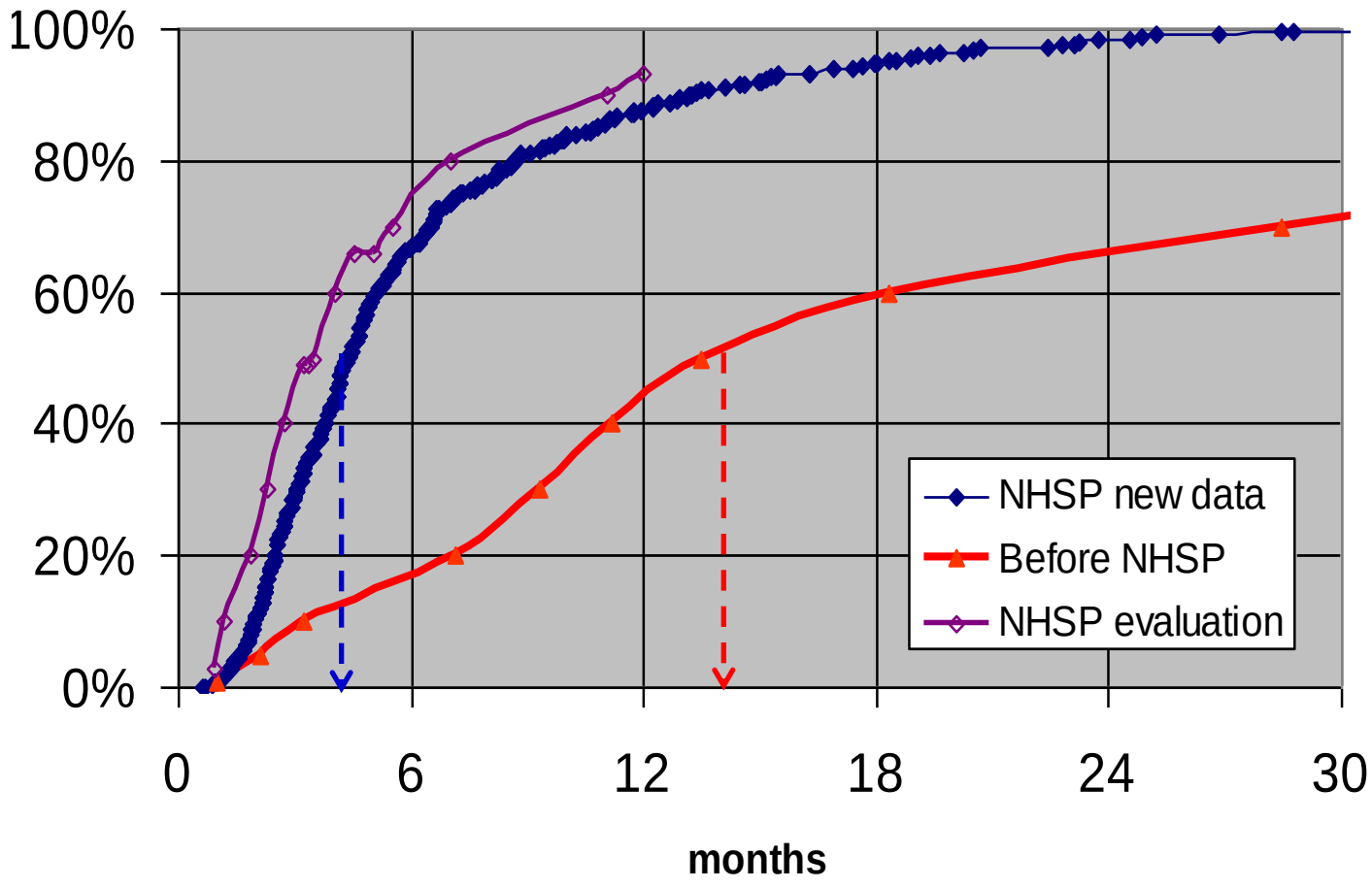
Special considerations for hearing aid fitting in young children: new and emerging developments

MANCHESTER 1824
The University of Manchester

Central Manchester University Hospitals NHS
NHS Foundation Trust

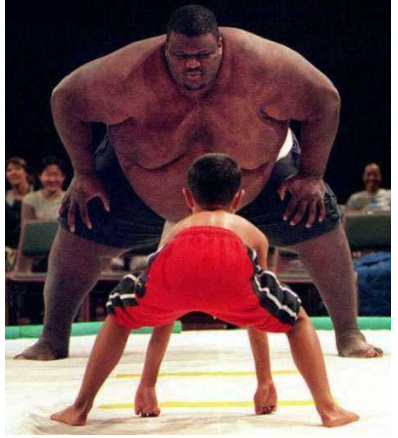
Manchester Academic Health Science Centre

