



Word recognition threshold from two to five years of age using an Automated Toy Test

Overview

- Automated McCormick Toy Test
- Avon Longitudinal Study of Parents And Children
- Word recognition threshold population data
- Clinical implications



Speech recognition testing

- Speech recognition tests are commonly used in paediatric audiology
 - Screen for hearing loss
 - Method of estimating hearing threshold
 - Evaluating functional impact of OME and sensorineural hearing loss
 - Assessing benefit from hearing aids
- Speech testing can be used from a developmental age of 2 years upwards



Automated McCormick Toy Test

- Common test used in paediatric audiology is the McCormick Toy Test (McCormick, 1977)
- The automated version was developed by IHR
- 7 paired words
- Automatic stepwise method for finding threshold
- The test can be performed in both quiet and noise



🌟 Automated McCormick Toy Test

- Provides measure of **word recognition threshold (WRT)**
- Close relationship between WRT and HTL (Summerfield et al, 1994)
- 35 dB (A) is the cut-off level for normal hearing (Palmer et al, 1991; Summerfield et al, 1994)
- Test-retest reliability is 7 dB
- No age normative data available



🌟 Automated McCormick Toy Test

- There is a developmental improvement on psychoacoustic tests with age (Schneider and Trehub, 1992)
- Most cross-sectional studies of word recognition show an improvement in performance with age
 - 9 dB from 5 to 10 years (Elliot et al, 1979)
 - 4 to 6 dB from 3 to 6 years (Jerger and Jerger, 1982)
 - 0.5 dB/year from 2 to 13 years (Palmer et al, 1991)



Automated McCormick Toy Test

- Does age influence performance on the automated McCormick Toy Test?
- Does variation in test set-up influence performance?



🌟 Automated McCormick Toy Test

- OME has a variable effect on hearing thresholds
- Evidence that early OME/hearing loss influences later auditory sensitivity (e.g. Gravel et al, 2006)
- How does OME influence WRT across the age range?
- Is early OME associated with worse WRT?



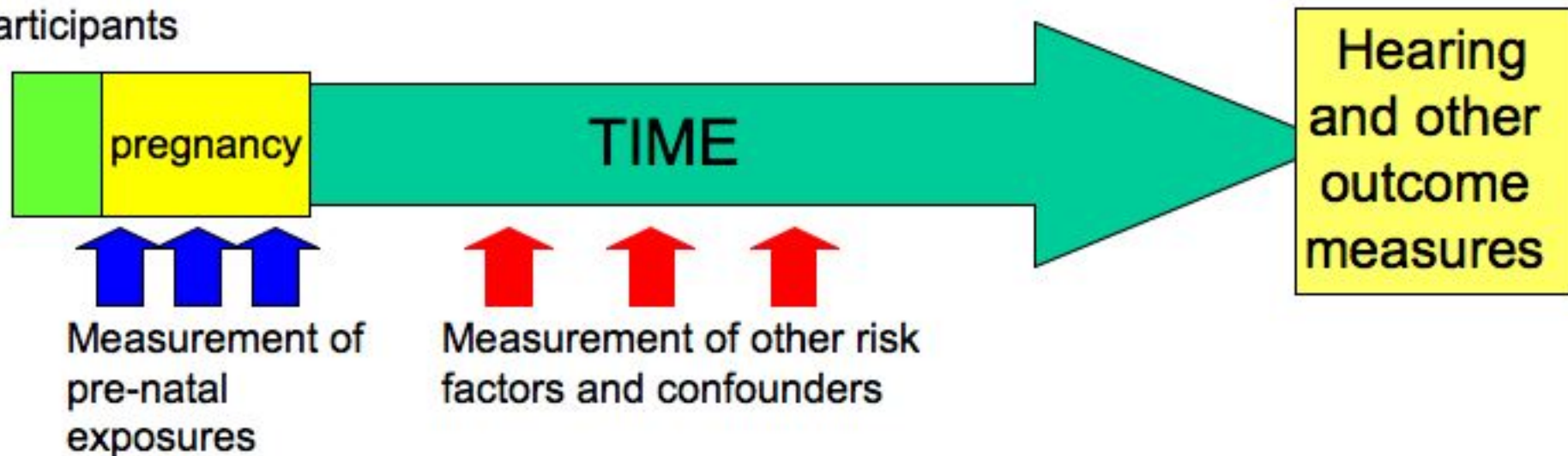
🌟 Avon Longitudinal Study of Parents And Children (ALSPAC)

