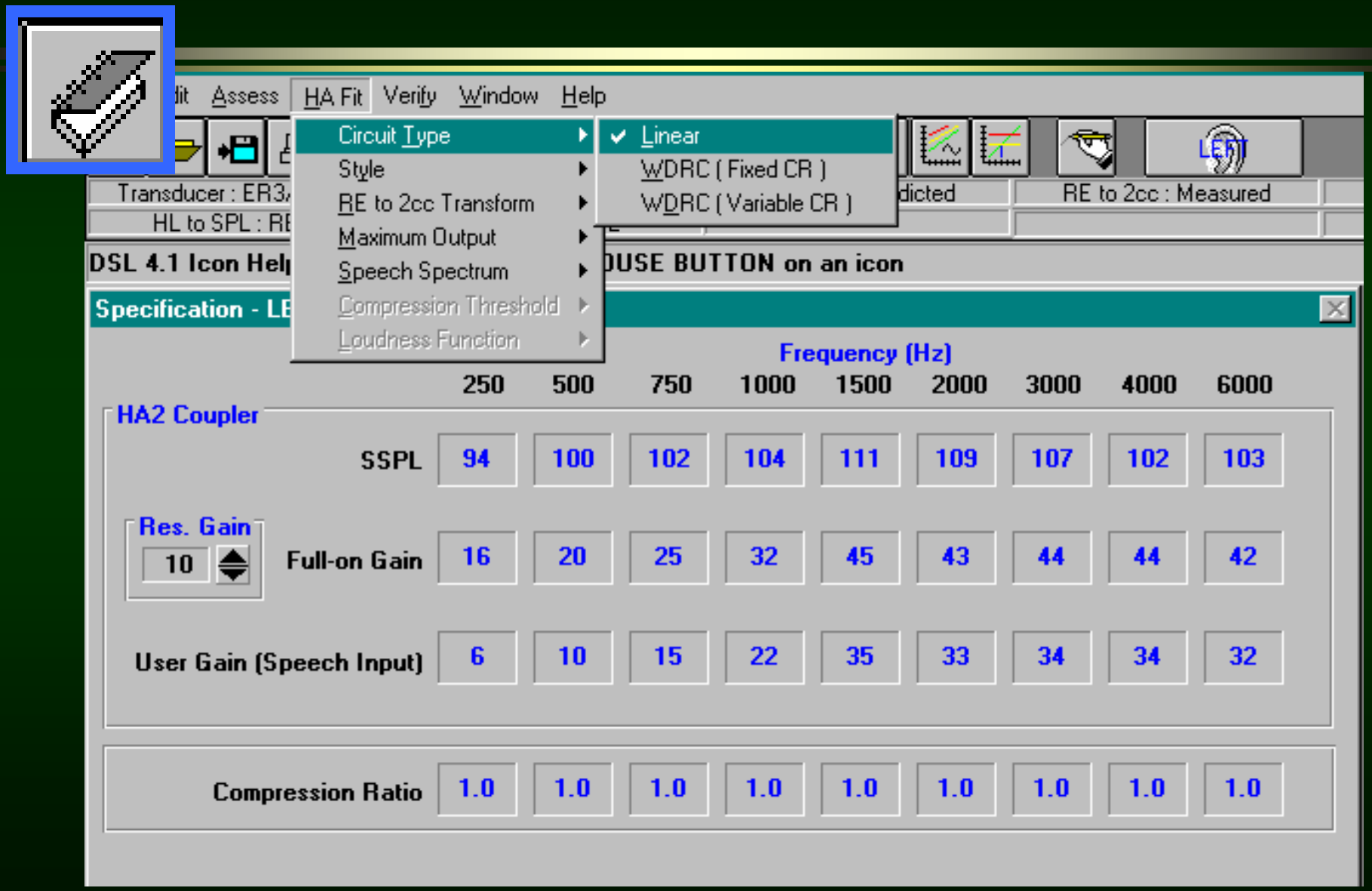


How are RECDs used??
In Hearing Instrument Fitting

To develop 2cc coupler performance targets



Specification Window



How well does this work???

Validation Studies

Preferred Listening Levels of Children who use Hearing Aids: Comparison to Prescriptive Targets

Scollie, Seewald, Moodie and Dekok

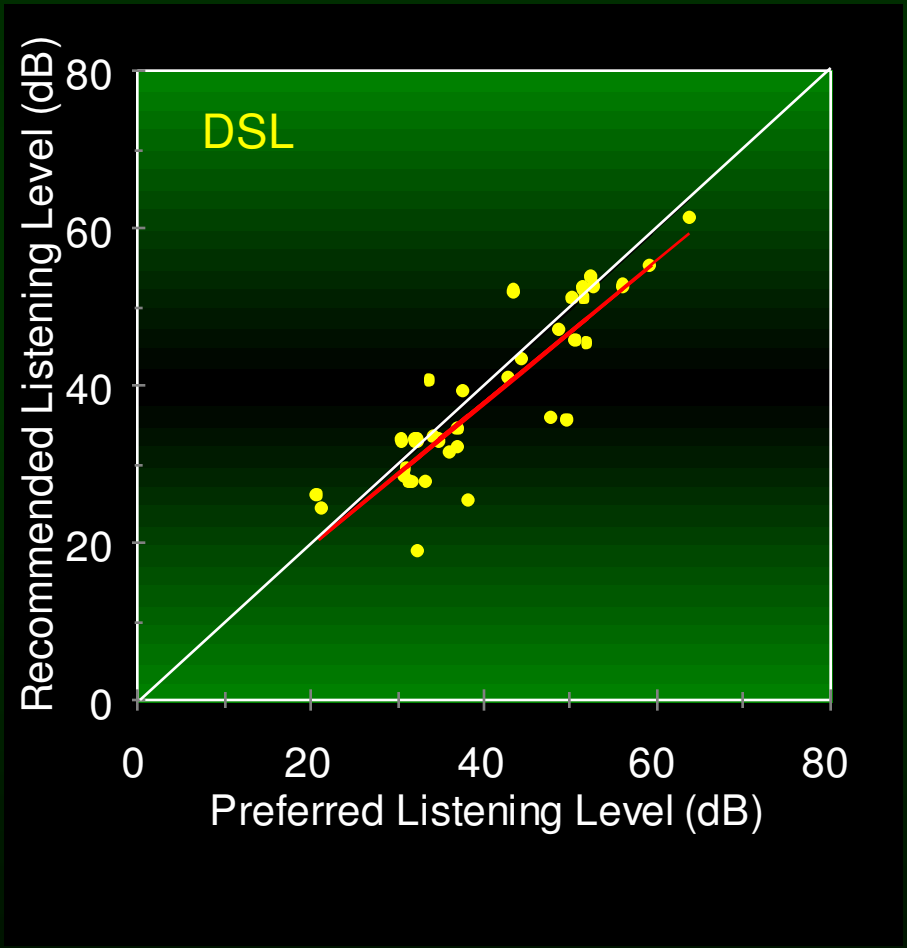
JAAA 2000

Scollie et al. (2000)

- **N = 18 Mean age = 10 years**
  Mild to Profound SN hearing loss
- **The subjects listened to average conversational speech and adjusted their VC to the level they preferred.**
- **The subjects preferred VC setting, for an average speech input, was compared to DSL prescribed settings.**

Preferred Listening Levels in Children

PLL / DSL Comparison

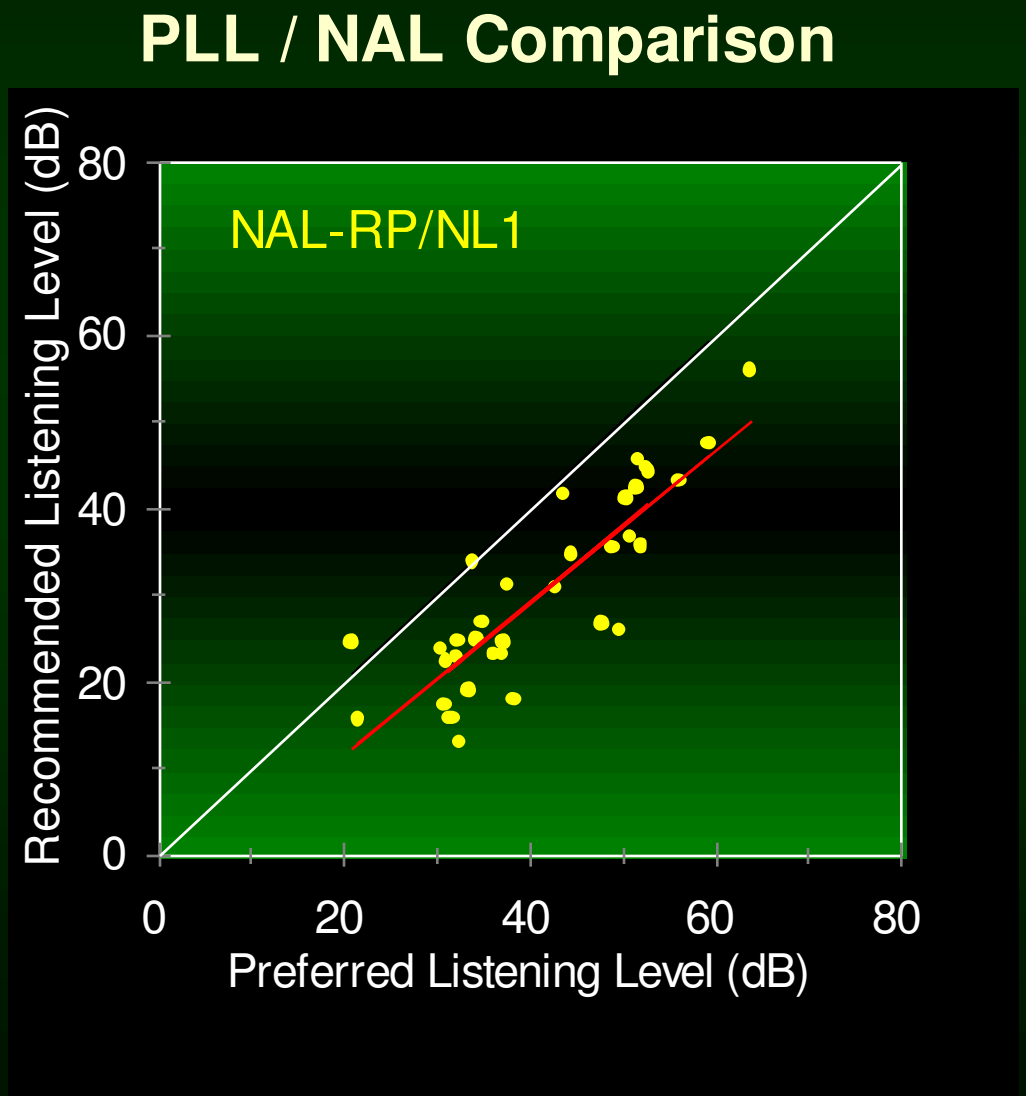


Preferred Listening Levels in Children

PLL / DSL Comparison

- On average, the children's preferred listening level was 2 dB above the DSL v4.1 prescribed setting.

