

Optimizing outcomes with hearing aid verification

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Who am I?



- Director of the Research
- Director of the Audibility, Perception, and Cognition Laboratory

Three components of auditory experience

Language input

Audibility

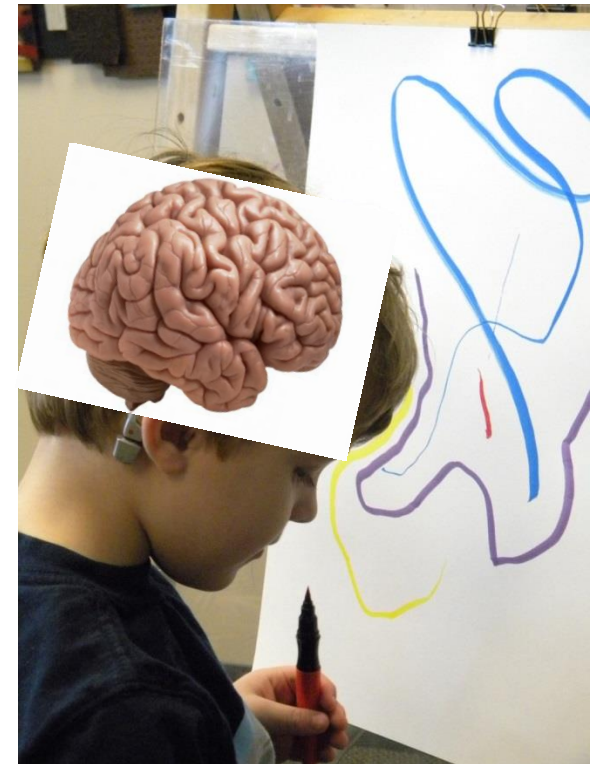
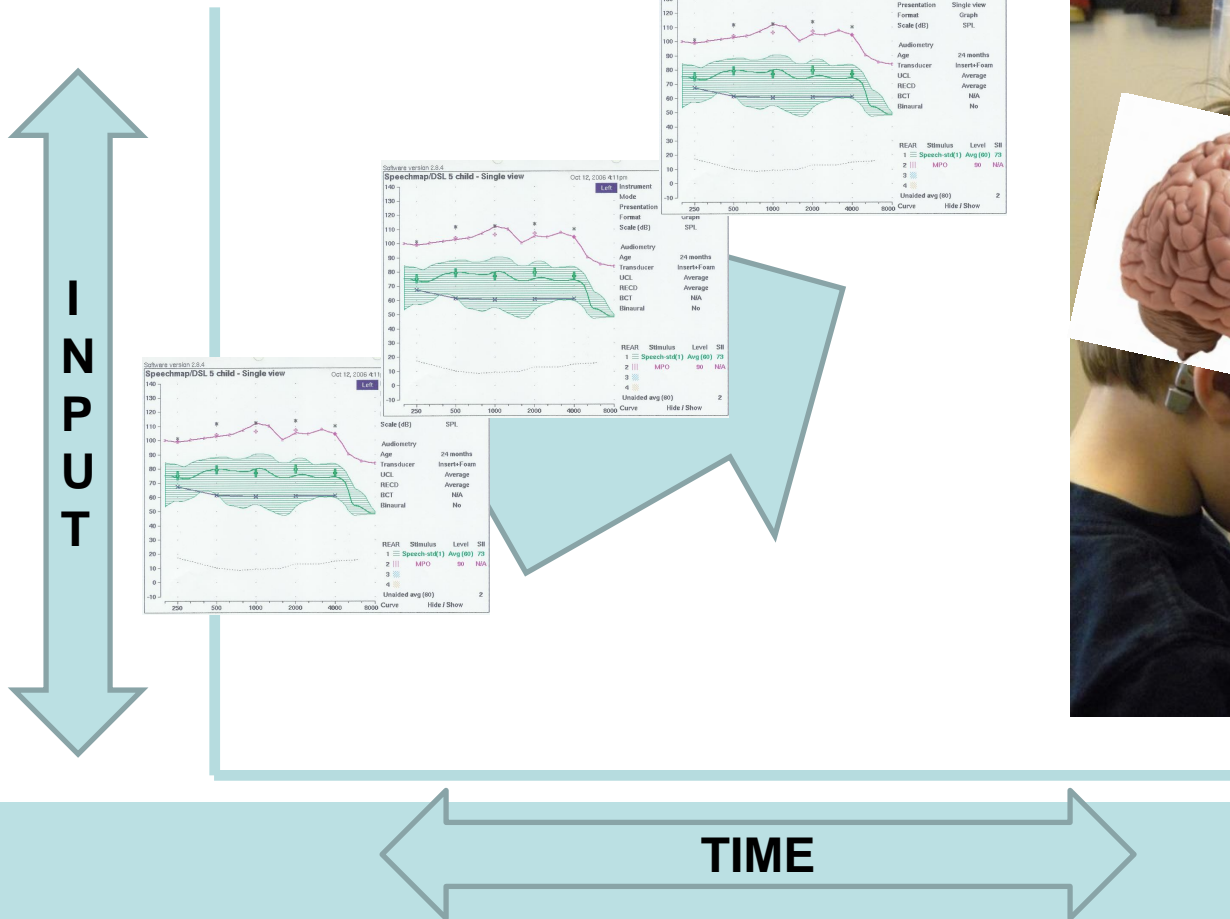


Hearing
aid use



Auditory
exposure

Cumulative Auditory Experience



GOAL

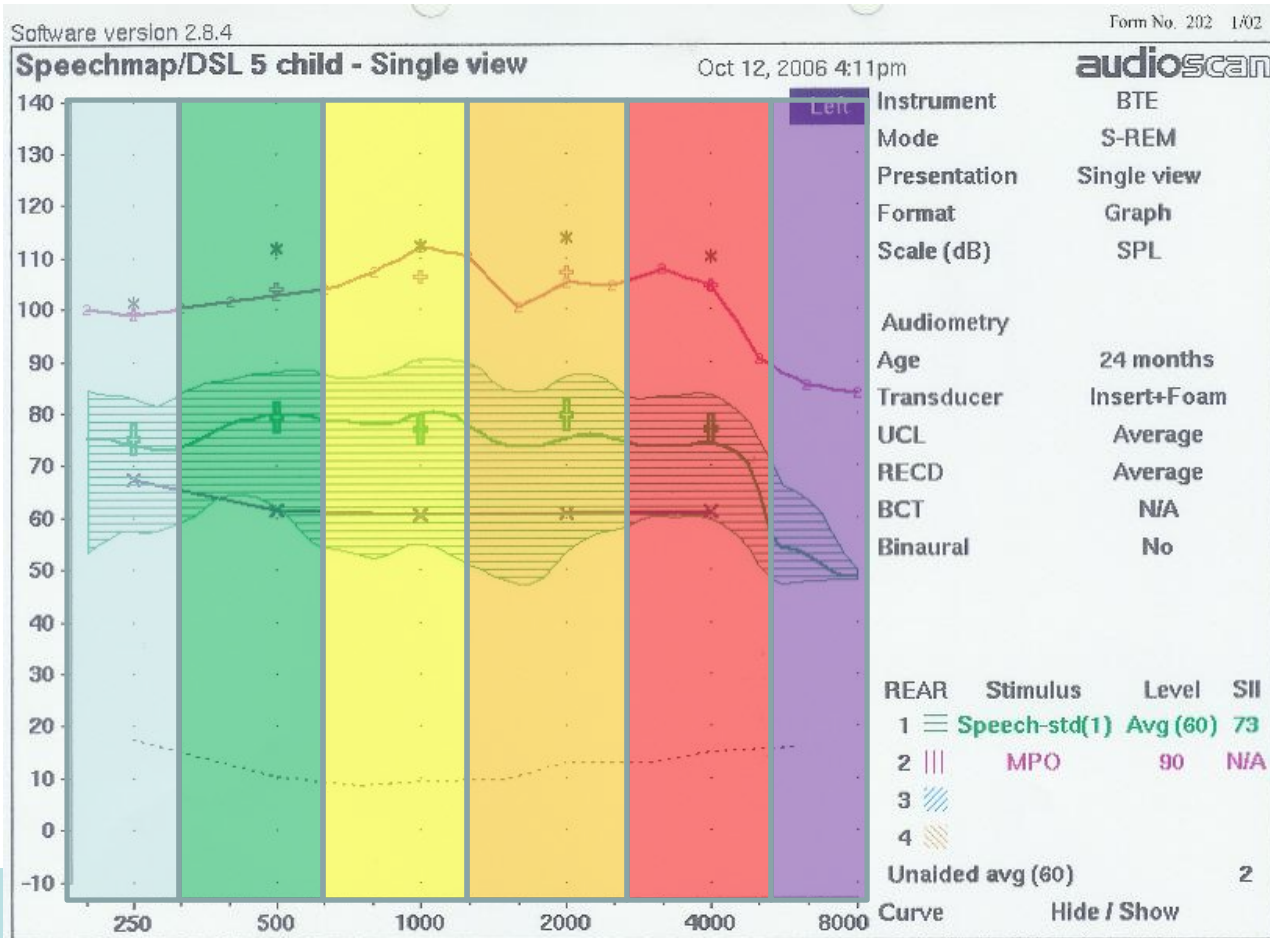
- To provide early and appropriate amplification to support communication development
 - Make speech information audible
 - Support parents and caregivers
 - Information
 - Emotional support