- Prospective cohort study
- Aims to understand the ways in which the **physical** and **social** environment interact, over time, with **genetic** inheritance to affect health, behaviour and development in children and then into adulthood
- All children born to women due to give birth in Avon between April 1991 – December 1992
- 14,893 mothers joined the study (~80% of population)



🌟 Avon Longitudinal Study of Parents And Children (ALSPAC)

Selection of participants



- Exposure measured before knowledge of outcome
- Contemporaneous measures of exposure variables
- Recall bias minimised

🌟 Avon Longitudinal Study of Parents And Children (ALSPAC)



- Self-completion questionnaires to mothers, their partners and from age 5 the children
- Medical & educational records
- Hands-on assessment at frequent intervals on random 10% sample – the Children in Focus
- Annual hands-on assessment of whole study from age 7 onwards
- Biological samples from mother, her partner and child



🌟 Avon Longitudinal Study of Parents And Children (ALSPAC)

- Summary of hearing assessments

	Age (months)											
	8	12	18	25	31	37	43	49	61	84	108	132
Tympanometry												
Toy Test												
Audiometry												

Key:

	Children in Focus (~1000 children attended)
	Whole ALSPAC cohort (~7000 children attended)

Research aims

1. To investigate the association between the WRT and:
 - a) The number of toy pairs
 - b) The number of reversals
2. To provide longitudinal WRT reference data between age 2 ½ and 5 years age with and without current OME
3. To determine the effect of a positive history of OME up to age 4 on WRT at age 5?



Method

- Data were available through the ALSPAC study
- Testing was performed by qualified audiologists in a quiet room
- Ethical approval was obtained from the ALSPAC Ethics and Law committee
- Performance on the Automated McCormick Toy Test was assessed at 2 ½, 3 ½ and 5 years age



Method

- Tympanometry was assessed at 9 time points between 8 months and 5 years
- Tympanograms were classified as type A, B, C1 or C2
- Descriptive statistical analysis was used to provide normative data