Preferred Listening Levels in Children

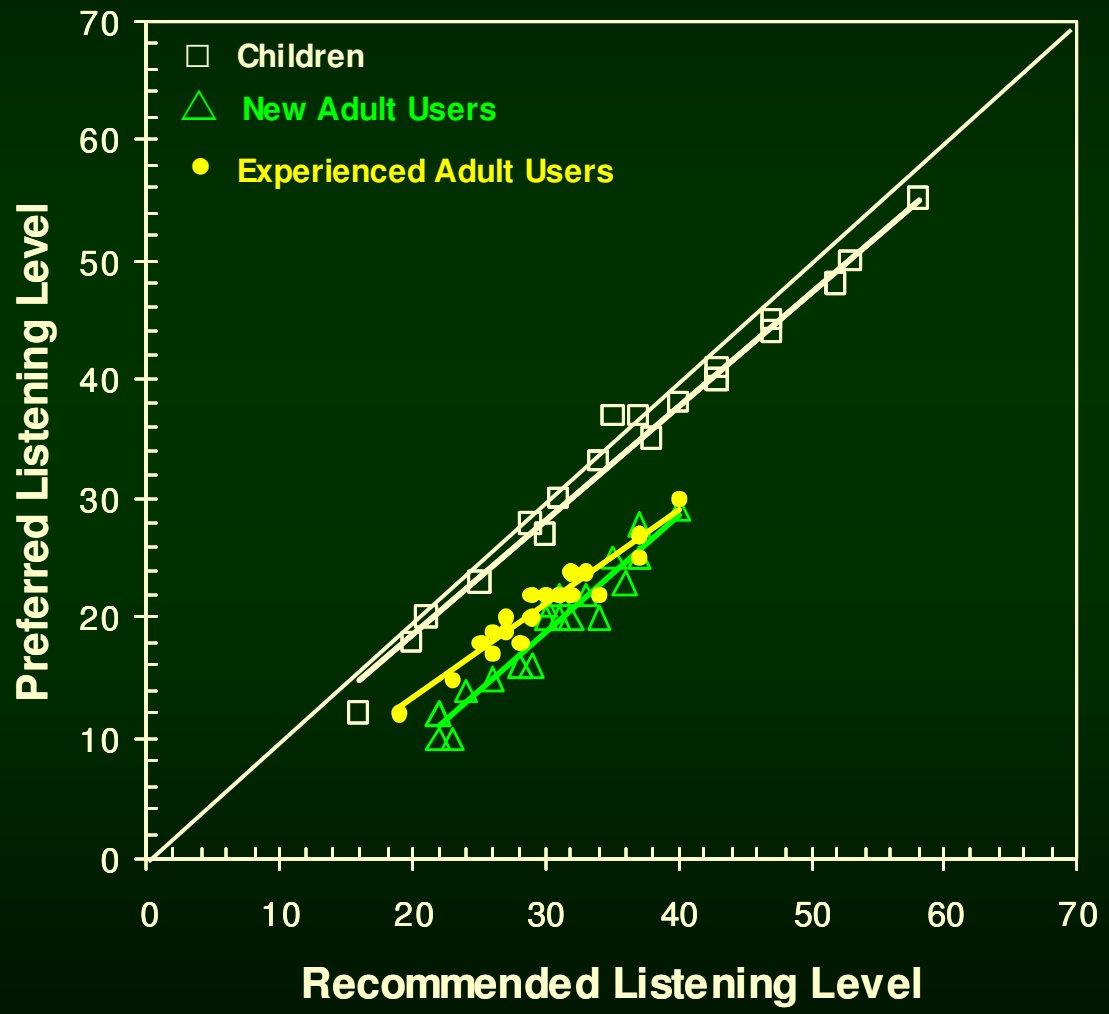


Preferred Listening Levels in Children

PLL / NAL Comparison

- On average, the NAL prescribed setting was 11 dB lower than the subject's PLLs
- The PLLs were within 5 dB of the NAL prescribed settings for 9% of the subjects

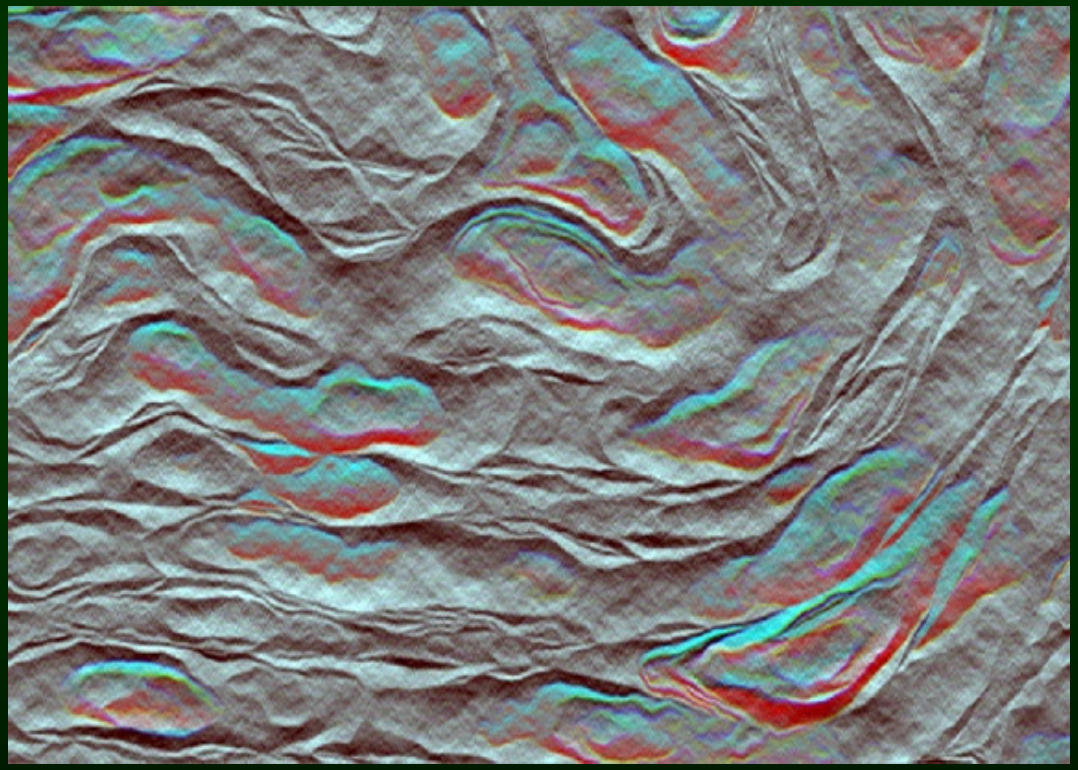
Adult/Child Preferred Listening Levels



Scollie, Cornelisse, Seewald, Moodie, Bagatto, Laurnagaray, Beaulac & Pumford (2005)

DSL is just about right!

A New Wrinkle



A new wrinkle . . . .

Thresholds
in
dB HL or dB nHL

“Quick Fit”
In
Manufacturer’s Software

A Question . . .

How similar are proprietary algorithms for fitting infants and young children ?

A Study

- Instruments from five “pediatric friendly” manufacturers programmed using the proprietary algorithm

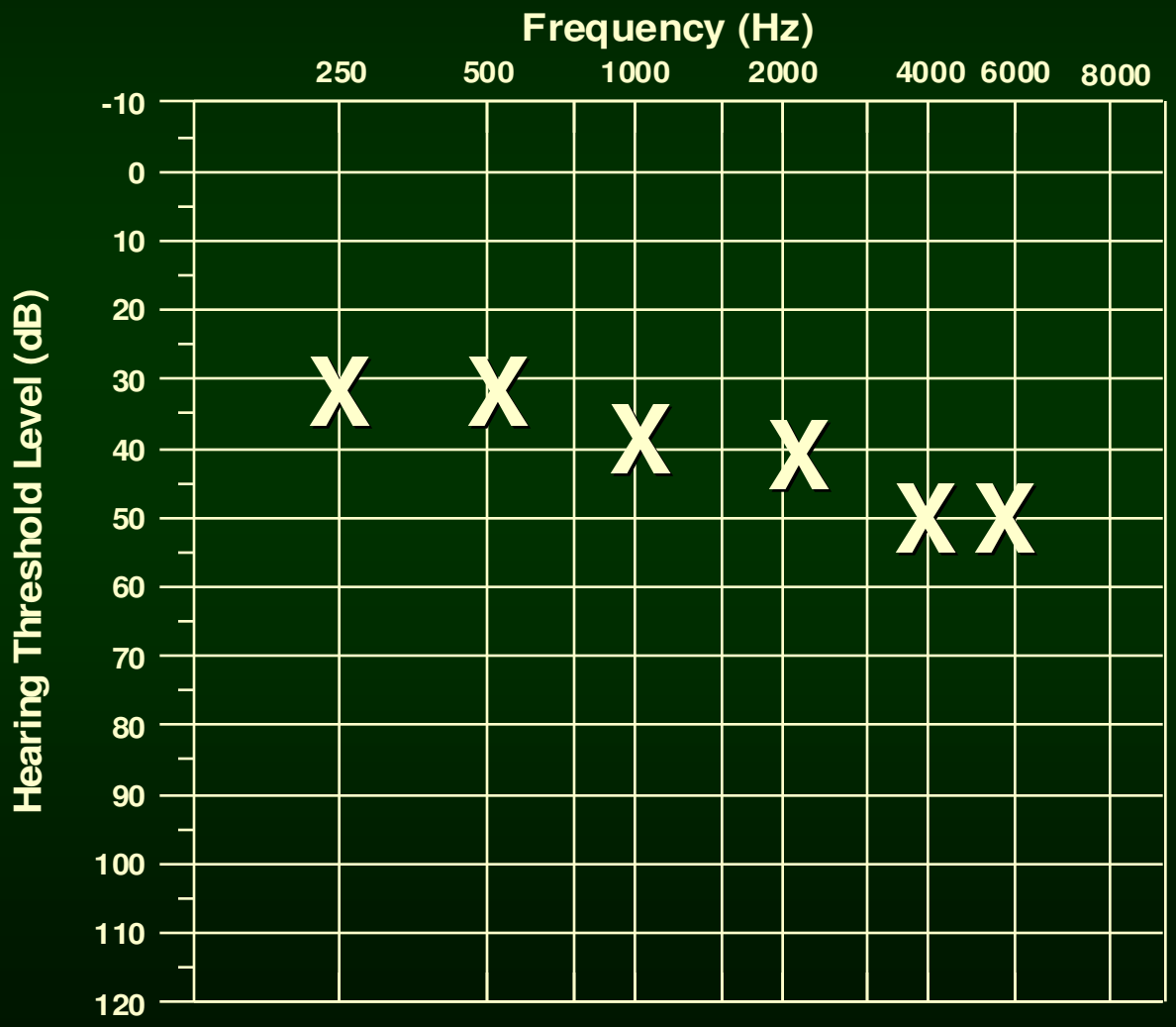
- Nine different audiograms were used (mild through profound)

- Average RECD for a 6 month old applied

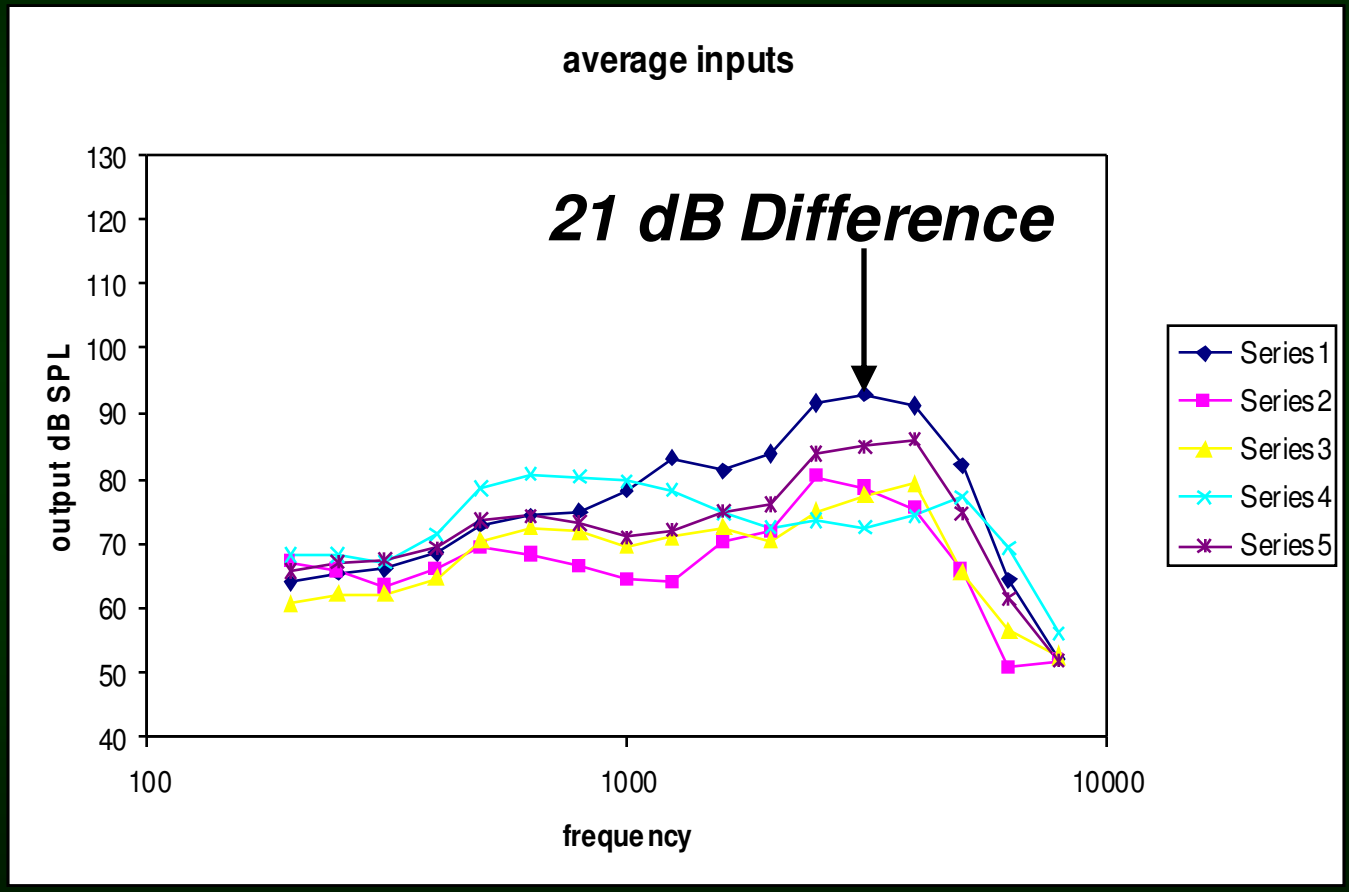
A Study

- Simulated real-ear hearing instrument performance was measured for :
  - soft speech
  - average speech
  - loud speech
  - output limiting