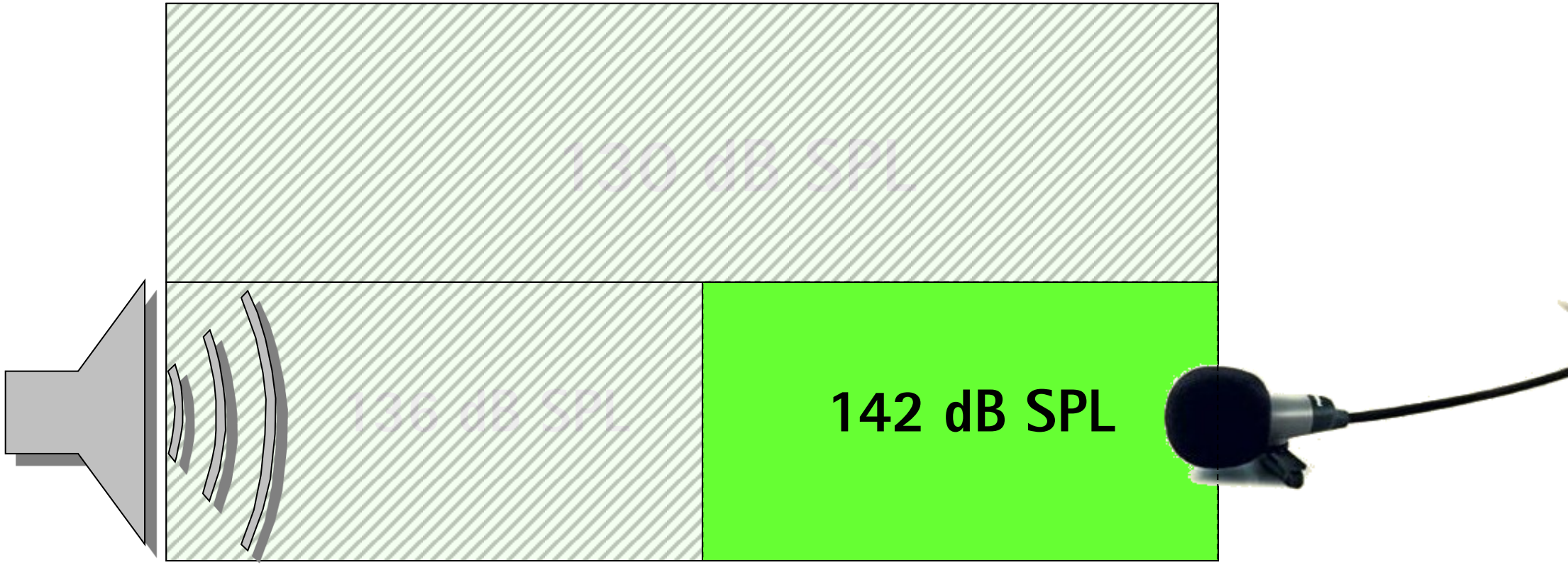
Age at hearing aid fitting



For 2012/13, median age at hearing aid fitting was 80 days

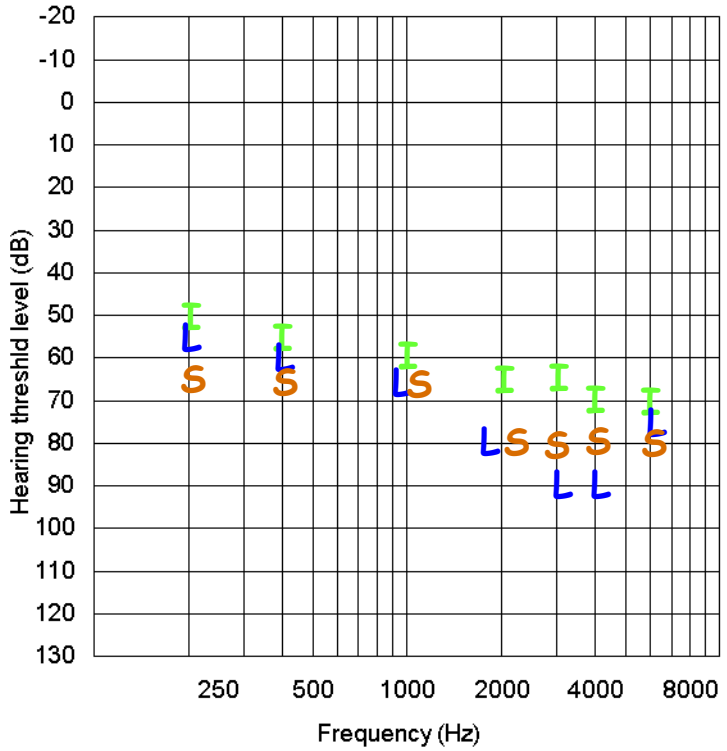
A CHALLENGE: SIZE MATTERS



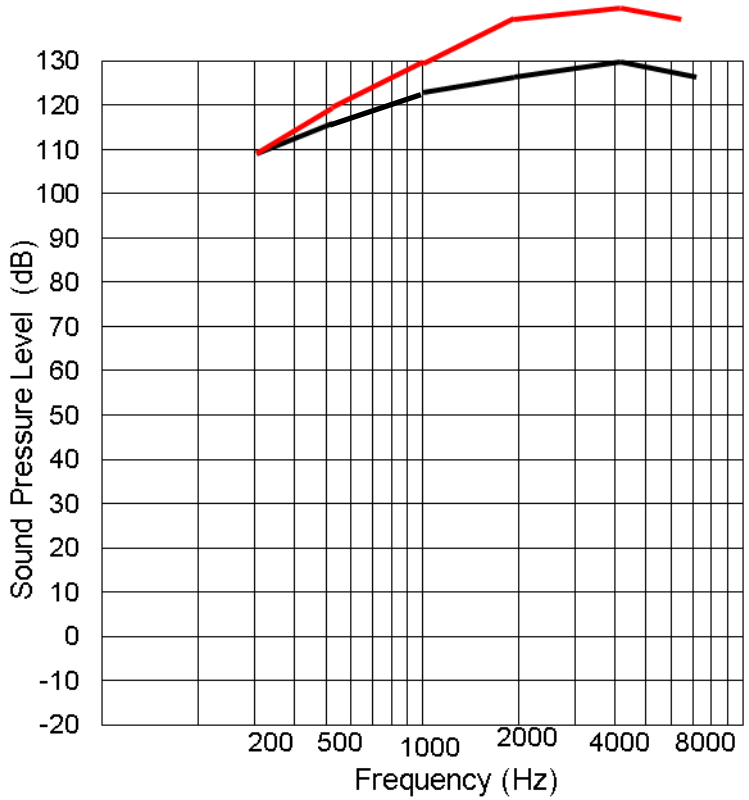


Implications for small ears

ASSESSMENT



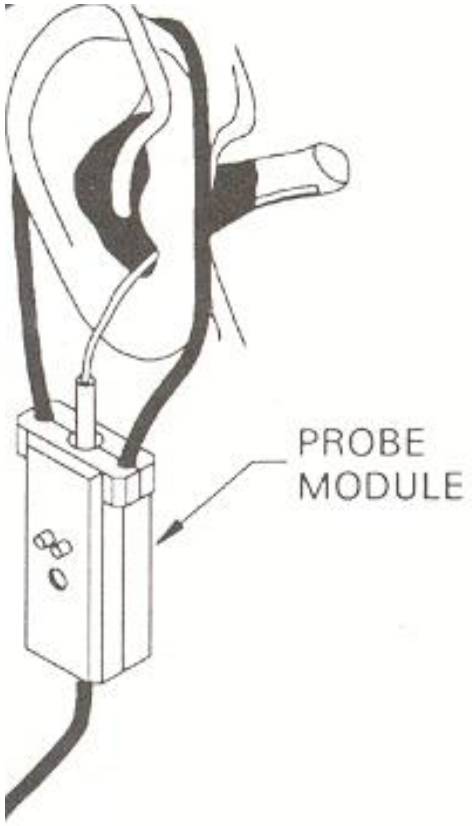
AMPLIFICATION



[Adapted from Seewald & Scollie, 1999]