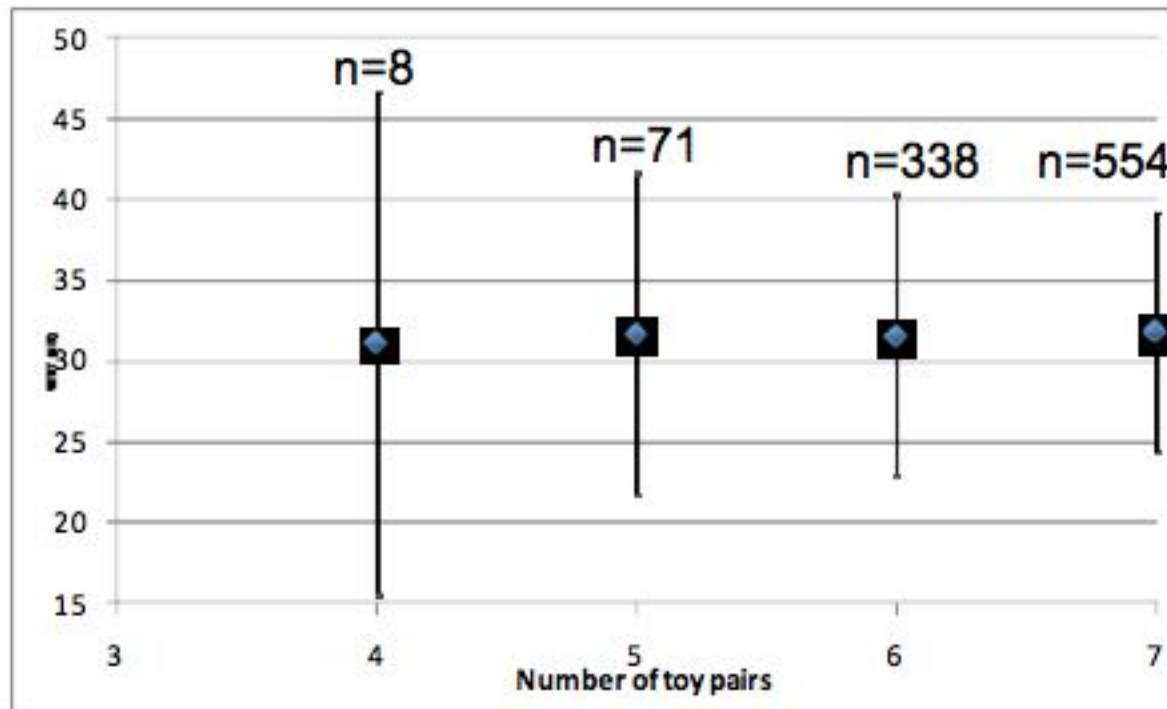
Results

- 762 children attended all 3 time points
- Those attending the Children in Focus test sessions were more advantaged than the rest of the cohort
 - Mothers more highly educated ($p < 0.001$)
 - Mothers older ($p = 0.006$)
 - A lower proportion in local authority housing ($p < 0.001$)



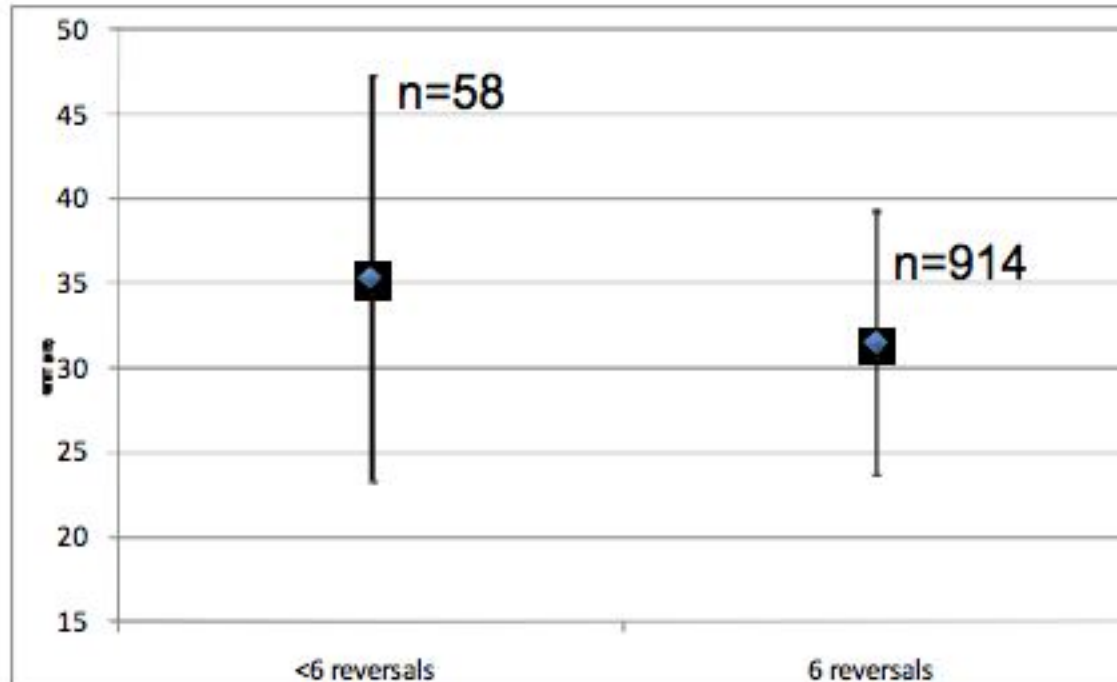
🌟 Results 1. Association between number of toy pairs and WRT