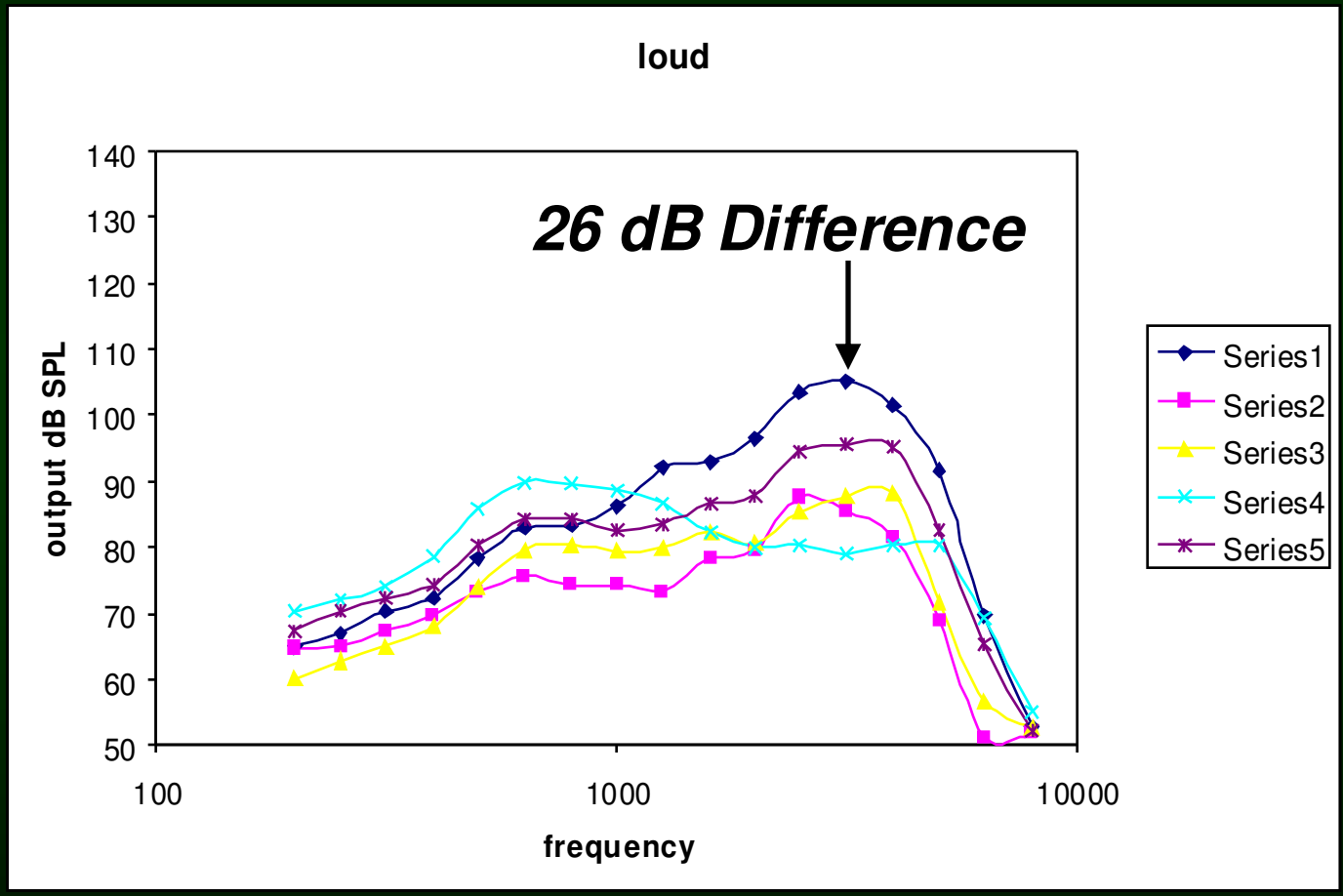
Sample Findings



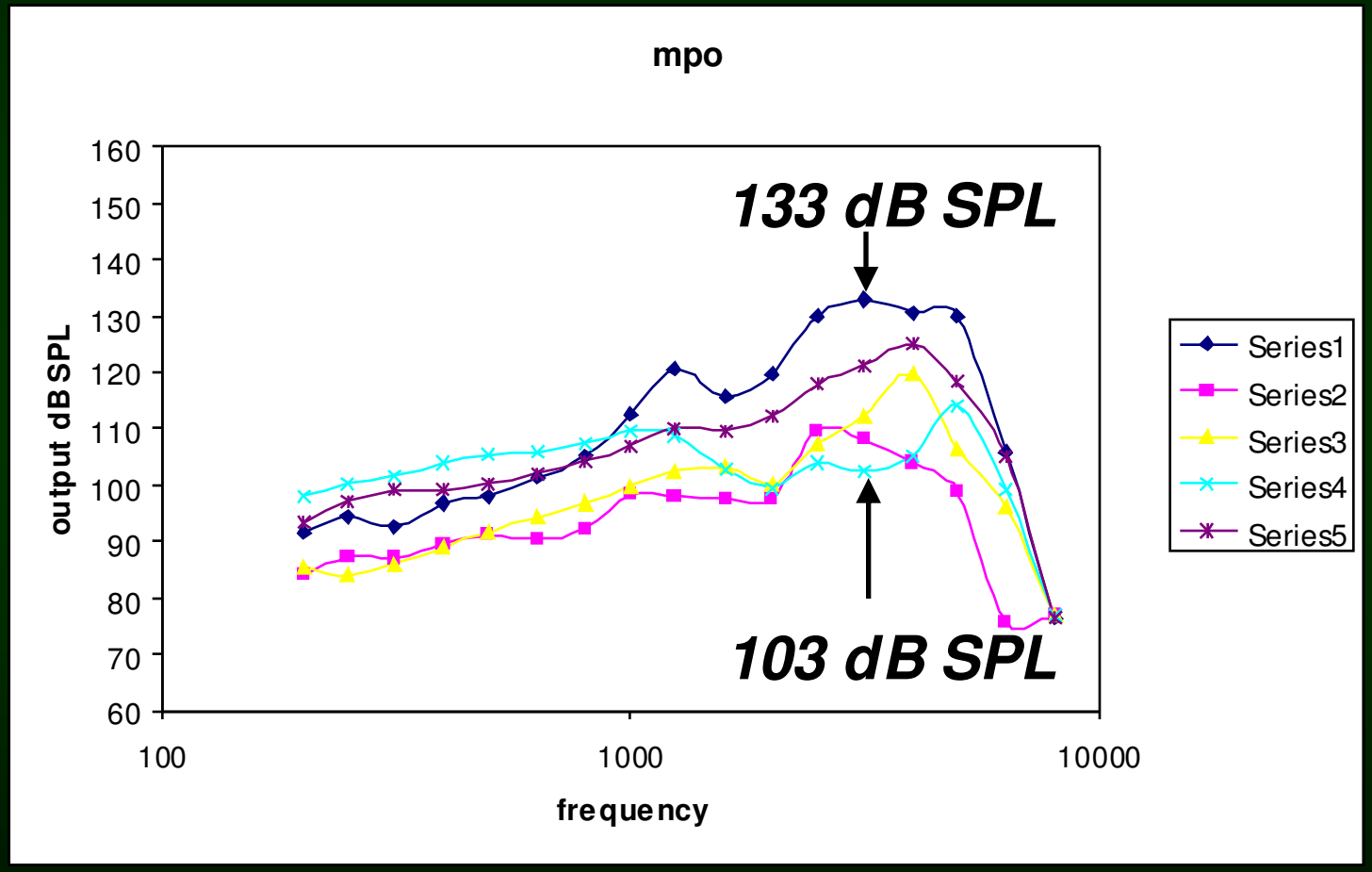
Sample Findings: Average Speech Input

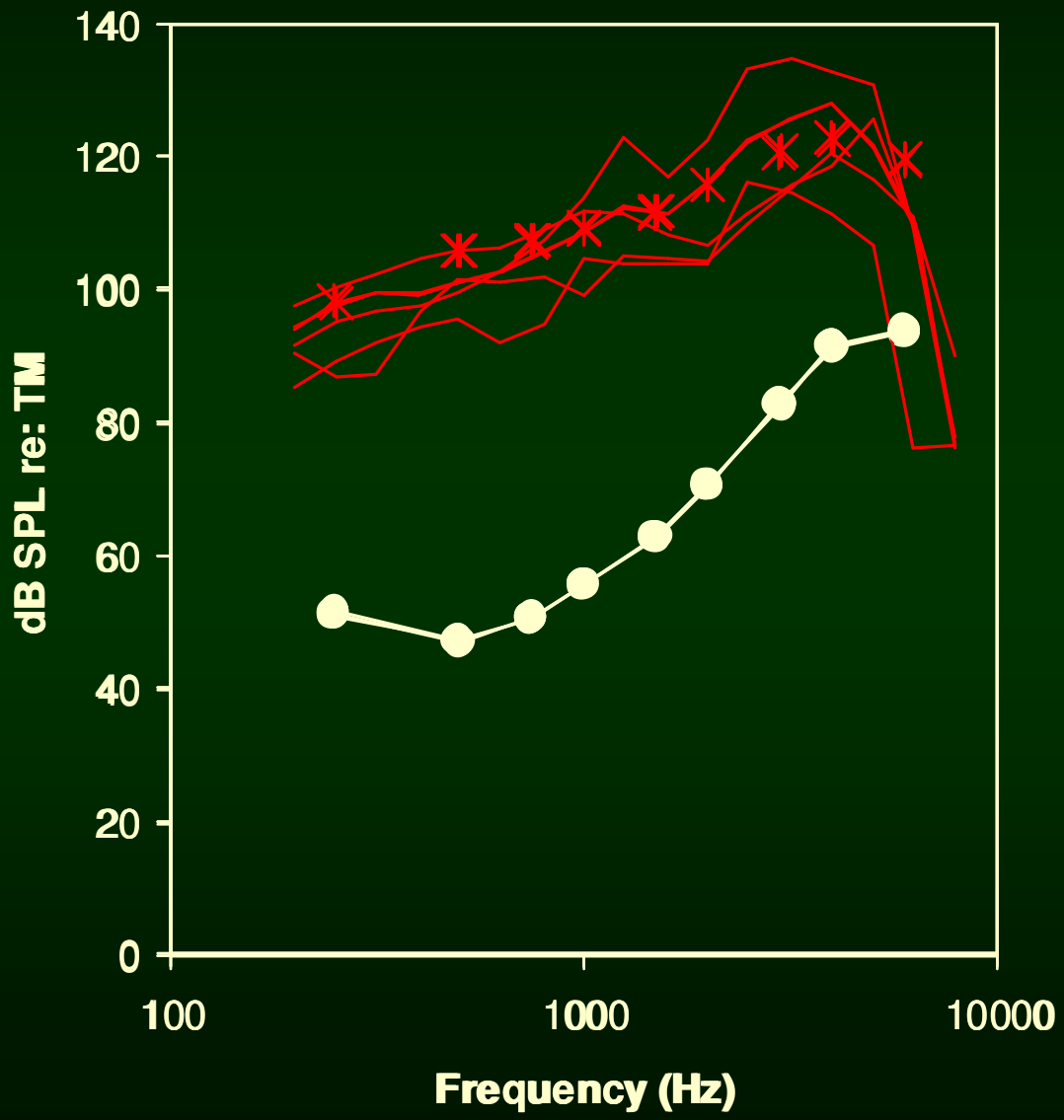


Sample Findings: Loud Speech Input



Sample Findings: Output Limiting Levels




140
120
