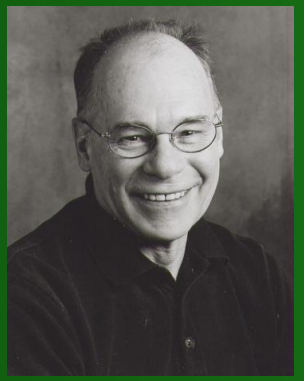
Richard Seewald

Centro de Investigación de Audición Infantil
Centro Nacional de Audiología. University of Western Ontario
London, Canadá



- Investigador pionero en el campo de la audiología y la adaptación pediátrica de audífonos
- Reconocido internacionalmente por crear el método de Nivel de Sensación Deseada (DSL) para la adaptación pediátrica de audífonos
- Director y editor de las actas de las conferencias internacionales sobre tratamiento precoz de la hipoacusia en la infancia

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Unidad de Sordera y Vértigo

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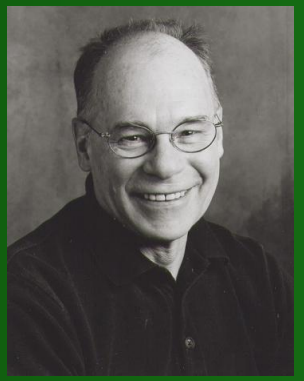

Componentes esenciales del proceso de adaptación pediátrica de audífonos

Essential components of the pediatric hearing instrument fitting process

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Essential Components of the Pediatric Hearing Instrument Fitting Process

Richard Seewald

National Centre for Audiology

The University of Western Ontario

London Ontario Canada

Outline

- Resources
- Essential Elements for Pediatric Fitting
- On the Use of Clinical Protocols

Resources

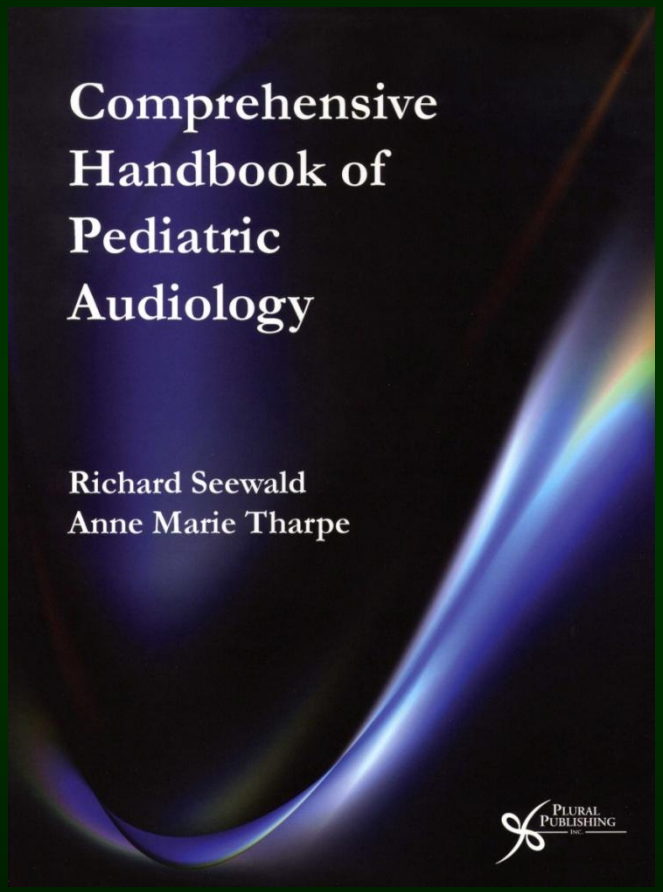
- *Ontario Infant Hearing Program Protocols:*

http://ihp.mtsinai.on.ca/

- *DSL Website:*

http://www.dslio.com

Resources



Pluralpublishing.com

Resources

A Sound Foundation Through Early Amplification:

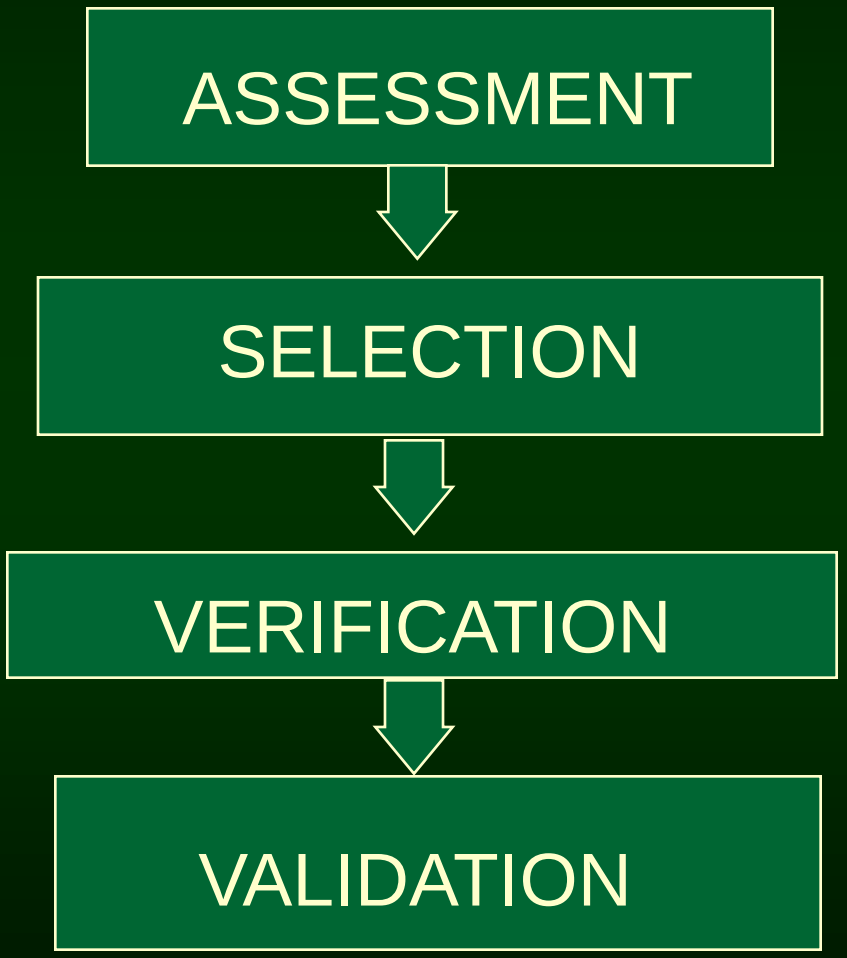
Proceedings of the 5th International Conference

July 2011 by Phonak AG

Modern Hearing Instrument Technologies

- **Directional Microphones**
- **Frequency-lowering Technologies**
- **Feedback Control Systems**
- **Digital Noise Reduction**
- **FM-systems**
- **etc.**

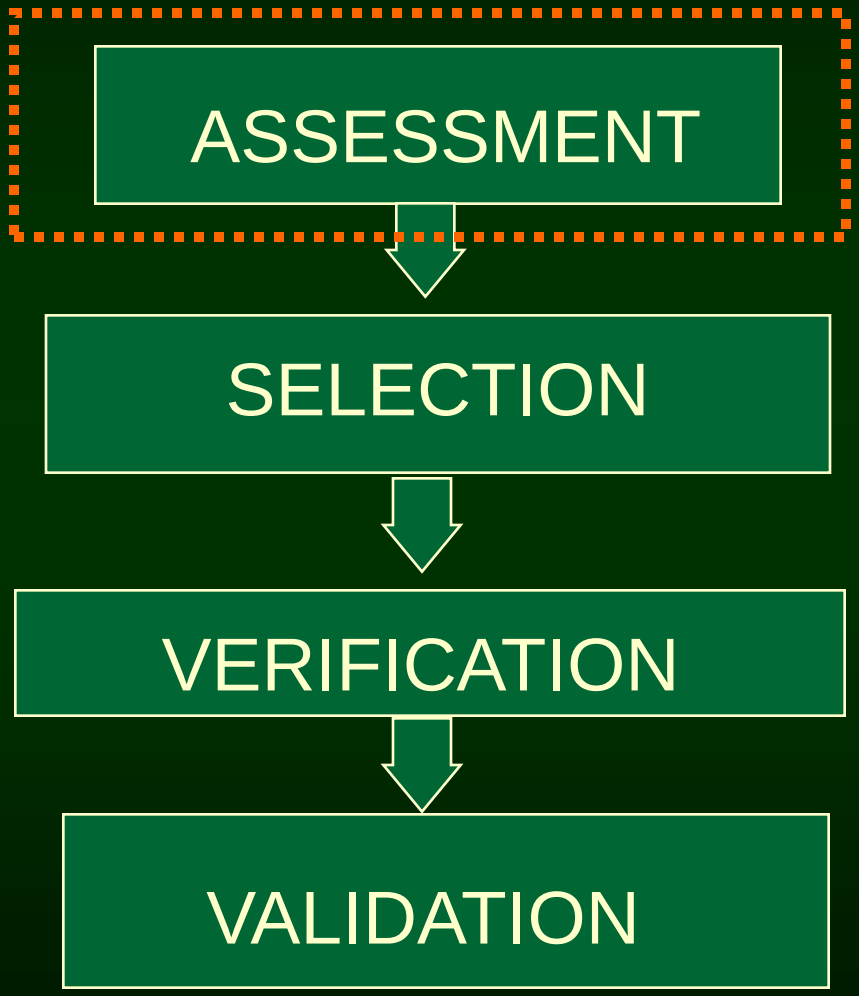
The Fitting Process



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 their residual auditory capacity can be maximized.*

The Fitting Process



Assessment Considerations for Fitting Infants and Young Children with Amplification

Component #1

We need ear-specific and frequency-specific threshold estimates for air and bone conduction before proceeding with the prescription and fitting of amplification for infants and young children.

Component #2

We need to measure the external ear acoustics of the individual infant/child using the real-ear to coupler difference (RECD) procedure for the purposes of audiometry and hearing instrument fitting.

Why ????

Acoustic Transforms in Audiometry and Hearing Instrument Fitting

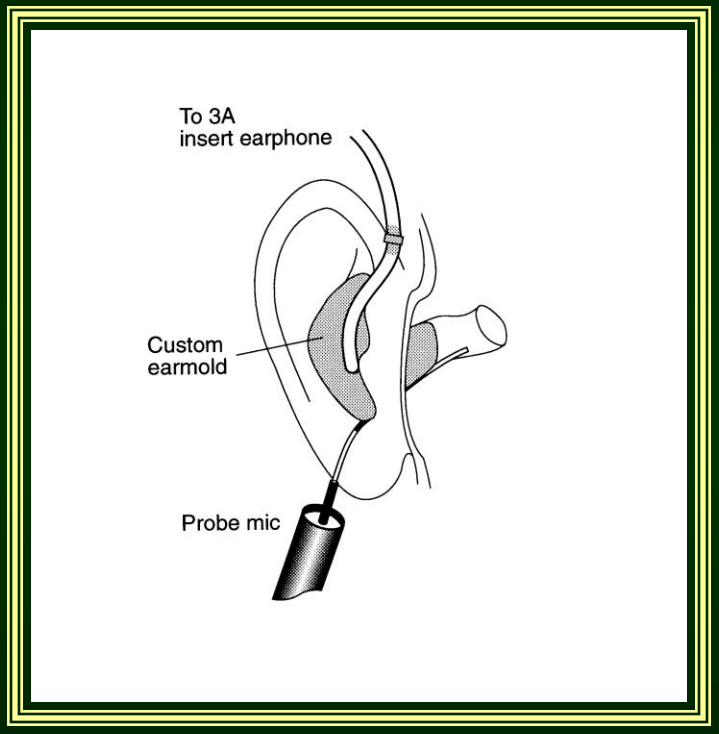
Assumption:

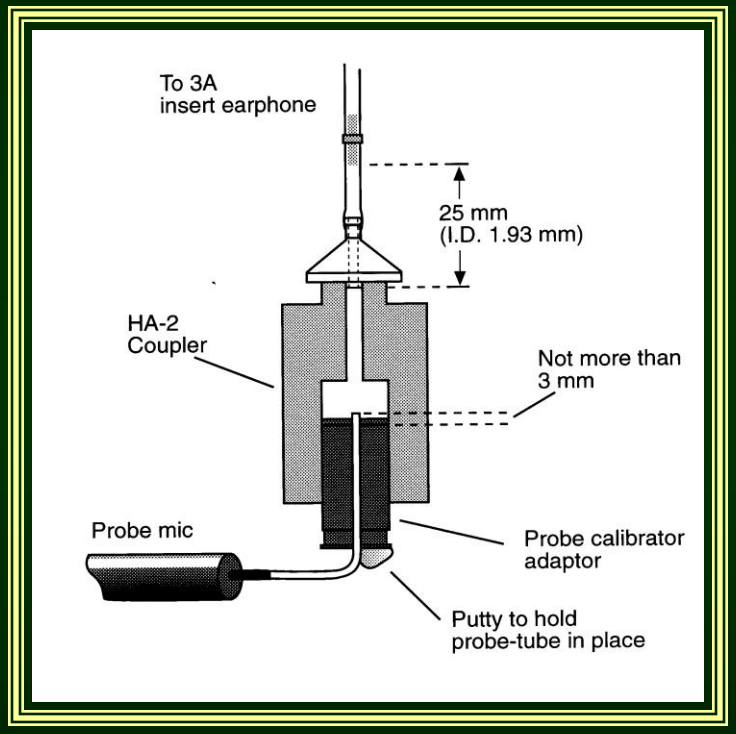
The real-ear to coupler difference (RECD) values across frequencies are equal to those measured for an average adult.