Solution: measure sound level in the ear canal

Direct in-situ measurement

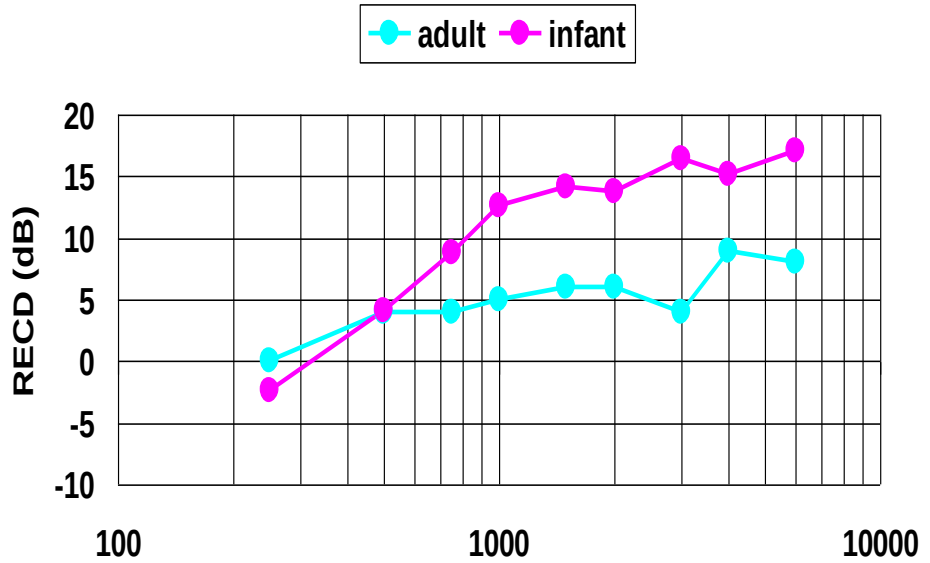


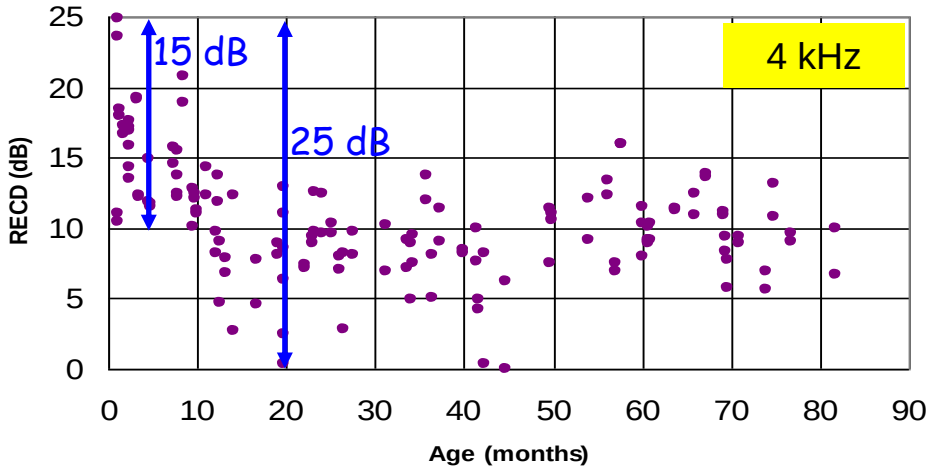
“Correction” added to test box response

[Clinical procedure described by Moodie et al (1994) using an insert transducer and an HA2 coupler]

Ear-to-Coupler Level Difference: ECLD

(ANSI S3.46-2013)



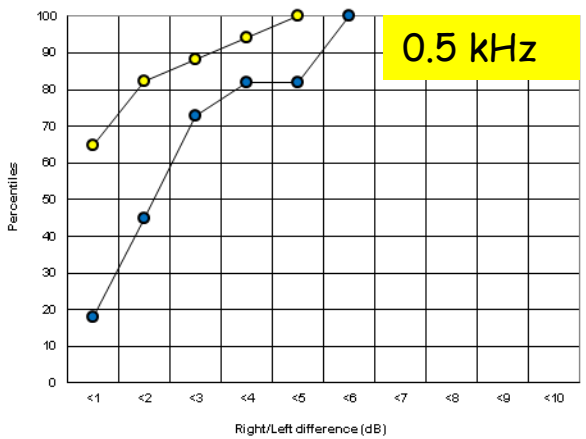


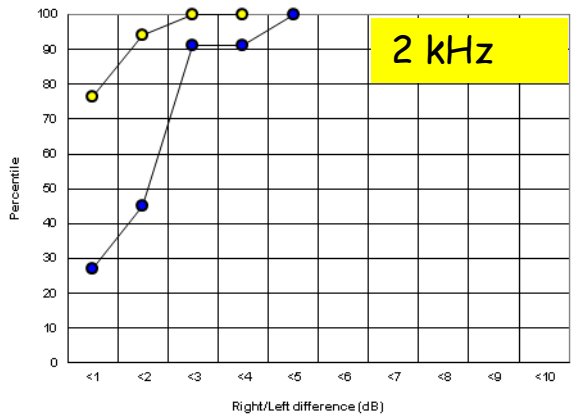
[Adapted from Bagatto et al, 2002]

Why measure in each child?

- Children differ from adults
- Children of same age differ
- Each child changes over time