Audibility

- How well we can hear a specific sound
- Children can only develop what they hear
- Determined by:
 - Hearing thresholds
 - **Level** and **location**
 - Noise
 - Device (if present)



SPL-o-gram SII Snapshot

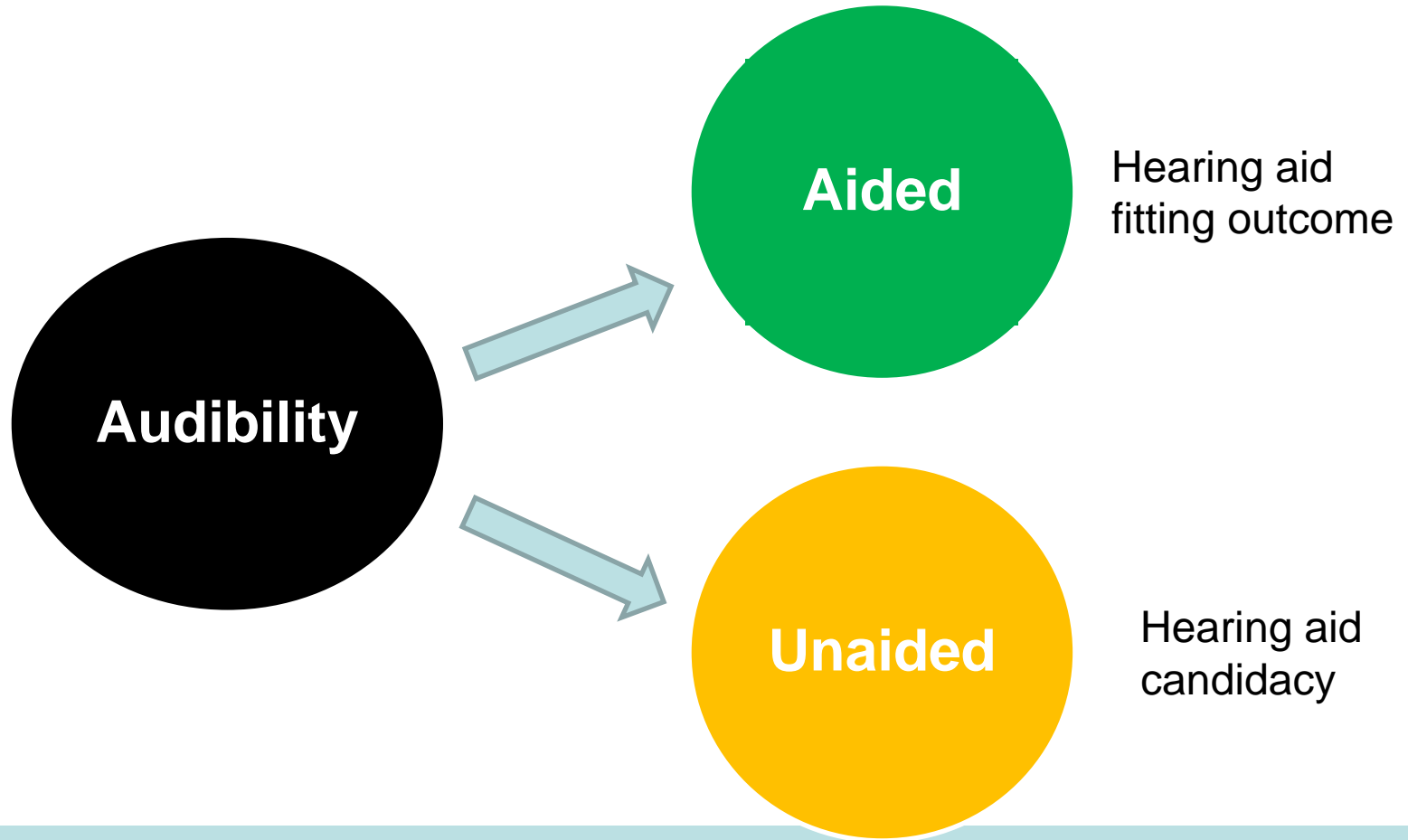


For each band –
 Audibility x FIW =
