

Speech perception and brain function: Experimental and clinical studies

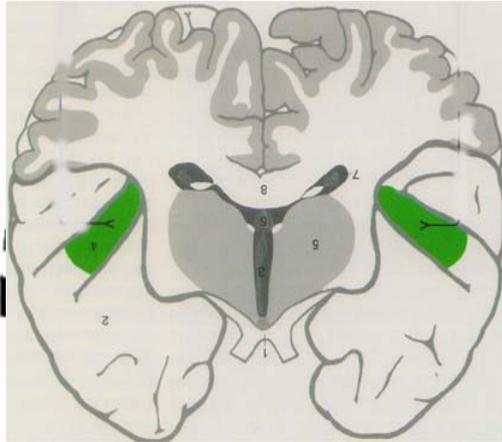
Kenneth Hugdahl

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Division of Psychiatry, Haukeland University Hospital, Bergen

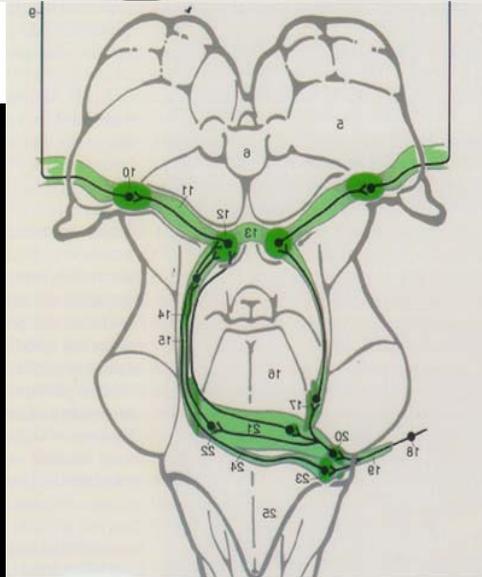


Dichotic presentations of consonant-vowel syllables: The Right Ear Advantage (REA)

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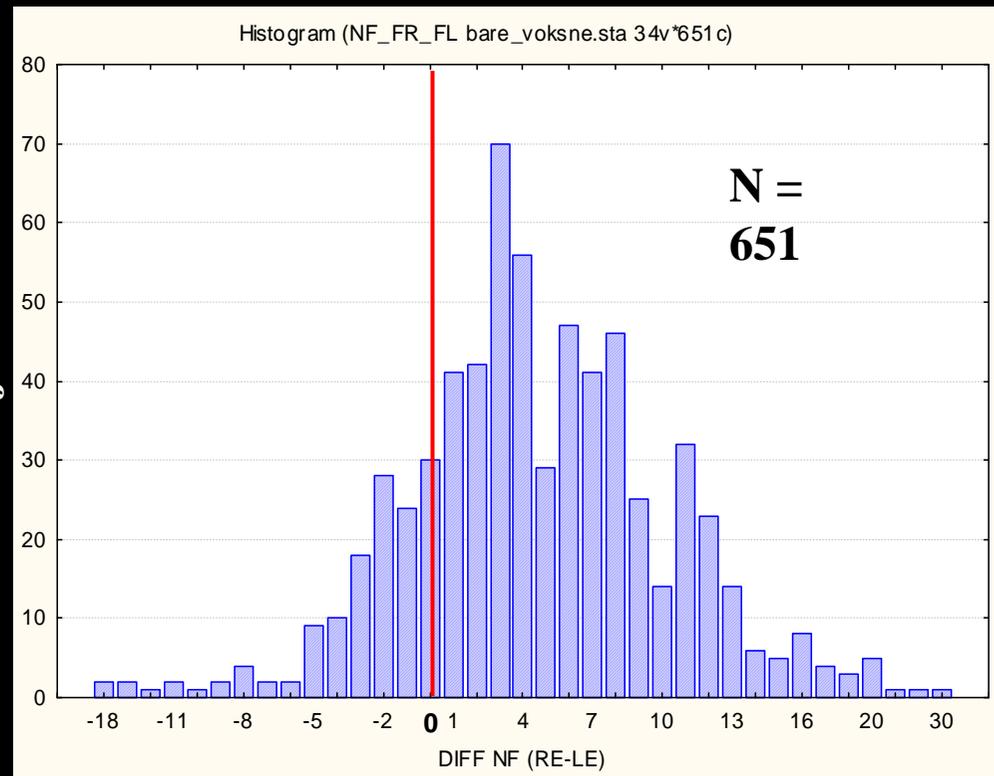
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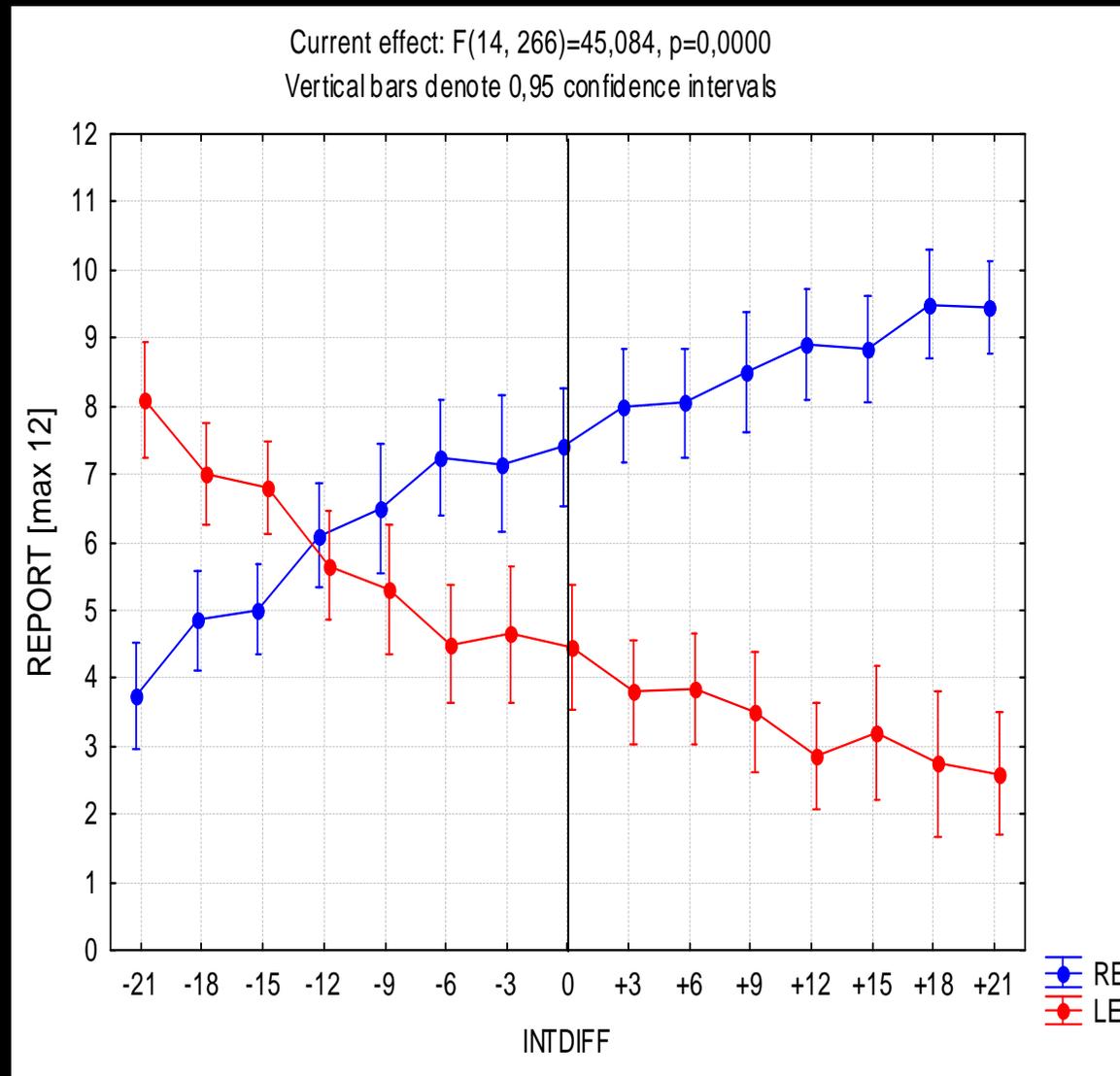
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Subjects



University of Bergen DL database / Hugdahl, K & Davidson, R.J. (Eds.). *The Asymmetrical Brain*, (2003). MIT Press, USA

The strength of the REA in terms of intensity difference for the right and left ear stimulus