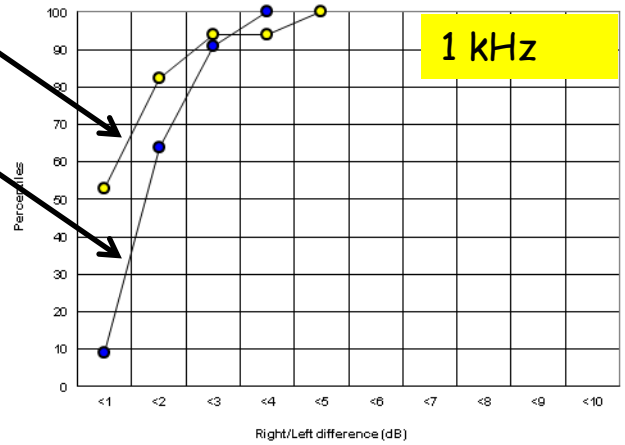
Similar right and left ears

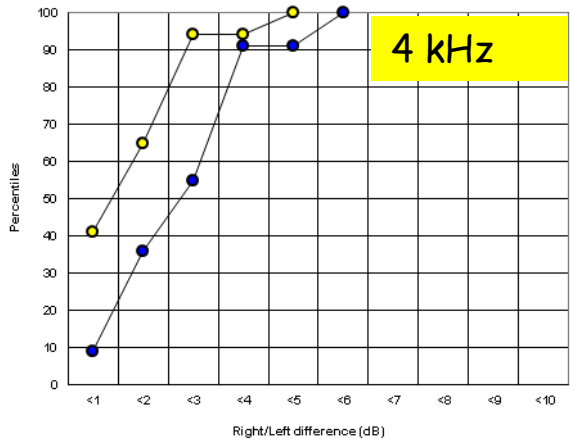




School age

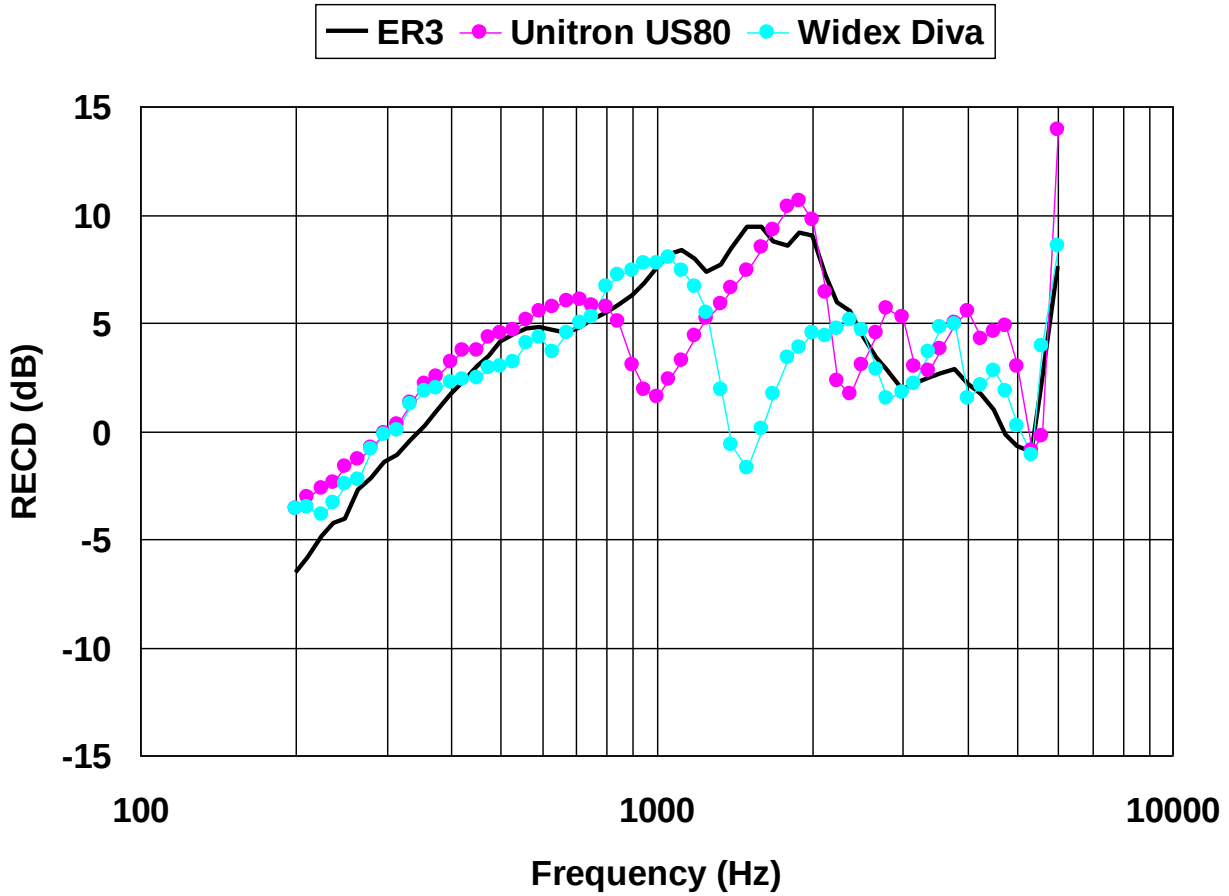
Pre-school





[Adapted from Munro & Howlin, 2010]

Influence of RECD/ECLD transducer

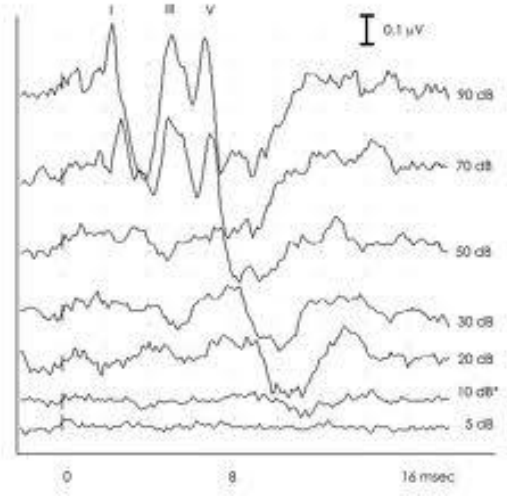


[Adapted from Munro & Toal, 2005]

Integrated RECD/ECLD measurements

A CHALLENGE: BRIDGING THE GAP

Hearing aid fitting



Behavioural assessment

Frequency-specific ABRs provide an accurate prediction of hearing thresholds in infants, but ……

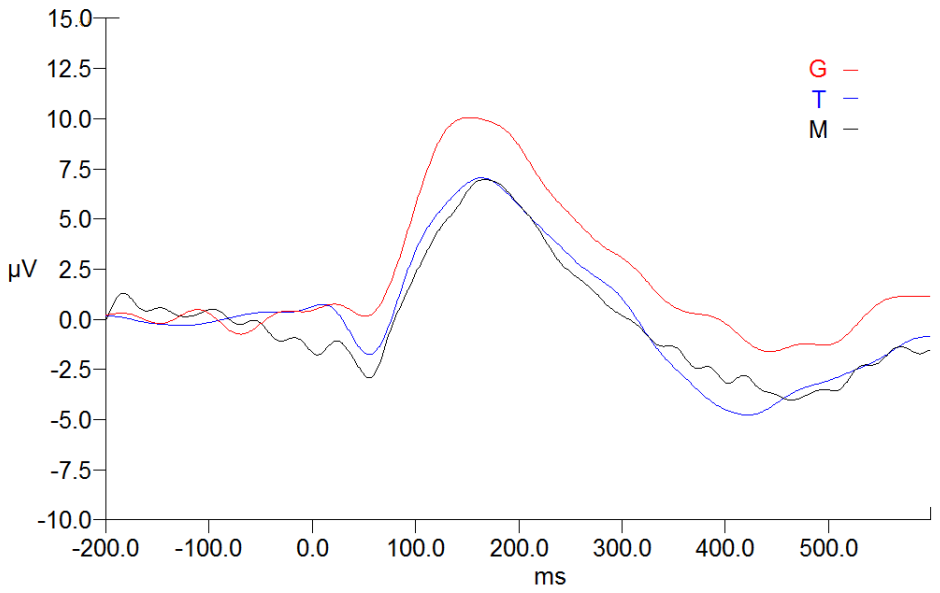
- behavioural thresholds often deviate from predicted threshold by 10 dB, and occasionally by 20 dB (Stapells, 2011)
- in severe hearing loss, no ABR (Stelmachowicz, 2008)
- middle-ear disease and concomitant medical problems can complicate (Stelmachowicz, 2008)
- ABRs typically absent in some populations e.g., auditory neuropathy (Roush et al, 2011)

Patient Public Involvement

- motivate and reaasure parents
- reassure audiologist
  - appropriateness of amplification settings
  - alert when current intervention may be inappropriate
  - expedite alternative strategies
    - e.g., frequency lowering devices, cochlear implant

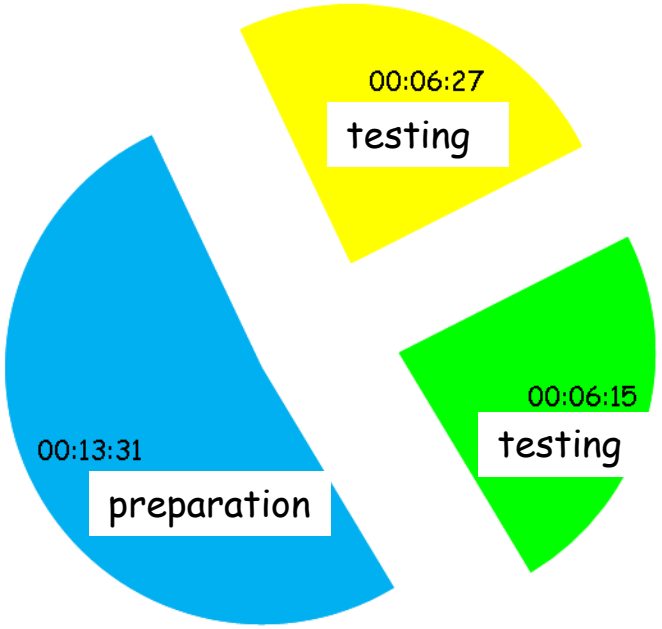
Cortical auditory evoked potentials

- 100 normal-hearing (4-39 wks)
- Stimuli (/m/, /g/, /t/) 65 dB SPL from loudspeaker
- Infant alert on parents lap
- Recorded:
  - test duration, completion rate, response detection rate, parent rating scale and interview