 weighted audibility

SII = Sum of
 weighted
 audibility of all
 frequency bands

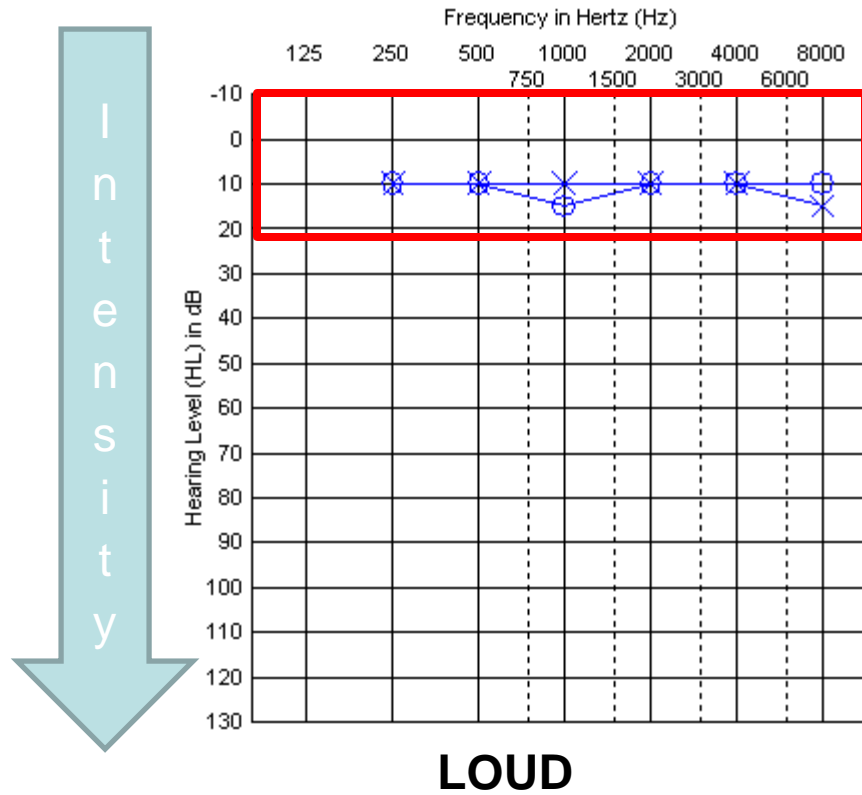


Audibility



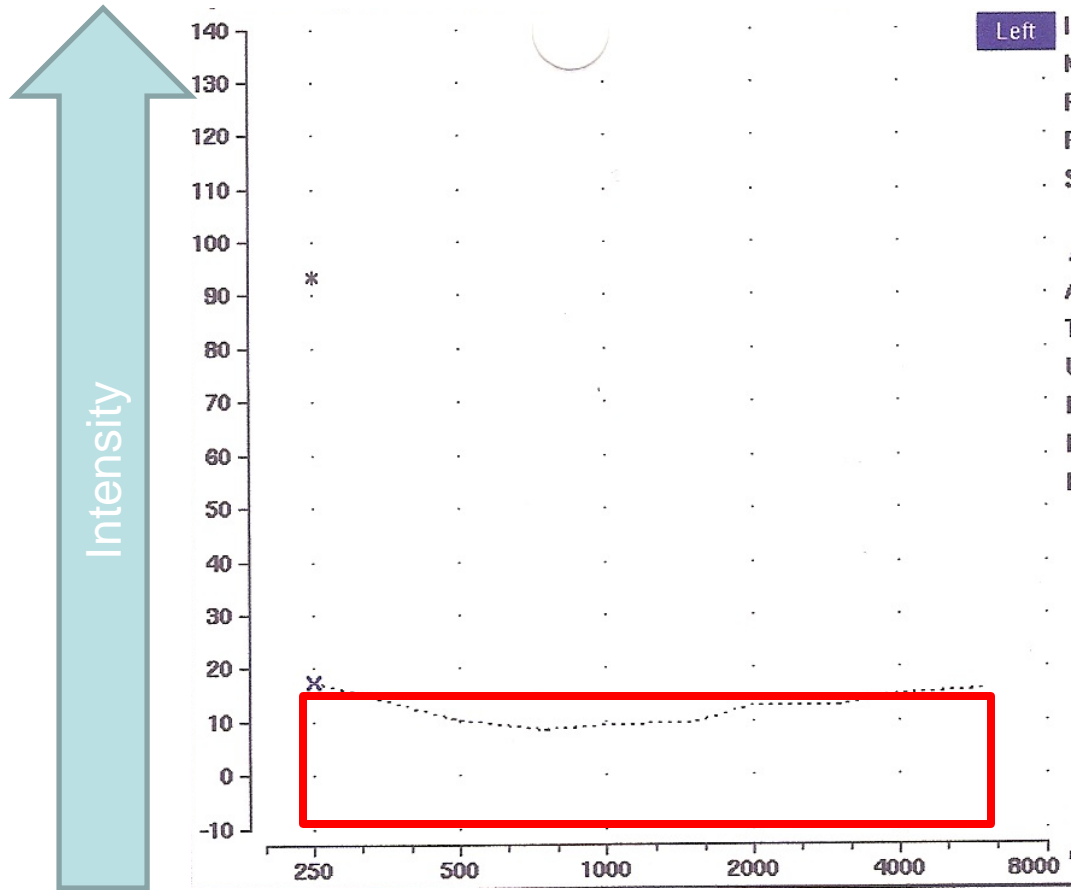
Audiogram

SOFT

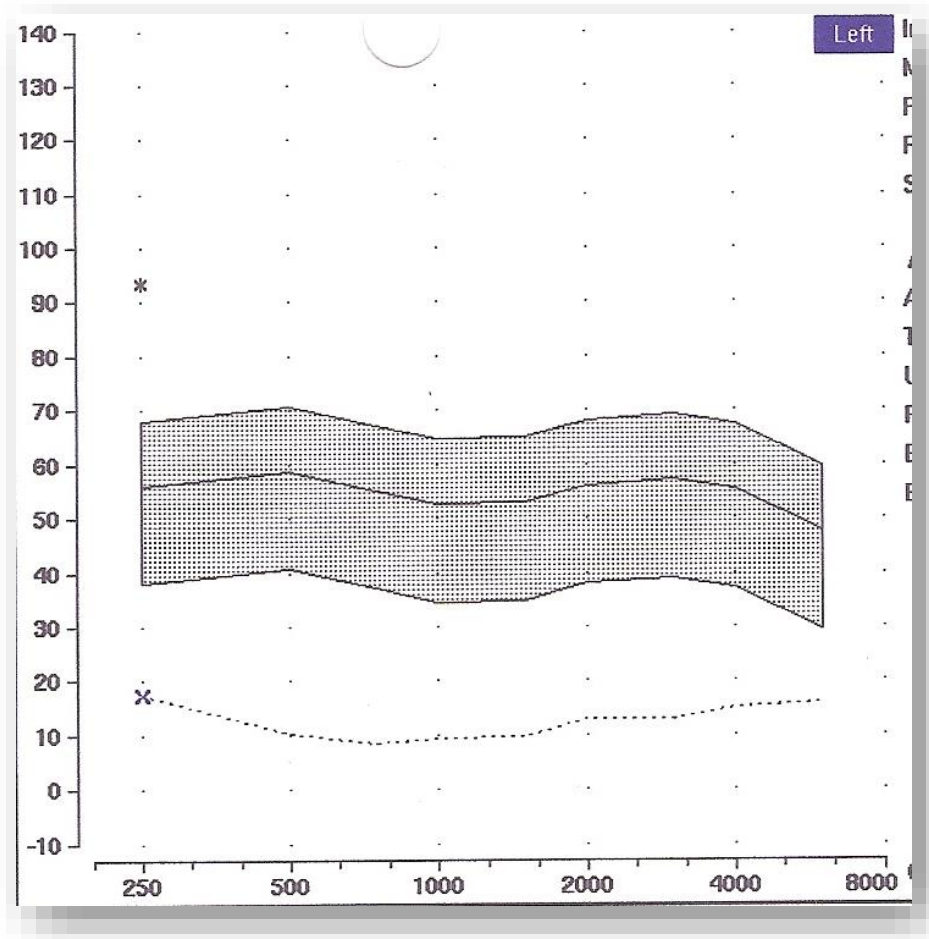


X – Left ear
O – Right ear

SPL-o-gram

