

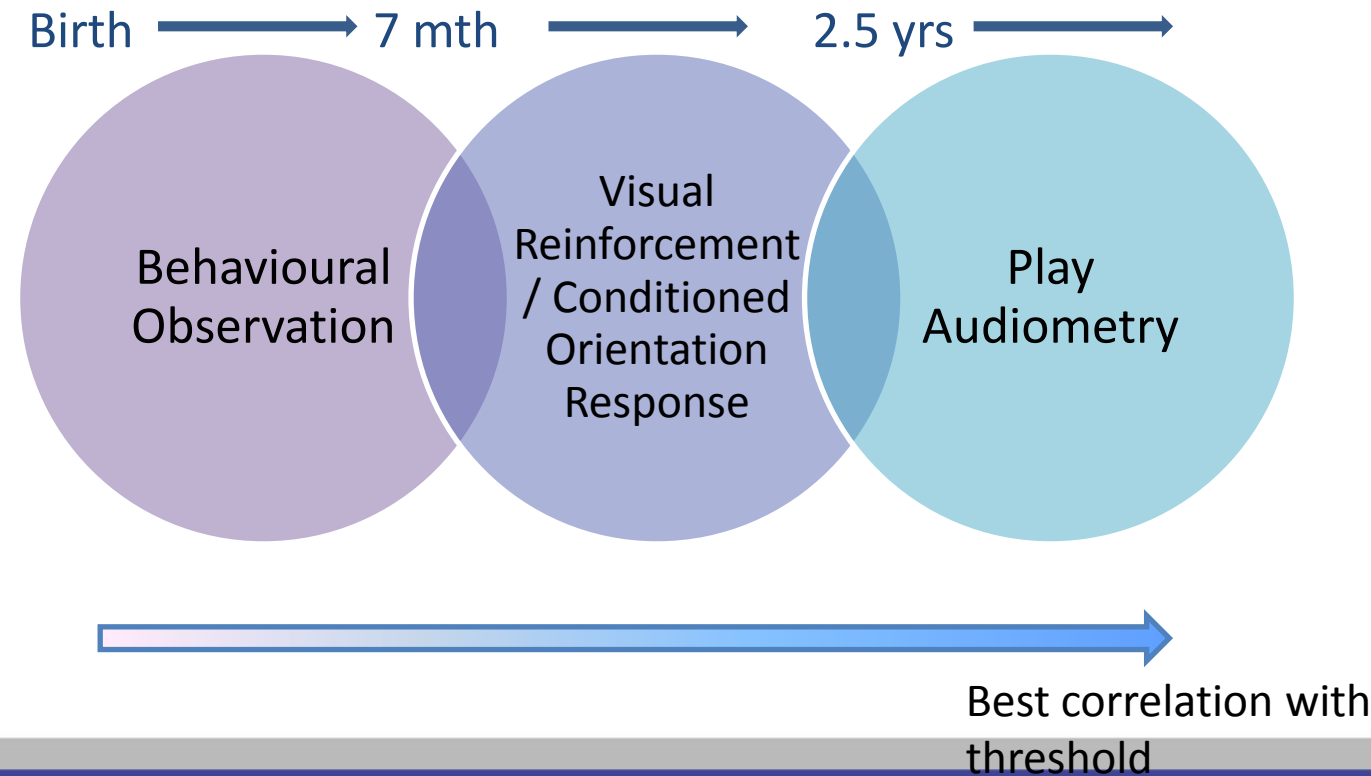
# Behavioural Audiometry for Infants and Young Children *Whose hearing loss has been detected in infancy*

Alison King, Principal Audiologist, Paediatric Services, Australian Hearing  
*International Paediatric Audiology Conference*  
***Saturday 12 April, 2014, Shanghai, China***