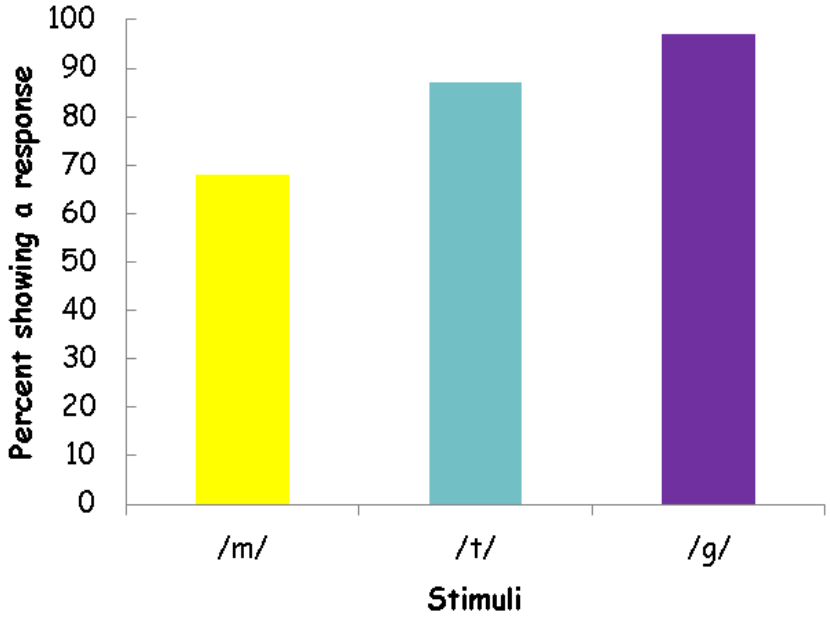

15.0
12.5
10.0
7.5
5.0
µV 2.5
0.0
-2.5
-5.0
-7.5
-10.0
-200.0
-100.0
0.0
100.0
200.0
300.0
400.0
500.0
ms
G
T
M

Completion Rate: >95%

Test Duration



Detection Rate

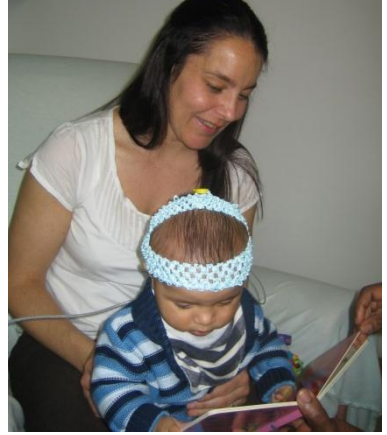


Parent rating scale

1=most favourable response, 8=least favourable

1.	Information about procedure	**1.2**
2.	Parents view about procedure	**1.3**
3.	Distress to baby	**1.7**
4.	Tolerating procedure	**1.6**
5.	Maintaining attention (quiet but alert)	**2.5**
6.	Parents views on attaching electrodes	**1.6**
7.	Information about outcome	**1.5**
8.	Test environment	**1.6**

Important next steps

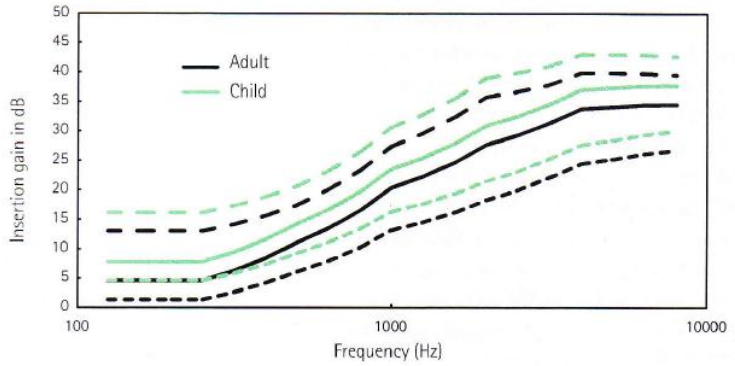


- What proportion of time is a response to an audible stimulus absent?
- What proportion of absent cases show a response on retest?

Personalisation of prescription

Age

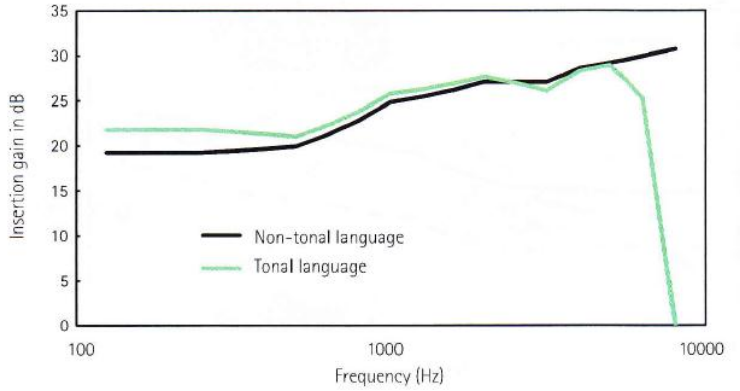
Figure 7
The effect of age on the NAL-NL2 prescription when the adult and the child have the same gently sloping hearing loss. The prescriptions are shown for input levels of 50 dB SPL (dotted lines), 65 dB SPL (solid lines), and 80 dB SPL (broken lines).



Children prefer more gain than adults

Language

Figure 5
The effect of language on the NAL-NL2 prescription shown here for a flat 60 dB HL hearing loss at 65 d
SPL input.