RECDs in Infants: Key Points

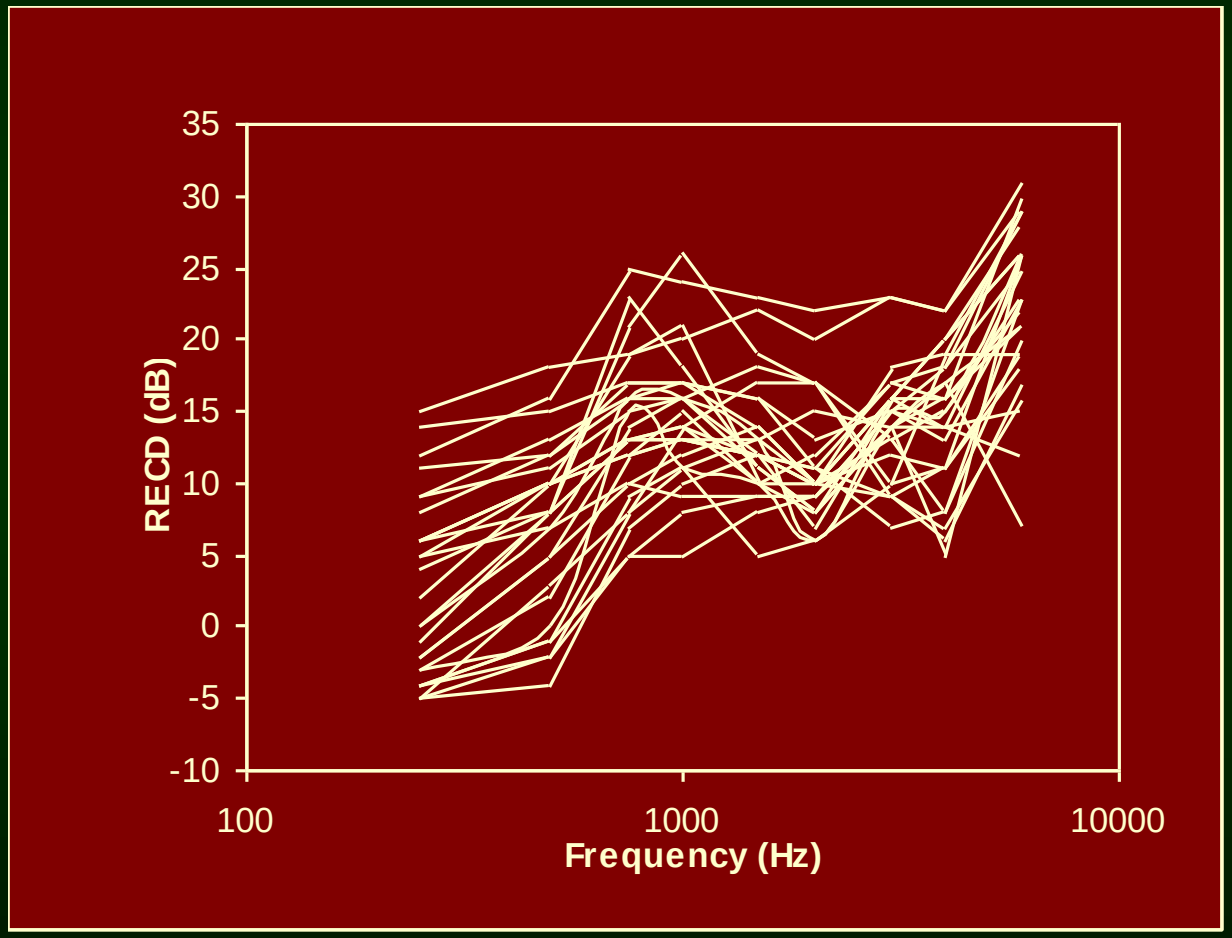
- RECDs in infants and toddlers differ significantly from average adult values.
- RECDs vary from infant to infant.
- RECDs will change for a given infant over time.

The Real-ear to Coupler Difference (RECD)





A sample of RECD values for infants



Component #3

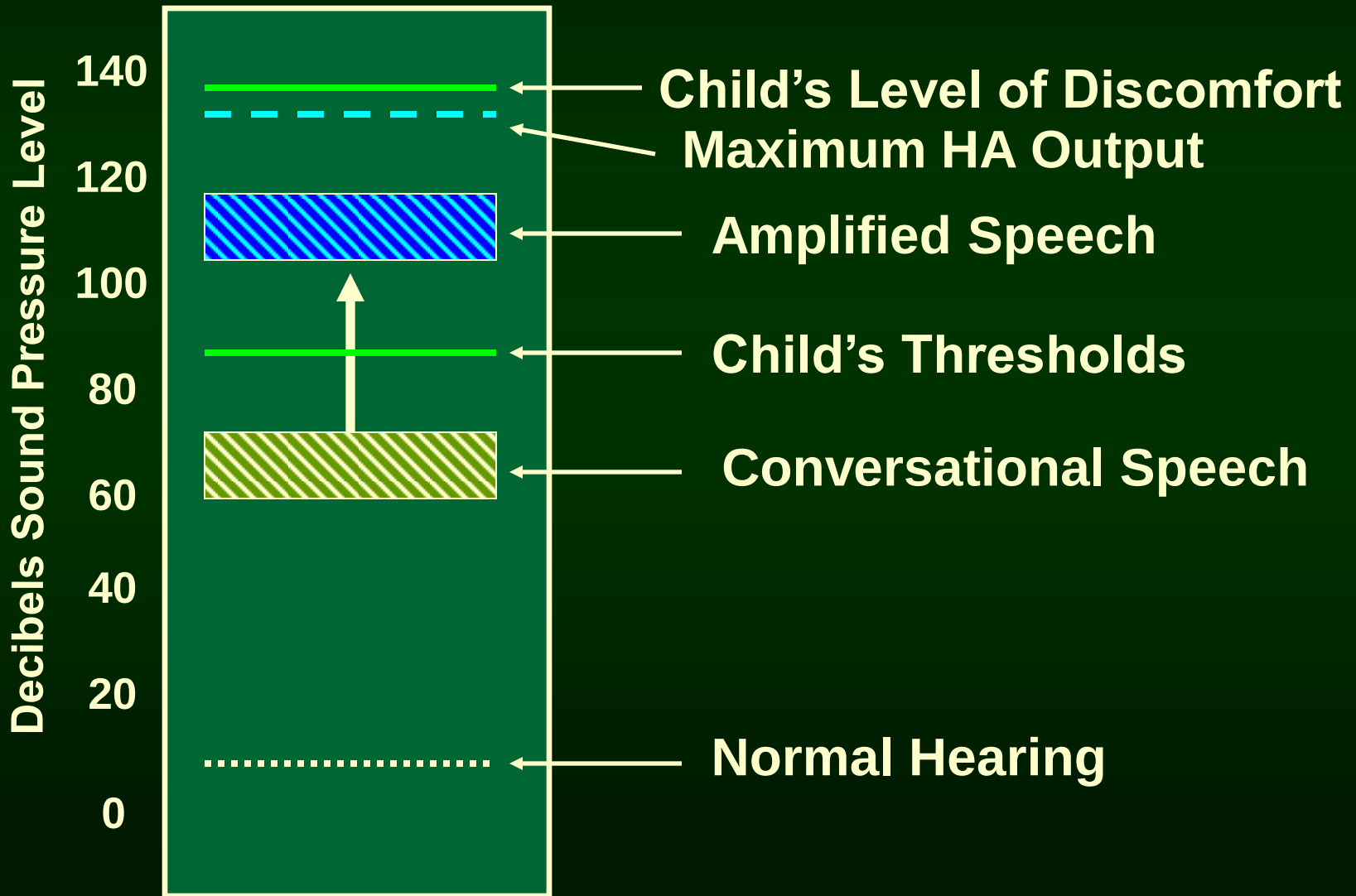
We need to convert all audiometric data from dB HL to dB SPL in the ear canal.

Why ?

Component #3

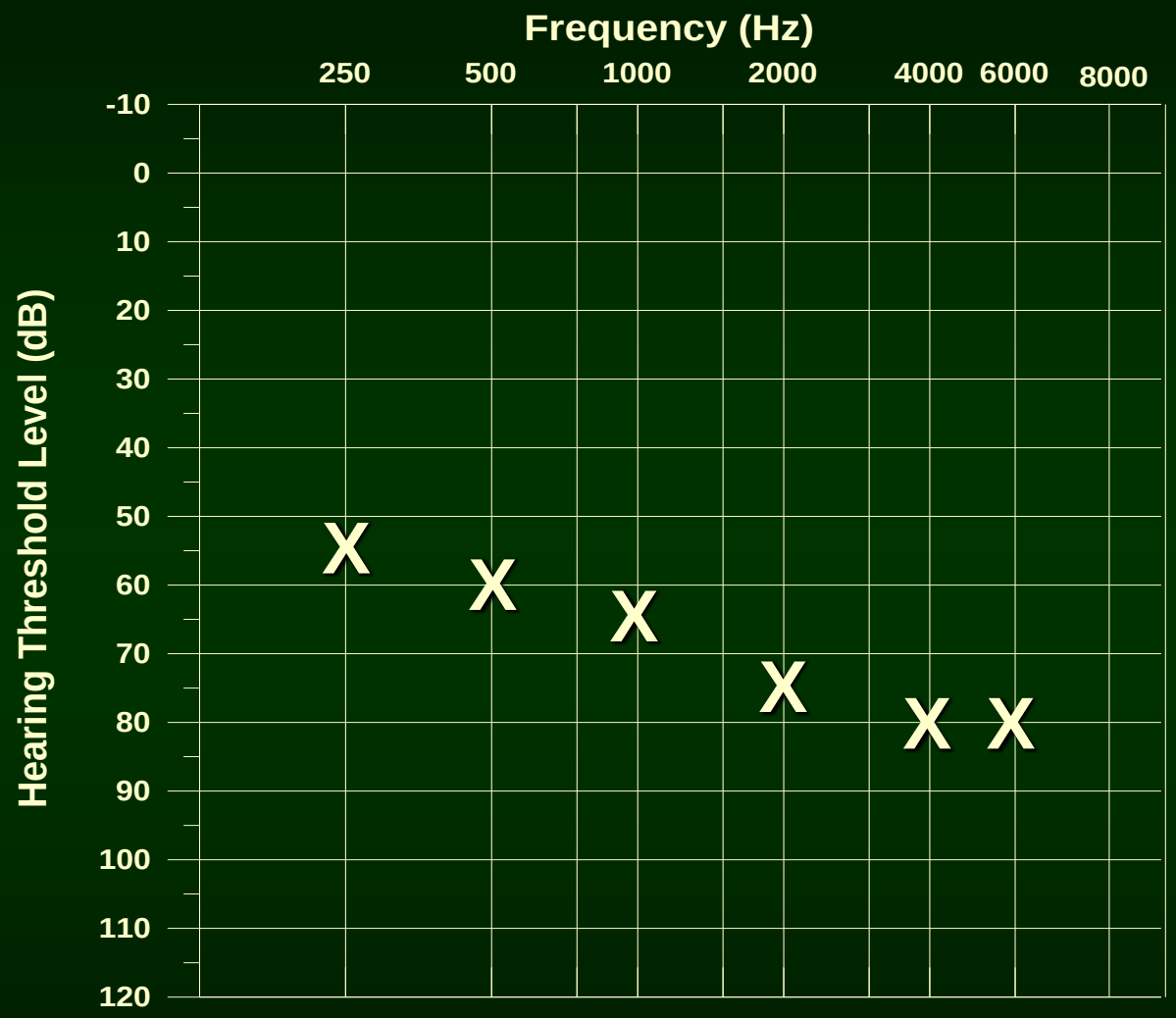
To ensure that we have a good match between audiometric characteristics of the child and amplification characteristics of the hearing aid all variables we are working need to be defined using a common point of reference.