# Diagnosis and Management of Hearing Loss in Children

- Quantify the type, degree and configuration of hearing loss as accurately as possible
  - Understand the likely impact of hearing loss
  - Identify range of intervention options
    - Benefits and limitations
  - Behavioural thresholds are the gold standard for defining hearing when the child can be conditioned to respond reliably to sound
- Explain the results and options to parents/carers
- Parents and clinician agree on the management plan

# Behavioural Assessment



# Behavioural Observation

- **Observe subtle *unconditioned* changes in behaviour in response to sound**
  - Eye turn, eye widen, sucking, alerting, stilling
- **Minimum Response Level (MRL) is not a threshold**
  - Dependent upon infant's age and state during testing
  - Responses likely to be suprathreshold
  - Correlation with Pure Tone Thresholds is variable

# Unconditioned responses vary with age

Age	MRL (noisemakers)	MRL Warble tones
0-6 weeks	50-70 dB SPL	75 dB HL
6 weeks – 4 mths	50-60 dB SPL	70 dB HL
4-7 mths	40-50 dB SPL	50 dB HL
7-9 mths	30-40 dB SPL	45 dB HL

Reference: Northern and Downs 2002

# Unconditioned responses

- **Thompson & Bruce, 1974 : 190 Normally hearing infants age 3-59 mths**
  - 10% responded  $\leq 20\text{dB SPL}$
  - 50% responded  $\leq 50\text{dB SPL}$
  - 90% responded  $\leq 88\text{dB SPL}$
  - Children who could be reliably tested with both BOA & play audiometry responded to softer sounds using play audiometry

# Is BOA still relevant in 2014?

## For children who have a cochlear hearing loss

- Evoked Potentials provide the most accurate threshold estimation
- BOA may be useful for parent education
  - Demonstrate subtlety of infant hearing responses
  - Demonstrate change in response levels when comparing aided & unaided conditions
- Lack of exposure to sound can impact upon unconditioned responses
  - May not be a useful demonstration at first fitting appointment

# Is BOA still relevant in 2014?

## For children who have Auditory Neuropathy Spectrum Disorder

- Evoked Potentials do not correlate with behavioural thresholds
- BOA forms part of the test battery
  - Combine with Cortical Auditory Evoked Potentials and functional hearing assessment (eg PEACH, Ching et al, 2007)
- Consider amplification if responses consistently poorer than age-appropriate responses