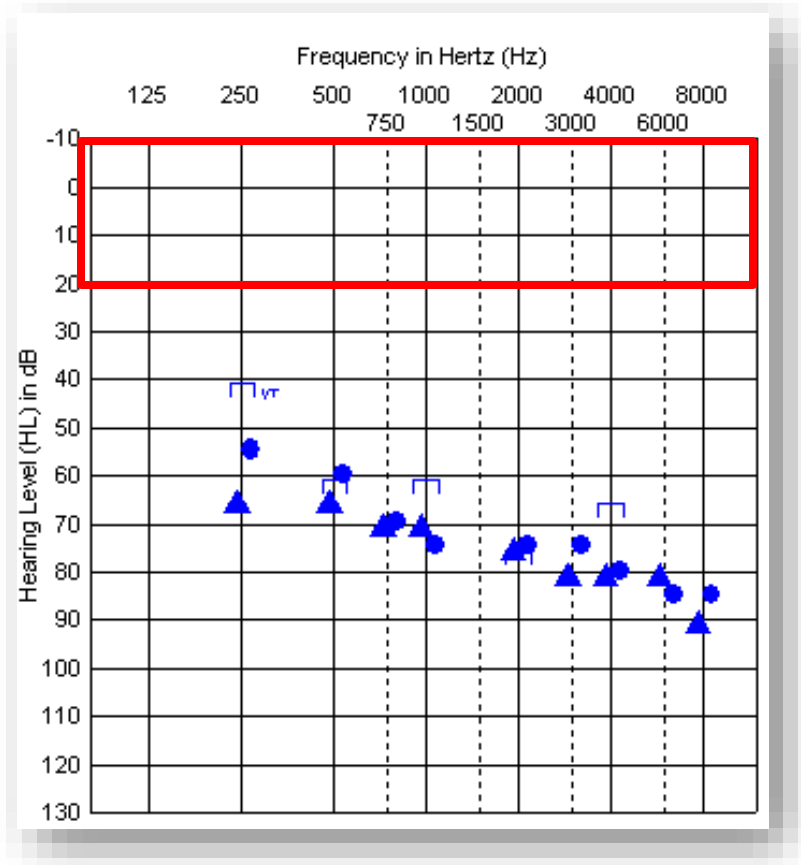


Average speech spectrum

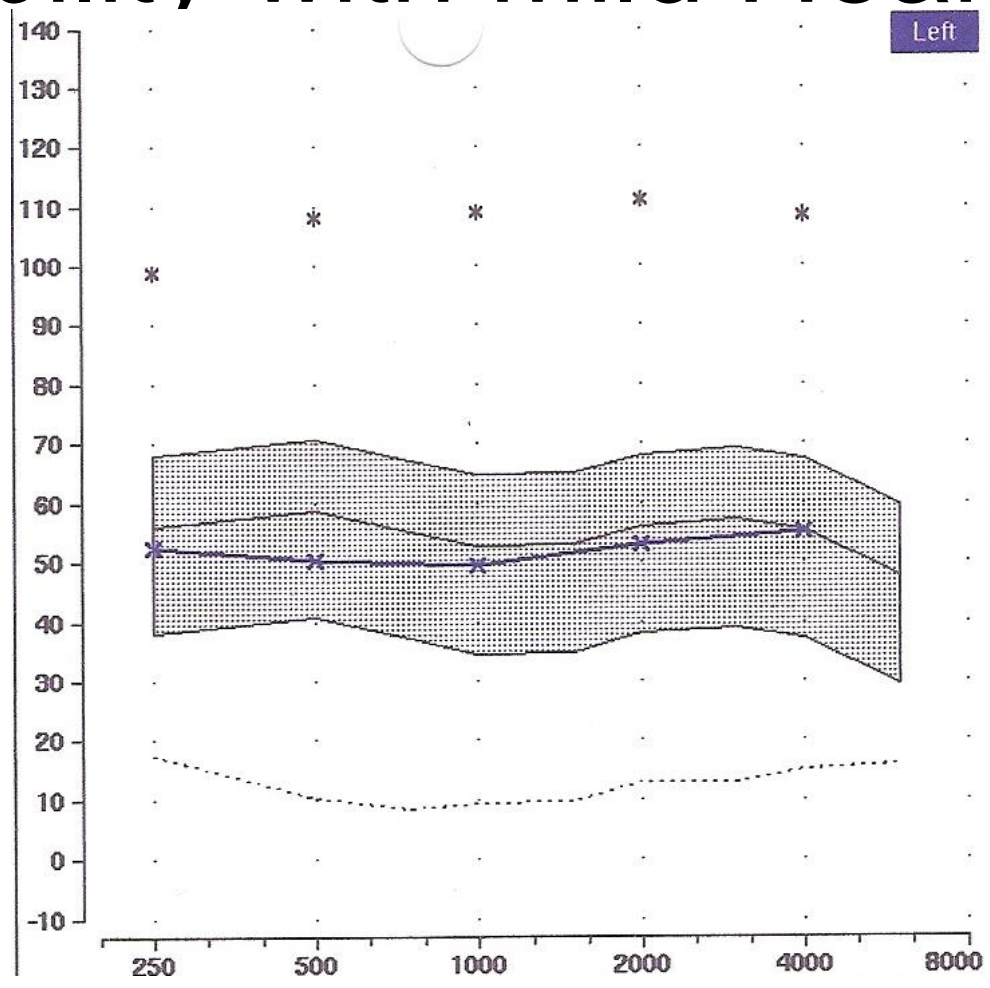


Hearing Thresholds

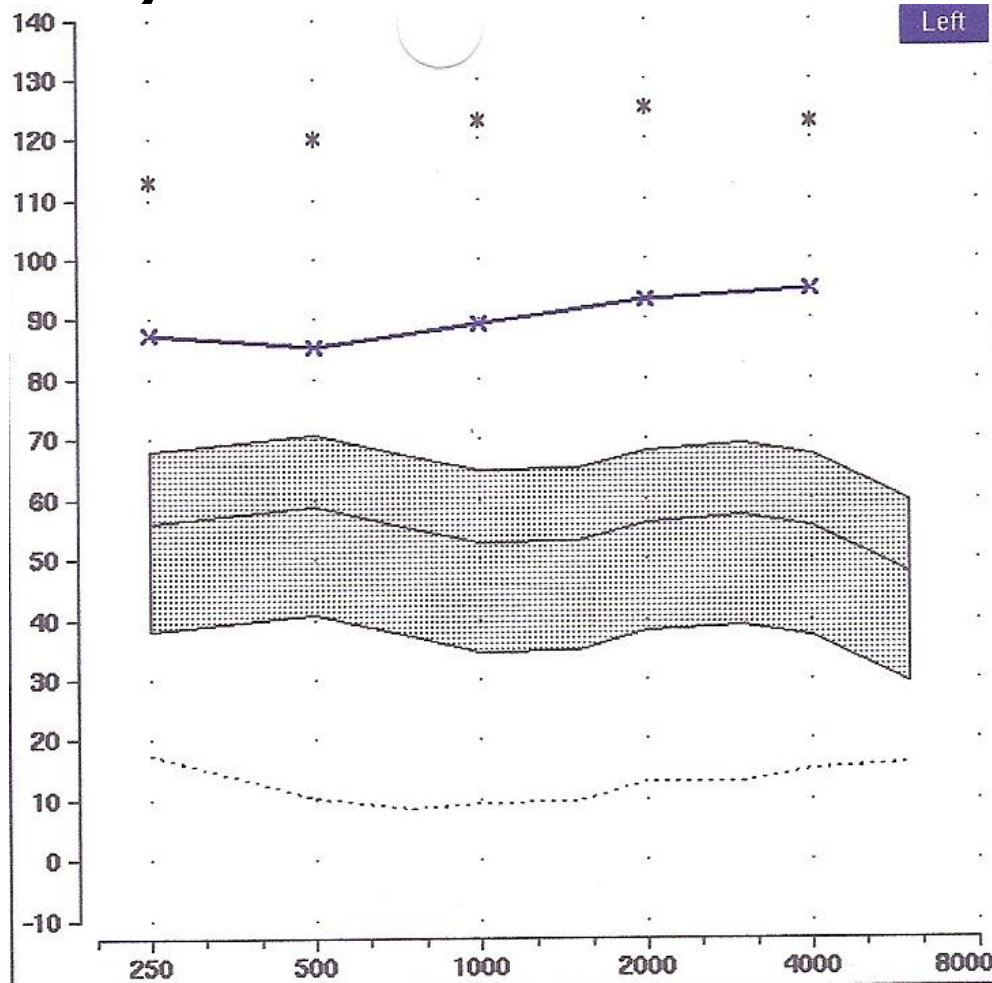
- Hearing loss results in loss of audibility for speech and other important sounds.
- Greater hearing loss = more limited audibility