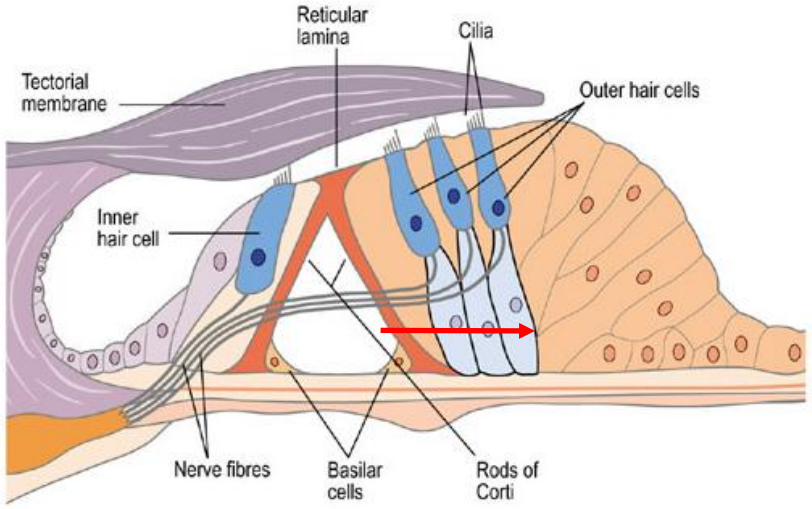


More low-frequency gain for tonal languages

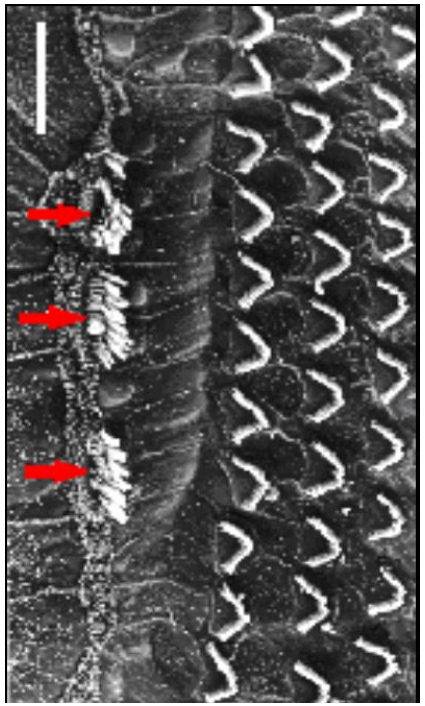
[Dillon, 2011]

COCHLEAR DEAD REGIONS

Organ of Corti



Dead region

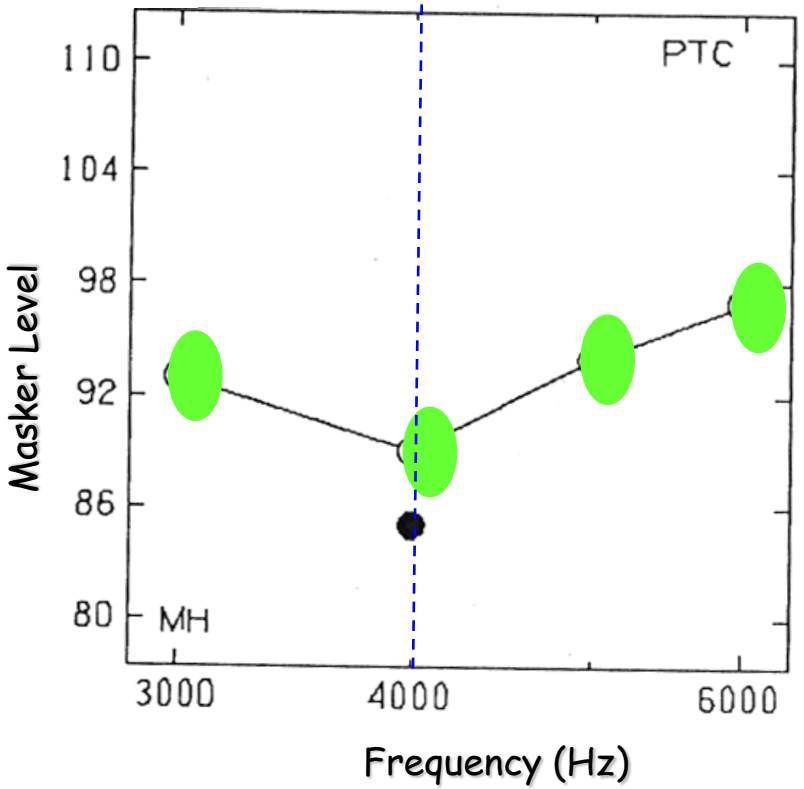


Bronx Waltzer mutant mouse

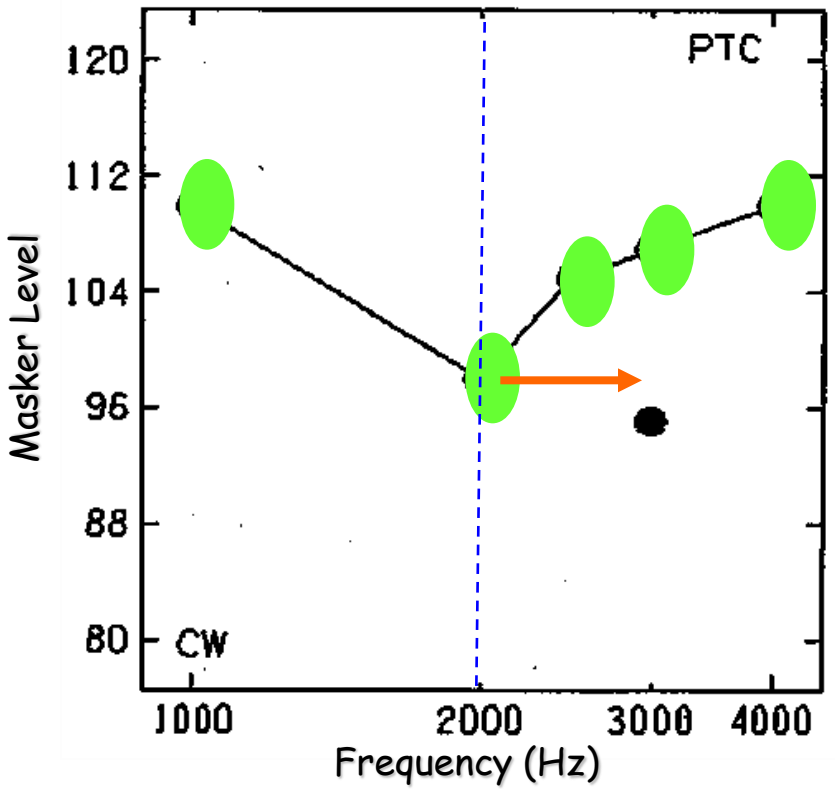
[courtesy of Andy Forge]