The SPLogram



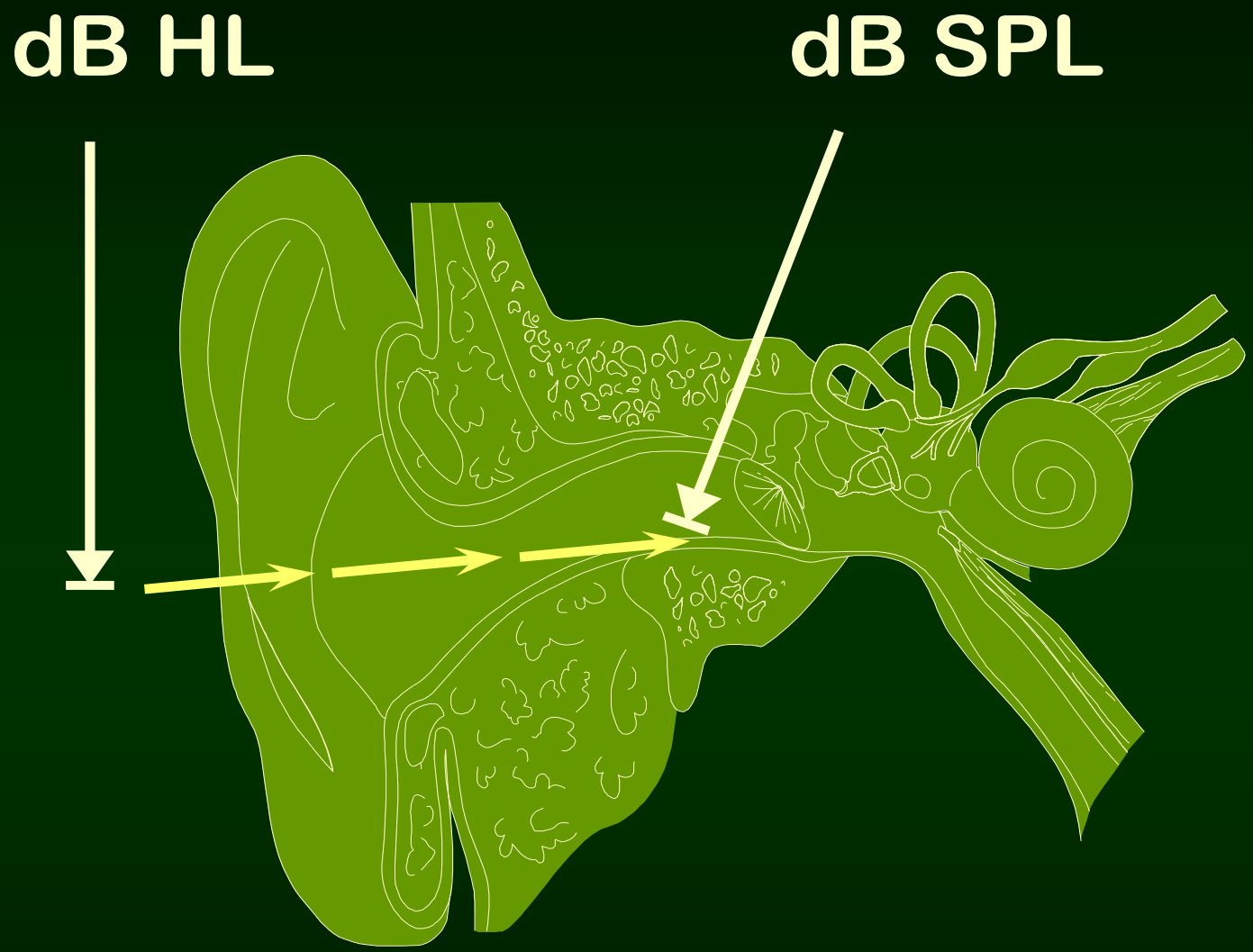
The DSL Method uses the RECD to…

- Convert audiometric measures obtained using insert phones from dB HL to dB SPL in the ear canal
- Convert gain and output limiting requirements in the real ear to 2cc coupler equivalents
- Convert test box measurements of hearing instrument performance to estimated real-ear performance

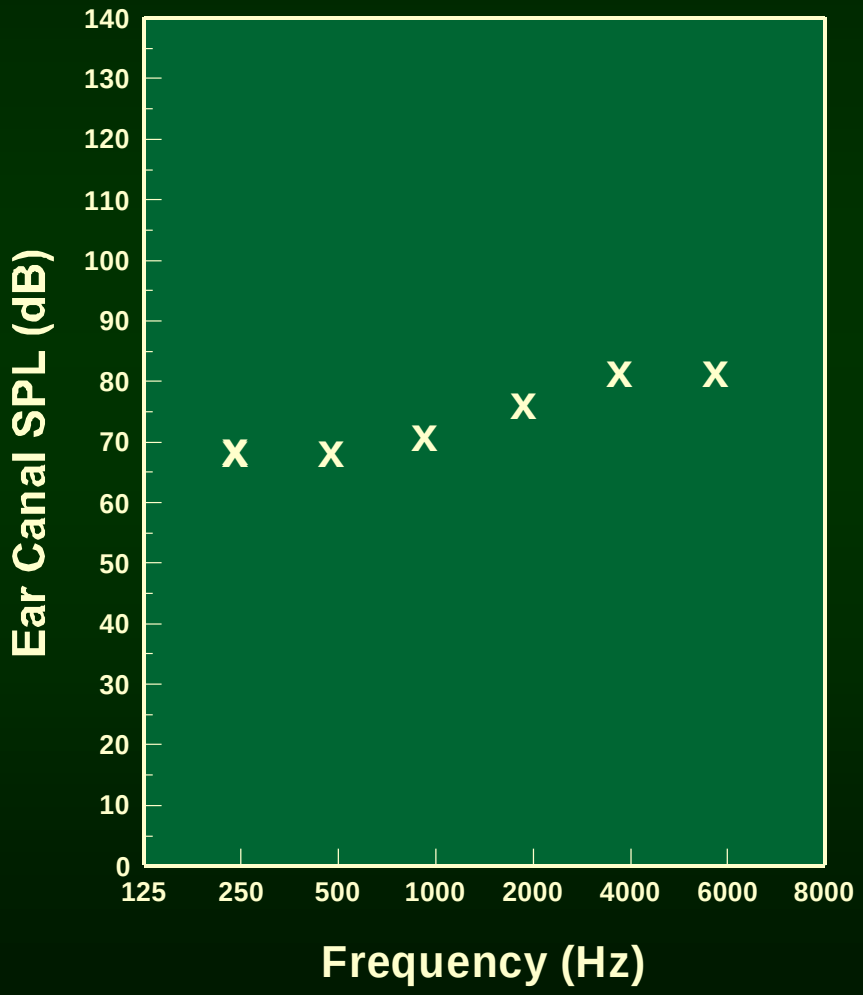

Frequency (Hz)
250
500
1000
2000
4000
6000
8000
Hearing Threshold Level (dB)
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
X
X
X
X
X
X

Audiometric Assessment

- Conducted with insert earphones
- Connect inserts to personal earmolds
- Measure the RECD


dB HL
dB SPL

The SPLogram



Using frequency-specific ABR measures for hearing instrument fitting

Accuracy of Predicting Behavioral Thresholds from ABR Threshold Estimations in RESPL

Bagatto, Seewald, Scollie, Liu, & Hyde

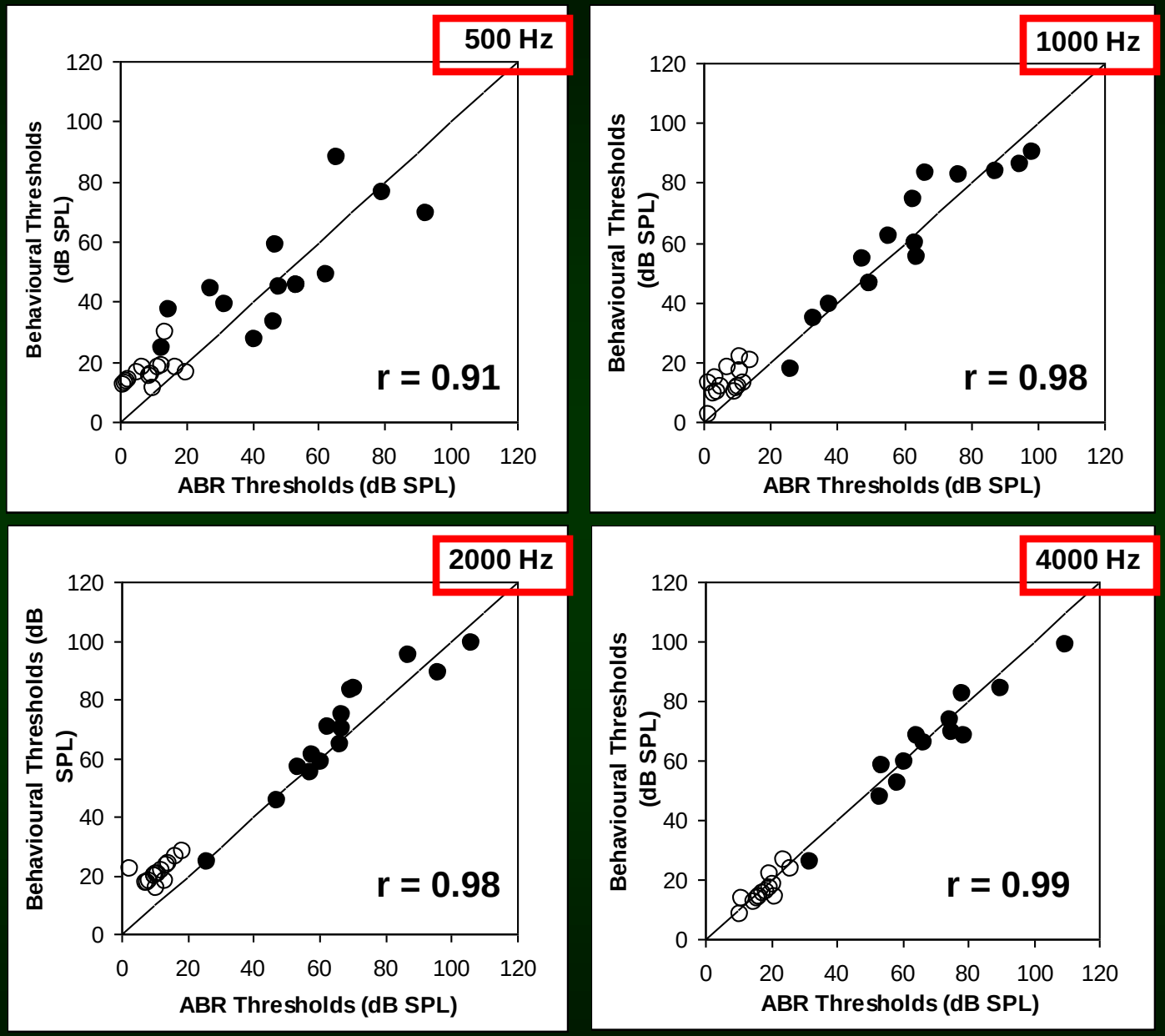
Trends in Amplification (2005)

Procedure

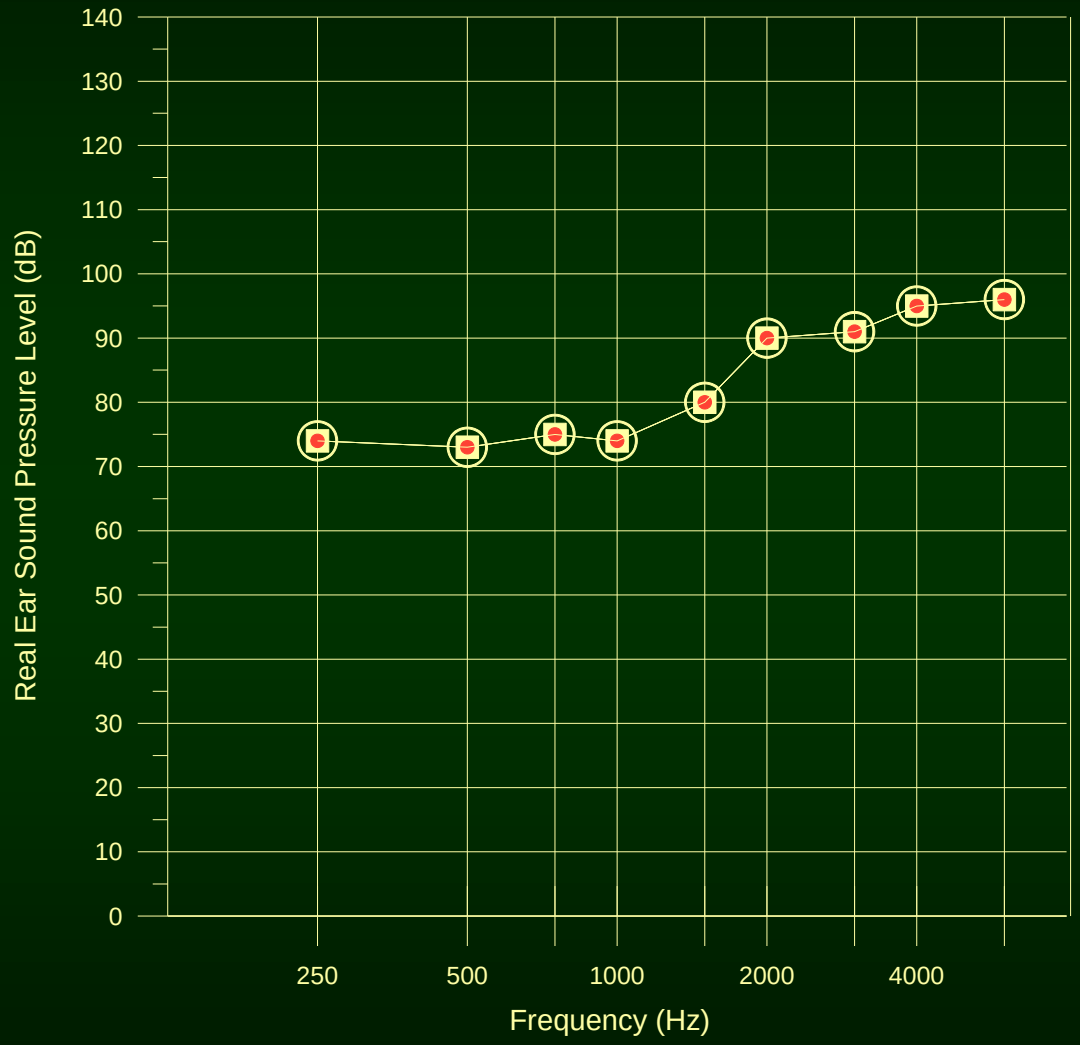
- Subjects
  - 15 children & young adults with SNHL
  - 15 young adults with normal hearing
- RECD measures
- Behavioural audiometry
  - .5, 1, 2, 4kHz