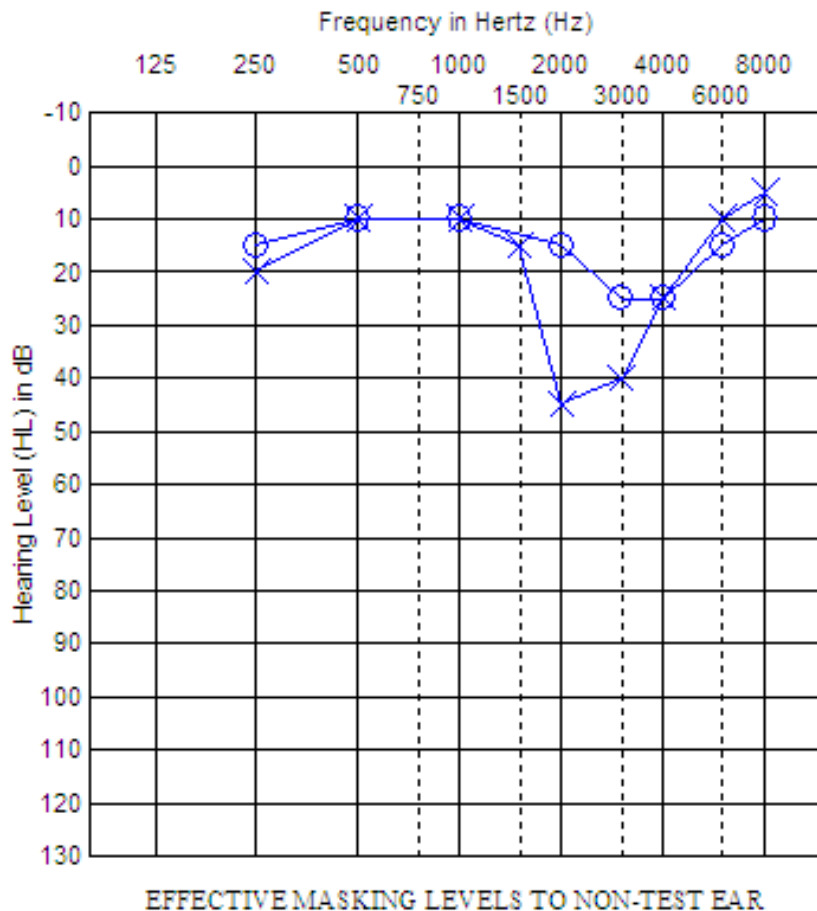
Audibility with Mild Hearing Loss



Audibility with Severe Hearing Loss

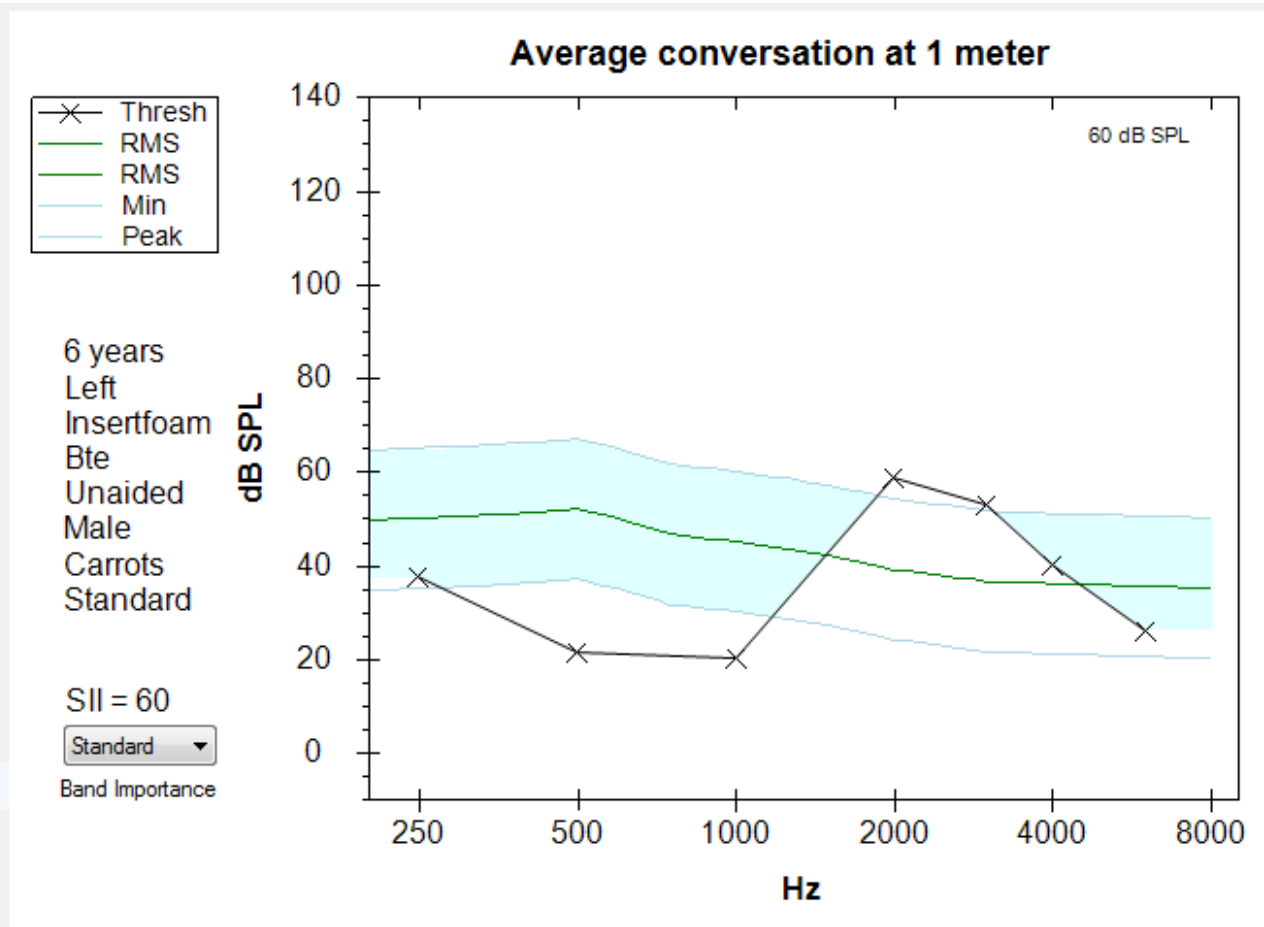


Candidate for amplification?



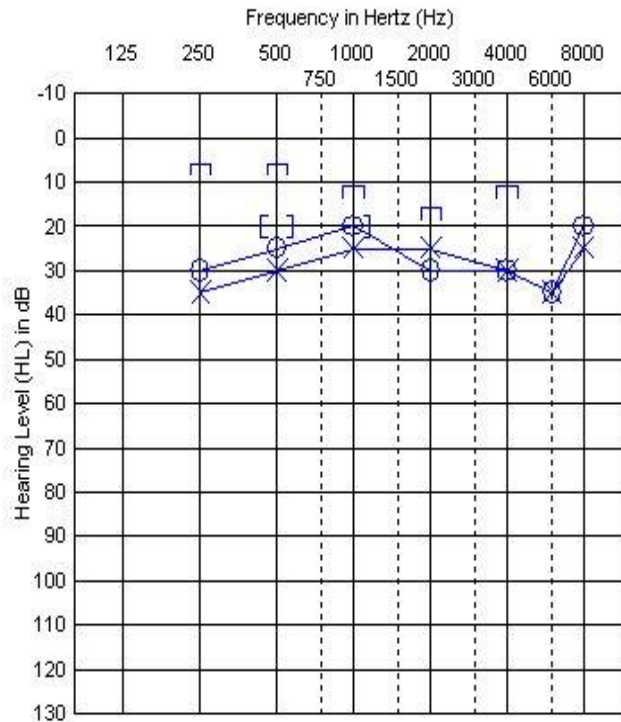
- 6 year-old
 - 100% PBK in quiet
 - BKB-SIN + 2 dB SRT
- No difficulties in classroom or parent concerns

Unaided audibility



Hearing aid candidacy

- Audiogram method



EFFECTIVE MASKING LEVELS TO NON-TEST EAR

Reliability: Good Fair Poor
 Method: VRA CPA **Conv** Computer

KEY TO AUDIOGRAM

Ear	R	L	
AC (TDH-49)	○	×	WR - Word Recognition
AC (ER-3A)	●	▲	SAT - Speech Awareness Thr.
BC (masked)	[]	SRT - Speech Reception Thr.
NR	↙	↘	SL - Sensation Level
Unmasked BC]		SF - Sound Field
SF Warble Tones	☐		ETF - Eustachian Tube Function
Single Responses	+		NR - No response
Vibrotactile	vr		DNT (CNT) - Did (Could) Not Test

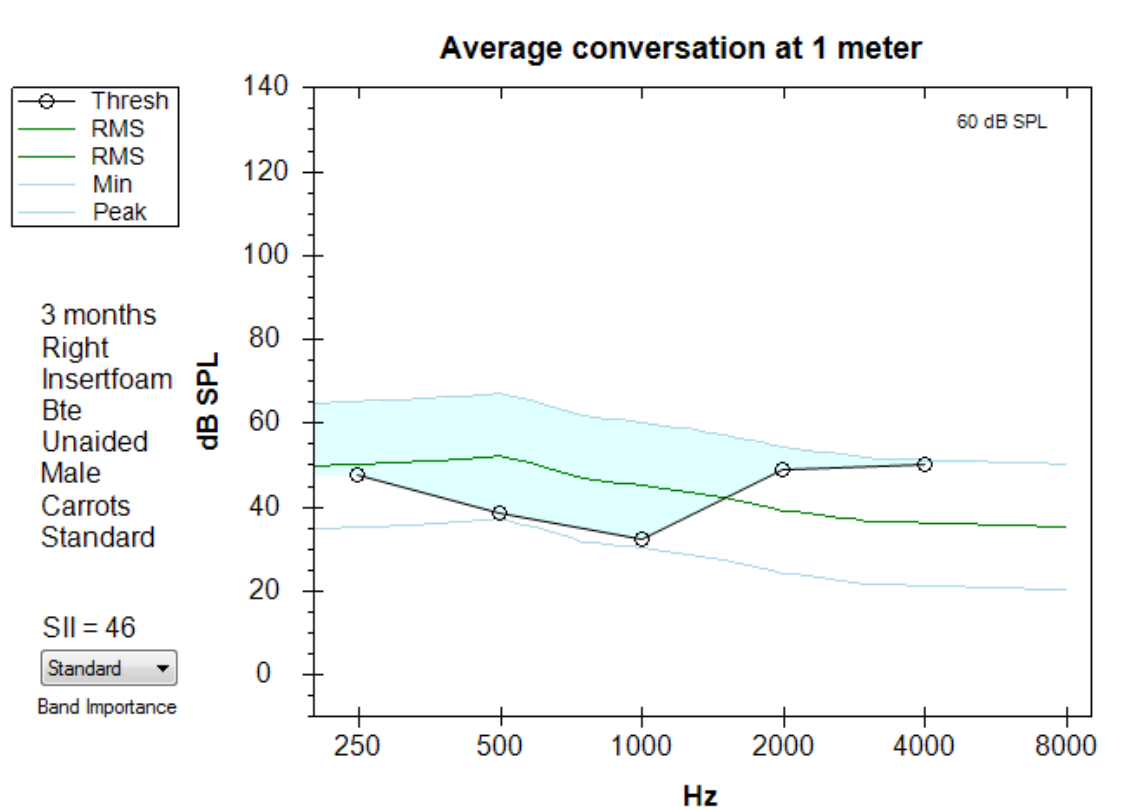
Speech Audiometry

EAR	SRT	SAT	Level		Speech Materials		
			%	%			
R	20		75	68	75	76	NU-6
L	20		60	76	75	72	NU-6
SF					75	88	
BC							

(Masked) (*=half list)