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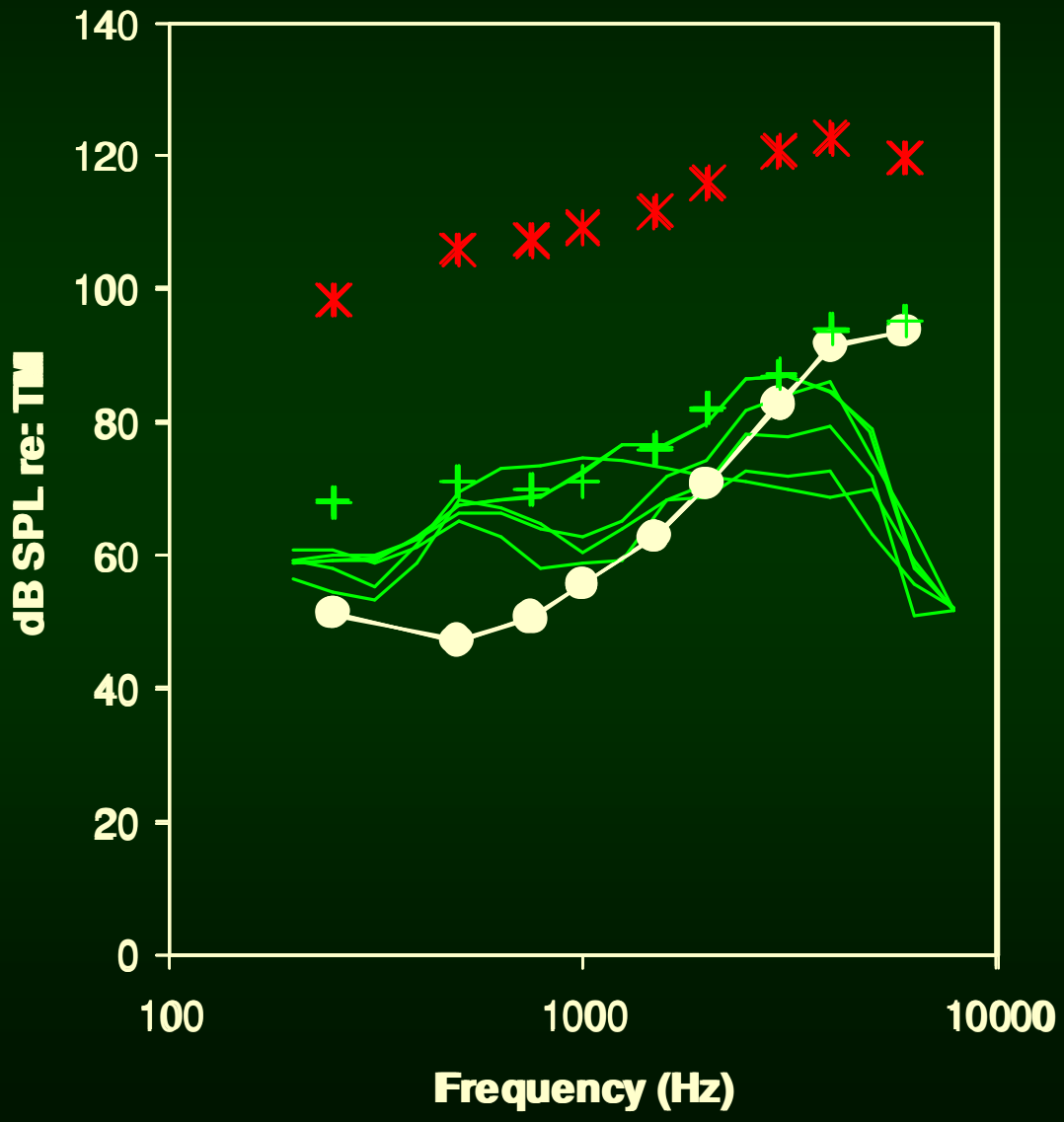
20
0
dB SPL re: TM
100
1000
10000
Frequency (Hz)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dB SPL re: T
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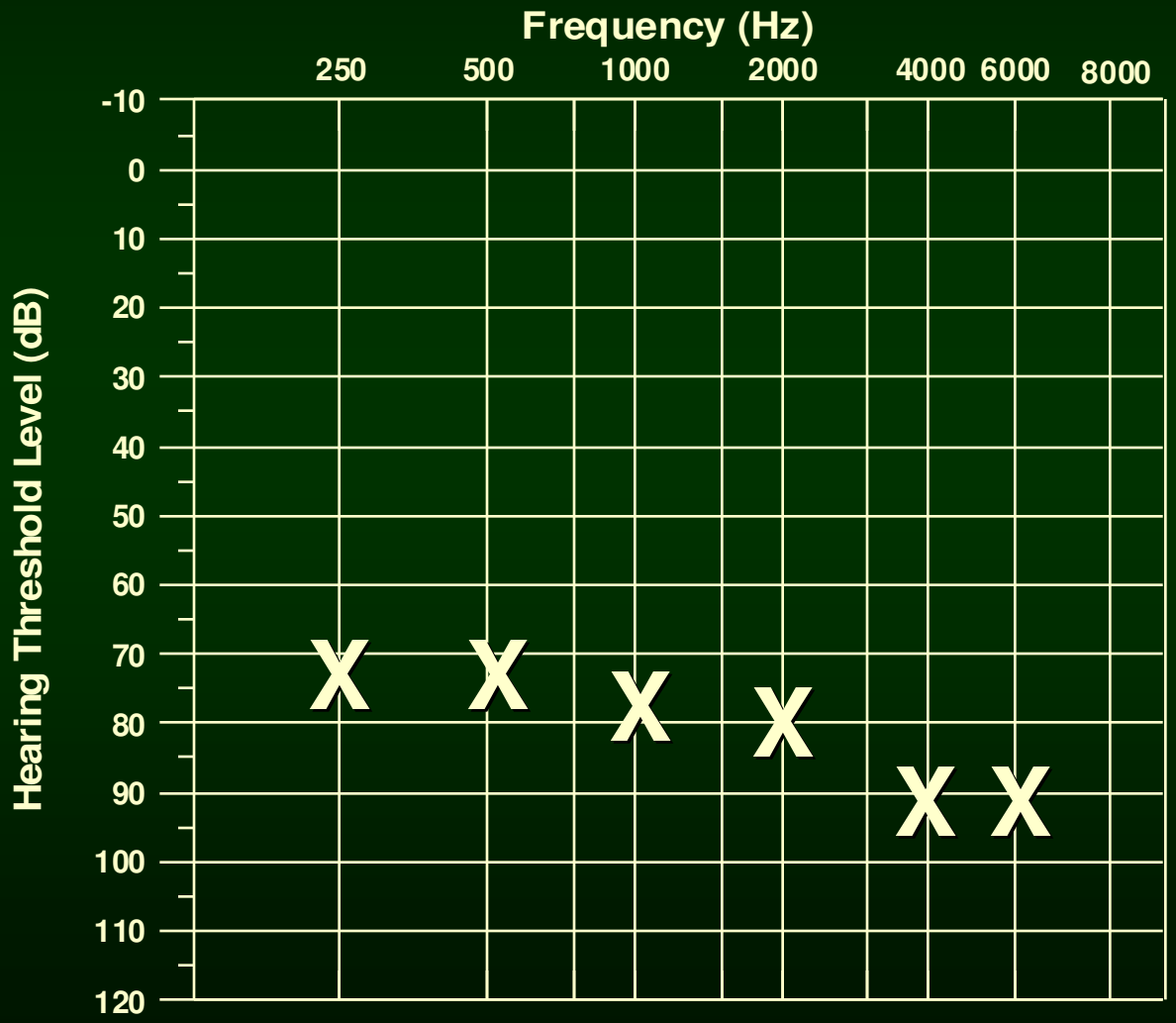
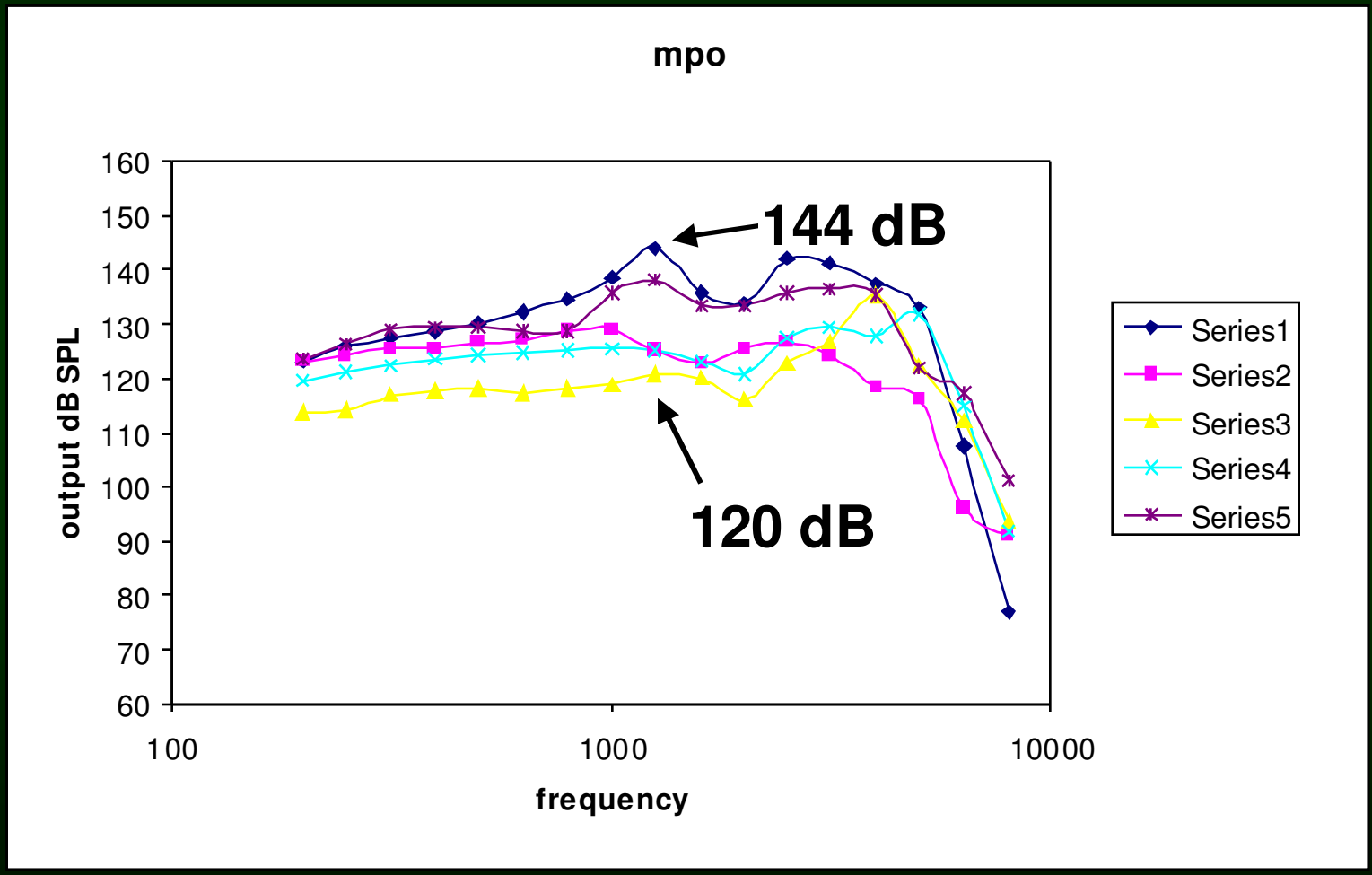
Frequency (Hz)