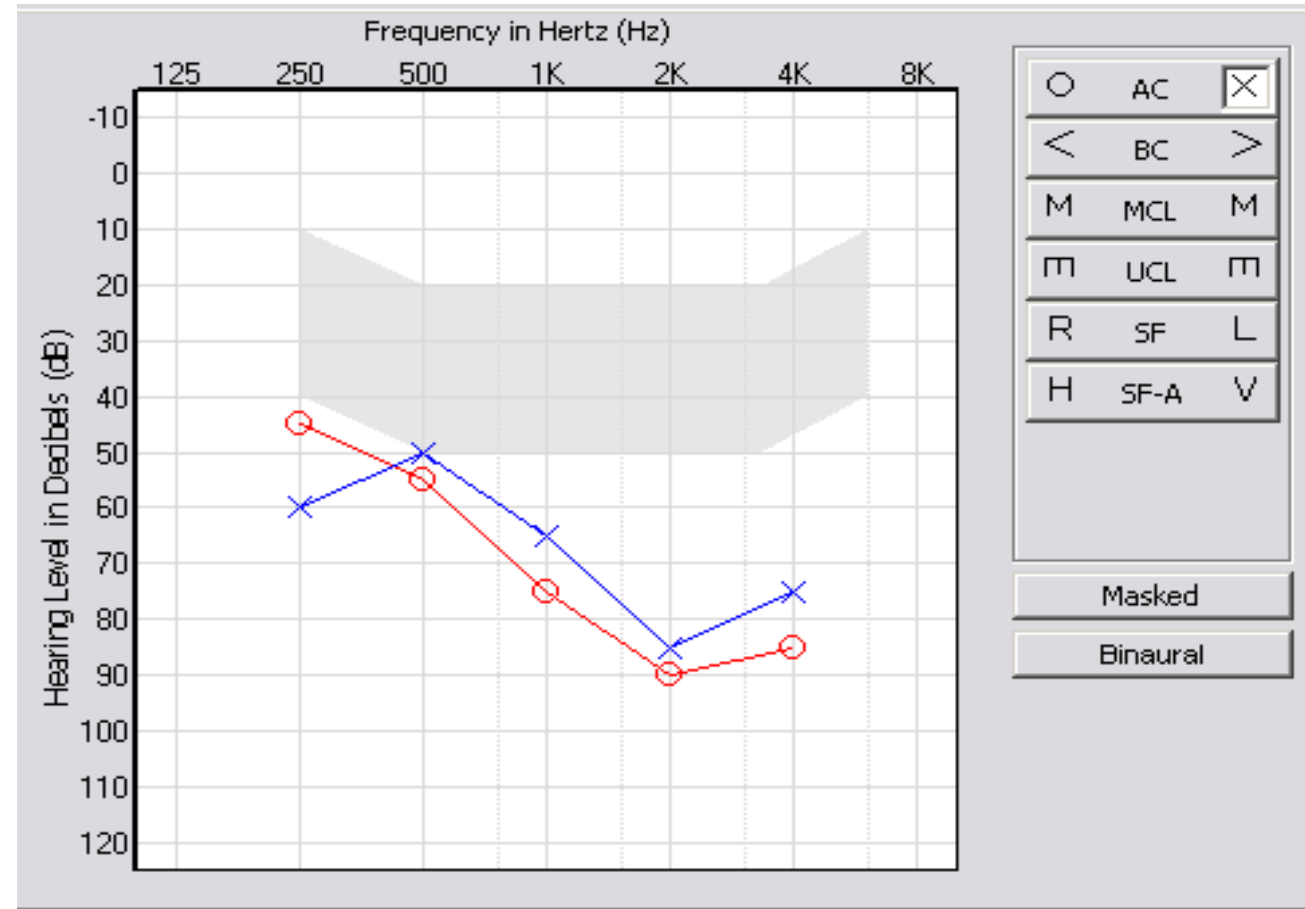


# Case Study – child M

*born 29 weeks gestation, surviving twin*

Corrected Age (weeks)	Best Minimum Response Level dB(A)	Age Ave. MRL for Normal Hearing dB(A)
5	55-60 (light sleep)	50-70
11	70 (deep sleep)	50-60
16	60 (awake, calm)	40-50
19	55 (awake, calm)	40-50