- Mean WRT (+/-1 SD) at 2 ½ years old
- $P=0.99$



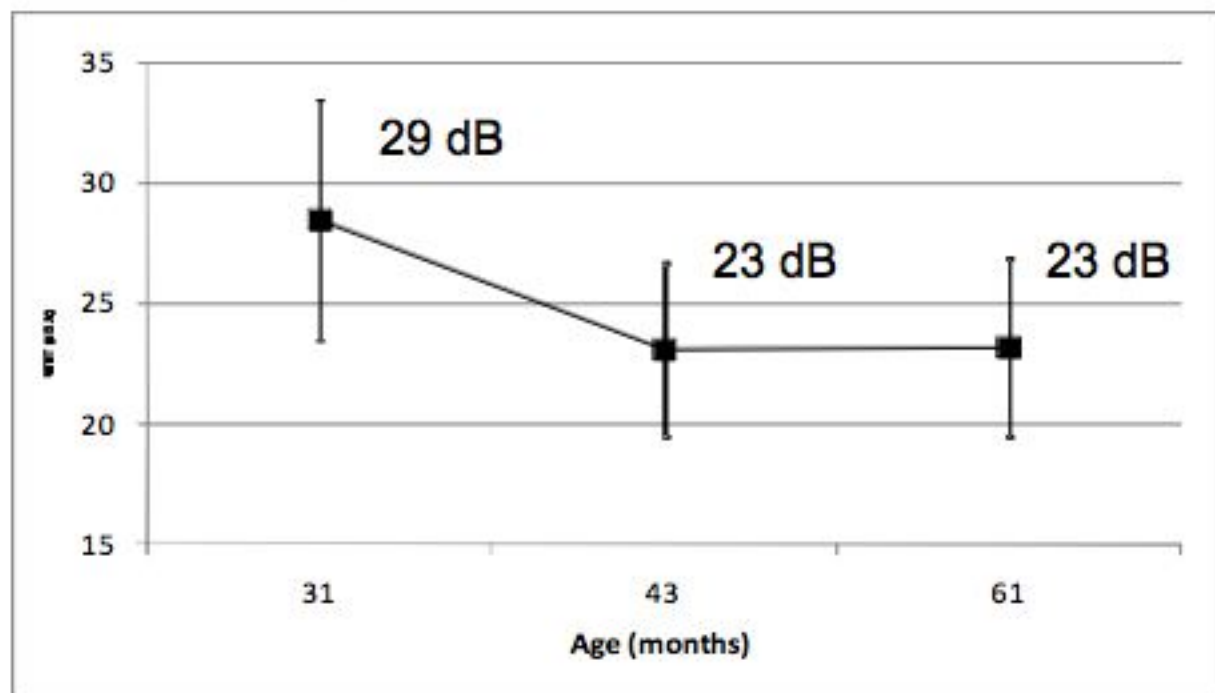
🌟 Results 2. Association between number of reversals and WRT

- Mean WRT (+/-1 SD) at 2 ½ years age
- $p=0.001$



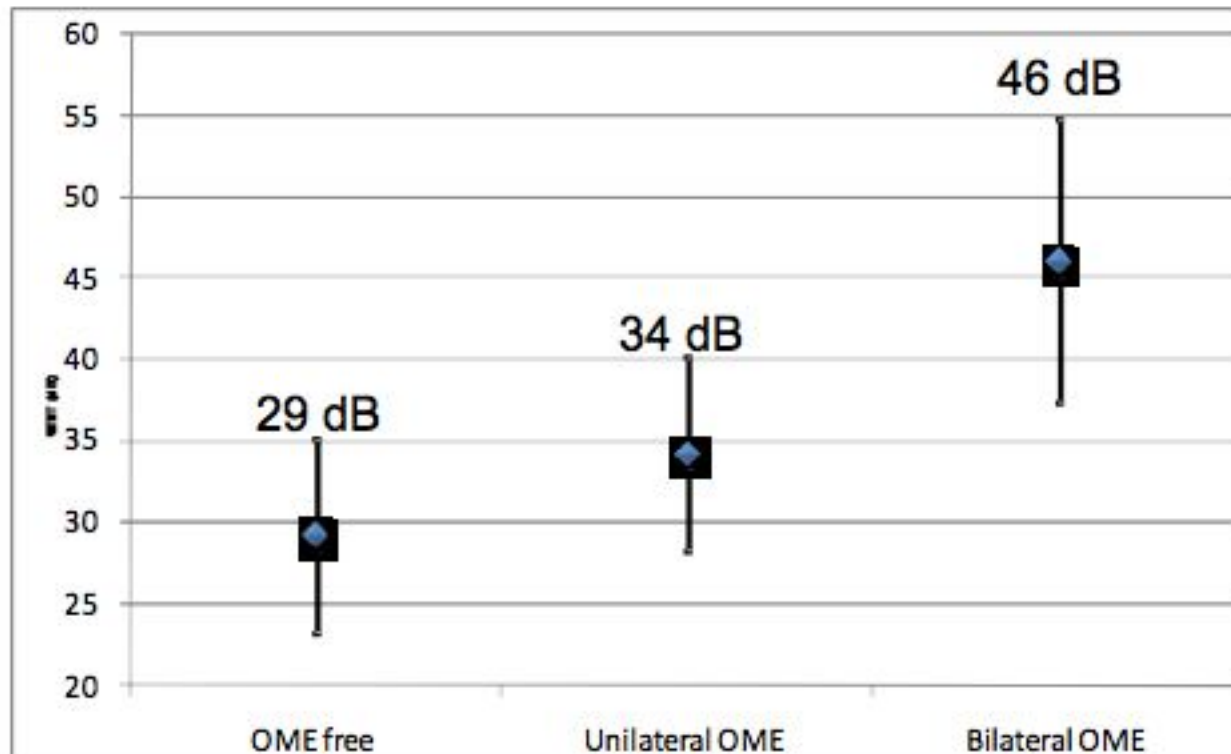
🌟 Results 3. WRT by age in children OME free