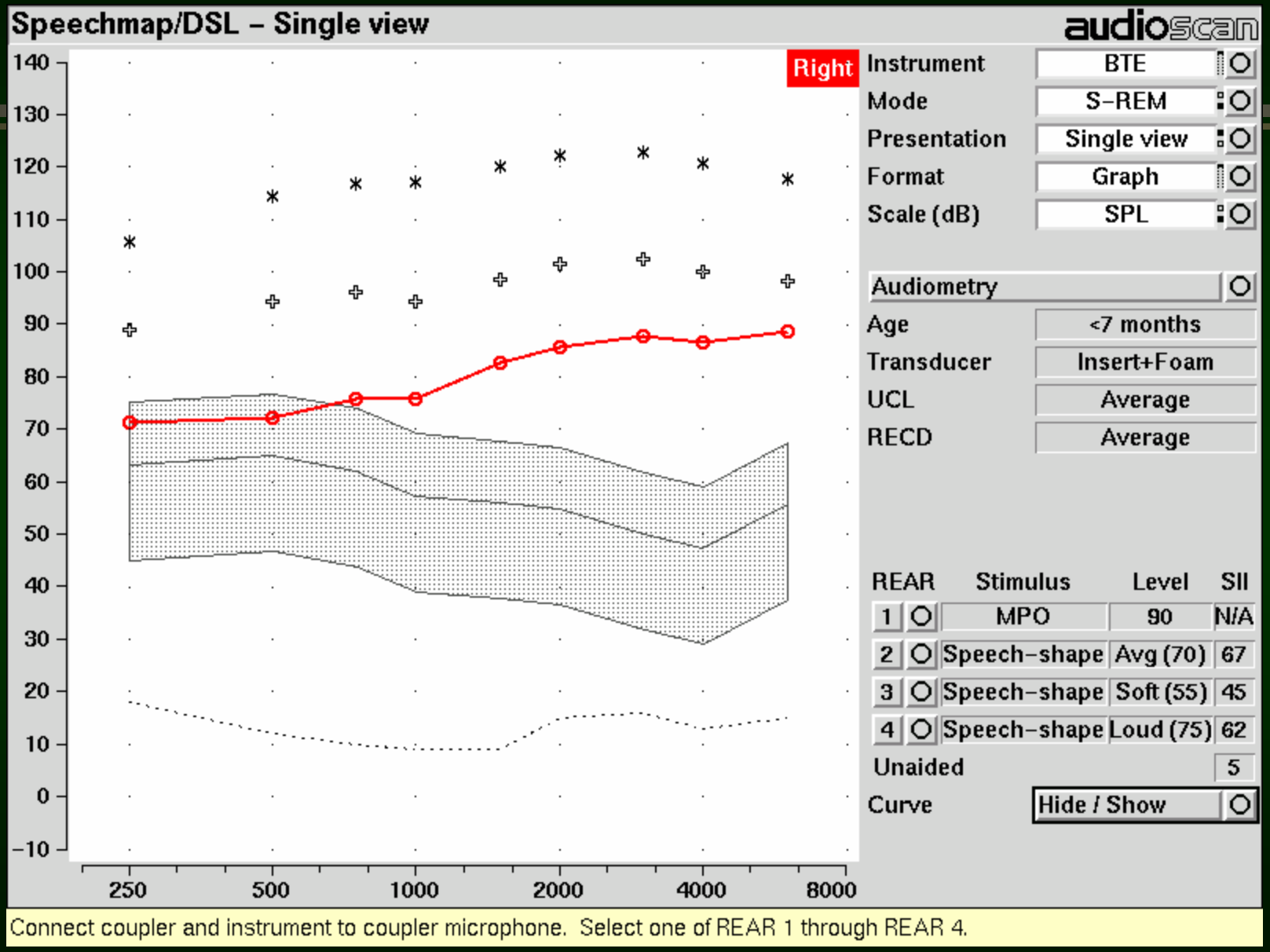
Sample Findings



Sample Findings: Output Limiting Levels



Endpoint: Electroacoustic Selection



The Fitting Process

ASSESSMENT

SELECTION AND FITTING

VERIFICATION

VALIDATION

What we want to know

That we have achieved a good match between the amplification characteristics of hearing instruments and the auditory characteristics of infants and children so that *the use of residual auditory capacity can be maximized.*

Verification: Measurement Options

I. Behavioral

Sound Field Aided Thresholds

II. Electroacoustic

A. Real-ear Measures

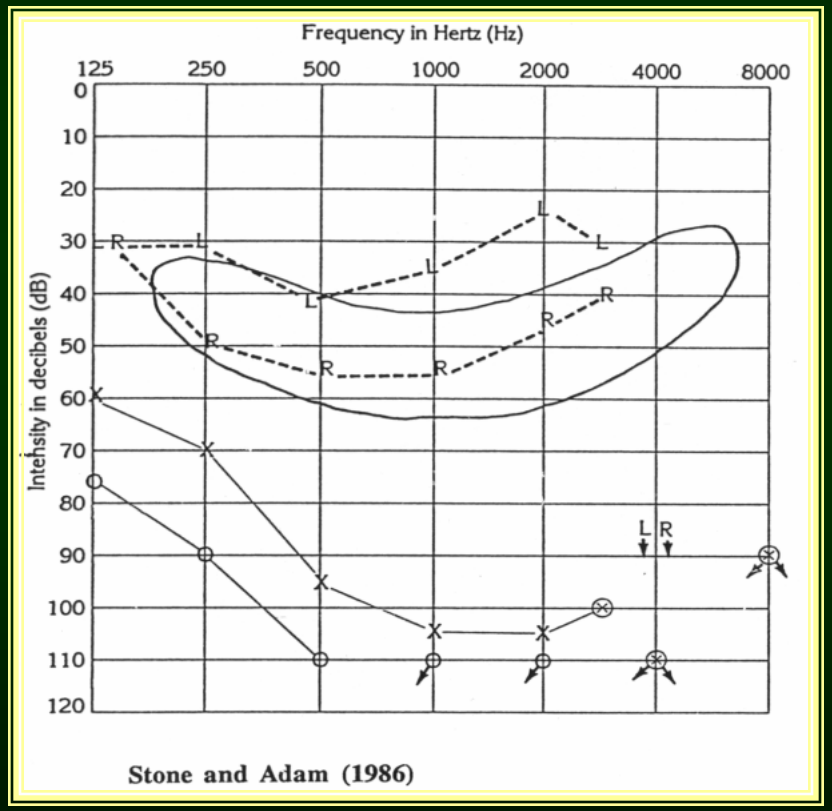
1. REIR
2. REAR x Input Level
3. RESR

B. Simulated Real-ear (coupler-based + RECD)

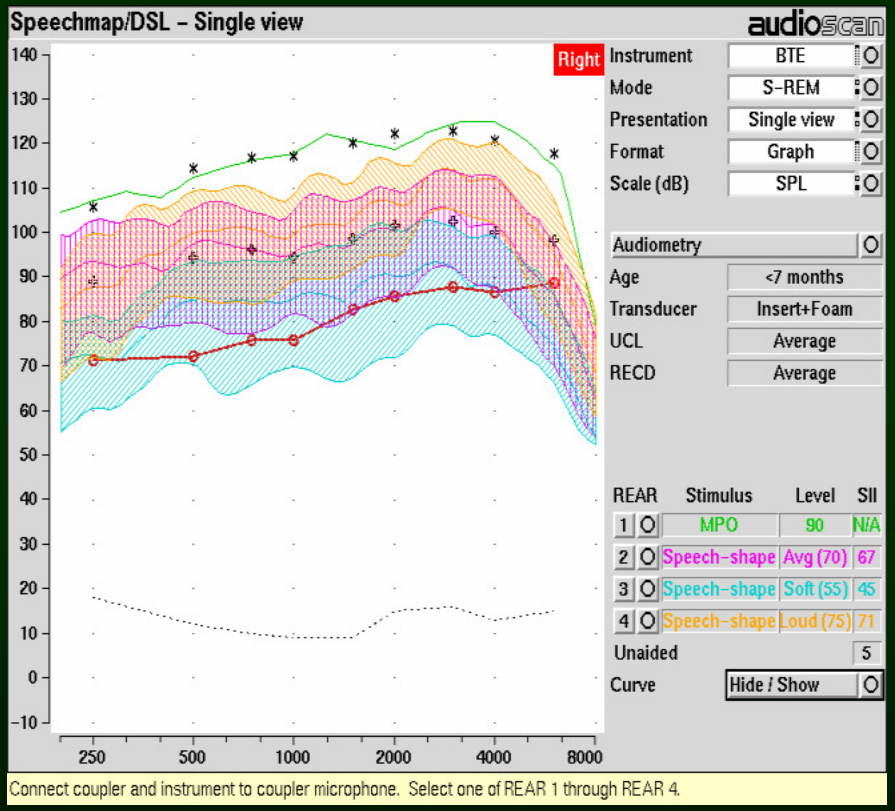
1. Predicted REAR x Input Level
2. Predicted RESR

Verification: Measurement Options

Behavioral Measures



Electroacoustic Measures



Verification: Measurement Options

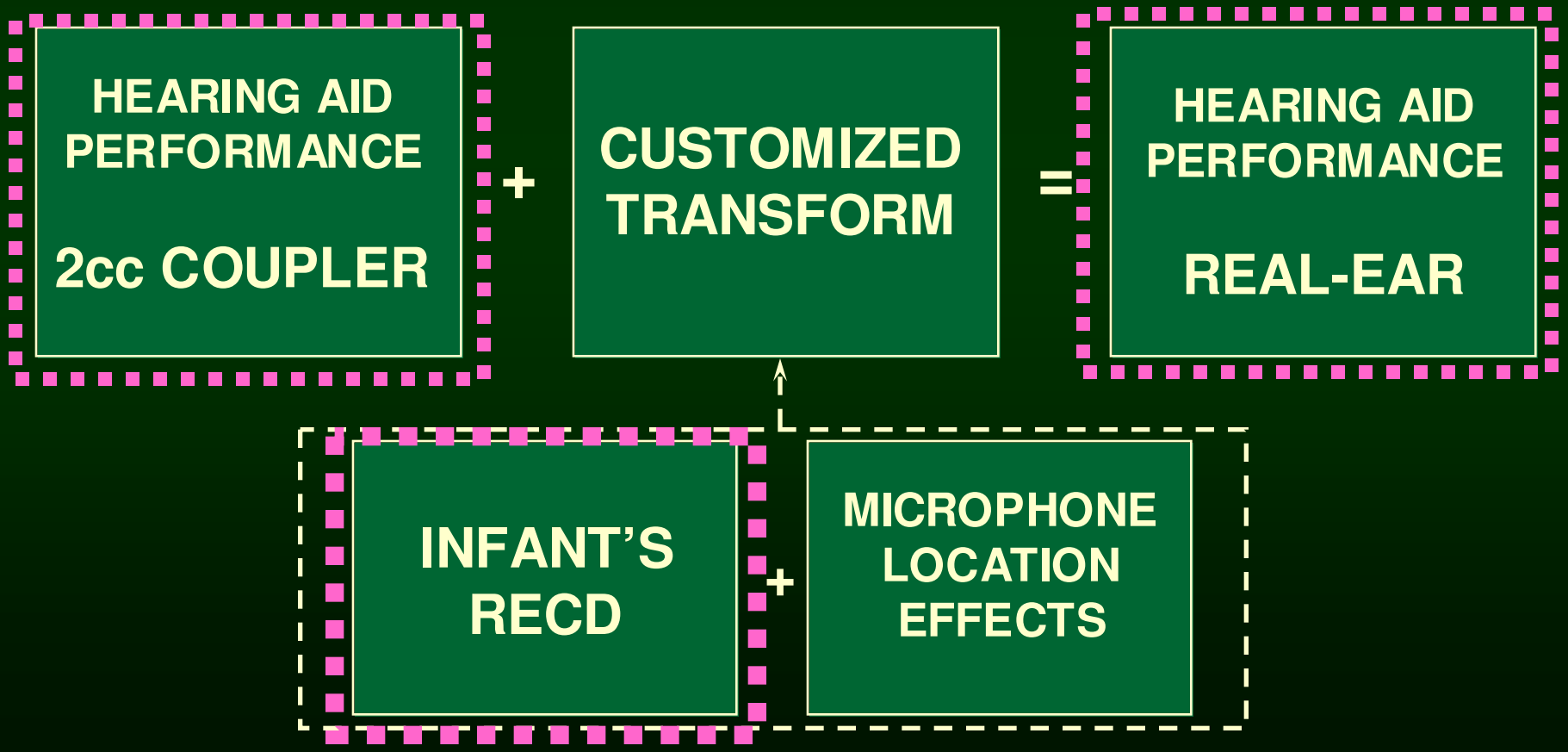
I. Behavioral
   Sound Field Aided Thresholds