Tuning curves: the most effective masker

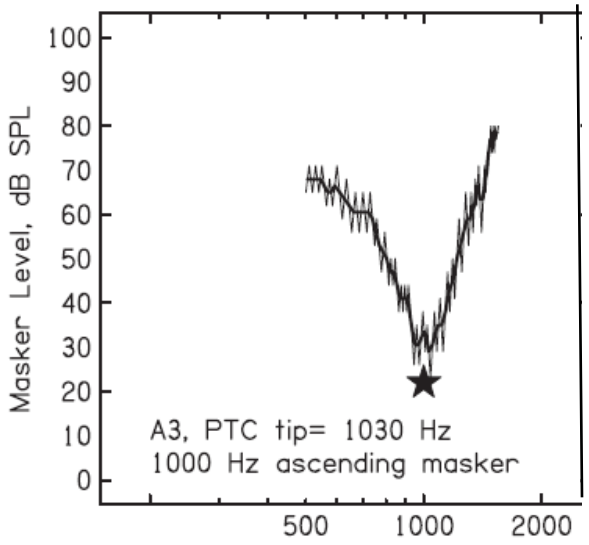
NO DEAD REGION

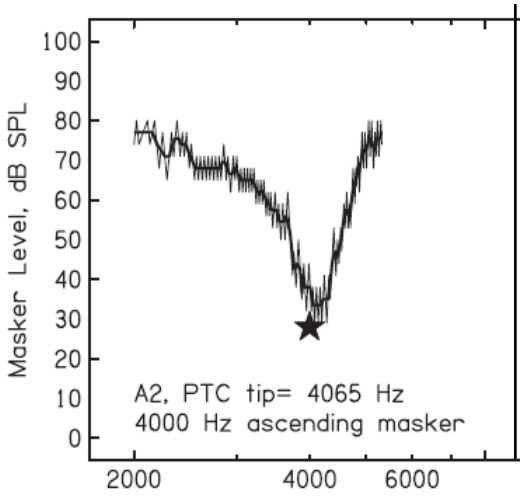


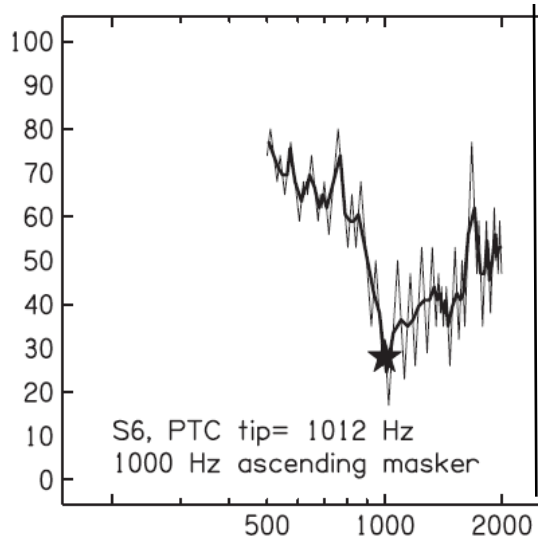
DEAD REGION

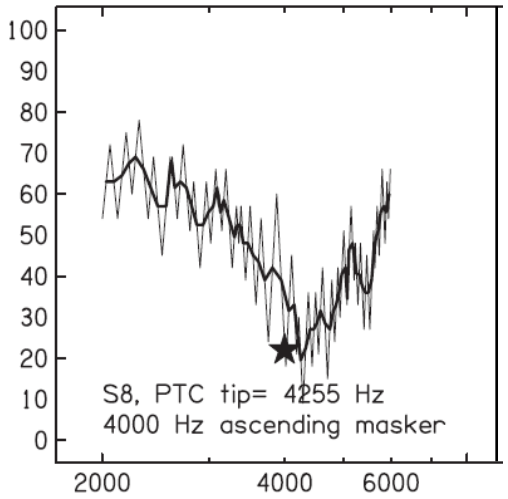


Fast Tuning Curves



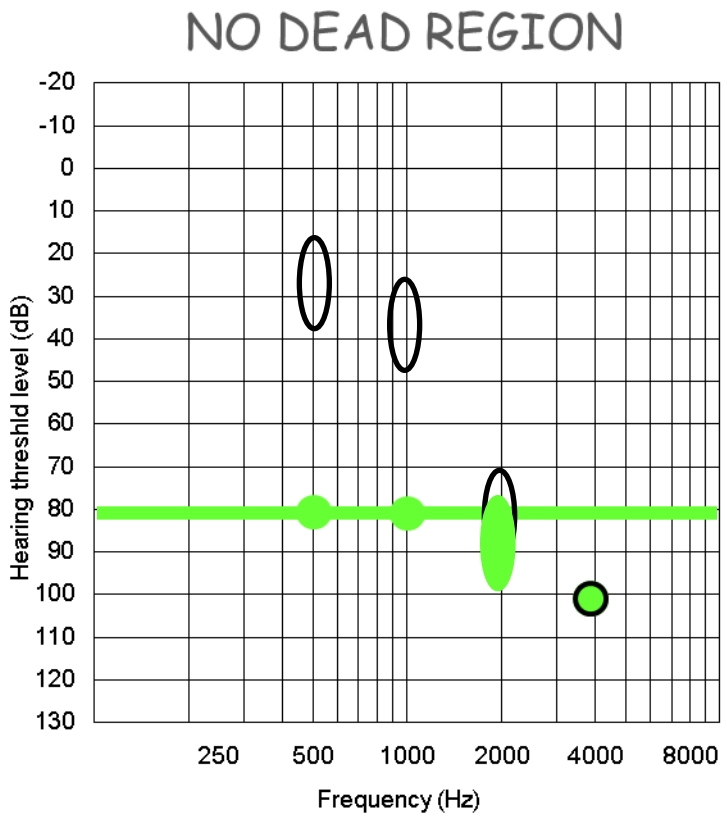


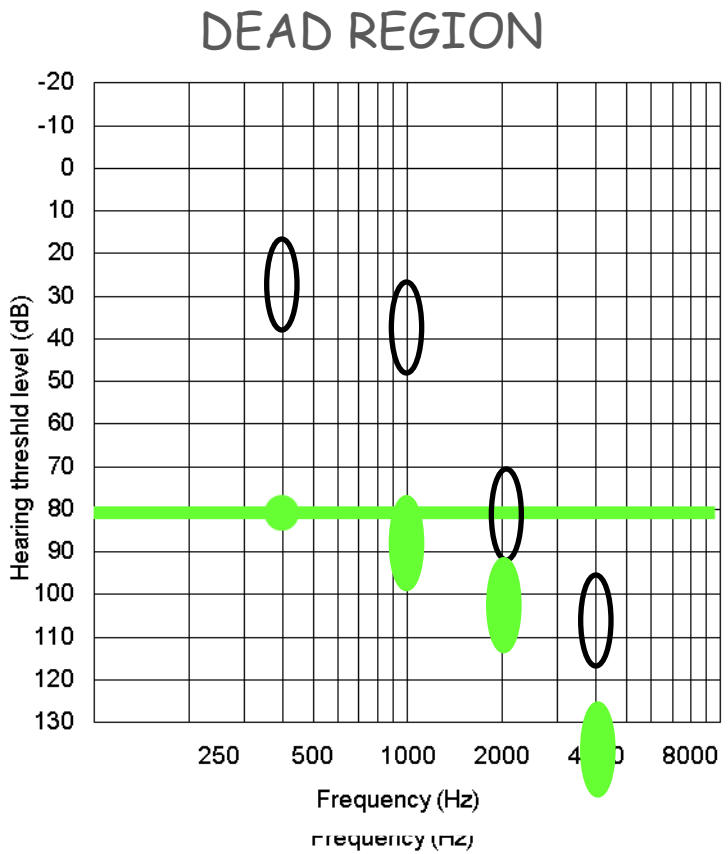




[Malicka et al, 2009]