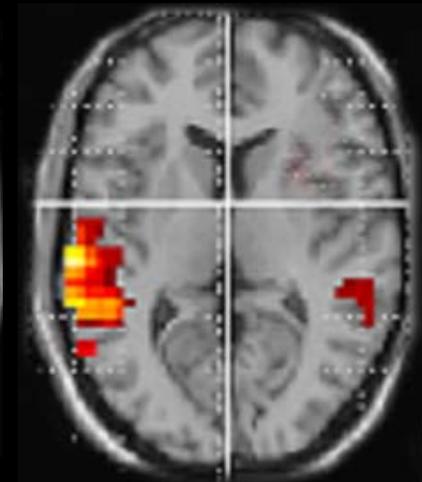
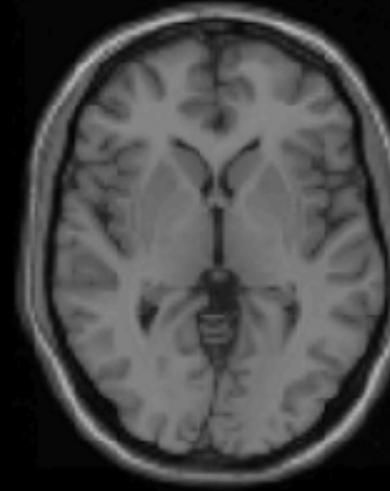
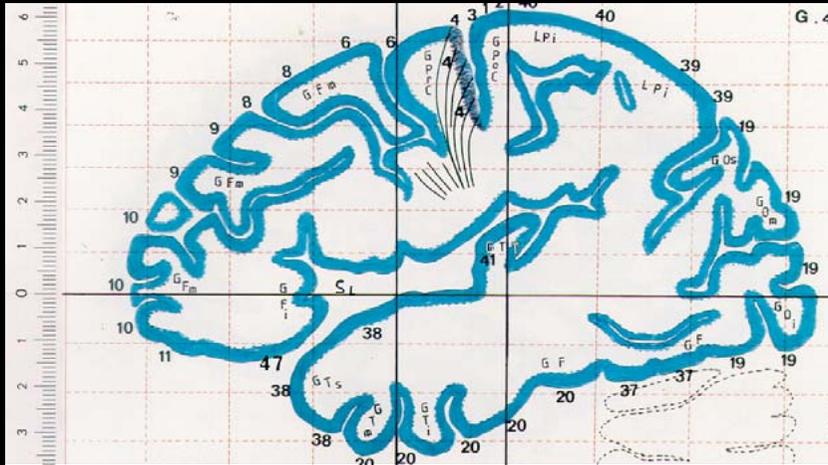
c.f. K. Hugdahl, R. Westerhausen, H. Hämäläinen et al. *Neuroscience Letters*, 2008

..where in the brain is the bottom-up REA located ?

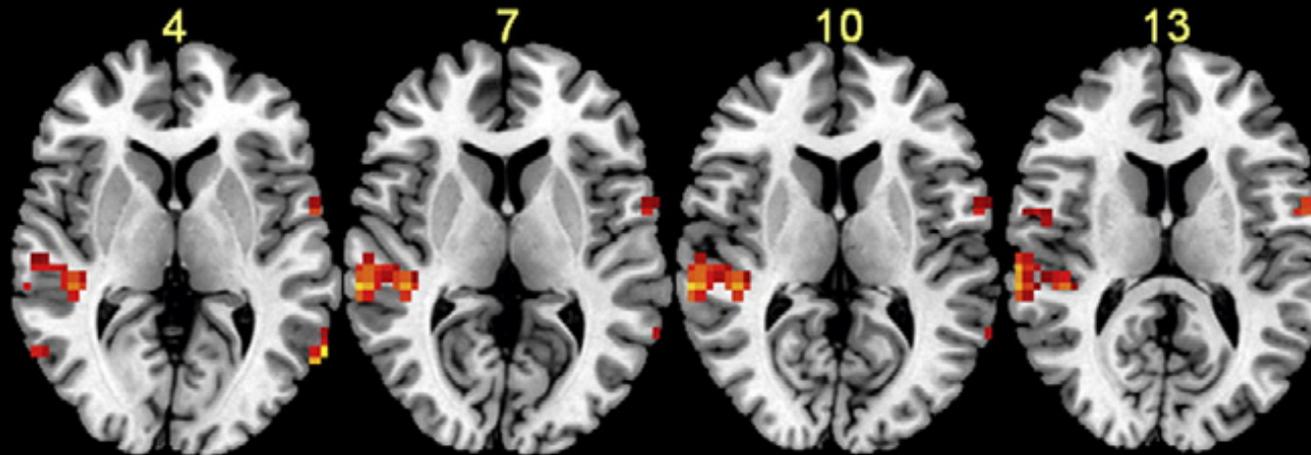
Talairach & Tournoux standardised brain atlas