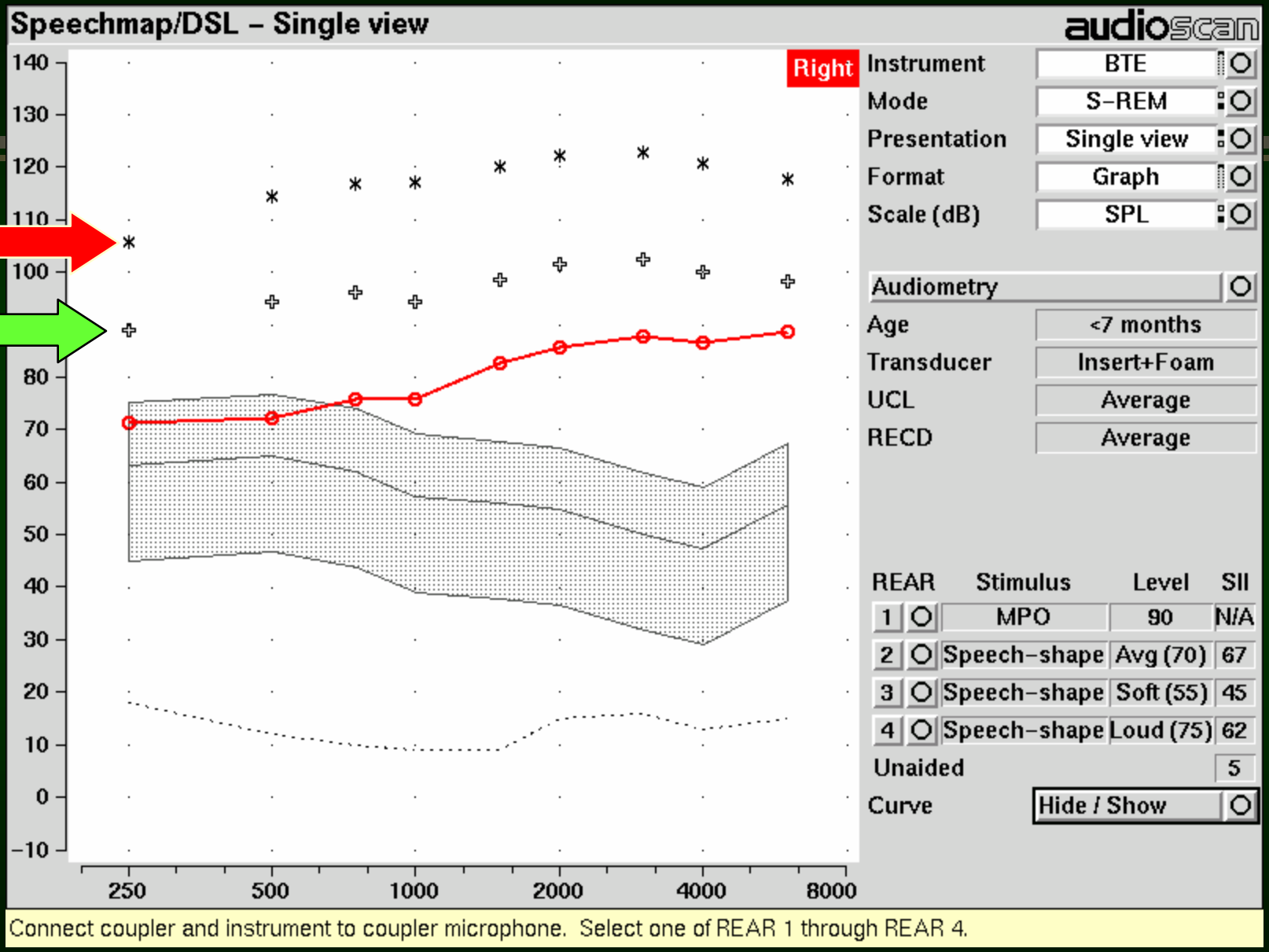
II. Electroacoustic
   A. Real-ear Measures
      1. REIR
      2. REAR x Input Level
      3. RESR