- FS-ABR threshold estimations
  - .5, 1, 2, 4kHz

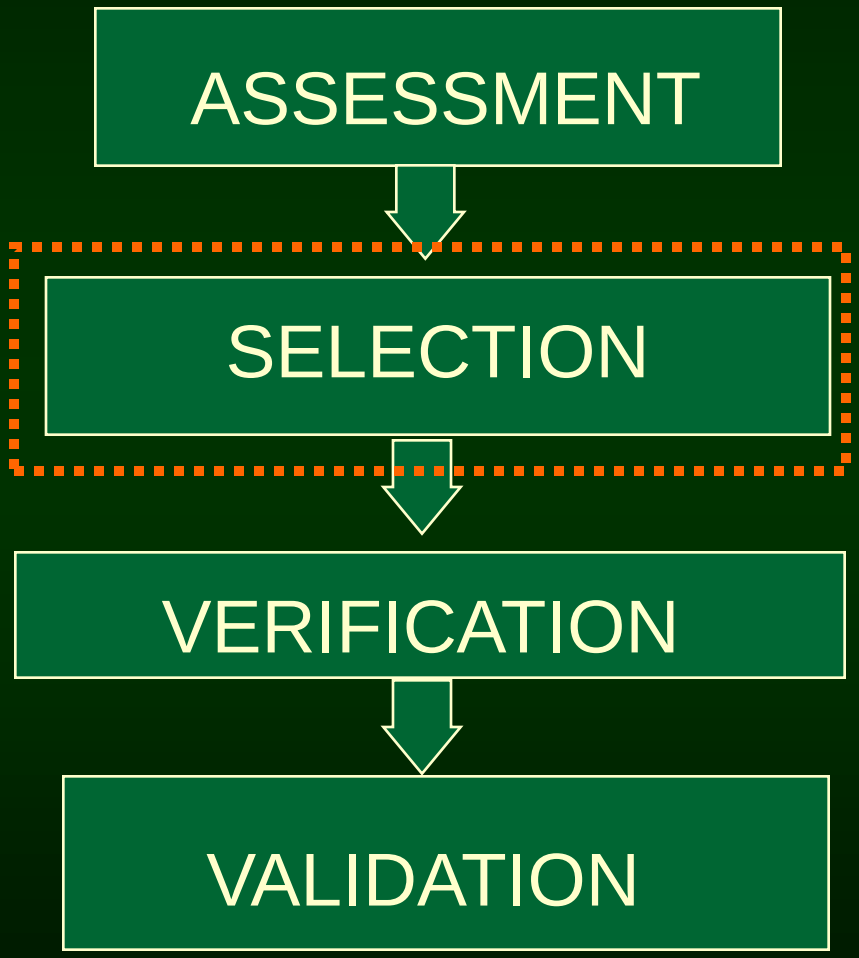
- Insert earphones used


500 Hz
r = 0.91
1000 Hz
r = 0.98
2000 Hz
r = 0.98
4000 Hz
r = 0.99
Behavioural Thresholds (dB SPL)
ABR Thresholds (dB SPL)
0
20
40
60
80
100
120

The SPLogram: In ear canal SPL



The Fitting Process



What we want to do. . .

To match the amplification characteristics of hearing instruments to the auditory characteristics of infants and children so that *the use of their residual auditory capacity can be maximized.*

Component #4

We need to use an evidence-based generic prescription procedure that has been developed specifically for application with infants and children (i.e. the DSL v5.0 Method)

Why not use a manufacturer-specific proprietary procedure ????

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

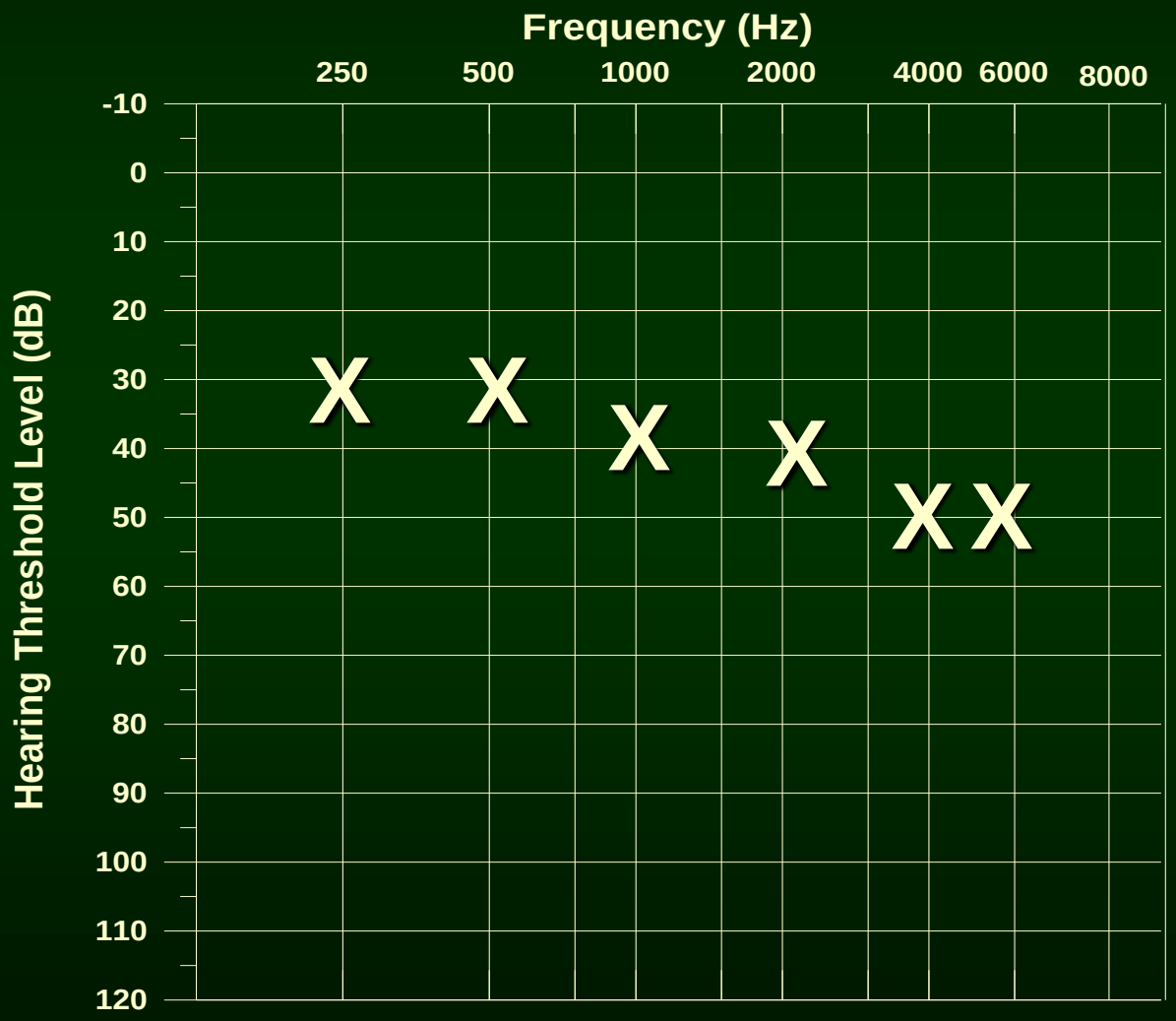
- Nine different audiograms were used (mild through profound)