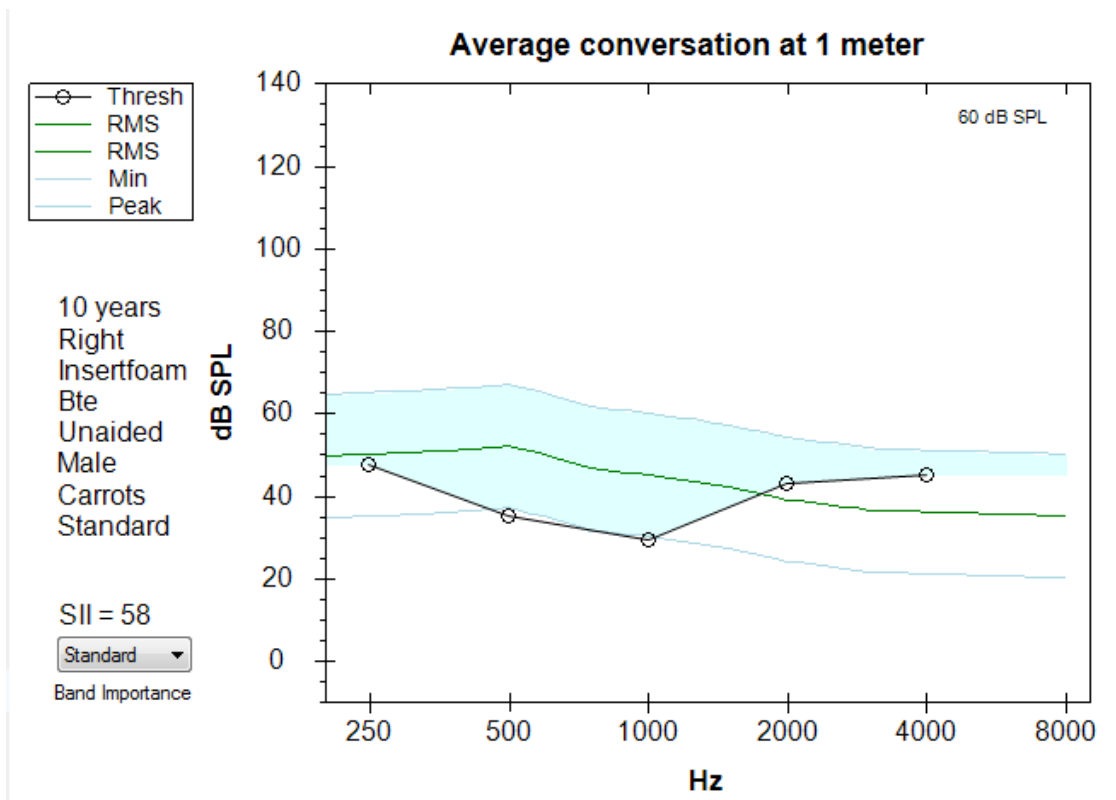
Hearing aid candidacy

- Audibility method – 3 month-old



Hearing aid candidacy

- Audibility method – 10 year-old



Hearing aid candidacy

- Audibility

How does ear canal acoustics influence diagnostic assessment?

How does the hearing loss impact audibility?

Goals of Pediatric Amplification

- Promote speech and language development
- Ensure **audibility** of speech
- Provide early intervention
- Minimize error
 - Not eliminate

How do we fit hearing aids for children?

- Verification
 - Measuring the output of the hearing aid in the child's ear to estimate audibility for speech.
- Prescriptive formulae
 - Desired Sensation Level (DSL; Scollie et al.)
 - Developed to maximize audibility regardless of hearing loss
 - Provides frequency-specific **targets** for speech based on degree of hearing loss

Desired Sensation Level

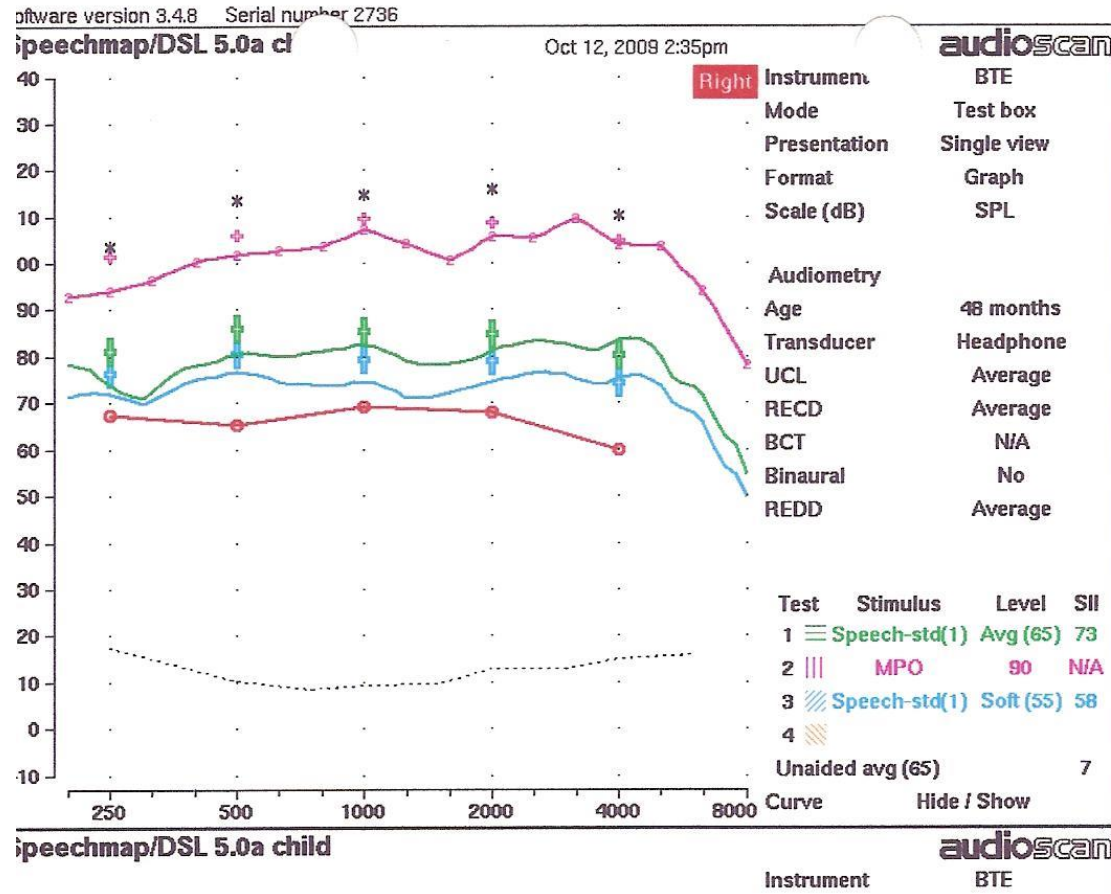
DSL has targets for multiple input speech levels

Soft – 50/55 dB SPL

Average – 60/65 dB SPL

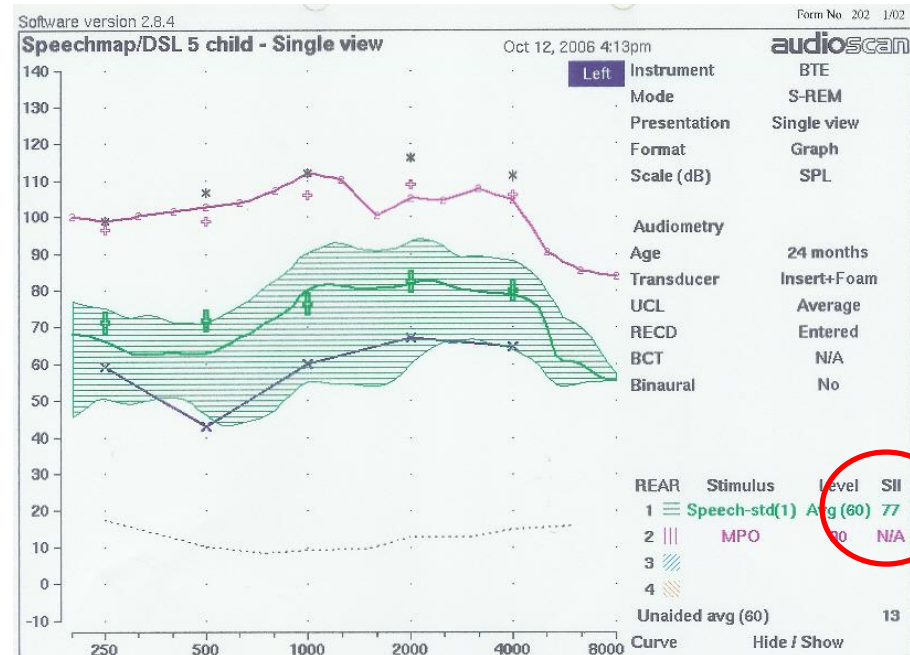
Loud – 70/75 dB SPL

Maximum Power Output (MPO) - Safety - 90 dB



Is matching prescriptive targets enough?