   B. Simulated Real-ear (coupler-based + RECD)
      1. Simulated REAR x Input Level
      2. Simulated RESR

How are RECDs used??
In Hearing Instrument Fitting

To predict real-ear hearing aid performance




Speechmap/DSL – Single view
audioscan
Right
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120
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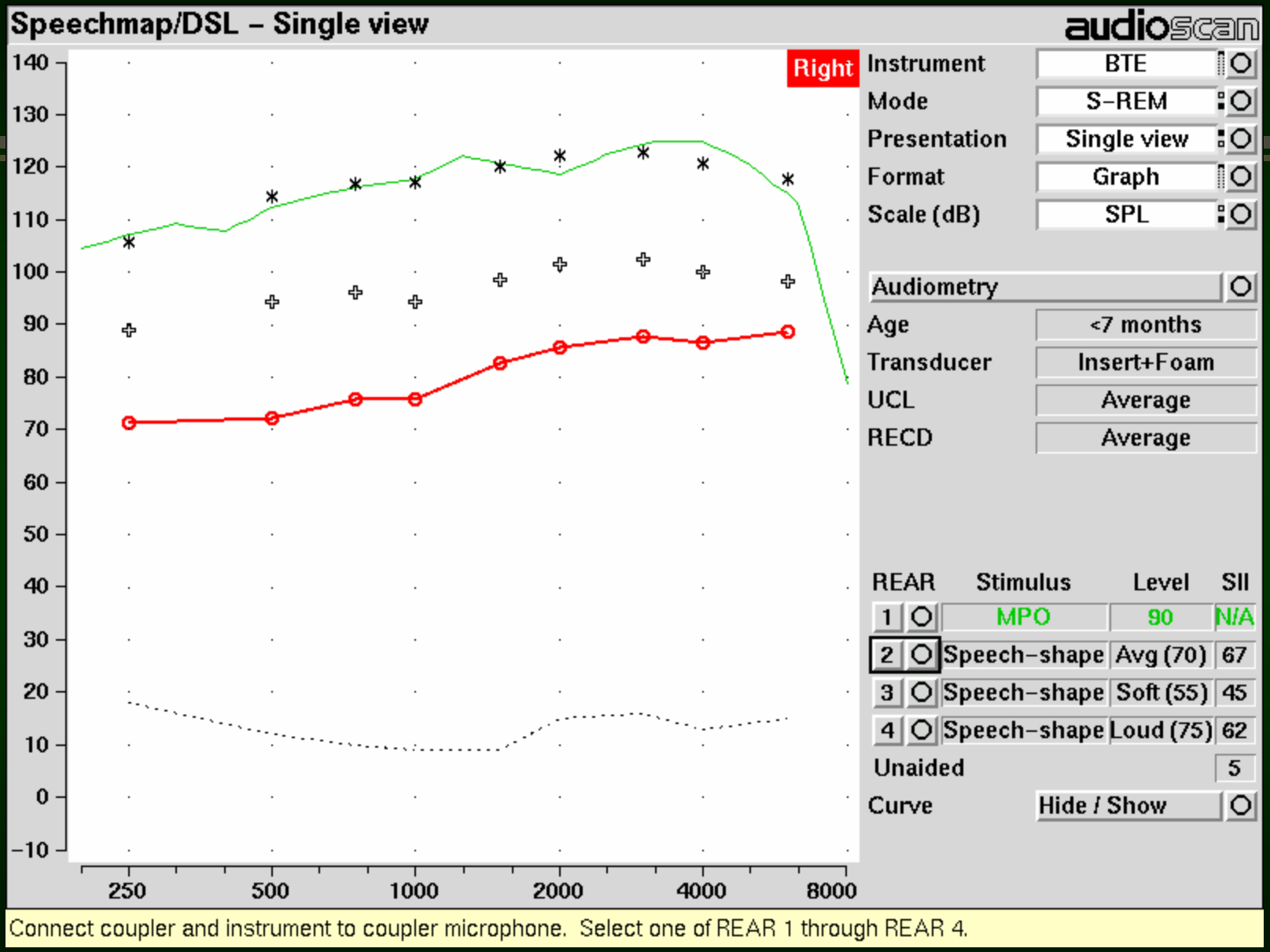
8000
Instrument
BTE
Mode
S-REM
Presentation
Single view
Format
Graph
Scale (dB)
SPL
Audiometry
Age
<7 months
Transducer
Insert+Foam
UCL
Average
RECD
Average
REAR
Stimulus
Level
SII
1
MPO
90
N/A
2
Speech-shape
Avg (70)
67
3
Speech-shape
Soft (55)
45
4
Speech-shape
Loud (75)
62
Unaided
5
Curve
Hide / Show
Connect coupler and instrument to coupler microphone. Select one of REAR 1 through REAR 4.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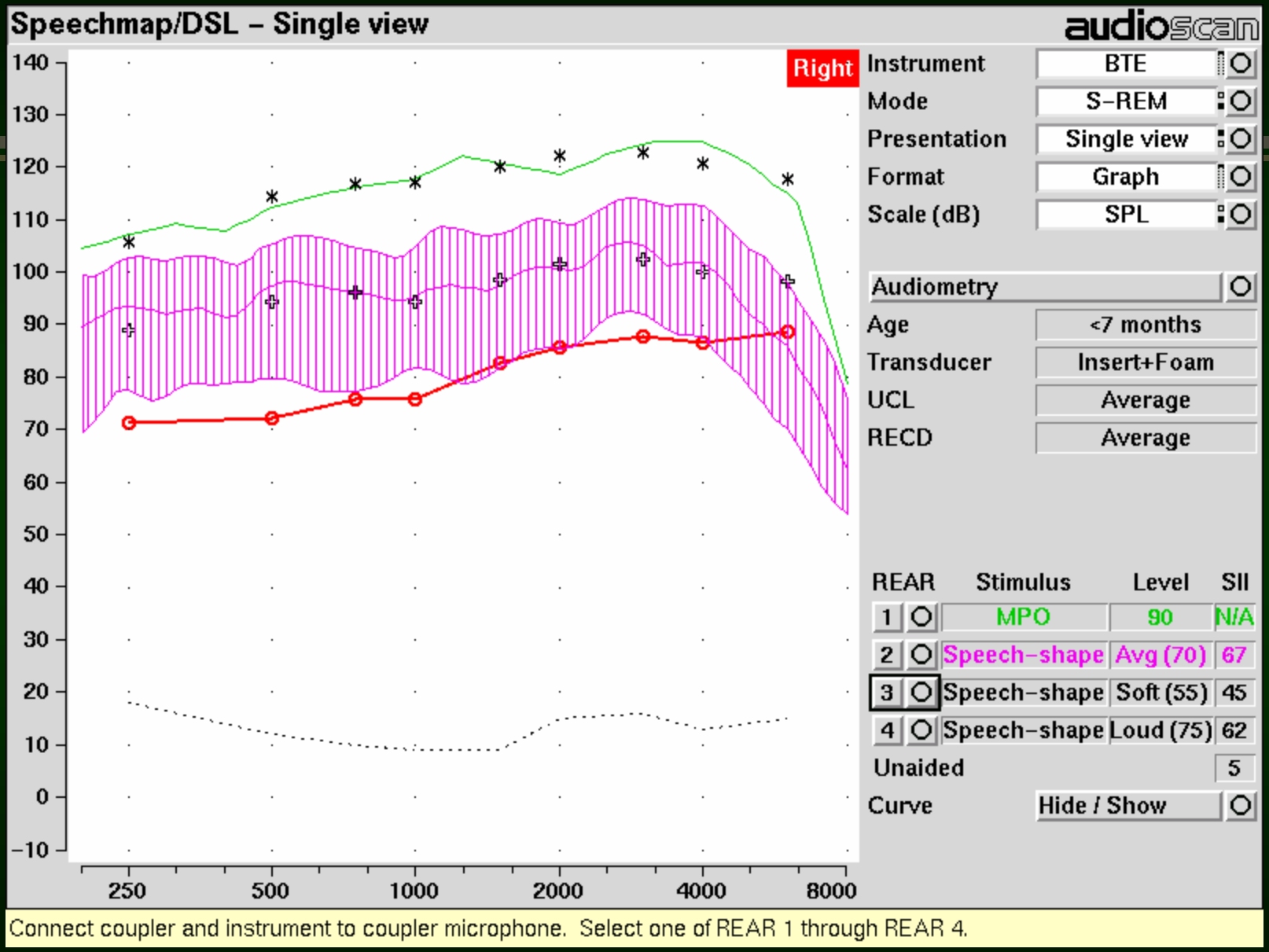
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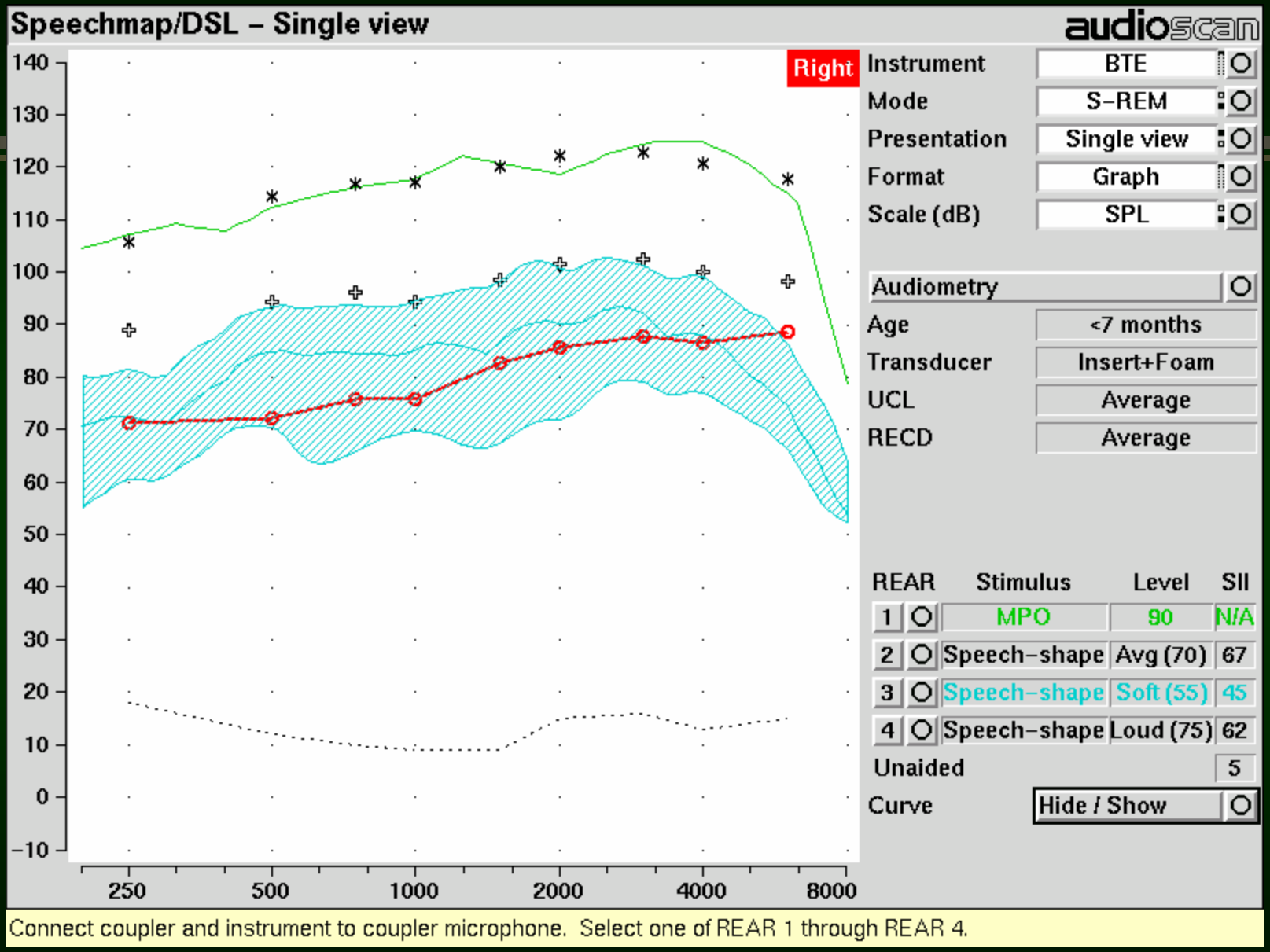
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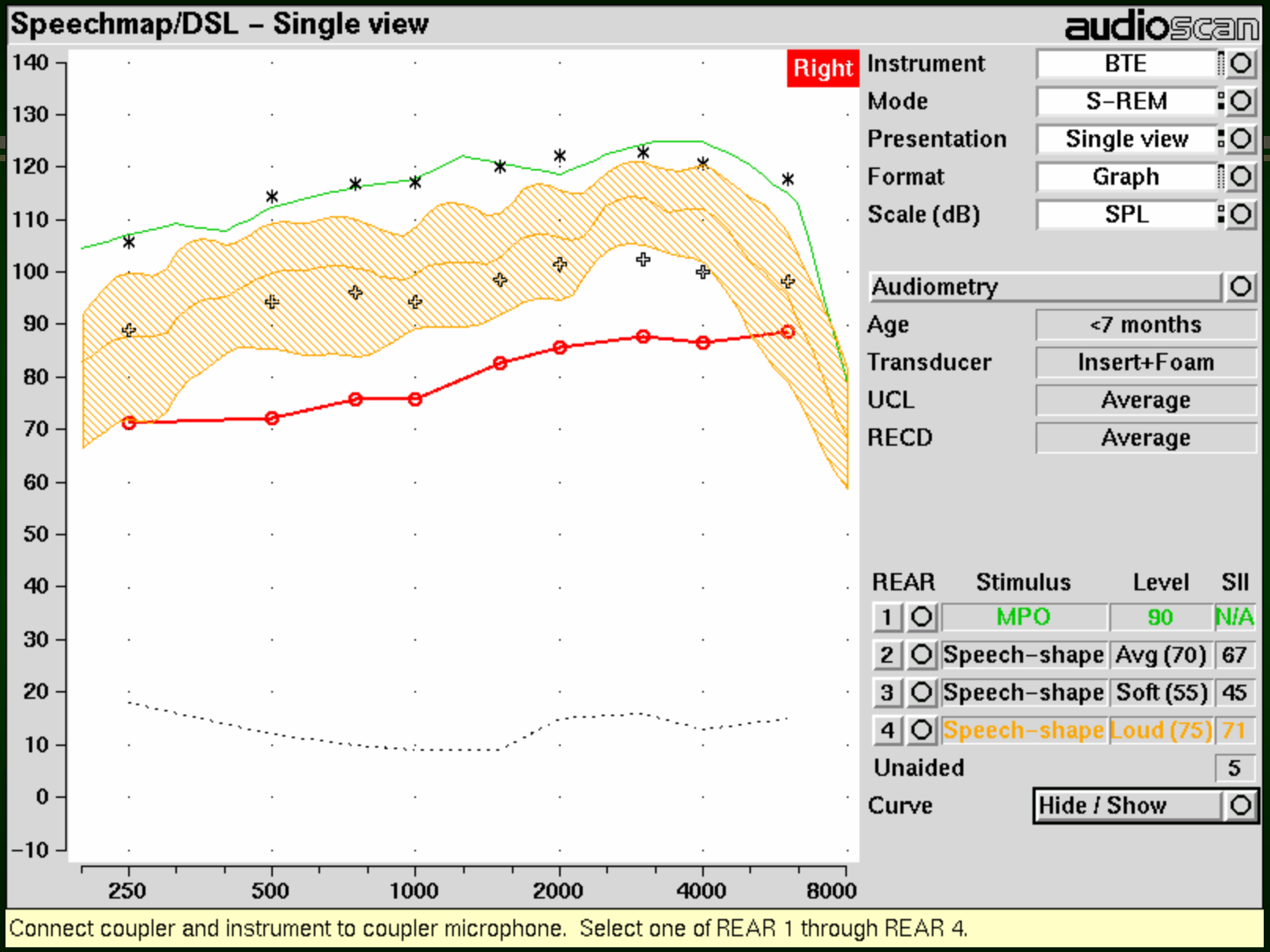
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Unaided
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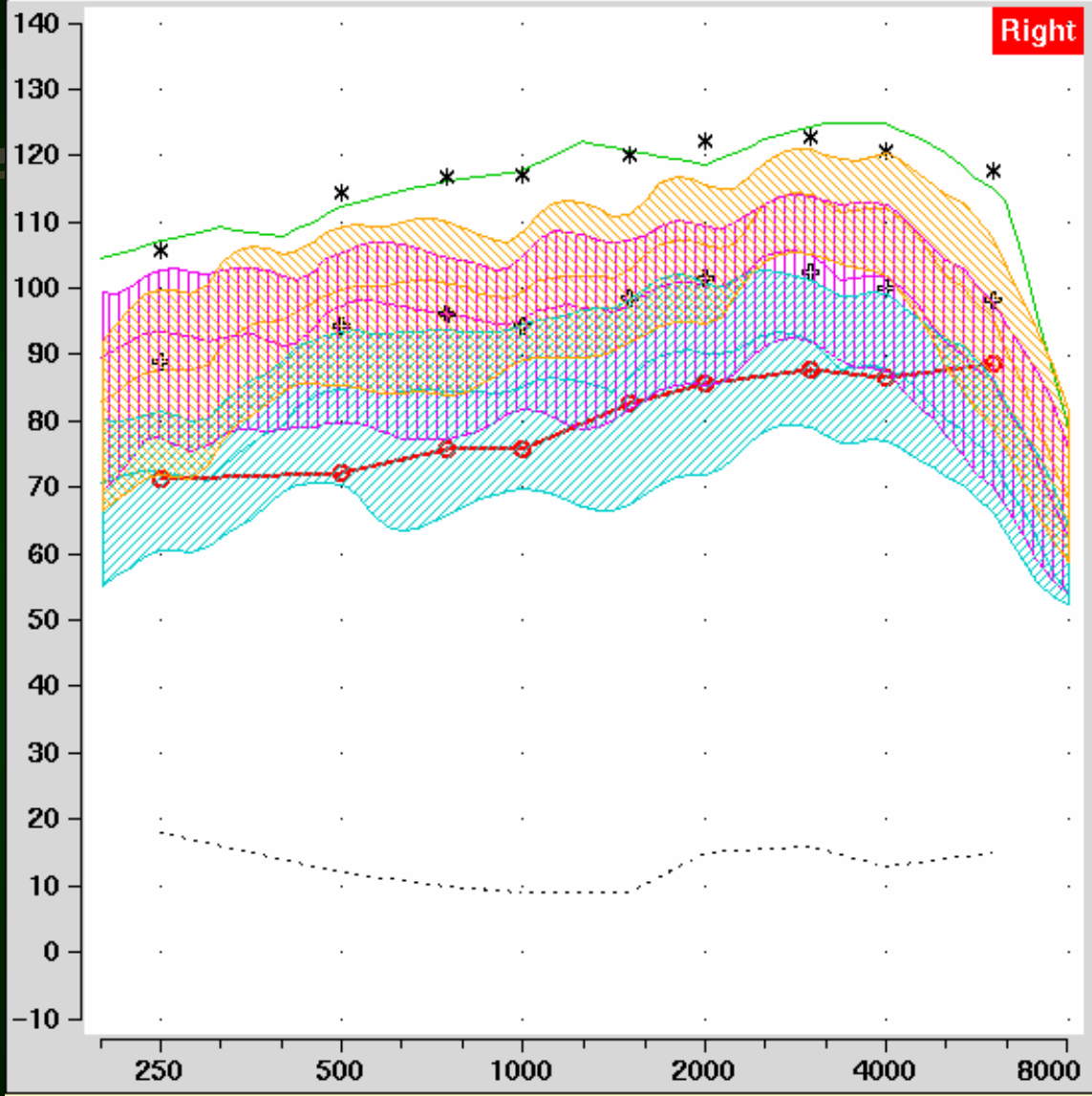
Speechmap/DSL – Single view

audioscan



Instrument	BTE
Mode	S-REM
Presentation	Single view
Format	Graph
Scale (dB)	SPL
Audiometry	
Age	<7 months
Transducer	Insert+Foam
UCL	Average
RECD	Average