MR structural image

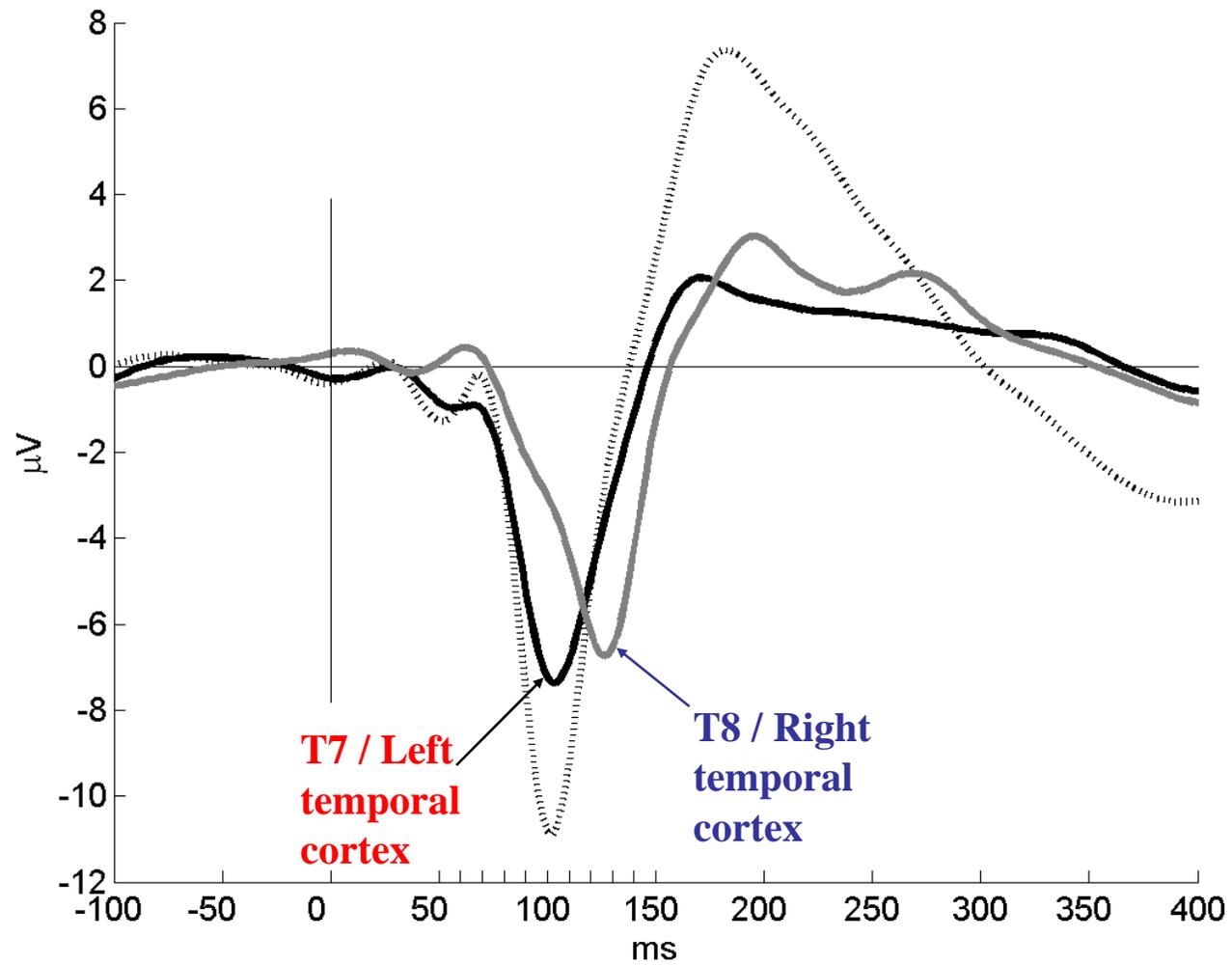
MR functional image



LM Rimol, K. Hugdahl, R. Savoy et al, *Neuroimage*, 2005



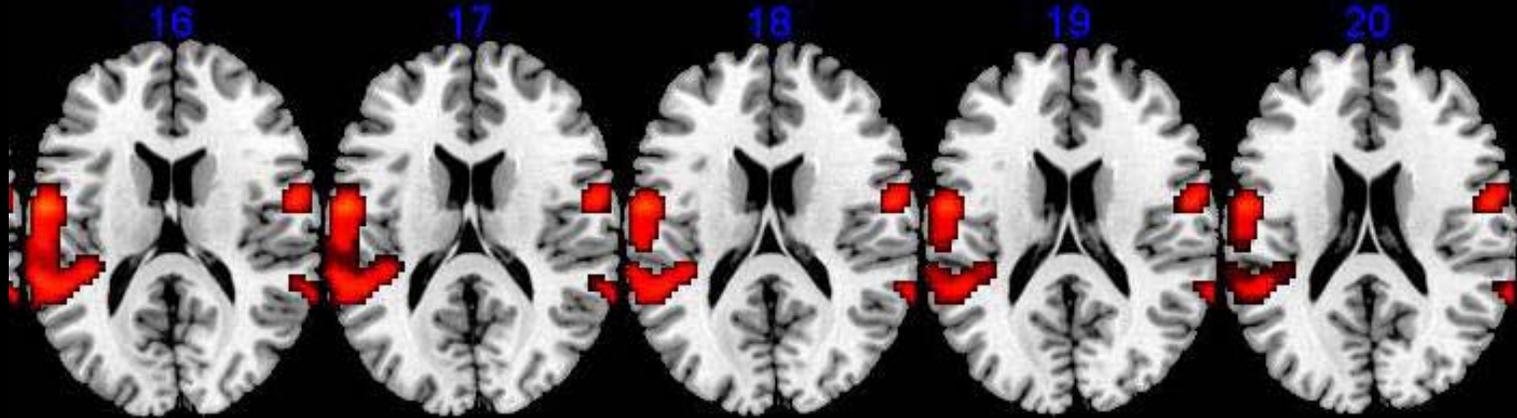
M. Van den Noort, K. Specht, K Hugdahl et al. *Neuroimage*, 2008



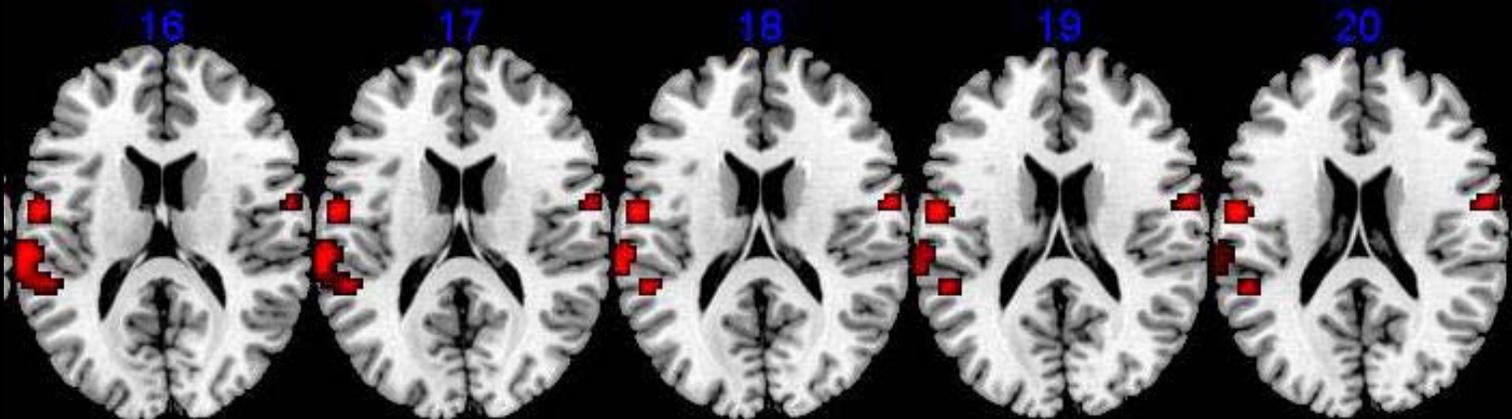
T Eichele, LM Rimol, H Nordby, K Hugdahl, *Cognitive Brain Research* (2005)

...and may have a glutamatergic mediation at the synaptic level

Drug
naive

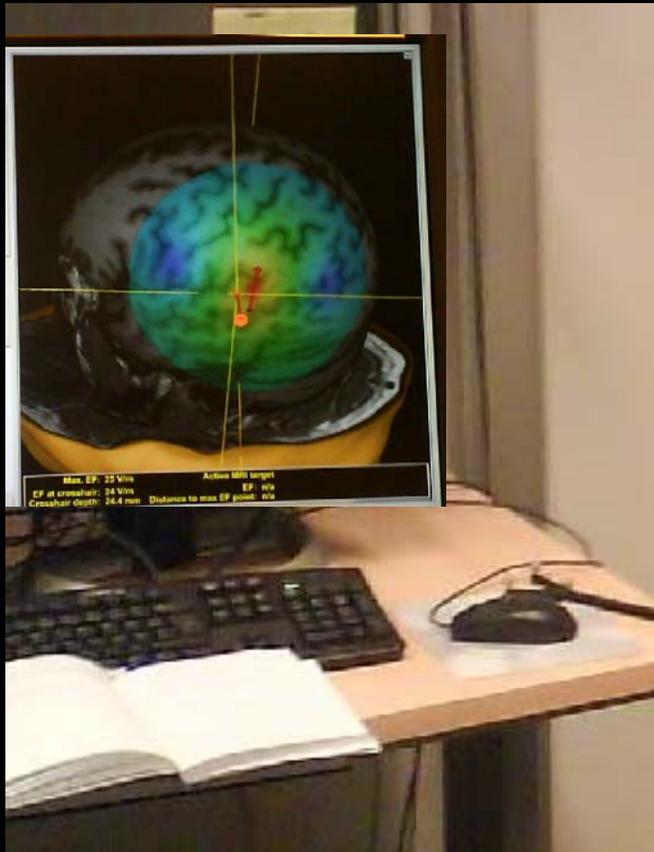


Meman-
tine

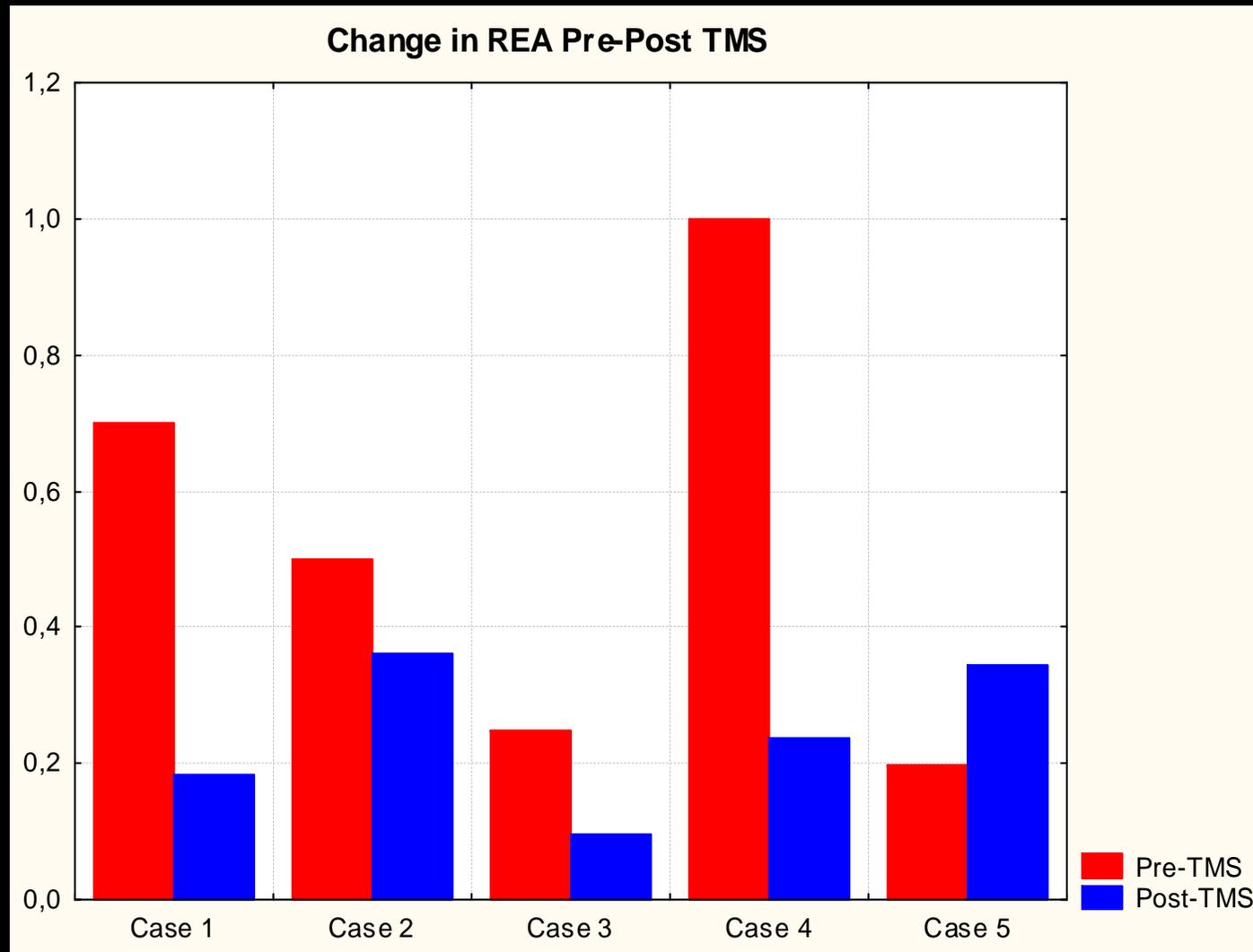


K. Hugdahl, E-M Løberg, H Wageningen et al., *Frontiers in Human Neuroscience*, 2008

If the REA is localized to the left STG/STS area, it should be attenuated or abolished after prolonged TMS stimulation