- Average RECD for a 6 month old applied

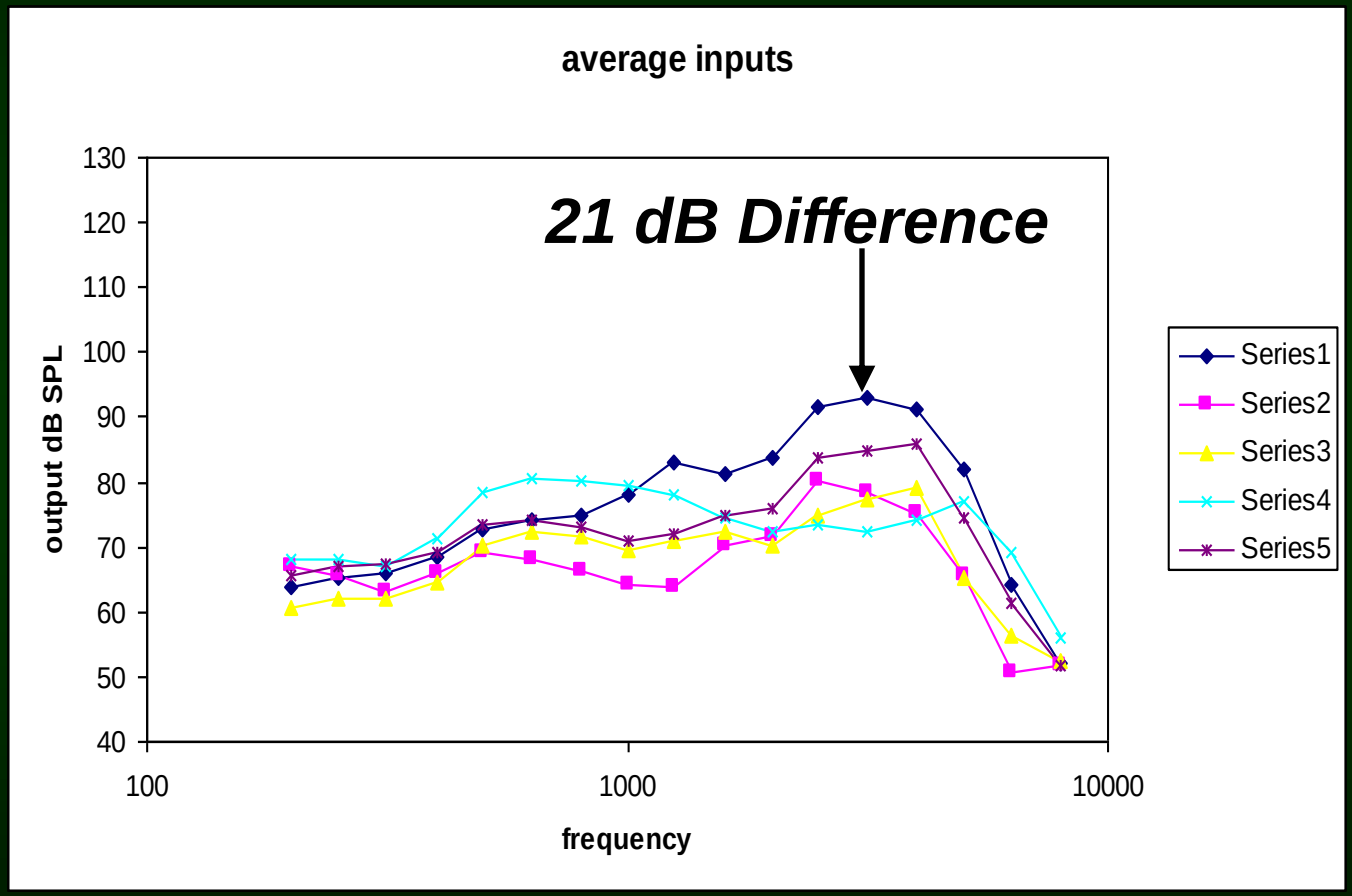
A Study

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

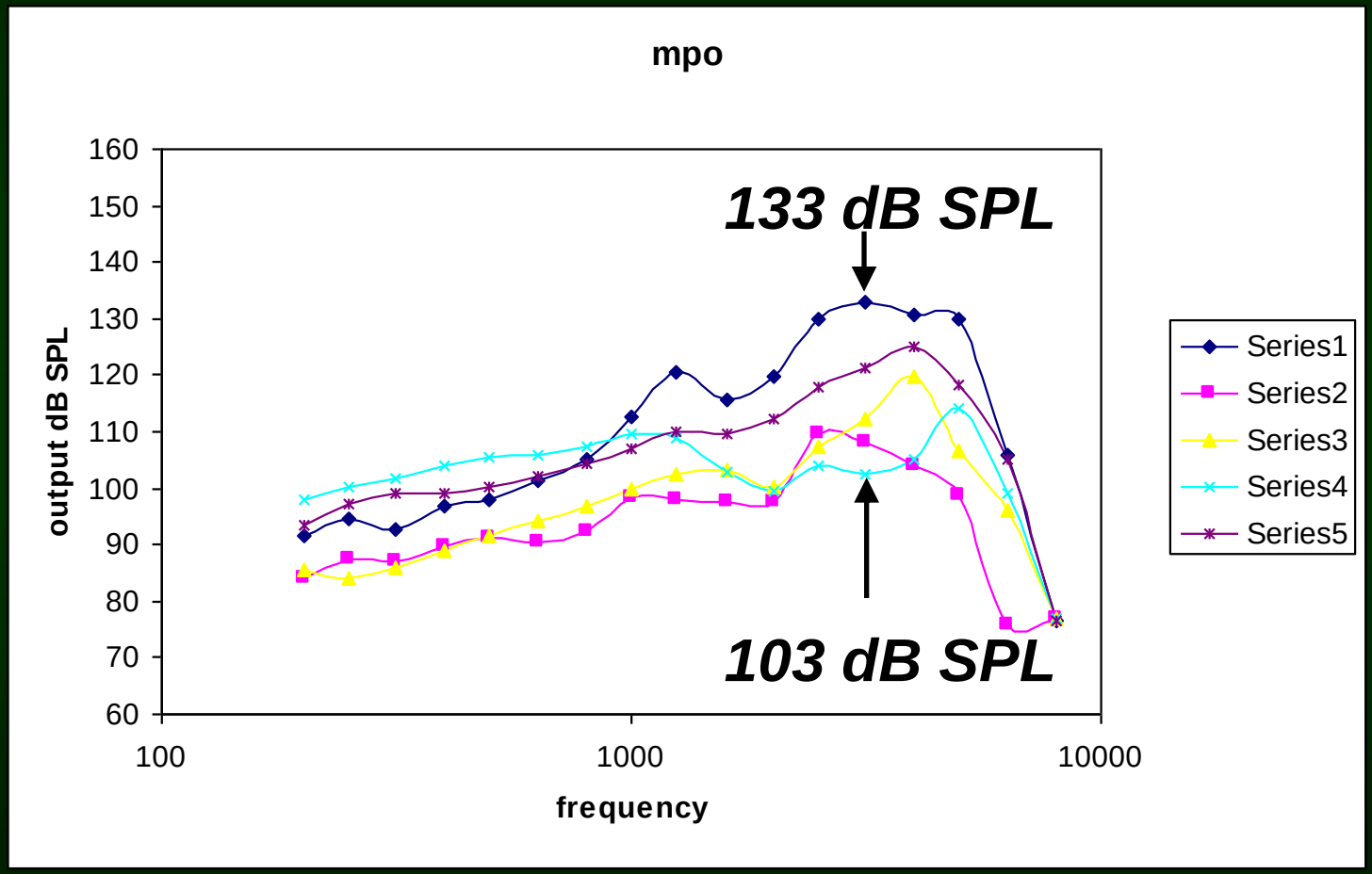
Sample Findings

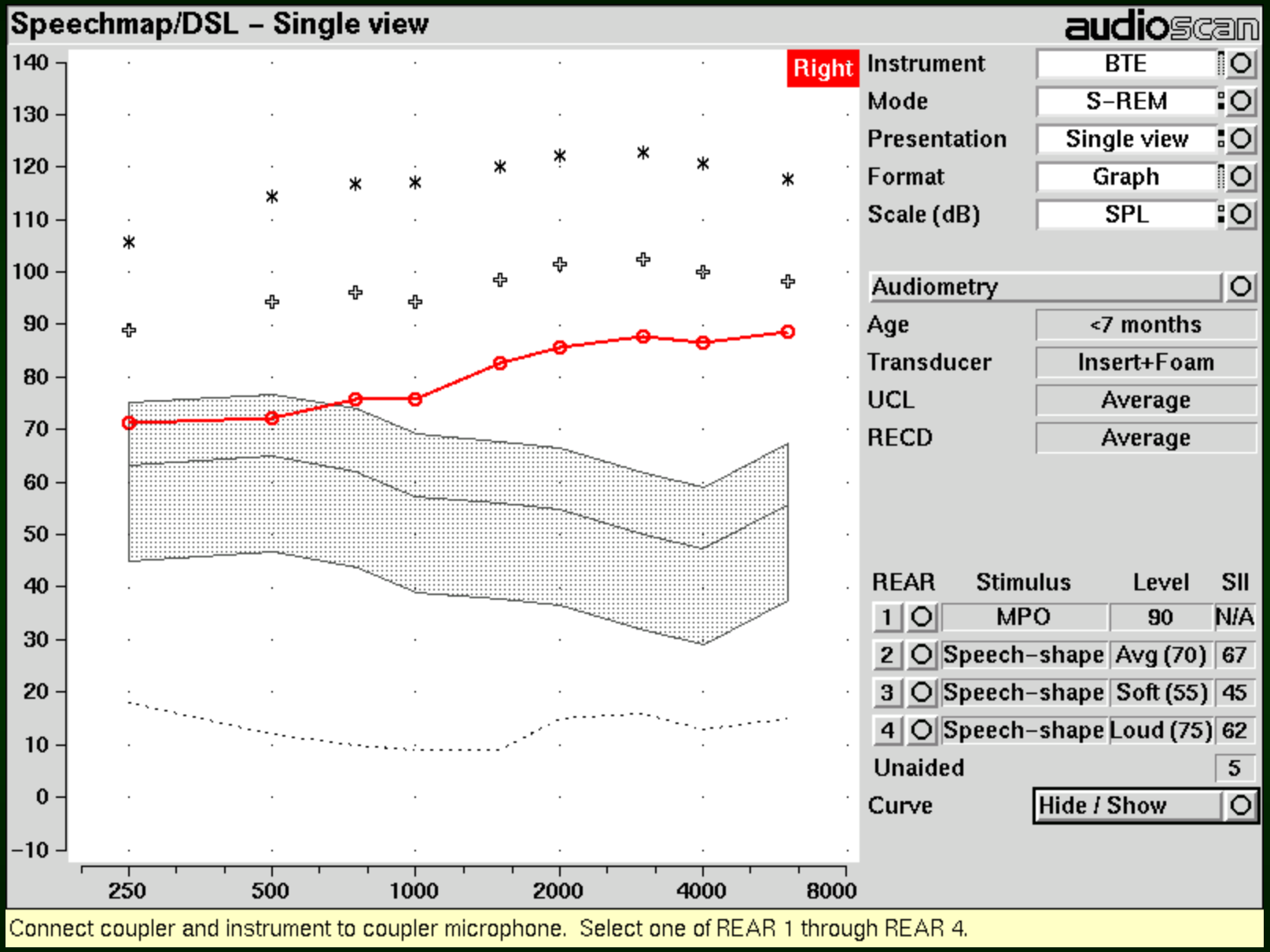


Sample Findings: Average Speech Input



Sample Findings: Output Limiting Levels




Speechmap/DSL – Single view
audioscan
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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
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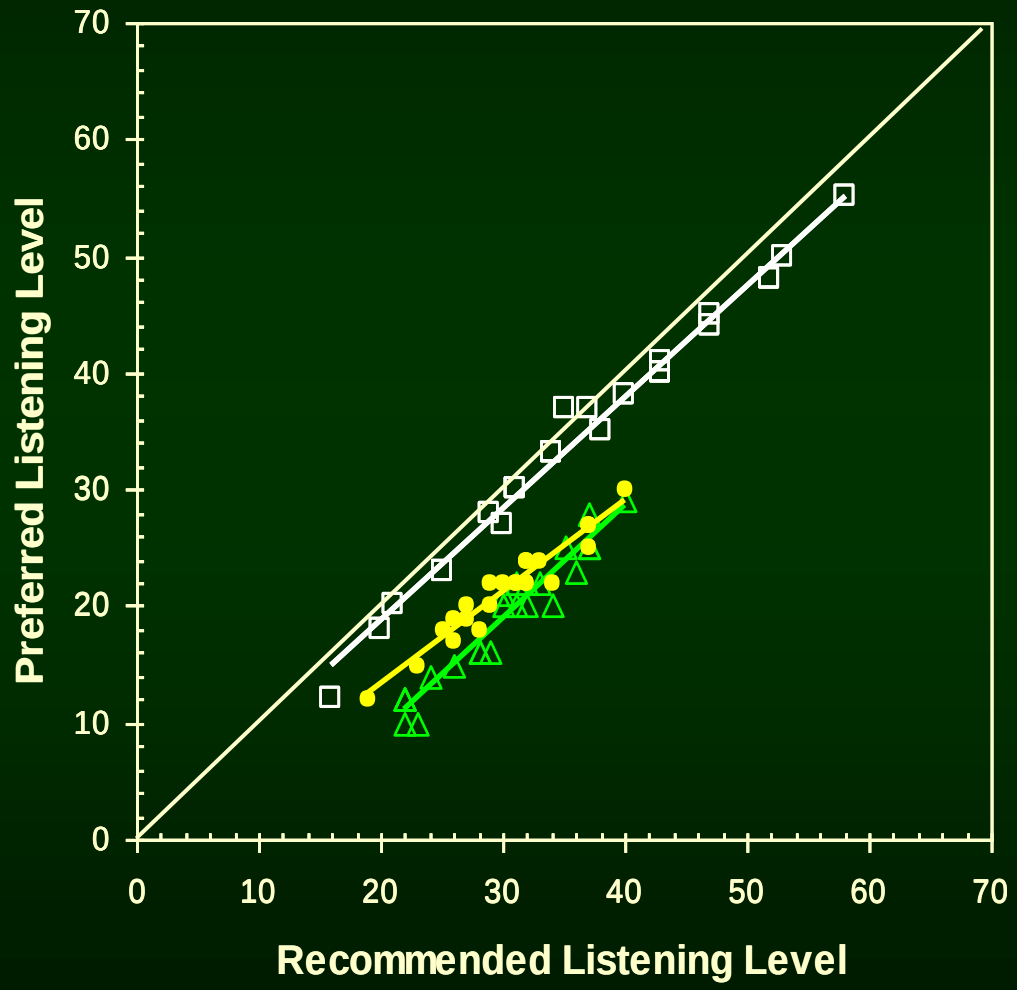
2
Speech-shape
Avg (70)
67
3
Speech-shape
Soft (55)
45
4
Speech-shape
Loud (75)
62
Unaided
5
Curve
Hide / Show
Connect coupler and instrument to coupler microphone. Select one of REAR 1 through REAR 4.

Accounting for adult / child differences



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- Convert audiometric measures obtained using insert phones from dB HL to dB SPL in the ear canal
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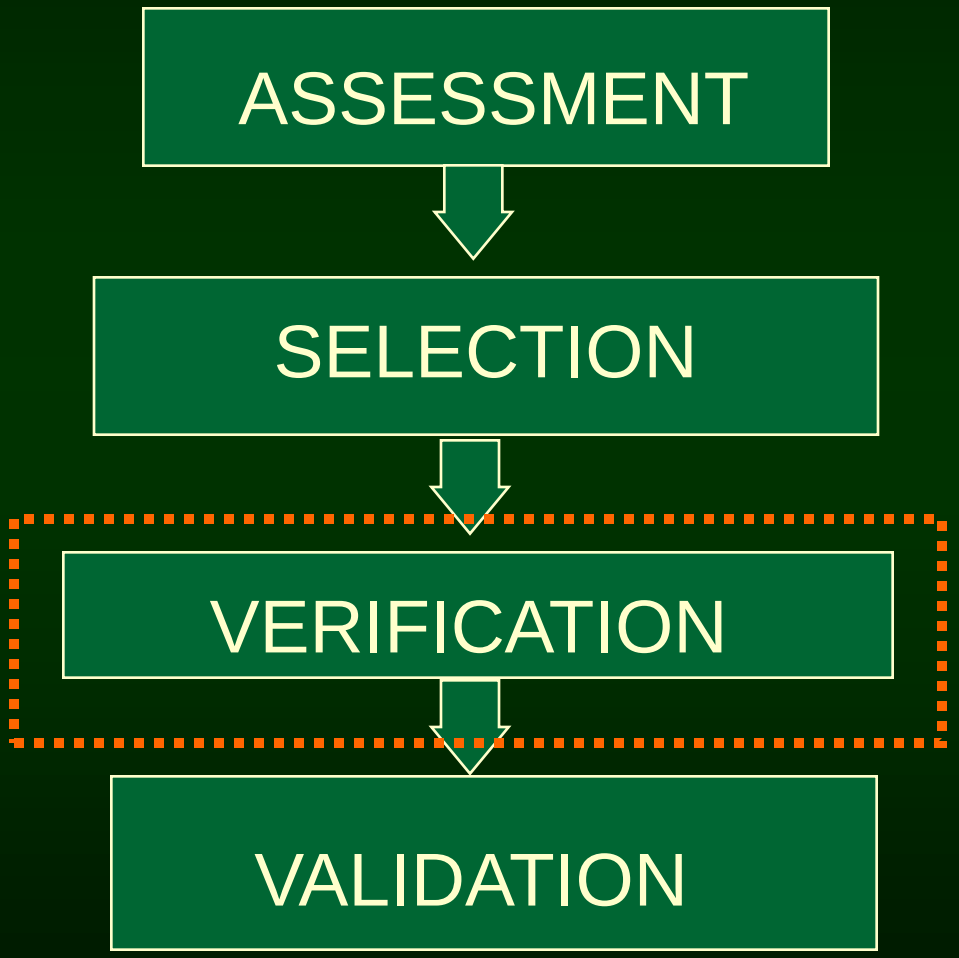
- Convert test box measurements of hearing instrument performance to estimated real-ear performance

Acoustic Transforms

The Fitting Process



Component #5

We need to verify that the desired real-ear performance of the hearing instrument has been provided to the infant or child.