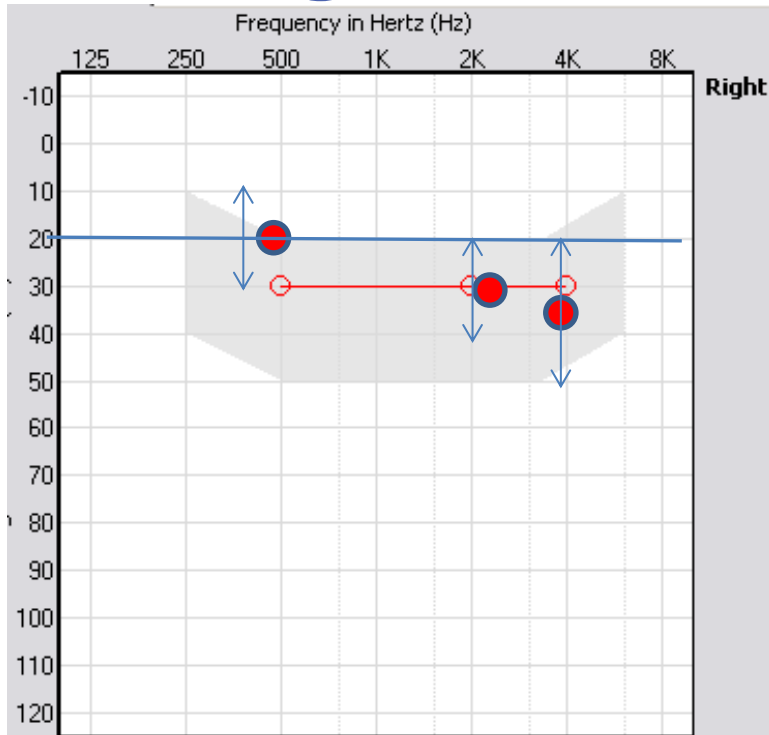
# Audiogram



# Infants who have a mild hearing loss

- Evoked potentials are used to estimate behavioural hearing thresholds
  - Based upon statistical relationships
- When the evoked potential threshold suggests a mild hearing loss be aware that some infants may have *normal behavioural thresholds*

# Evoked Potentials and Mild Hearing Loss



- = ABR (dBnHL)
- = Estimated Behavioural threshold
- ↕ = +/- 1 SD

Behavioural threshold (dBHL) = ABR (dBnHL) + correction

Air Conduction	500 Hz	2000 Hz	4000 Hz
Add this figure to the ABR threshold in dBnHL	-10	0	+5
Standard Deviation (used for determining deterioration)	10dB	10dB	15dB