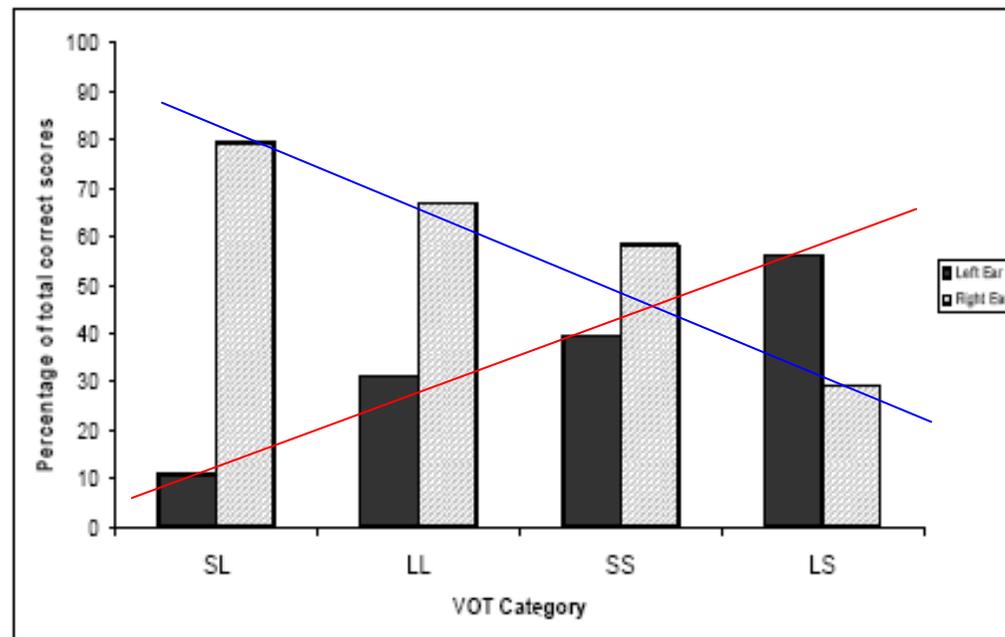
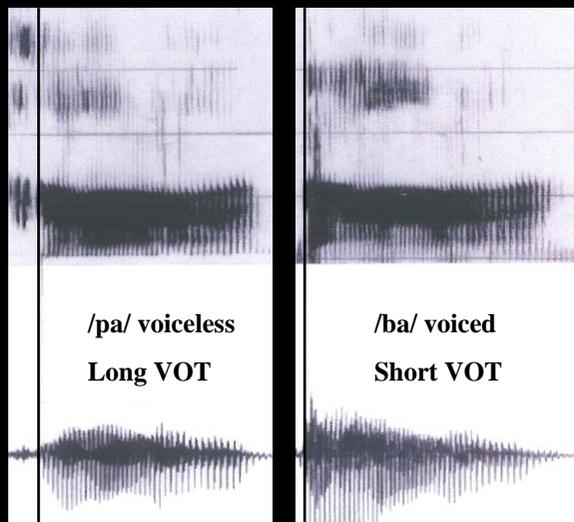


Effects of TMS over the left STG/HG area on the REA



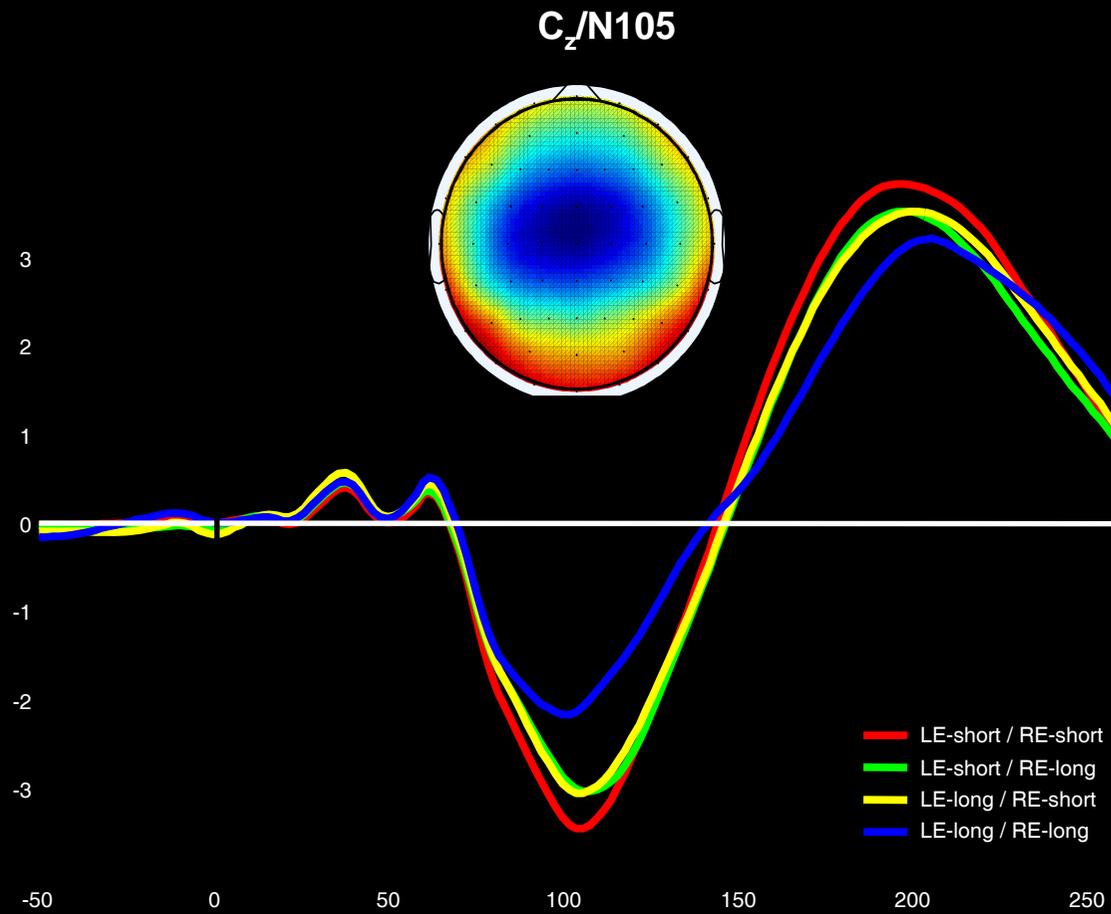
Postdoc Chris Gore,
University of Bergen

The effect of voice onset-time (VOT)



L.M. Rimol, K. Hugdahl, K. Specht et al., *Neuropsychologia*, 2006

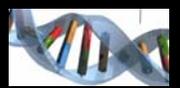
ERP in Dichotic Listening to CV-syllables: Effects of VOT



P. Sandman, K. Specht, L. Jäncke, K. Hugdahl, et al. *Restorative Neurology and Neuroscience*, 2007

Dyslexia

Genes



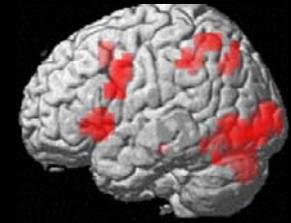
Environment



Structural brain anomalies (dysplasias, ectopias in the planum temporale area)



Functional brain anomalies (reduced blood flow in temporal lobe areas, increased blood flow in prefrontal areas)



Deficit in phonological decoding

General language abilities: speech development, articulation, language understanding

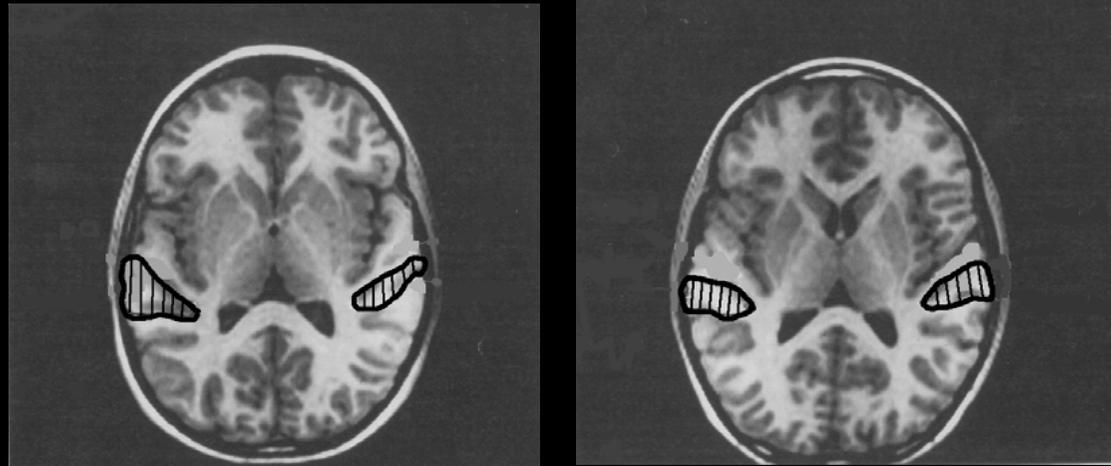
General cognitive abilities: Working memory, executive functions, IQ