Current clinical procedure: T.E.N. test





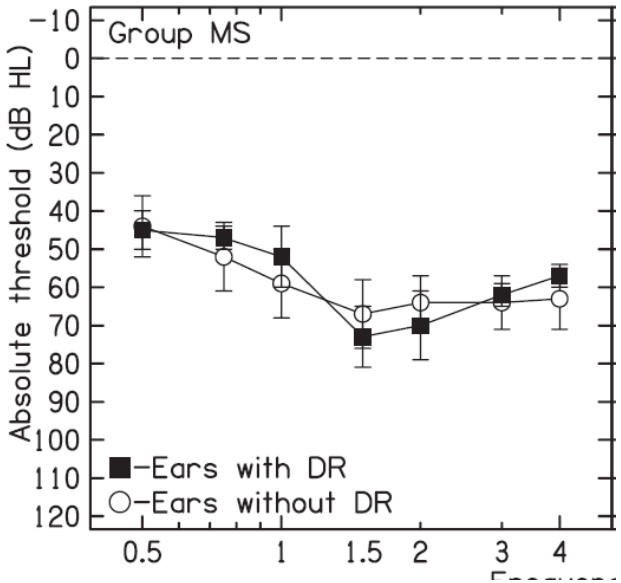
Diagnosing in children

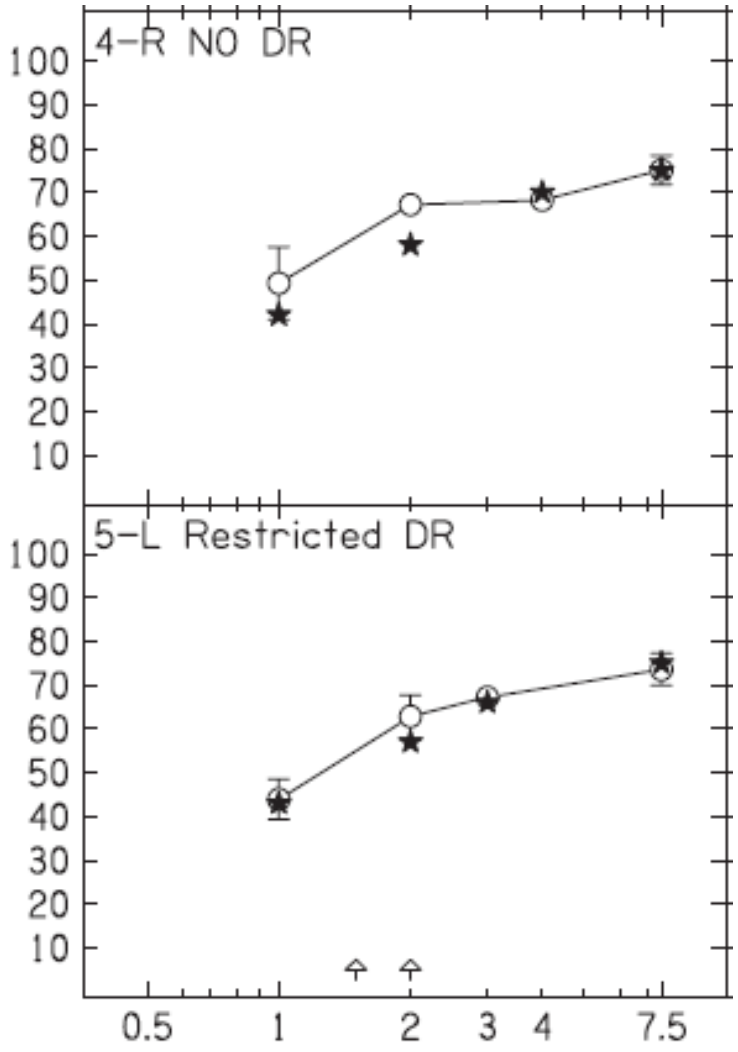
		TEN test	
		+	-
PTC	+	9	1
	-	3	8

[Malicka et al, 2013]

Children with moderate/severe loss

n=6 (9-12 year olds)

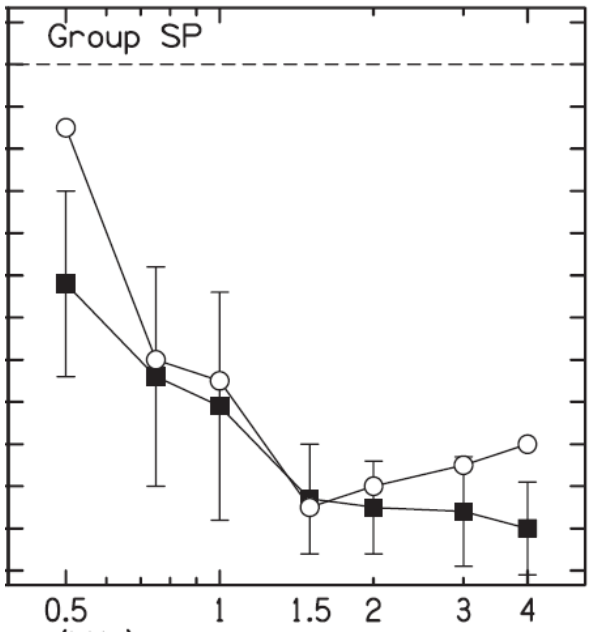


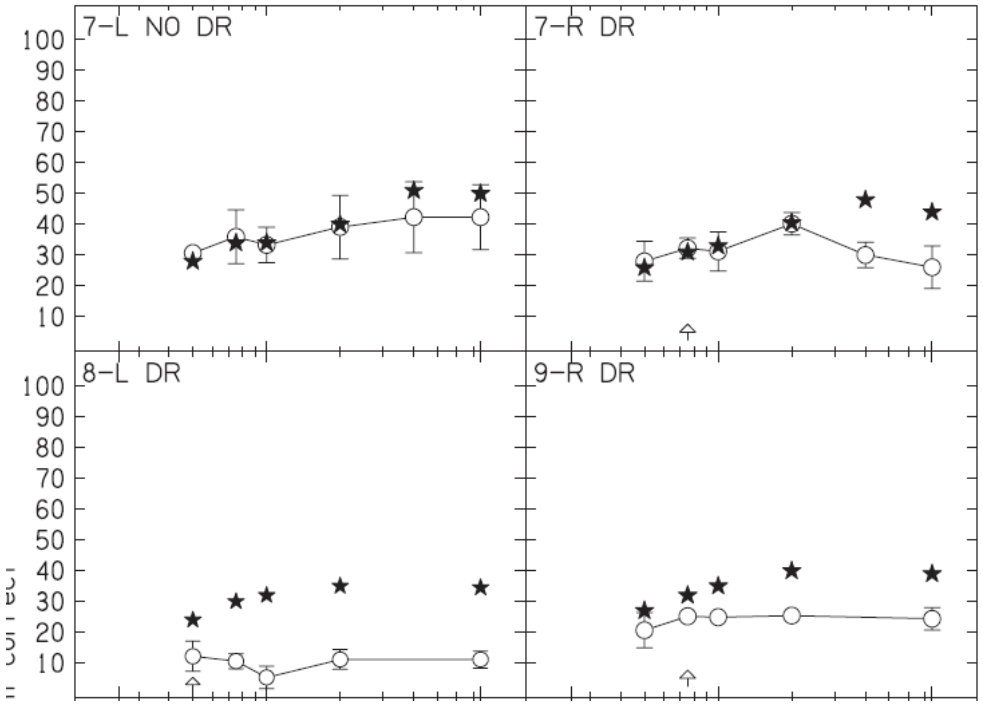


[Malicka et al, 2013]

Children with severe/profound loss

n=5 (8-13 year olds)





[Malicka et al, 2013]

TAKE-HOME MESSAGE

1. Size matters
   - account for ear canal acoustics

2. Bridging the gap
   - supplement existing procedures

3. Prescription targets
   - personalisation
   - Little evidence to change prescription if DR