- Mean WRT (+/-1 SD)
- 5 – 6 dB improvement in threshold



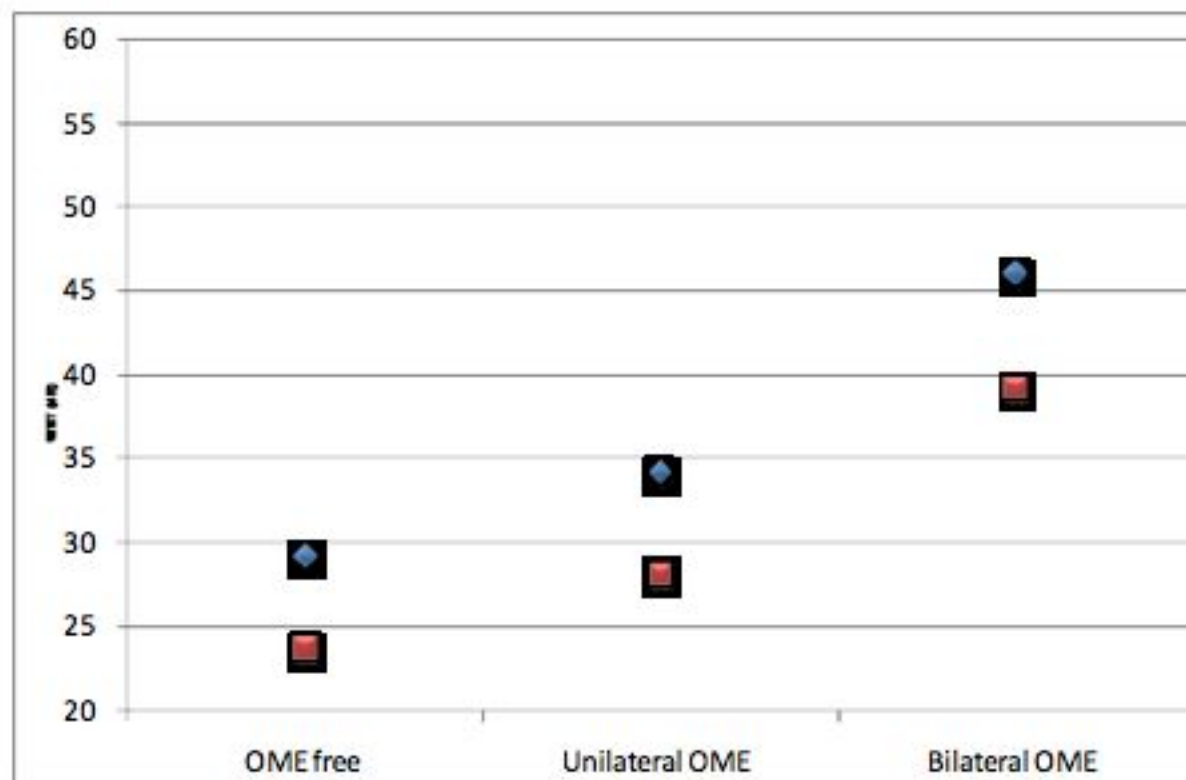
🌟 Results 4. WRT according to middle ear status