Impaired reading and writing performance

Secondary problems: sentence understanding, mathematics, self confidence, school performance, life-time achievements



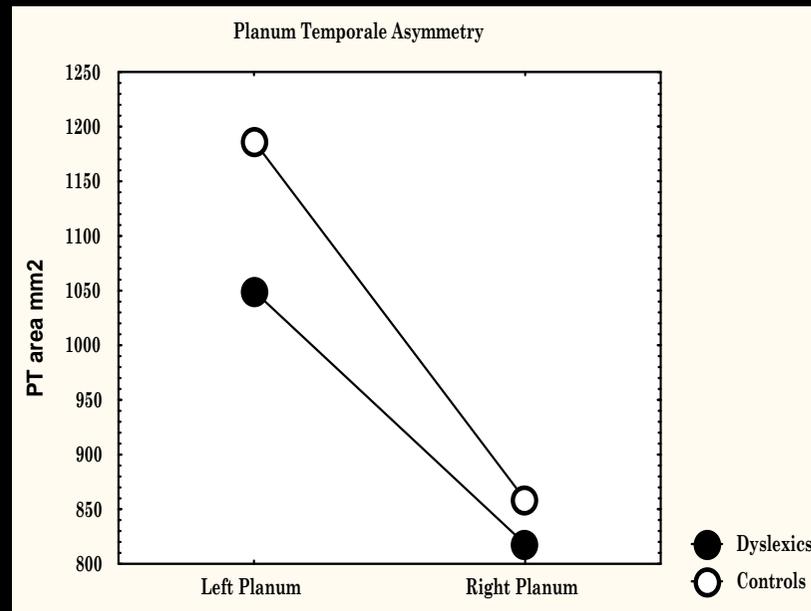
Reduced STG/STS grey matter volume in dyslexia

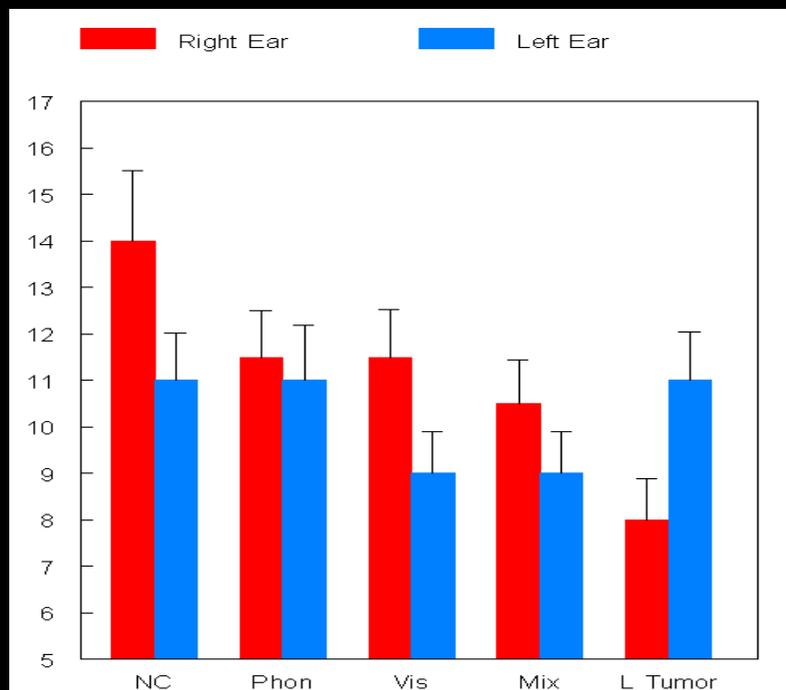


Hugdahl, Heiervang et al., *Scand. Audiol.*, 1998;

Heiervang, Hugdahl, Lundervold, Steinmetz et al. *Neuropsychologia*, 2000

Hugdahl, Heiervang, Lundervold et al., *Neuropsychologia*, 2003





Dyslexia children with a phonological decoding deficit fare worse on the DL test than other types of dyslexics

Dyslexia 1 = Diagnosis and no further assessment and/or training

Dyslexia 2 = Diagnosis and referred to special education unit for further assessment and/or training

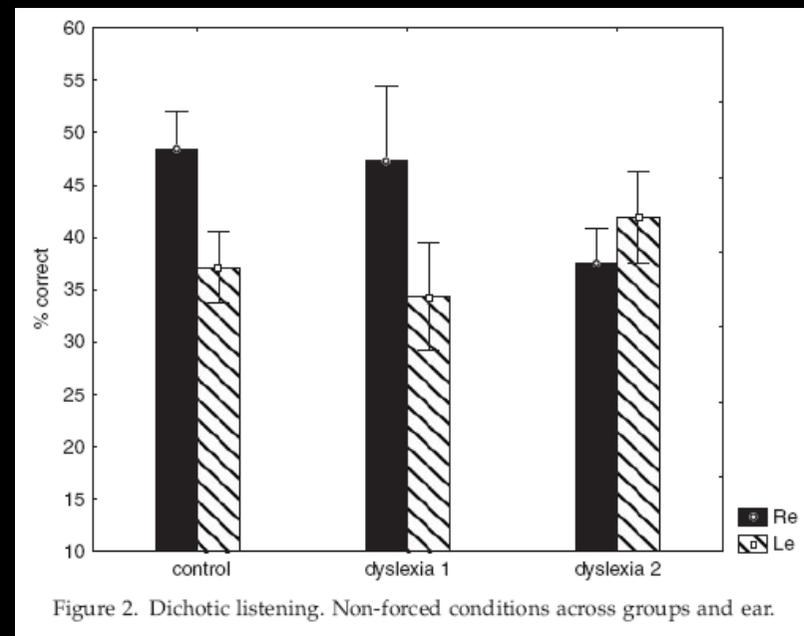


Figure 2. Dichotic listening. Non-forced conditions across groups and ear.

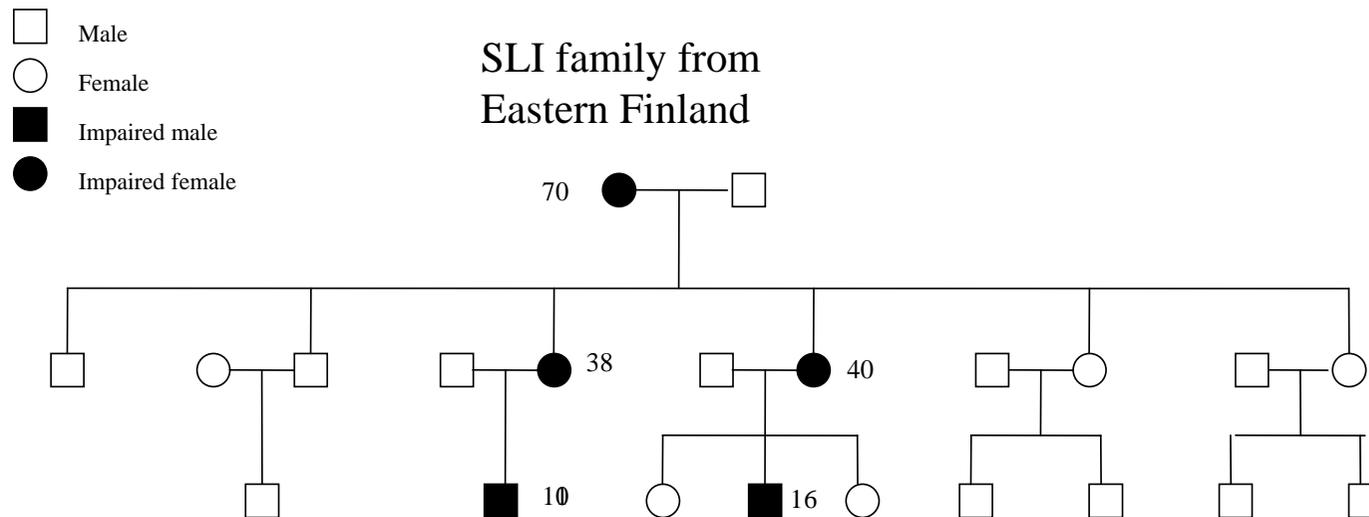
M Cohen, G Hynd, & K Hugdahl, *Brain and Lang.*, 1992