Why ?????

Electroacoustic Verification

We need to know the levels of sound that a hearing instrument delivers into the ear of an infant or young child.

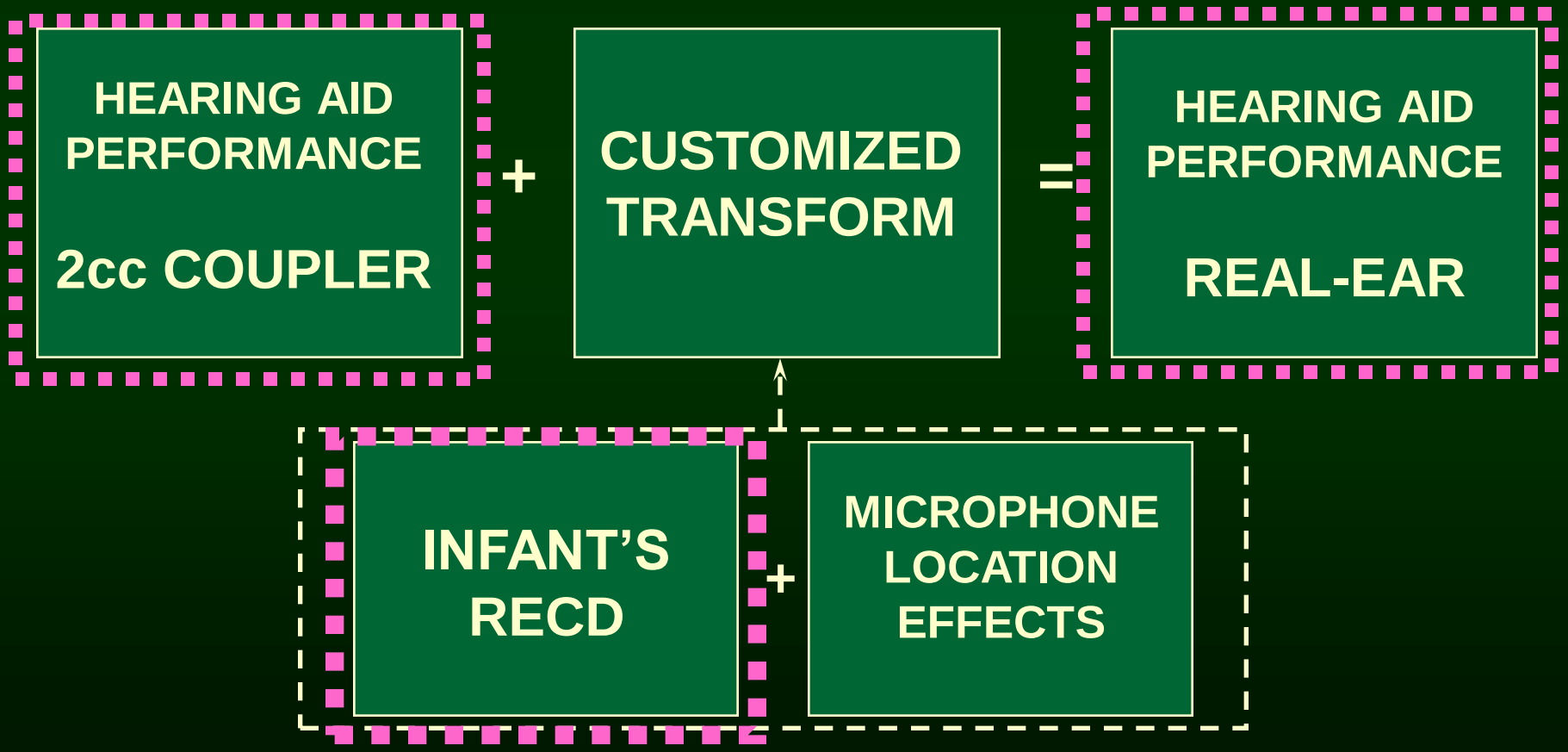
Consequently, comprehensive electroacoustic verification is an essential component in the pediatric hearing instrument fitting process.

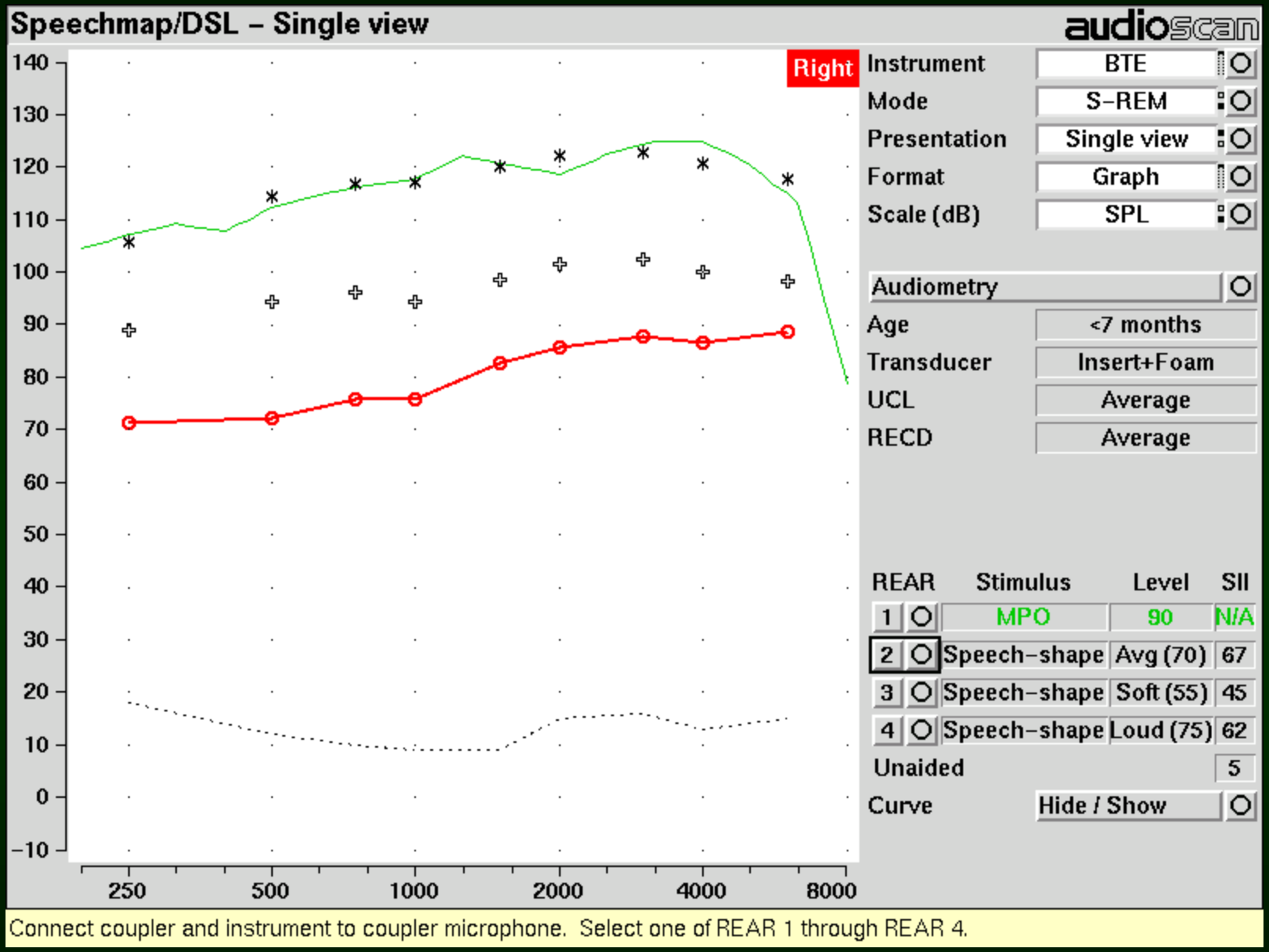
The DSL Method uses the RECD to…

- Convert audiometric measures obtained using insert phones from dB HL to dB SPL in the ear canal
- Convert gain and output limiting requirements in the real ear to 2cc coupler equivalents
- Convert test box measurements of hearing instrument performance to estimated real-ear performance