- Mean WRT (+/-1 SD) at 2 ½ years



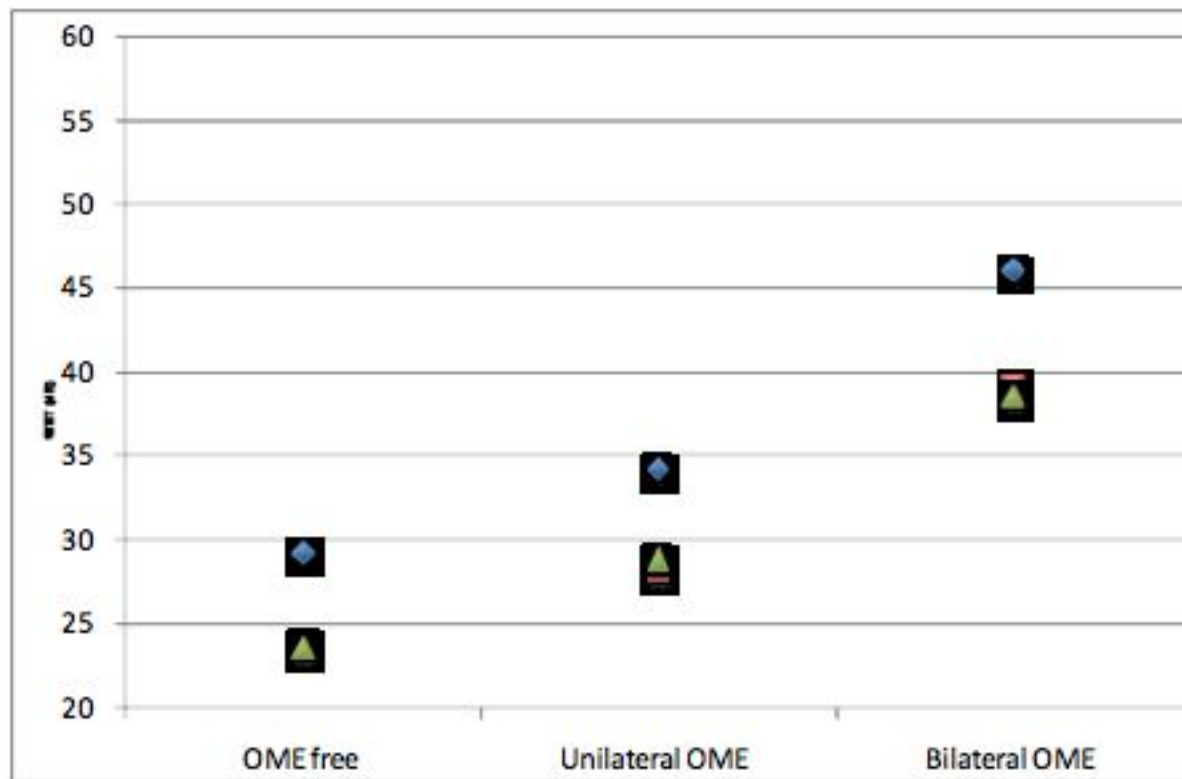
🌟 Results 4. WRT according to middle ear status