T Helland, A Asbjørnsen, AE Hushovd, K Hugdahl. *Dyslexia*, 2007

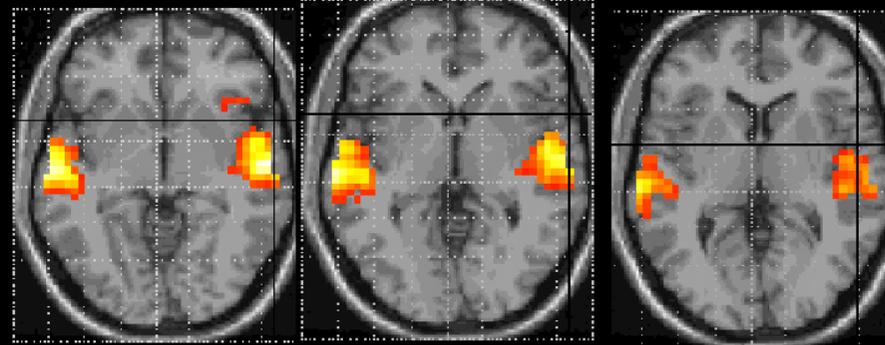
Specific Language Impairment (SLI)

Few words in lexicon. Late speech acquisition. Reduced speech frequency.
Resembles the language ability in younger children. Have problems finding the correct word although they seem to learn adequately in other areas. VIQ < PIQ

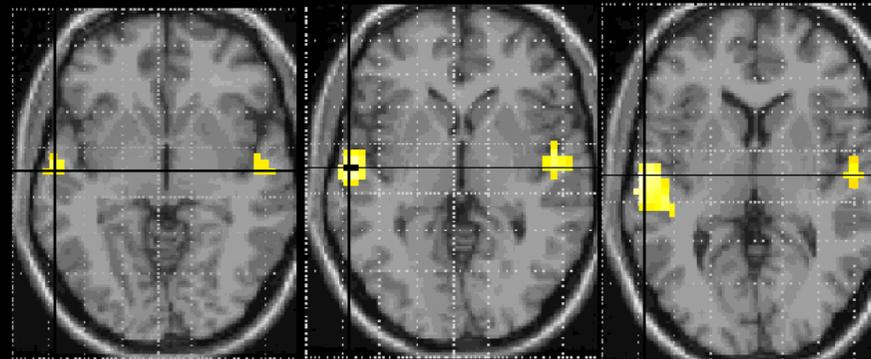
Affects morphology. Particularly word inflections. Frequent use of root morphemes and contentwords, have problems with function words



Age- and sex-matched control group



SLI-family group





Turid Helland, UiB (PI)

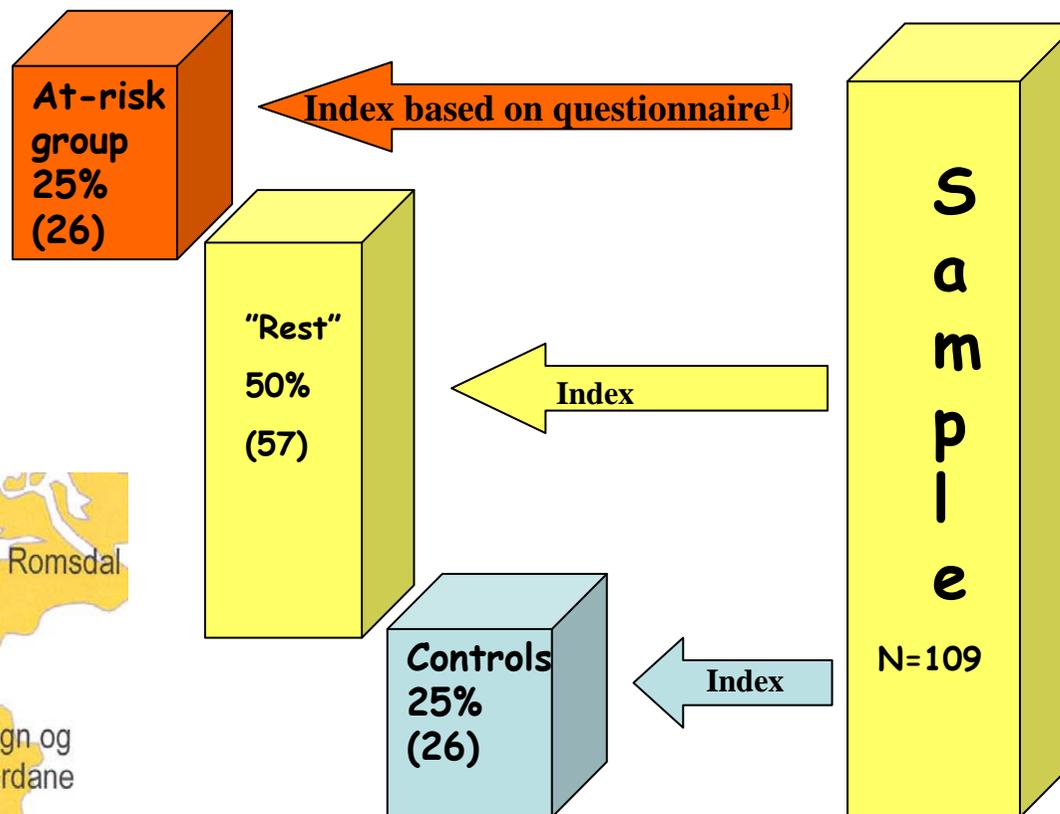
Sonja Ofte, Statped Vest, Bergen

Kenneth Hugdahl, UiB

Longitudinal study of language, reading, and mathematic skills development



Children (5 – 8 years) at risk for dyslexia



At-risk questionnaire:

- Birth complications
- General health
- Language development
- Motor development
- Special education services need
- Heredity factors