How are RECDs used??
In Hearing Instrument Fitting

To predict real-ear hearing aid performance

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Presentation
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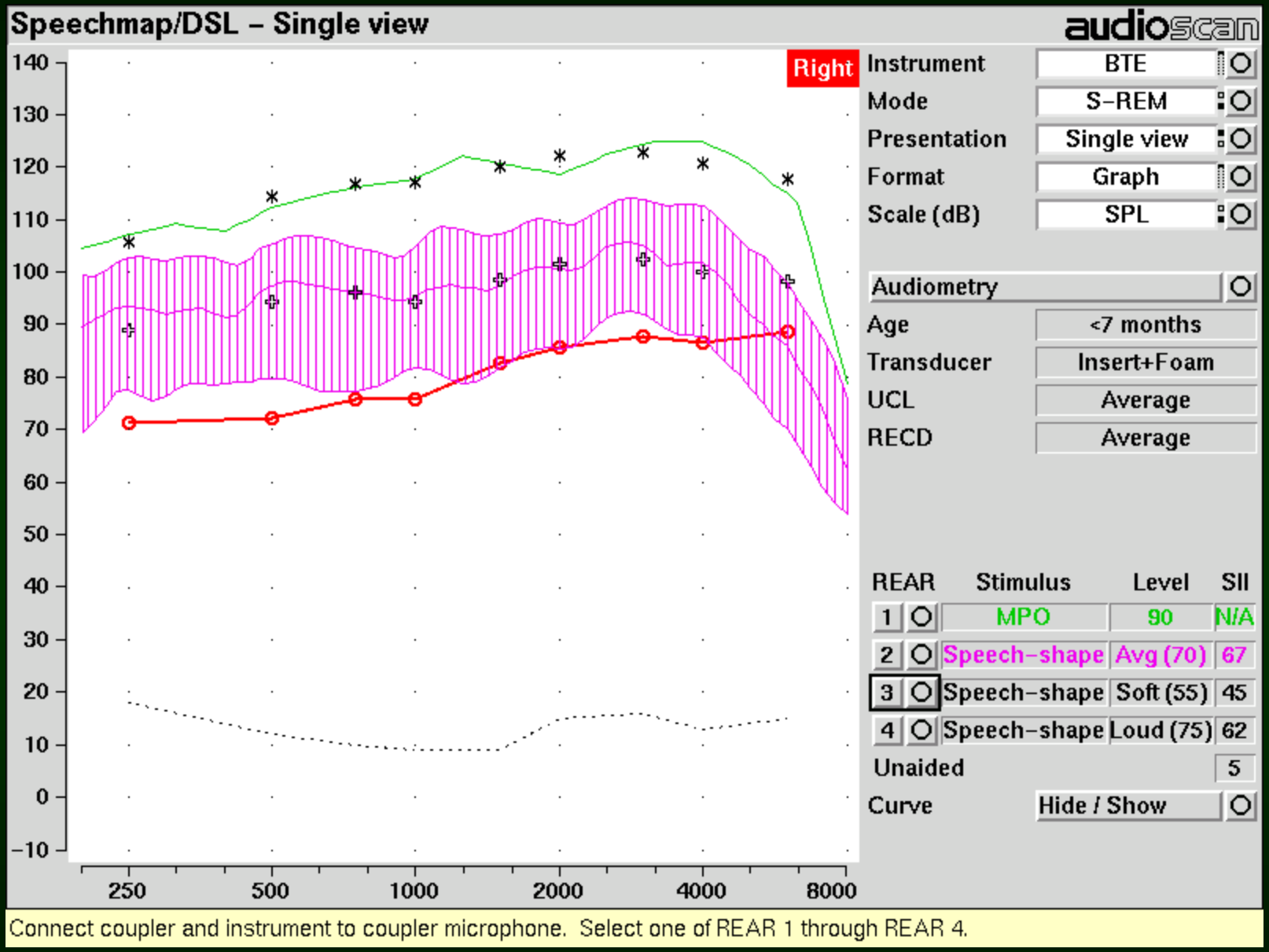
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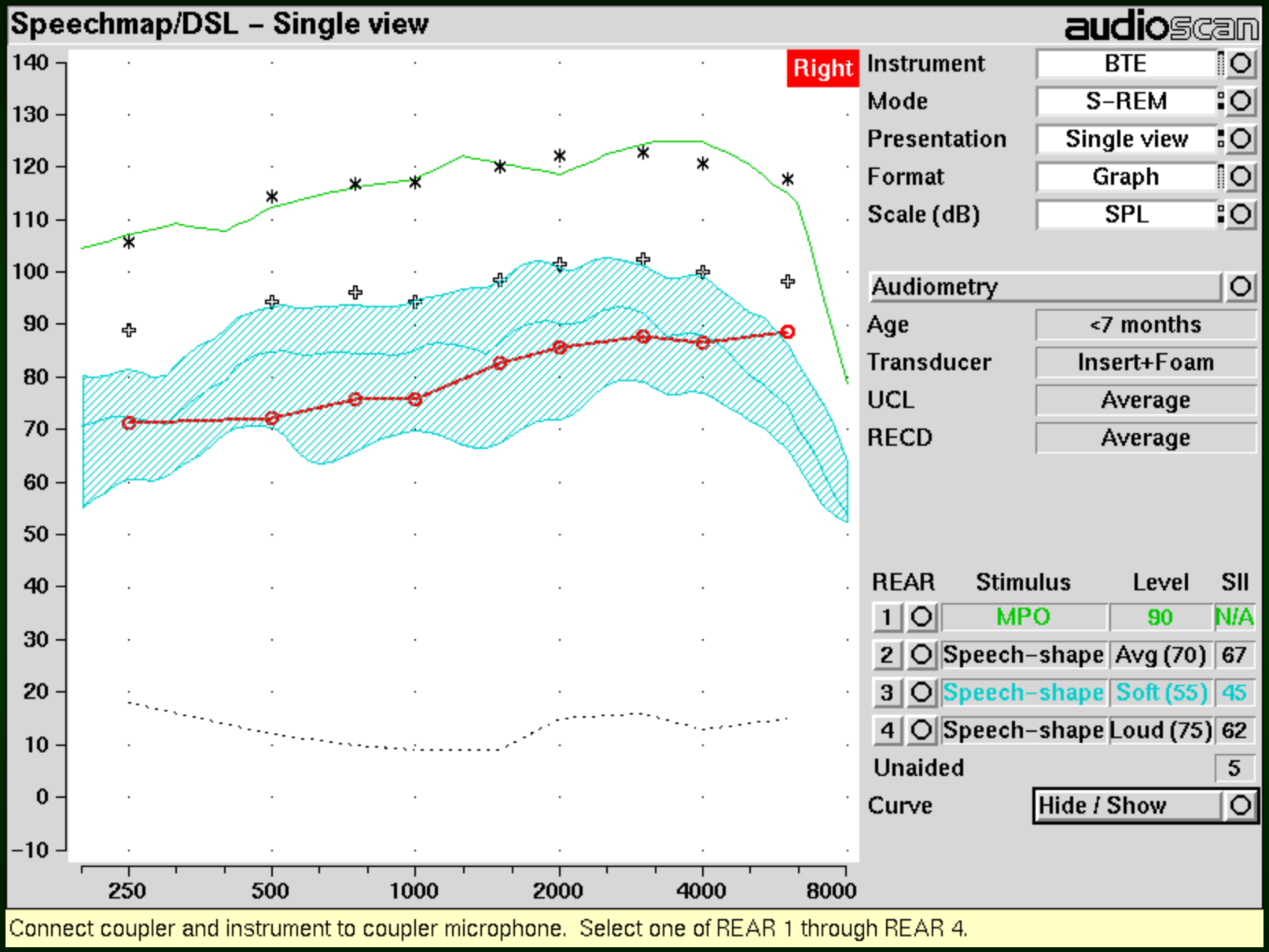
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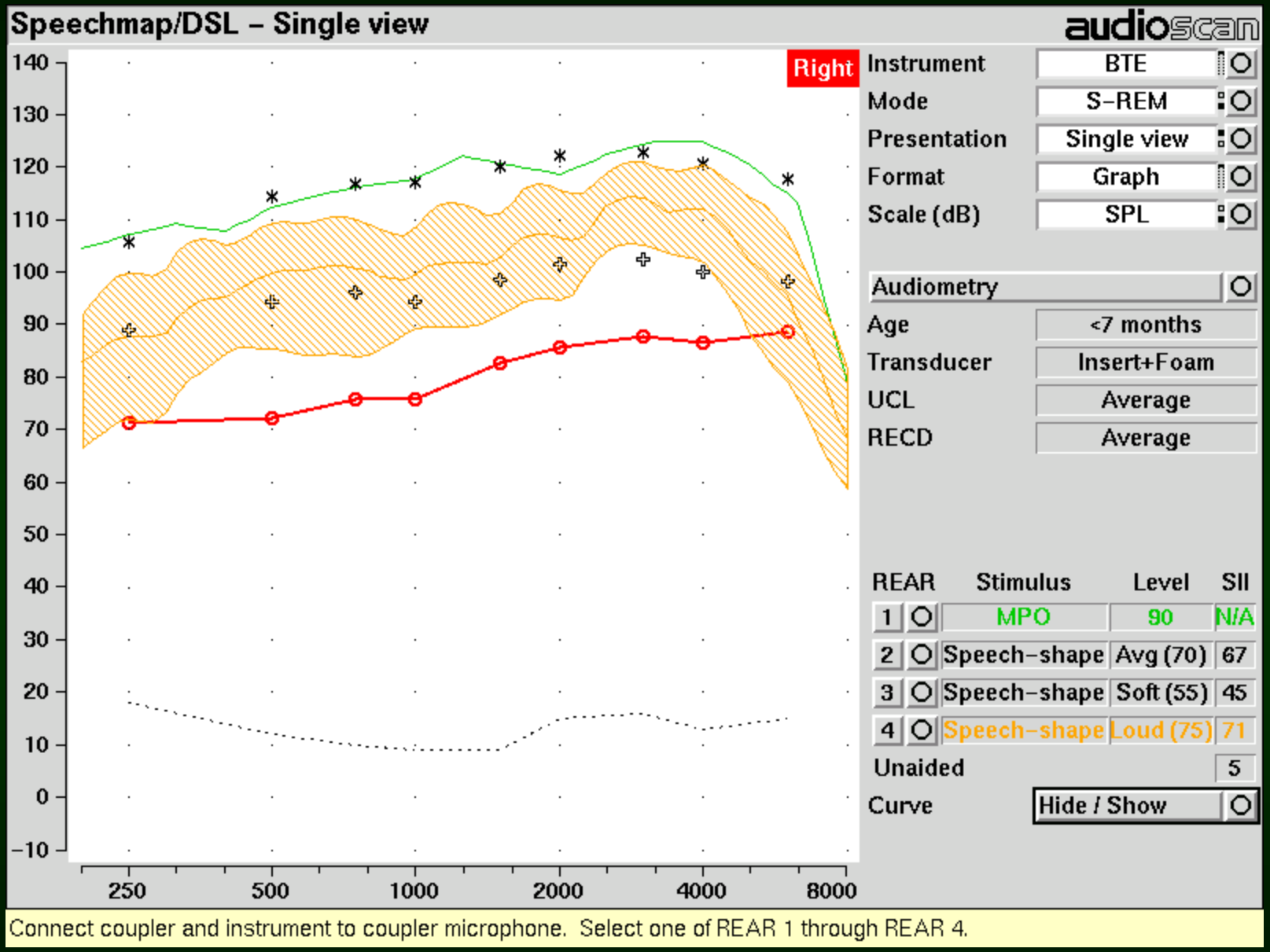
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Loud (75)
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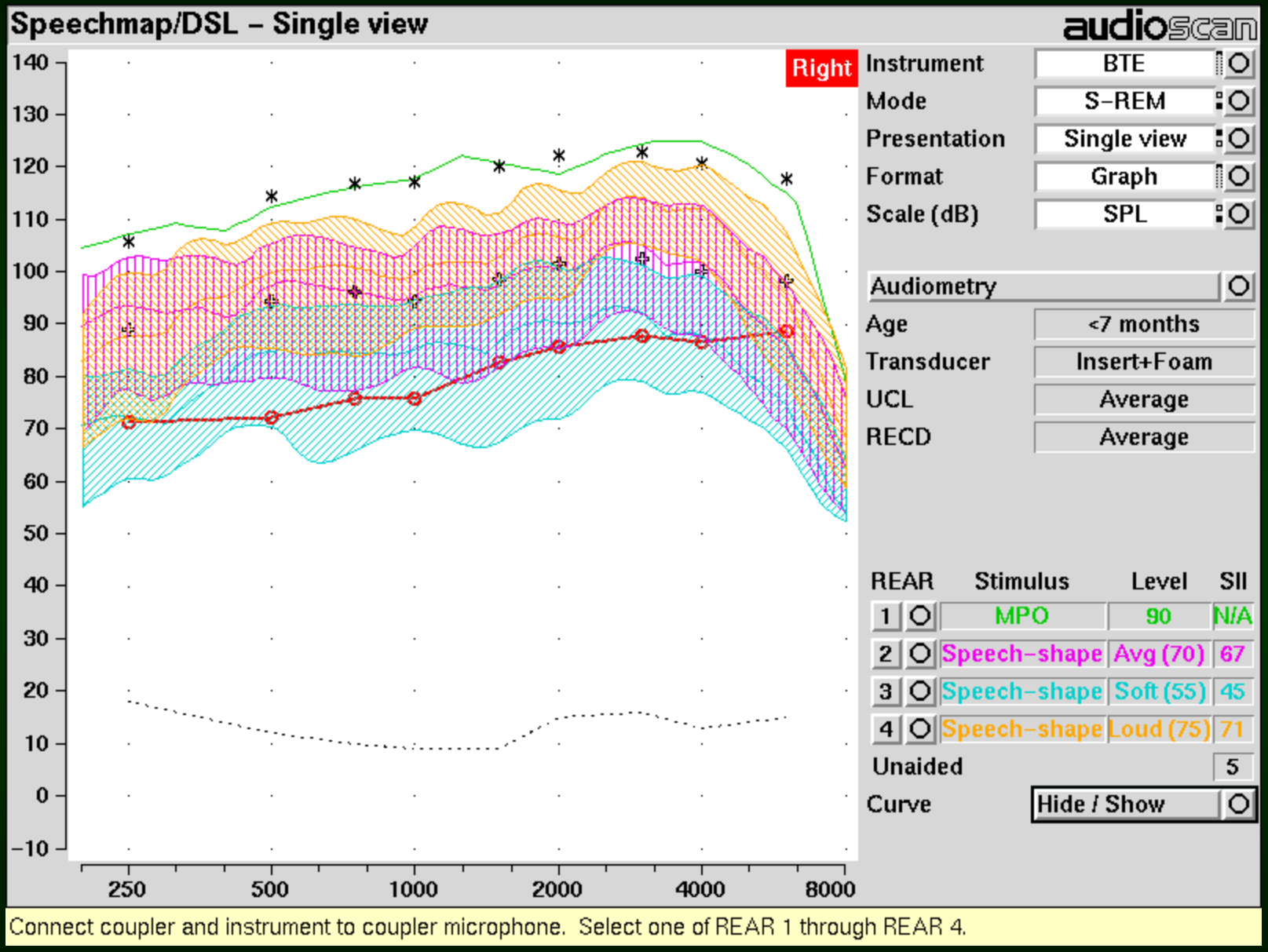
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Stimulus
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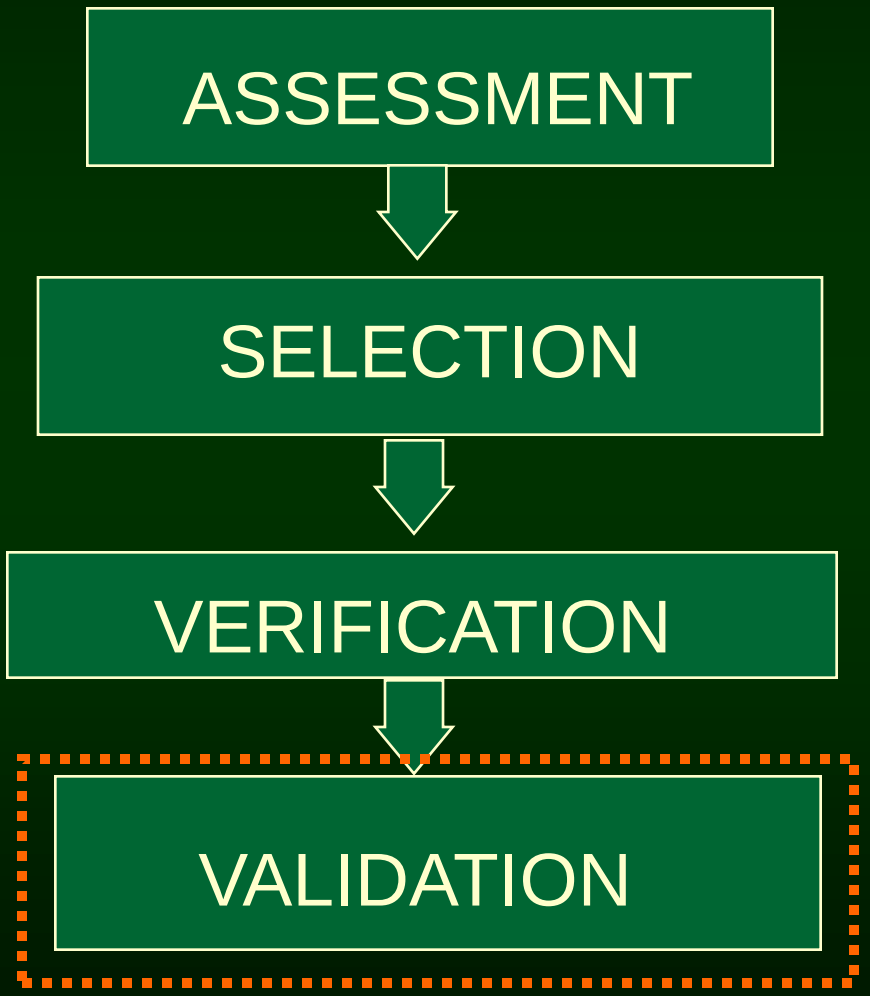
The Fitting Process