- Mean WRT at 2 ½ and 3 ½ years



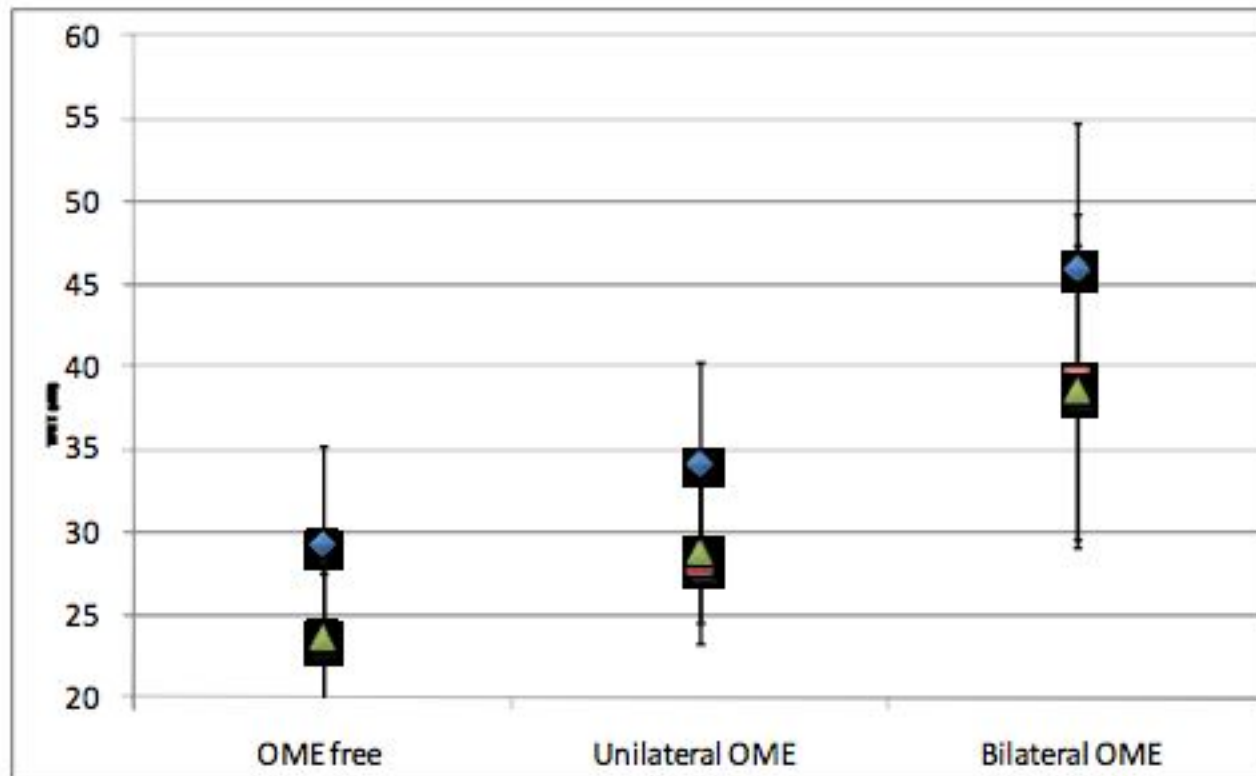
🌟 Results 4. WRT according to middle ear status

- Mean WRT at 2 ½, 3 ½ and 5 years



🌟 Results 4. WRT according to middle ear status

- Mean WRT (+/- 1 SD) at 2 ½, 3 ½ and 5 years



Method

- Linear regression was used to assess the influence of early OME on WRT at 5 years
 - Excluded children with fewer than 4 tympanometric assessments
 - Exposure: OME *positive* children were defined as those with 4 or more occasions of bilateral OME (type B or C2 tympanograms) between 8 months and 4 years
 - Outcome: WRT at 5 years
 - Statistically adjusted for presence of OME at 5 years, sex, age and social class



🌟 Results 5. Early OME and WRT at 5 years

- Effect size dB (95% CI) comparing the OME *positive* children to the rest of the group

	N	Unadjusted	Adjusted for OME at 5 years	Adjusted for OME at 5 years, age, sex & SES
OME neutral	858	Reference	Reference	Reference
OME positive	99	5 dB (4 to 6 dB)	2 dB (0.6 to 3 dB)	2 dB (0.6 to 3 dB)



🌟 Summary and clinical implications

- No association between number of toy pairs used (>3) and WRT
- Fewer toy pairs can be used in clinical practice if necessary



Summary and clinical implications

- Using fewer reversals was associated with an increased WRT
- Beware of terminating the test early