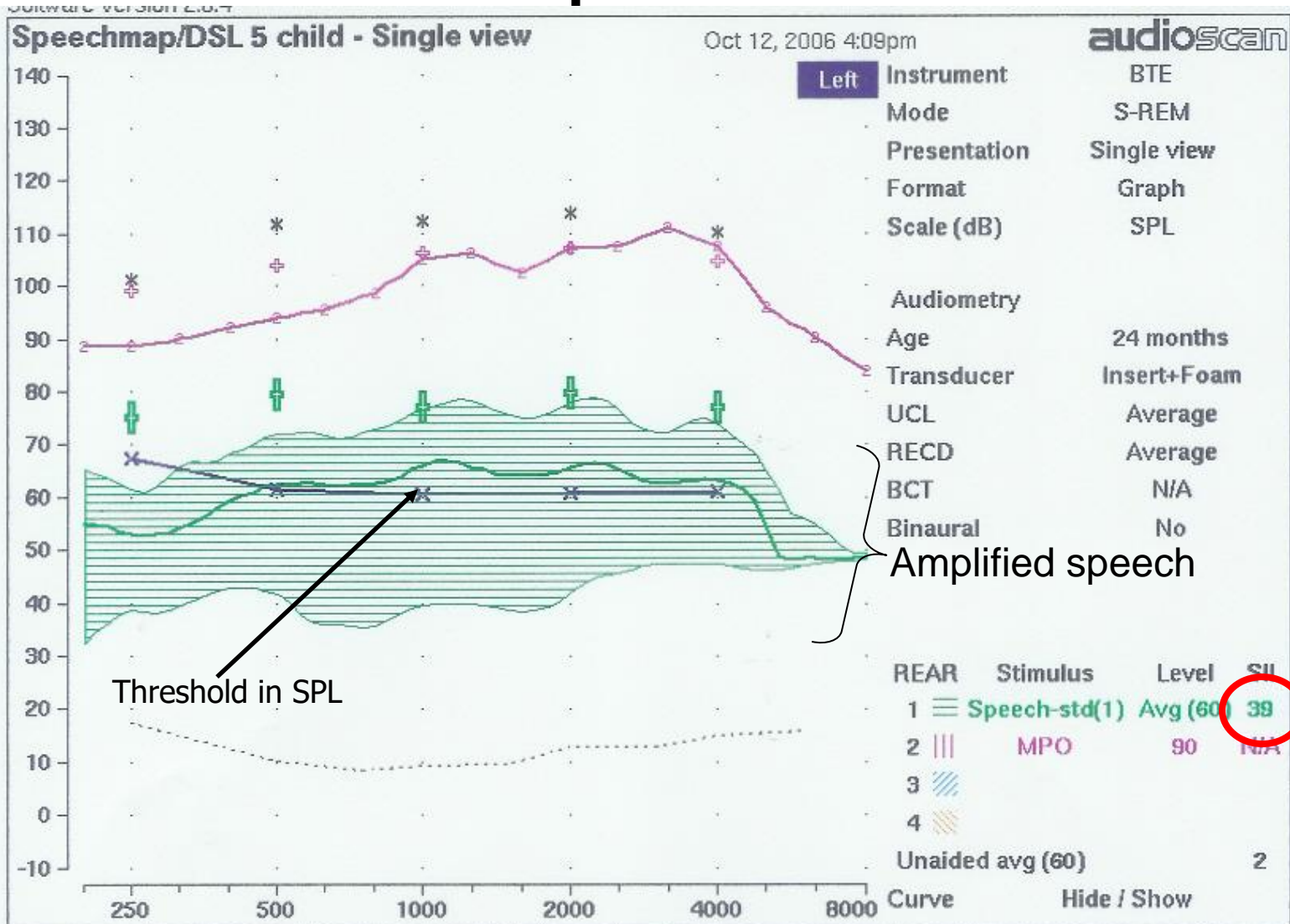
- Goal is audibility
- What about the speech intelligibility index (SII)?
 - SII objective measure of speech audibility
 - Number between 0 and 1 or percentage/proportion



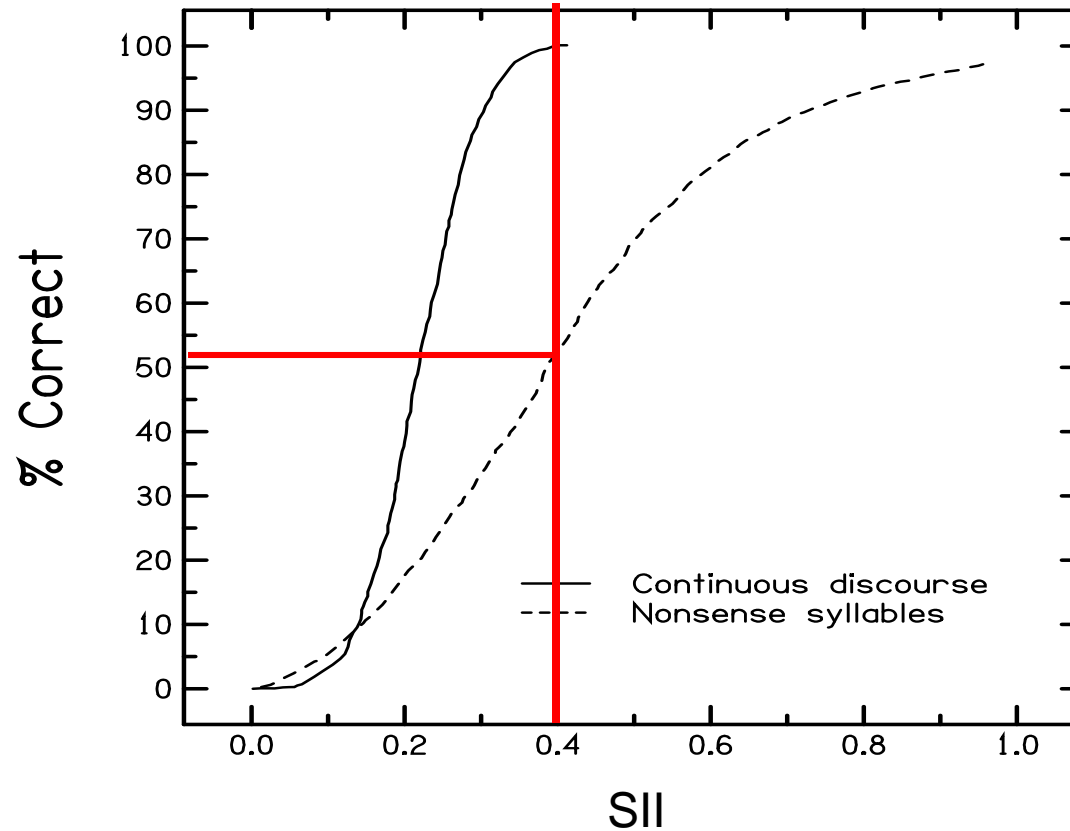
How do we interpret SII?

- More is obviously better!
- What number is the goal?
- What do we do when we don't have a good SII?