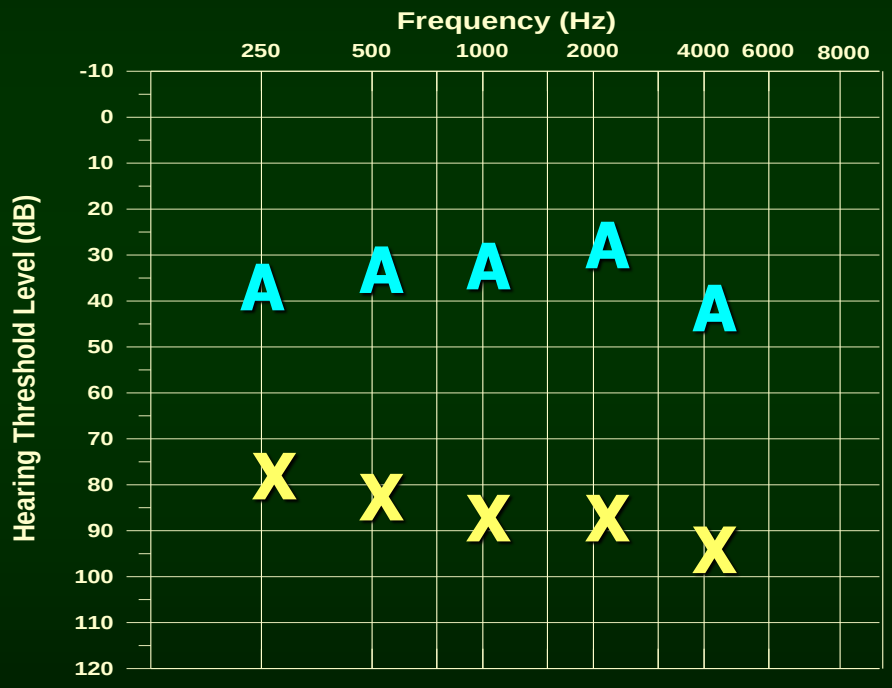
Component #6

We need to measure and monitor auditory performance and communication development with amplification over time.

- **objective measures**
- **subjective measures**

Component #6

- *Sound Field Aided Thresholds*



Component #6

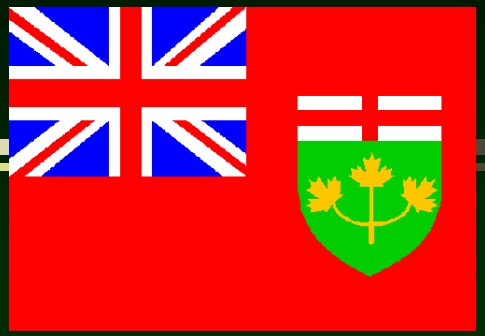
Validated Auditory-related Outcome Measures for Infants and Children:

- LittlEARS Auditory Questionnaire (Tsiakpini et al, 2004)
- Parent's Evaluation of Aural/Oral Performance of Children (PEACH) (Ching & Hill, 2005)

Infant Hearing Programs

Some thoughts on the need for clinical protocols

Ideally . . .



- Same equipment
- Same audiologic assessment procedures
- Same prescriptive procedures
- Same electroacoustic verification procedures, and so on . . .

Example

Hearing Instrument Fittings of Pre-School Children: Do we Meet the Prescription Goals?

Susan Strauss & Catherine van Dijk

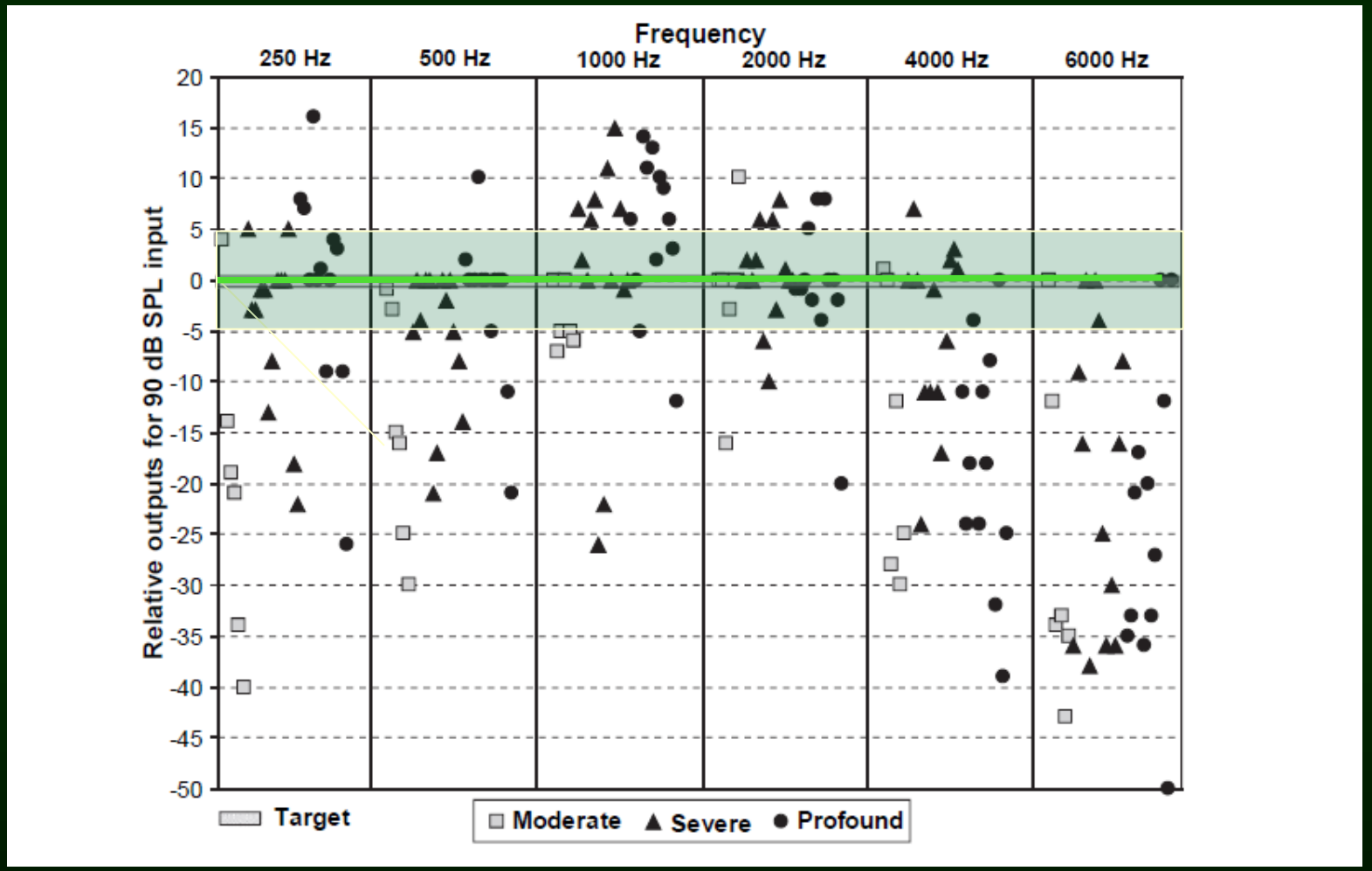
International Journal of Audiology

2008

Method

- Measured the output from 20 children's hearing instruments – total of 31 ears – moderate to profound hearing loss.
- Instruments fitted by a variety of clinicians.
- Compared the measured outputs to the DSLv5 prescribed levels for each child.

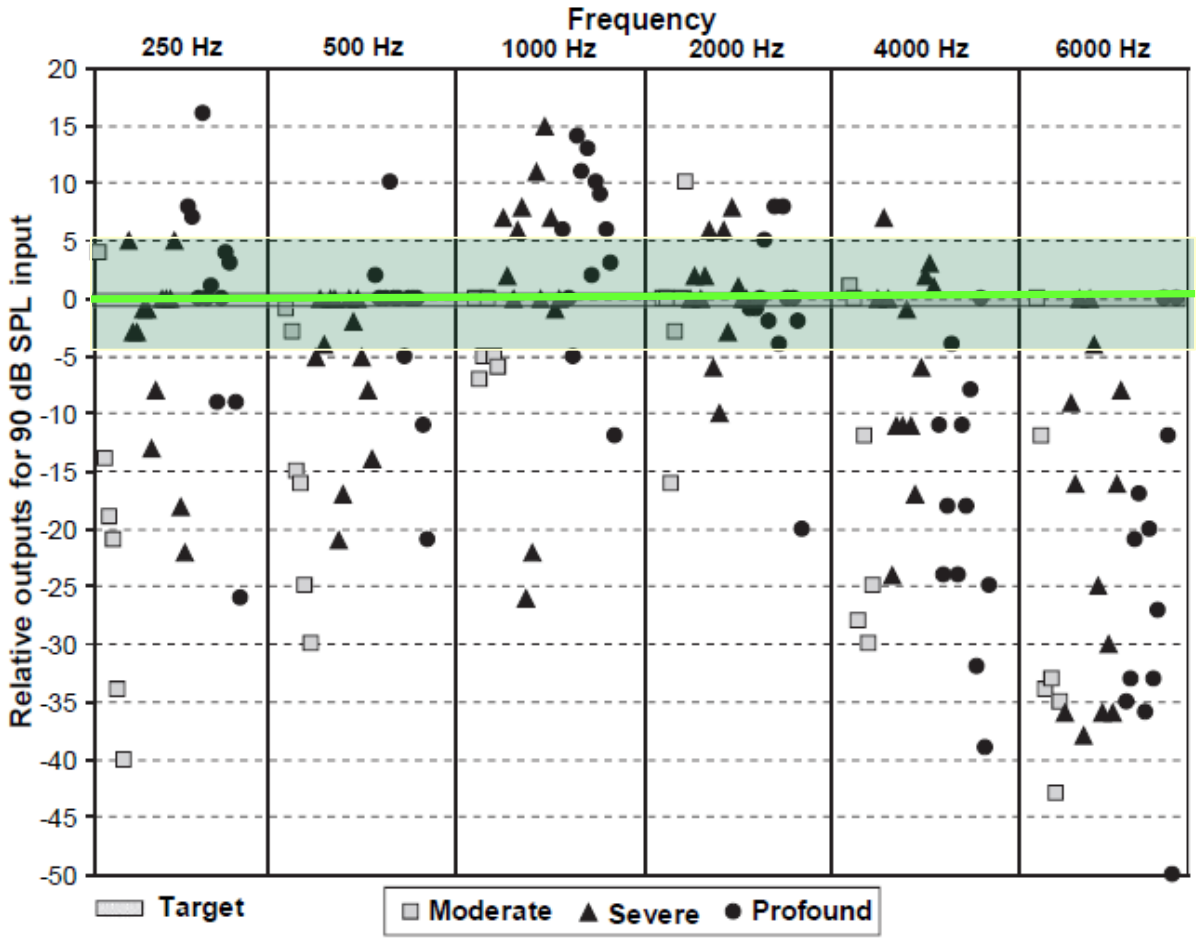
Results: 65 dB SPL speech input



Results: 65 dB SPL Input

- **Moderate Losses: 34%** had output values that were ±5 dB of the prescribed values.
- **Severe Losses: 47%** were within ±5 dB.
- **Profound Losses: 34%** were within ±5dB

Results: 90 dB SPL narrow band input



Results: 90 dB SPL Input

- **Moderate Losses: 34%** had output values that were ±5 dB of the prescribed values.
- **Severe Losses: 39%** were within ±5 dB.
- **Profound Losses: 92**% were 5 dB or more below the DSLv5 target values for output limiting.