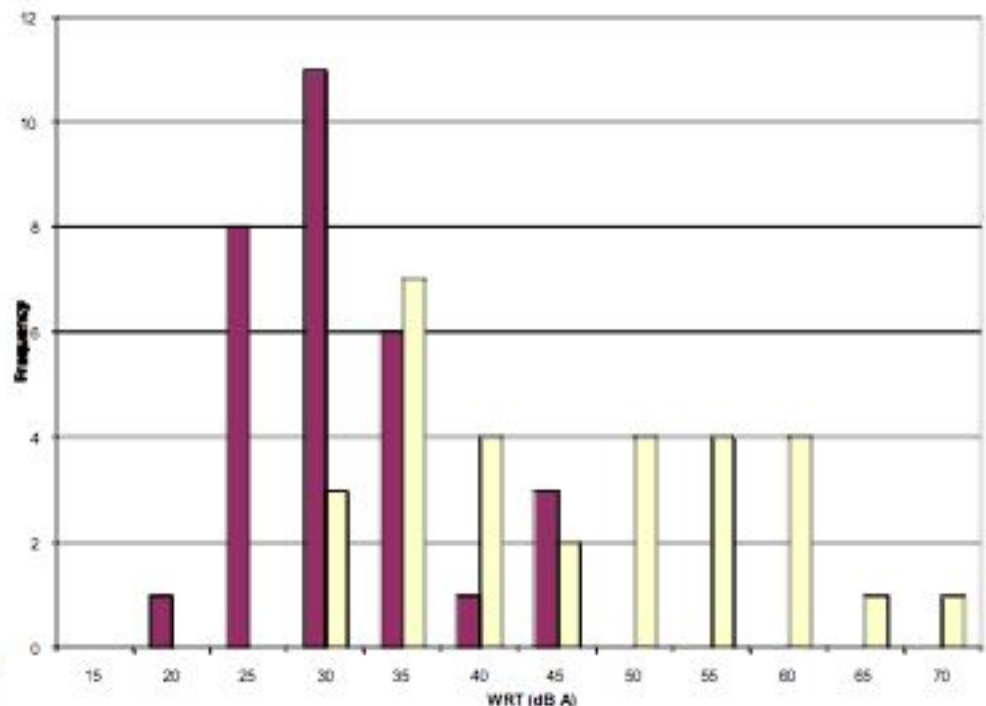
🌟 Summary and clinical implications

- Children who are OME free, score on average 29 dB at 2 ½ and 23 dB at age 5
- Expect children to score better than the 35 dB screening cut-off
- These norms can be used in clinic e.g. for evaluating hearing aid benefit



Summary and clinical implications

- Bristol Children's Hospital
- Data from 30 consecutive notes of children aided for persistent OME
- Aided (red bars) versus unaided WRT (yellow bars)



Most children fitted with Oticon Zest hearing aids

🌟 Summary and clinical implications

- There is a developmental improvement in WRT of 5 dB between 2 ½ and 3 ½ years
- This change is too small to detect within individual children



🌟 Summary and clinical implications

- Bilateral OME is associated with a mean decrease in WRT of 15 dB
- Greatest effect of OME on WRT at age 2 ½ years
- Demonstrates the impact of OME on WRT in relation to the population range



Summary and clinical implications

- Unilateral OME has a detrimental effect on word recognition
- Counsel parents of children with unilateral OME on the importance of good listening conditions and hearing tactics



Summary and clinical implications

- Early positive history of OME in the first 4 years of life is associated with a small deficit in WRT at age 5
- The deficit is too small to be detected within individual children
- Provides evidence for a small but lasting effect of early OME on auditory development up to age 5
- Limitation: definition of “OME positive”



Summary and clinical implications

- Limitations
- Observational methodology
- Generalisability of results
- No long term follow up of WRT



Future work

- ALSPAC is a unique resource
- Work is ongoing to further investigate the influence of early OME/hearing loss on development



Reference

- Hall AJ, Munro KJ & Heron J (2007) Developmental changes in word recognition threshold from two to five years of age in children with different middle ear status. *Int J Audiol* 46: 7, 355-361



Acknowledgements

- ALSPAC colleagues: Jean Golding, Dick Maw, Elizabeth Midgley, Judy Gravel, Sally Jones, Colin Steer
- Bristol Children's Hospital: Janine Matthews
- Institute of Hearing Research
- ALSPAC receives core-funding from Wellcome Trust, MRC and University of Bristol



 Any questions?