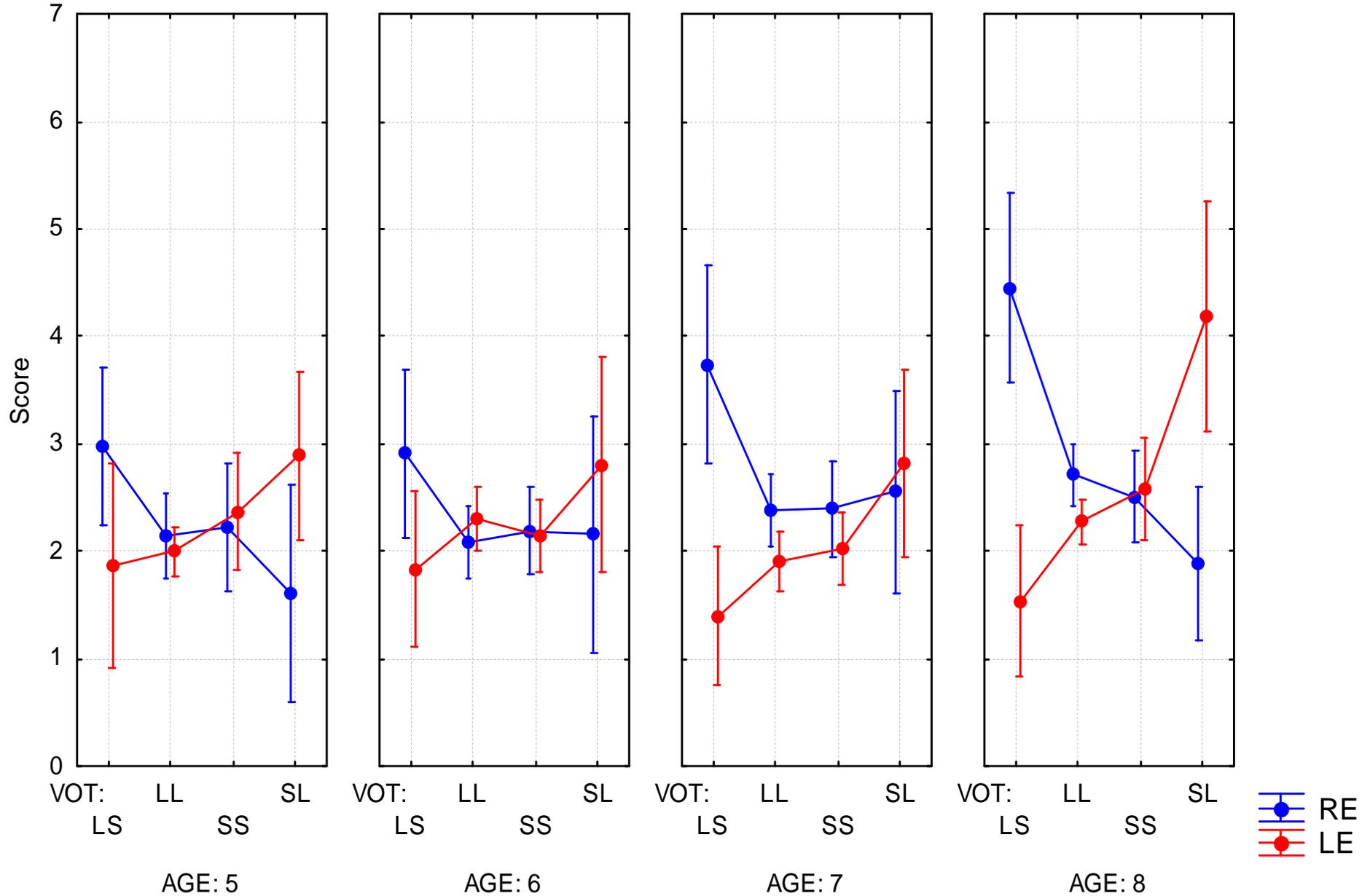


AGE*VOT*EAR*GROUP; N=21

Current effect: $F(9, 288)=,19454, p=,99464$

Vertical bars denote 0,95 confidence intervals

Factors: Levels
Group: con



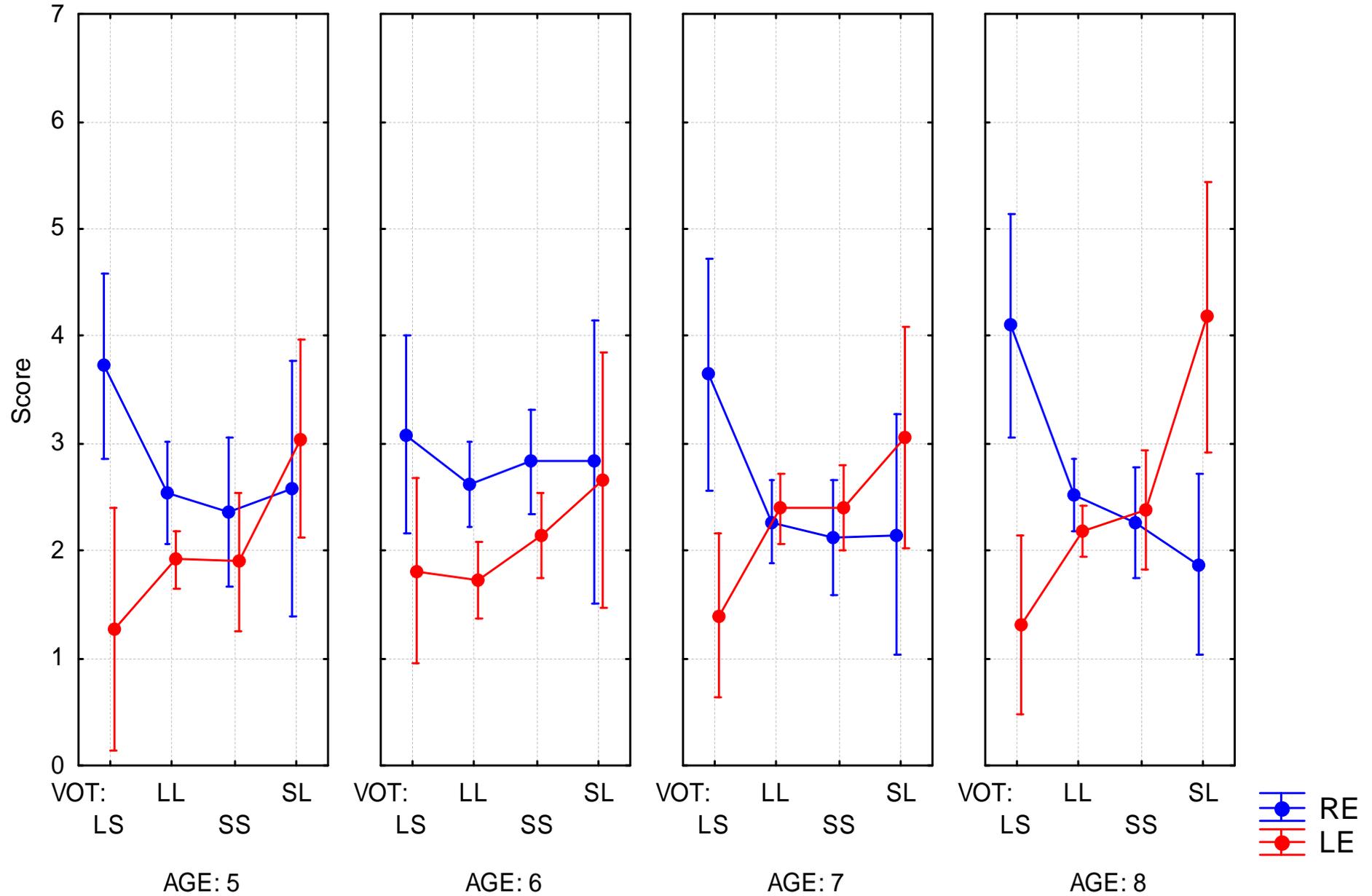
Group-effect

AGE*VOT*EAR*GROUP; N=15

Current effect: $F(9, 288)=,19454, p=,99464$

Vertical bars denote 0,95 confidence intervals

Factors: Levels
Group: risk

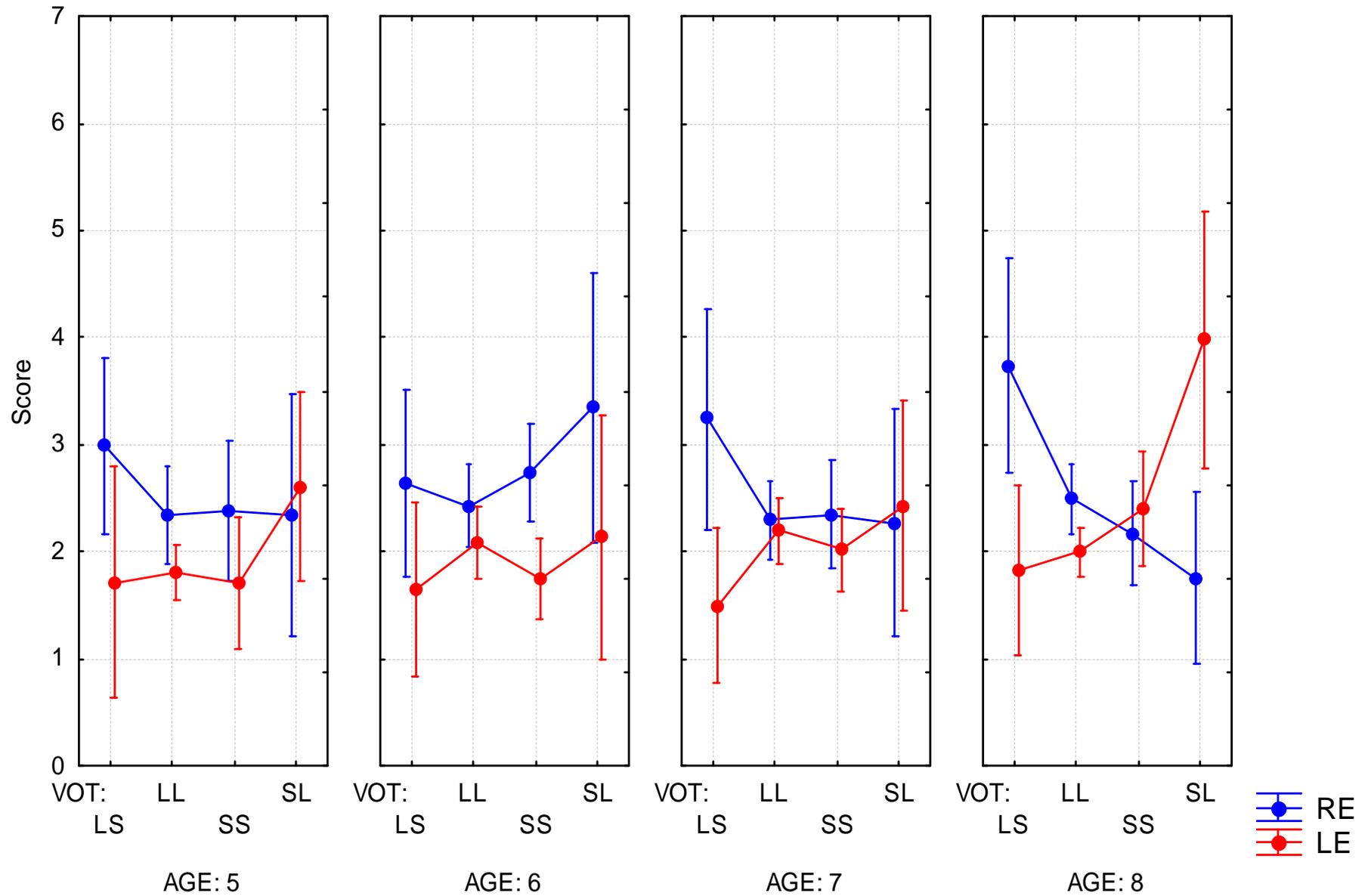


AGE*VOT*EAR*KJØNN; N=17

Current effect: $F(9, 288)=,49469, p=,87773$

Vertical bars denote 0,95 confidence intervals

Factors: Levels
KJØNN: Boys

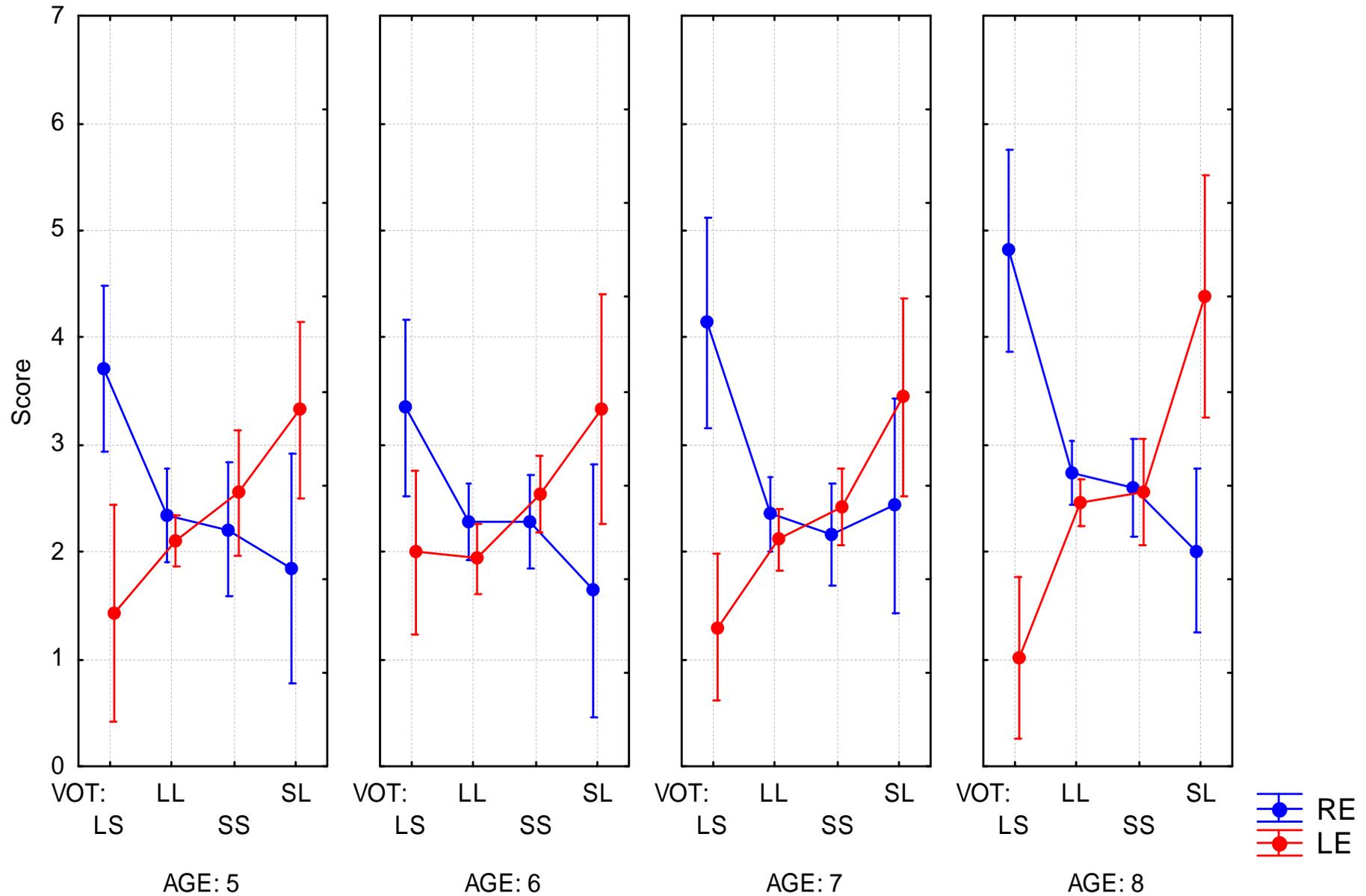


AGE*VOT*EAR*KJØNN; N=19

Current effect: $F(9, 288)=,49469, p=,87773$

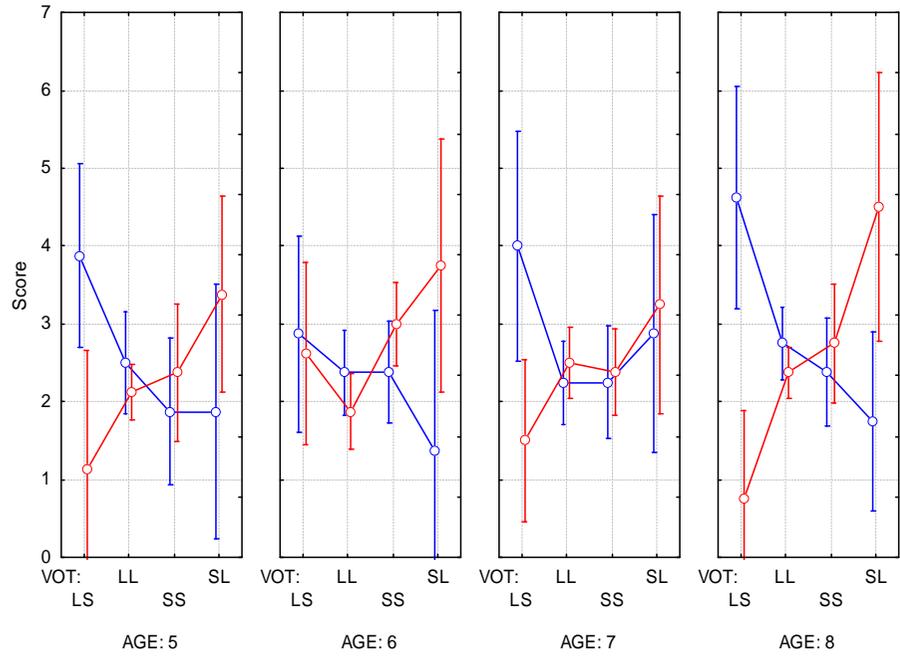
Vertical bars denote 0,95 confidence intervals

Factors: Levels
KJØNN: Girls