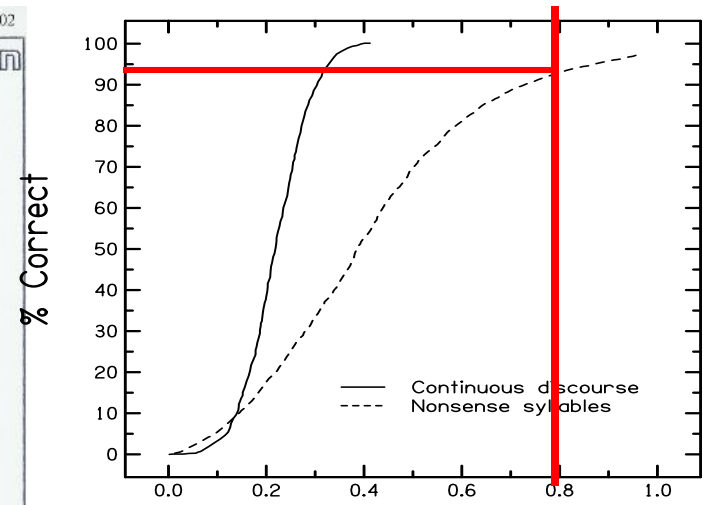
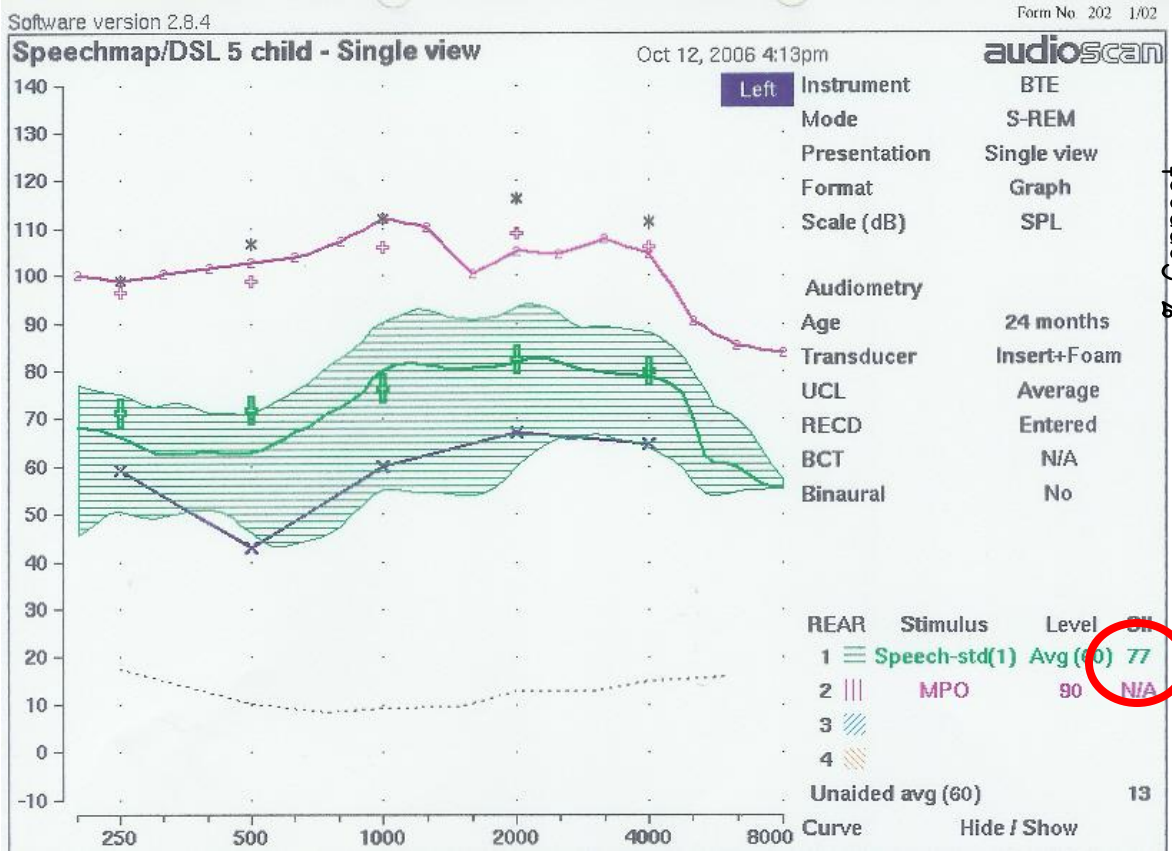
Example Patient



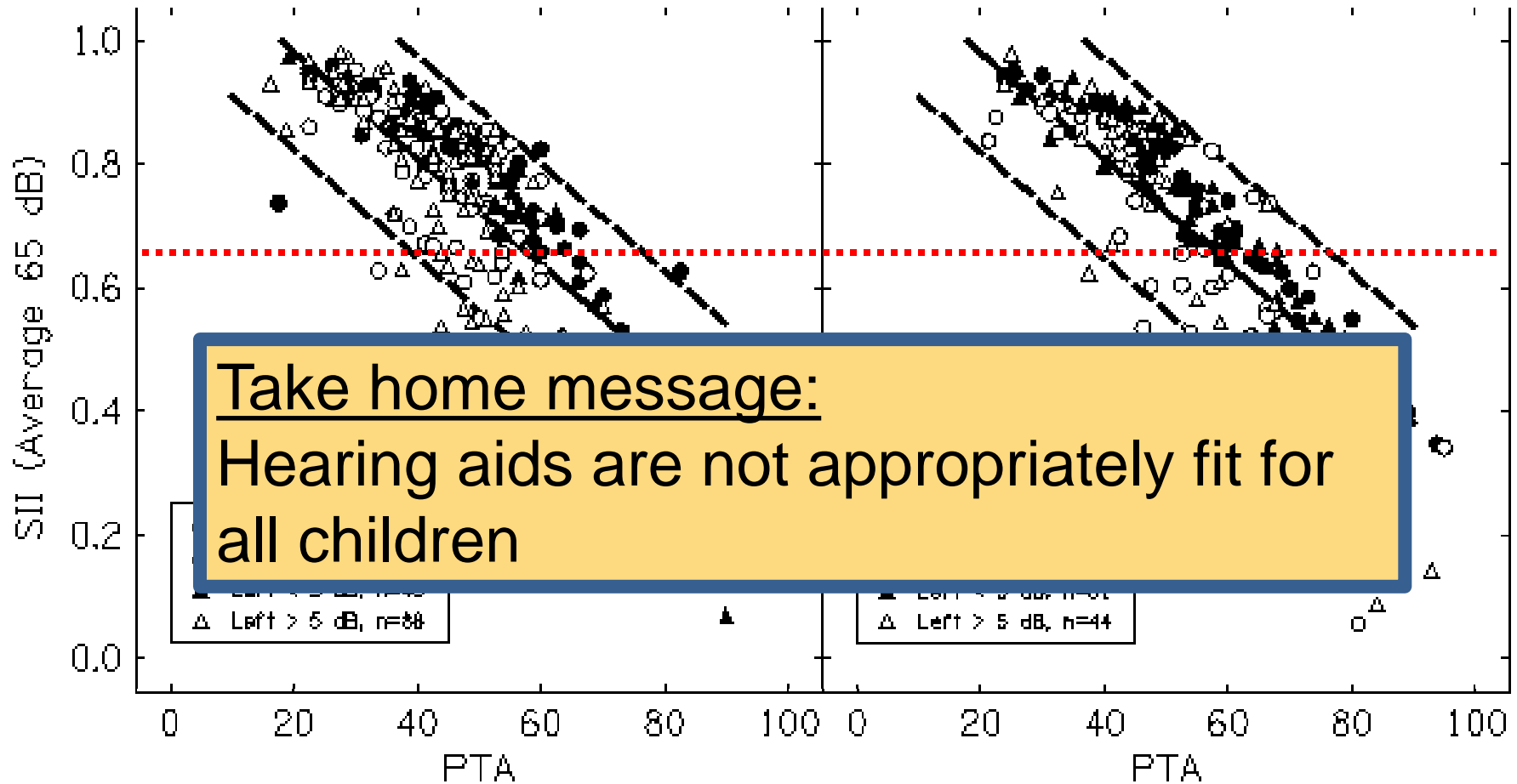
Audibility?



Adjustments?



Actual Hearing aid fit quality

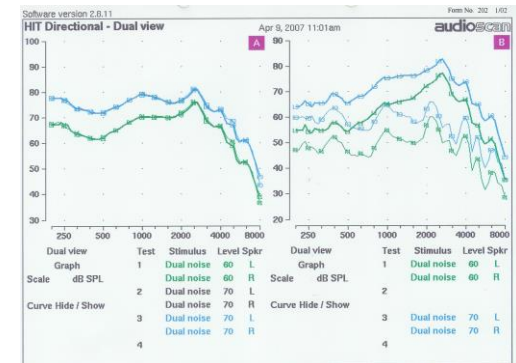
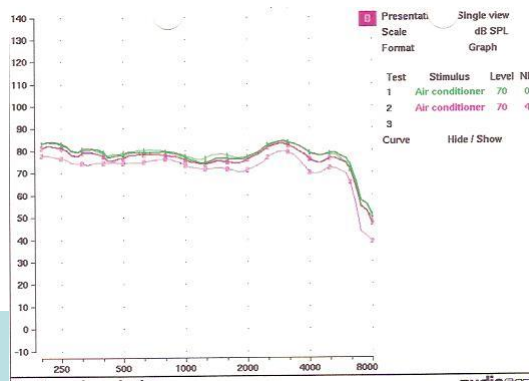
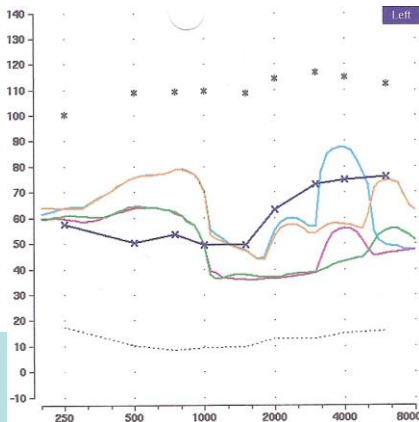


Summary SII

- SII is a useful tool:
 - May predict outcomes (e.g. Stiles et al. 2012)
- Use normative SII range from PedAMP
- Predictions of speech recognition for kids
 - Model using low context materials (nonsense syllables)
 - Measure empirically
 - Lots of variability

Verification Master Class

- Basic verification of audibility
- Advanced Verification
 - Frequency lowering (Sound Recover 2)
 - Directional microphones
 - Digital Noise Reduction





Thank you!