REAR	Stimulus	Level	SII
1	MPO	90	N/A
2	Speech-shape	Avg (70)	67
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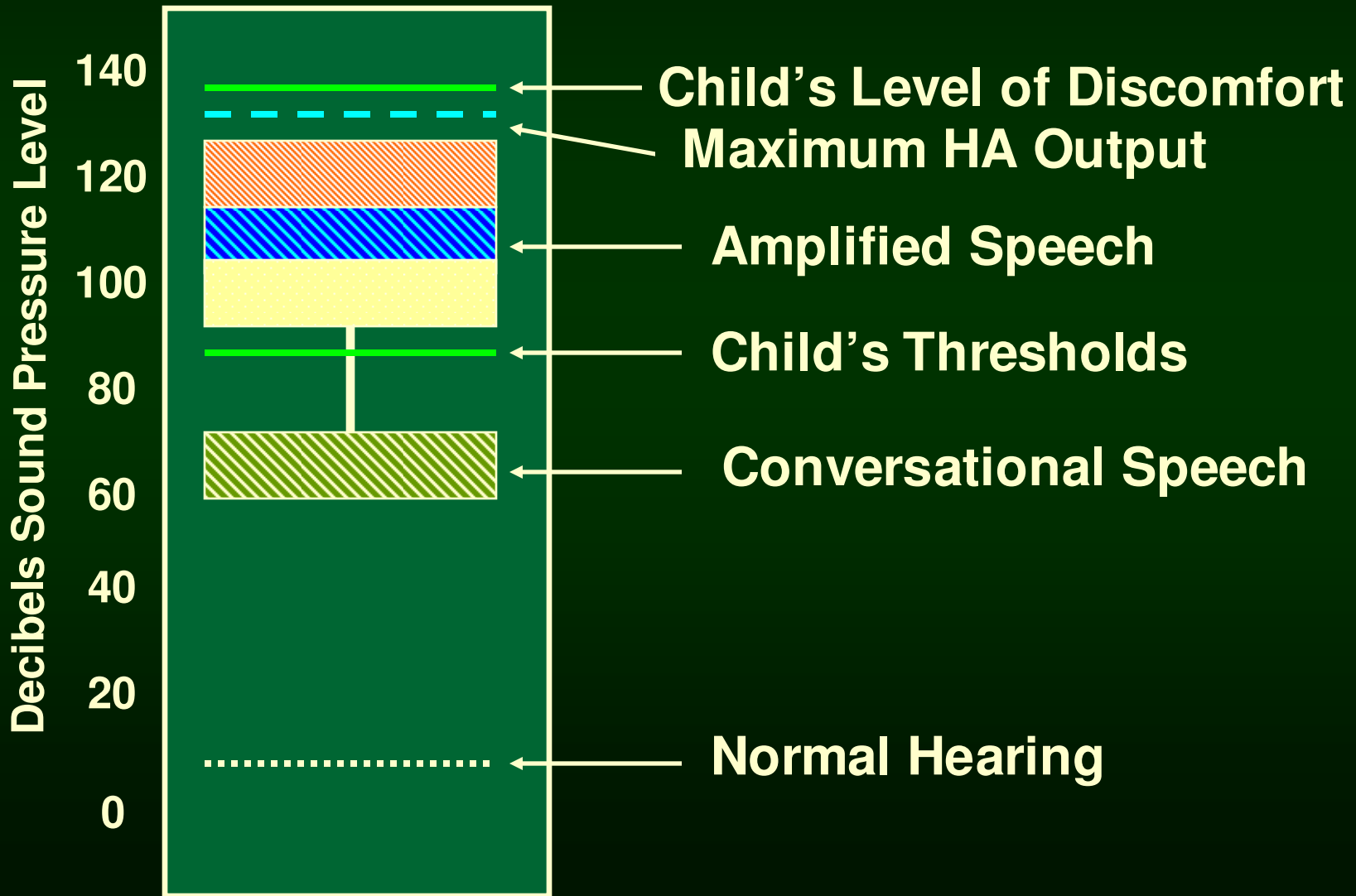
Unaided			5

Curve: Hide / Show

Connect coupler and instrument to coupler microphone. Select one of REAR 1 through REAR 4.

The Electroacoustic-based Approach to Fitting (from Erber 1973)



How well does this work???

Validation Studies

Repeatability of RECD Measures:

- N = 90 infants/children & 10 adults
- RECD measures obtained twice using the DSL method recommended protocol

Repeatability of RECD measures as a function of age group

Age Group	Mean Diff. (1st - 2nd)
0 - 5 months	1.6
6 - 12 months	1.5
13 - 18 months	1.6
19 - 24 months	1.7
25 - 36 months	1.9
Adult	0.5

Predictive Validity of a Procedure for Pediatric Hearing Instrument Fitting

Seewald, Moodie, Sinclair & Scollie

American Journal of Audiology (1999)

Predictive Validity of RECD Measures:

- N = 14 children, Ages: 3 -12 years
- **MEASURES:**
  - *RECD measures*
  - *Coupler measures (2cc gain / SSPL)*
  - *Real-ear measures (REAG / RESR)*
- Predicted values compared to direct measures

How well does this work???

Predictive Validity of RECD Measures:
95% Confidence Intervals

250	500	1000	2000	4000
± 2.9	2.4	2.4	1.7	2.2 dB

± 2.3 dB for 95% of subjects across frequencies

How well does it work???

Conclusion:

It is possible to derive accurate predictions of real-ear hearing aid performance on the basis of RECD measures.

Thus,

When this approach to hearing instrument fitting is taken with infants/ children, it is not necessary to try to measure an aided audiogram or make conventional probe microphone measures in the initial stages.

The "Coupler Approach" (Simulated Real-ear)

Relative Advantages

- Does not require a behavioral response
- Provide an accurate estimate of the maximum real-ear SPL
- Predicted REARs are measured with speech-like inputs

The "Coupler Approach" (Simulated Real-ear)

Relative Advantages

- The variability associated with sound field probe microphone measures with children is eliminated.
- All electroacoustic response shaping can be performed under the controlled acoustic conditions of the hearing instrument test box.

The "Coupler Approach" (Simulated Real-ear)

Relative Advantages

- This approach significantly reduces the amount of measurement time and cooperation required with each child.

The "Coupler Approach" (Simulated Real-ear)

Some Limitations

- This approach to verification does not quantify auditory performance with amplification. . . it is only predictive.

- It does require one probe microphone measurement.

- Care must be taken in selecting test signals

Some Current Issues in Verification

Questions, Questions, Questions . . .

- Is it possible to verify the electroacoustic performance of digital instruments - And, if so, how should we do this ??
- Can electroacoustic measurements using clinical test signals be used to predict the levels of amplified speech for digital instruments?
- If we can't verify electroacoustic performance, should we be fitting digital instruments to infants ?

The Problem . . .

- Many DSP instruments are designed to detect modulations to decide if they are receiving ‘speech’ or ‘noise’.

- Some of our common clinical test signals (eg. pure tones) do not modulate and thus are processed as “noise”.

What you should know . .

- All digital instruments do not implement noise reduction / speech enhancement strategies.
- For most that do, it is possible to turn off this feature for electroacoustic verification.
- If the NR/SE processing cannot be turned off, special care must be taken in test signal selection (eg. Modulated signals)

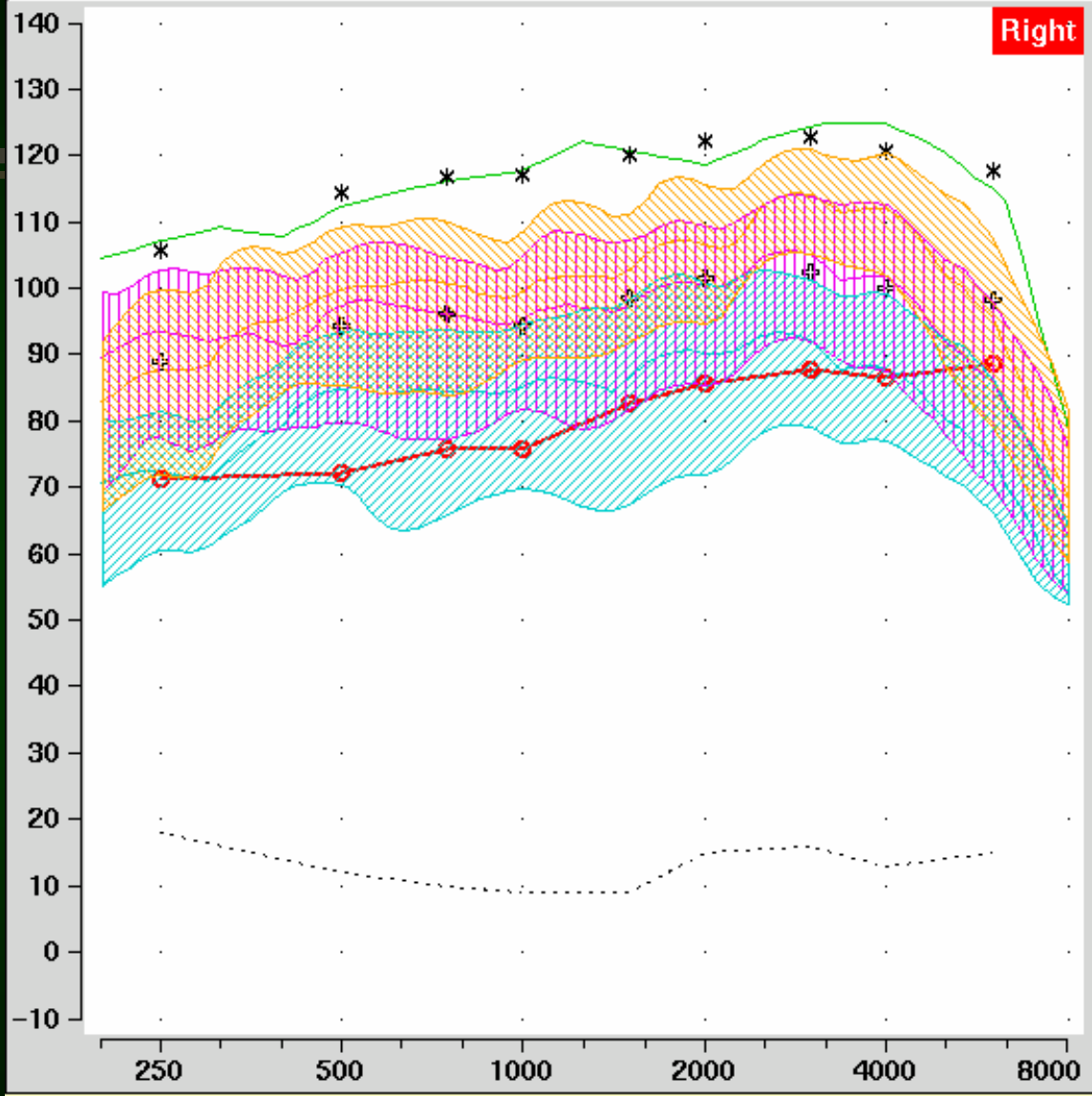
General Guidelines

For verification of digital hearing instruments:

- Turn the noise reduction / speech enhancement feature off.
- Use speech-weighted test signals.
- Use modulated signals.
- Study performance for low, average and high-level “speech” inputs - (55, 65, 75 dB SPL).

Speechmap/DSL – Single view

audioscan



Instrument	BTE
Mode	S-REM
Presentation	Single view
Format	Graph
Scale (dB)	SPL
Audiometry	
Age	<7 months
Transducer	Insert+Foam
UCL	Average
RECD	Average

REAR	Stimulus	Level	SII
1	MPO	90	N/A
2	Speech-shape	Avg (70)	67
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Unaided			5

Curve: Hide / Show

Connect coupler and instrument to coupler microphone. Select one of REAR 1 through REAR 4.

Muchas gracias !