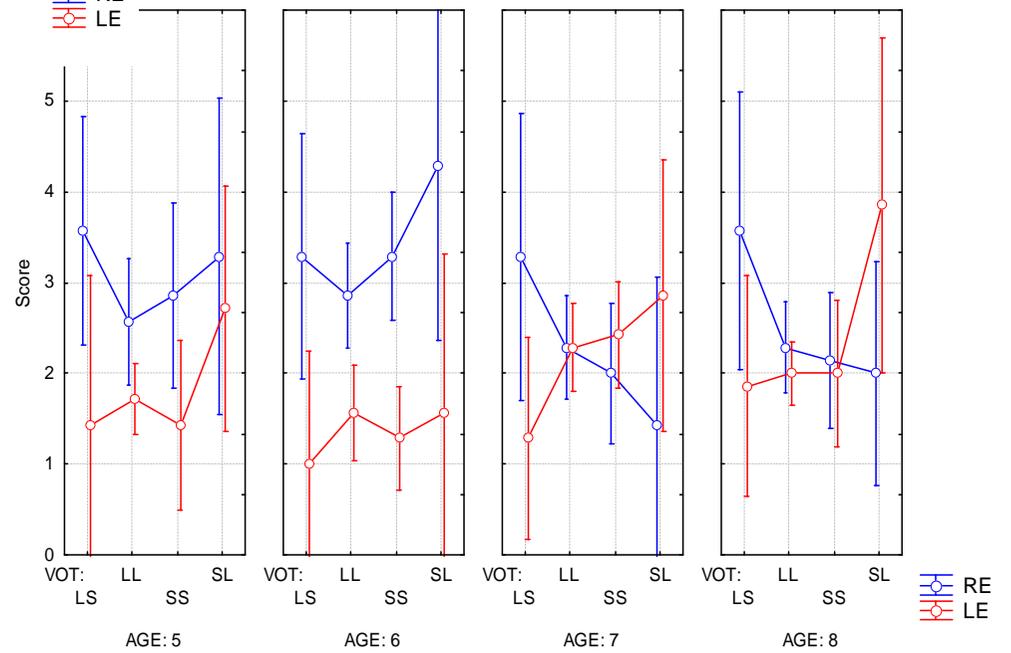
AGE*VOT*EAR*KJØNN*GROUP ; N=8
 Current effect: $F(9, 288)=1,2726$, $p=,25137$
 Vertical bars denote 0,95 confidence intervals

Factors: Levels
 KJØNN: Girls
 Group: risk



AGE*VOT*EAR*KJØNN*GROUP; N=7
 Current effect: $F(9, 288)=1,2726$, $p=,25137$
 Vertical bars denote 0,95 confidence intervals

Factors: Levels
 KJØNN: Boys
 Group : risk



Summary and conclusions

- Functional imaging and TMS data indicate that dichotic listening with CV-syllables tap a left lateralized phonological processing module
- Dyslexic children suffer from a phonological processing deficit, seen as a reduction in the right ear advantage, and corresponding left temporal lobe abnormality
- Children at-risk for dyslexia show a lack of VOT modulation, more evident in boys than in girls. A marker of phonological awareness ?



FIN