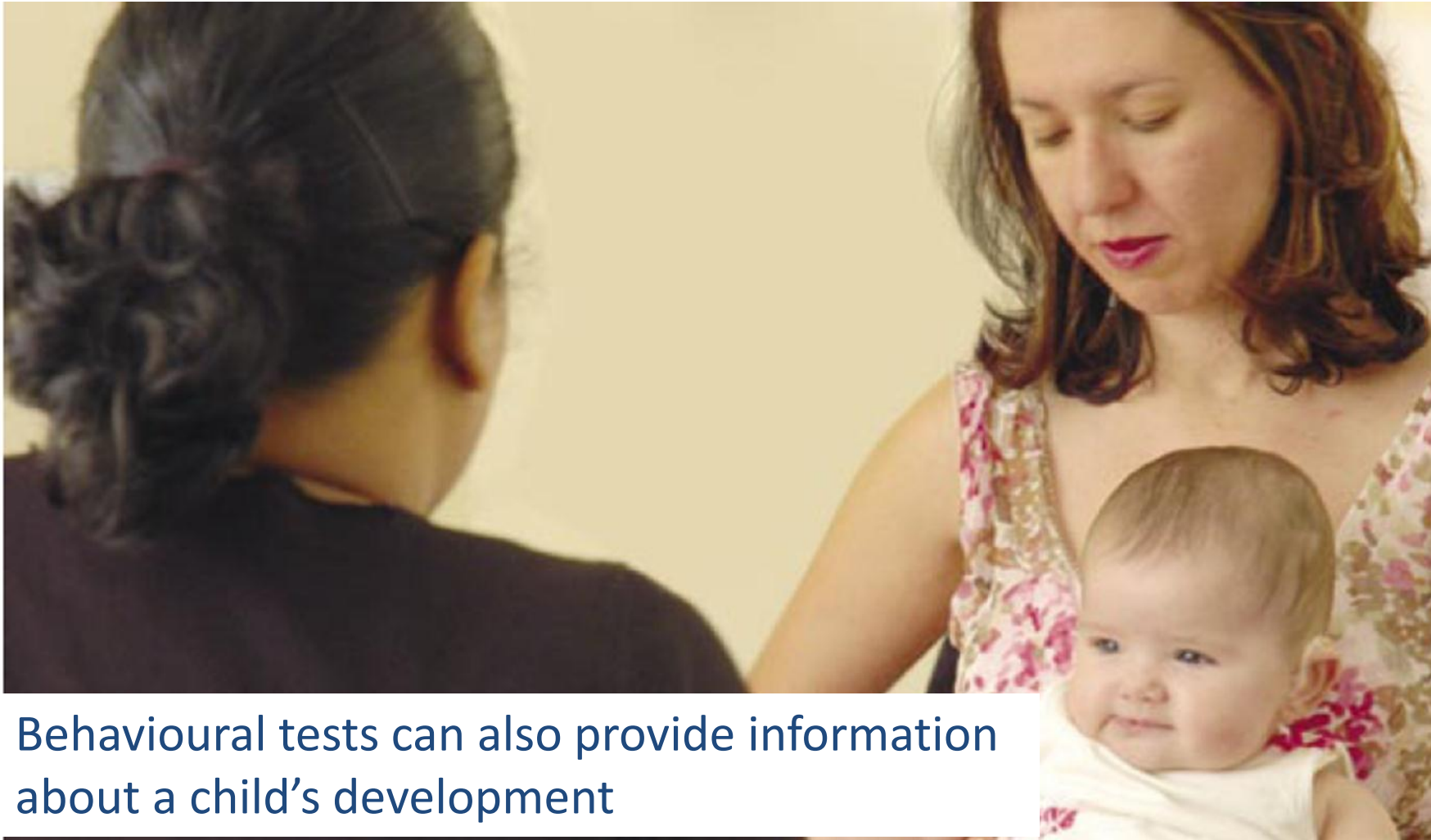
Van Der Werff et al  
2009

# Infants who have a mild hearing loss

- In this instance it is usually advisable to obtain further behavioural data before deciding whether or not to provide amplification
  - Visual Reinforcement Audiometry
  - Track progress with functional questionnaire such as PEACH – compare to age norms.
- Consequences of amplifying normal hearing likely to be more significant than consequences of delaying amplification for a mild hearing loss

# Visual Reinforcement Orientation Audiometry

- **Conditioned response**
  - Reinforces the natural tendency to turn towards a sound
  - Typically rewarded by an illuminated puppet or a film clip.
- **Child must be in a calm, alert state, not scanning room**
- **May be performed by a single audiologist or by 2 clinicians (tester & observer).**
- **Risk of observer bias in deciding if response is genuine**
  - Can be reduced by presenting masking noise to observer or by automating the reward system.



Behavioural tests can also provide information about a child's development

# Visual Reinforcement Orientation Audiometry

- **“Traditionally” tests were performed via loud speaker in the sound field.**
  - May still be best option for children who are restless or fearful
  - Does not differentiate between hearing in each ear
- **Ear specific information can be obtained**
  - Headphones (can be difficult to retain on head)
  - Insert earphones with foam tips or personal earmould
- **Important to know about hearing in each ear to advise parents about options**



# For children whose hearing loss is detected in infancy

- Behavioural tests are the gold standard for defining hearing loss
- The role of behavioural hearing tests varies depending upon
  - The child's age
  - The degree and configuration of hearing loss
  - The presence/absence of ANSD
- Behavioural tests also provide developmental information

## References:

Ching T.Y.C. & Hill M. (2007). The Parents' Evaluation of Aural/oral performance of Children (PEACH) scale: normative data. *J Am Acad Audiol*. 18(3): 221-237.

Northern, JL, Downs MP (2002) Hearing in Children. Lippincott, Williams and Wilkins 2002, p 167

Thompson, G., Weber, B.A. (1974)  
Responses of infants and young children to behavior observation audiometry (BOA). *Journal of Speech & Hearing Disorders*, Vol 39(2), May 1974, 140-147.

Vander Werff K.R.I, Prieve B.A, Georgantas L.M. (2009) Infant Air and Bone conduction Tone Burst Auditory Brain Stem Responses for Classification of Hearing Loss and the Relationship to Behavioral Thresholds. *Ear & Hearing* 30(3) 250 – 368.

*Thank you for listening*

Contact

[www.hearing.com.au](http://www.hearing.com.au)

[Alison.king@hearing.com.au](mailto:Alison.king@hearing.com.au)