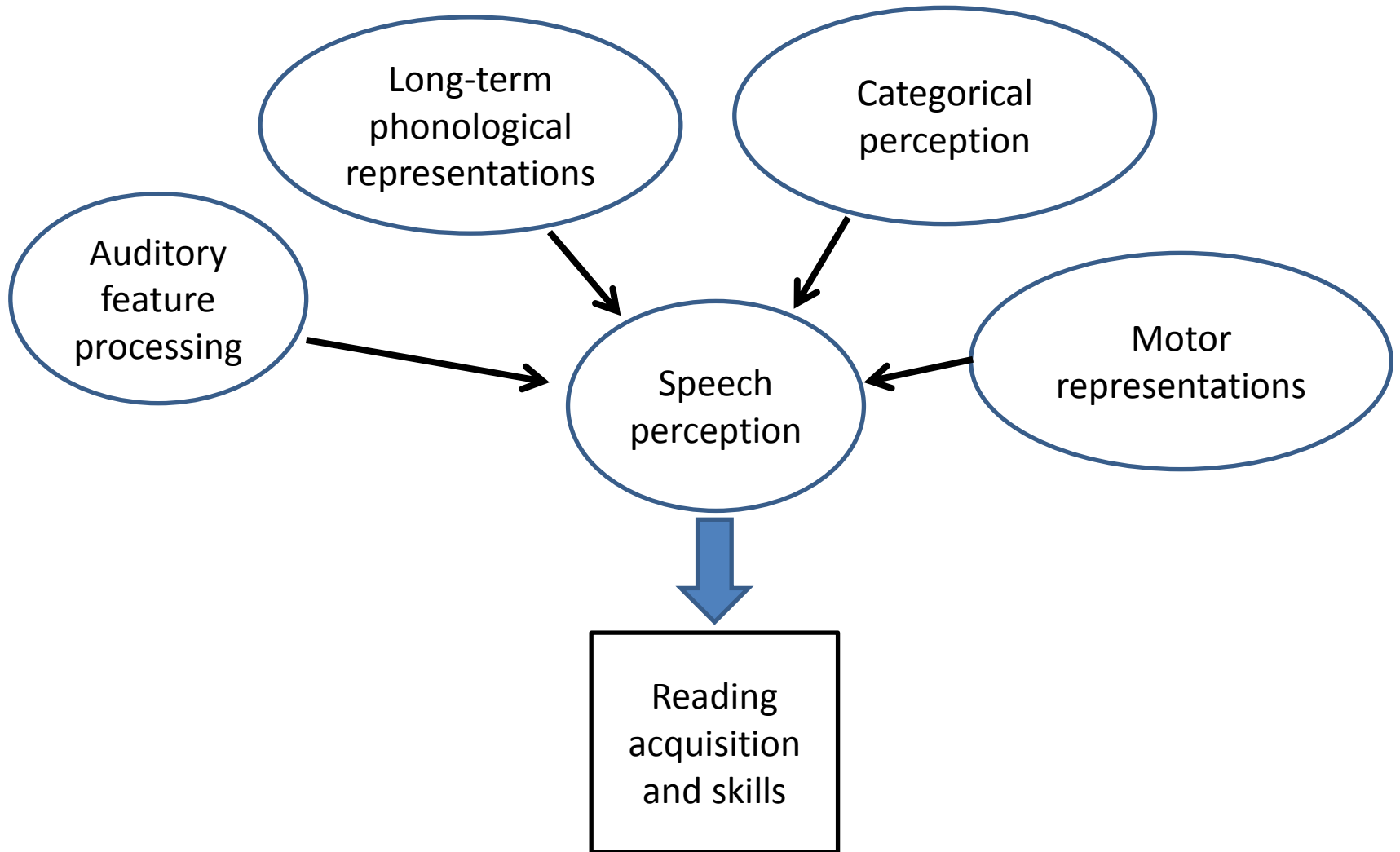


Dyslexia and speech perception

Jarmo Hämäläinen, Kaisa Lohvansuu,
Heikki Lyytinen, Paavo Leppänen

Department of Psychology
University of Jyväskylä, Finland

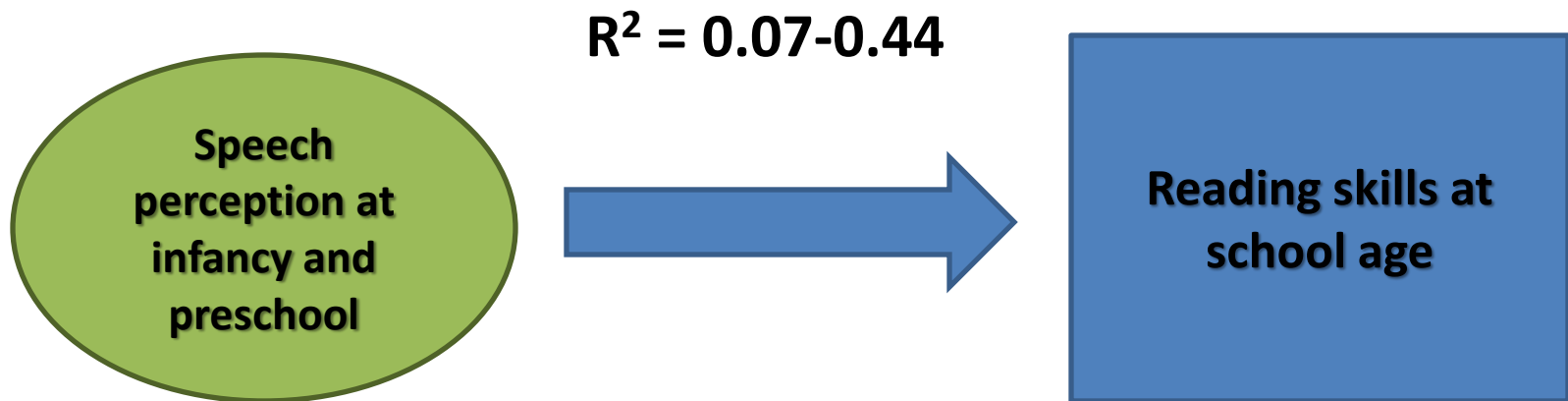
Background



Dyslexia and speech perception

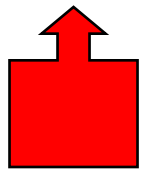
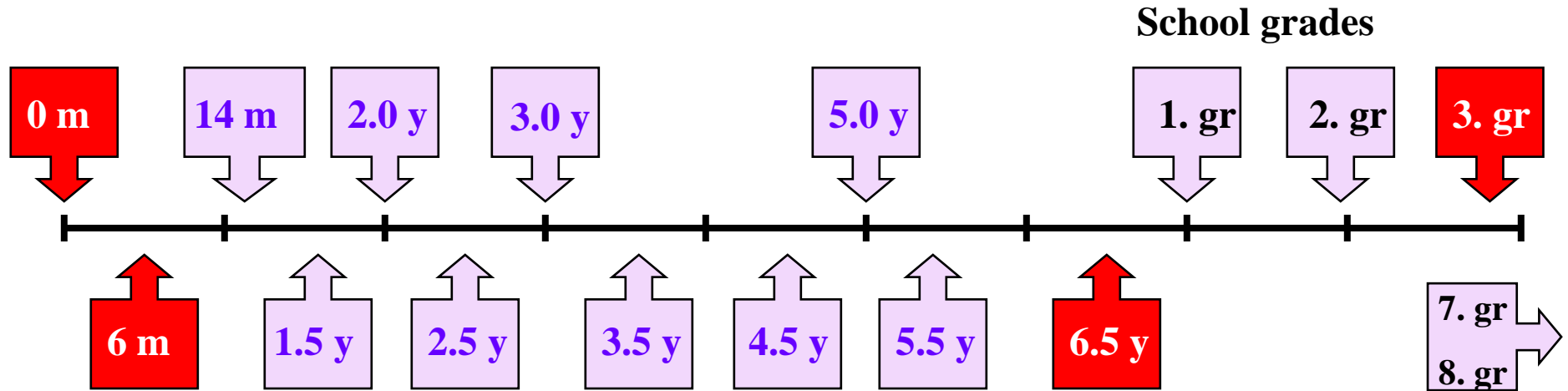
- Predictive relationships (infancy to school-age)
 - Persistency (infancy, kindergarten, school-age)
 - Jyväskylä Longitudinal Study of Dyslexia
- Foreign language phoneme perception and reading
 - Cross-linguistic study

Brain responses to speech sounds predict school-age reading



e.g., Espy et al., 2004; Hämäläinen et al., 2013; Lohvansuu et al., 2018; Maassen et al., 2012; Maurer et al., 2007; van Zuijen et al., 2013

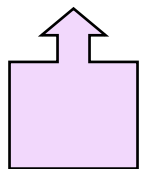
Jyväskylä Longitudinal Study of Dyslexia (JLD) - measurement phases



EEG measures



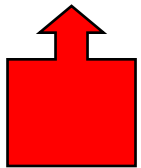
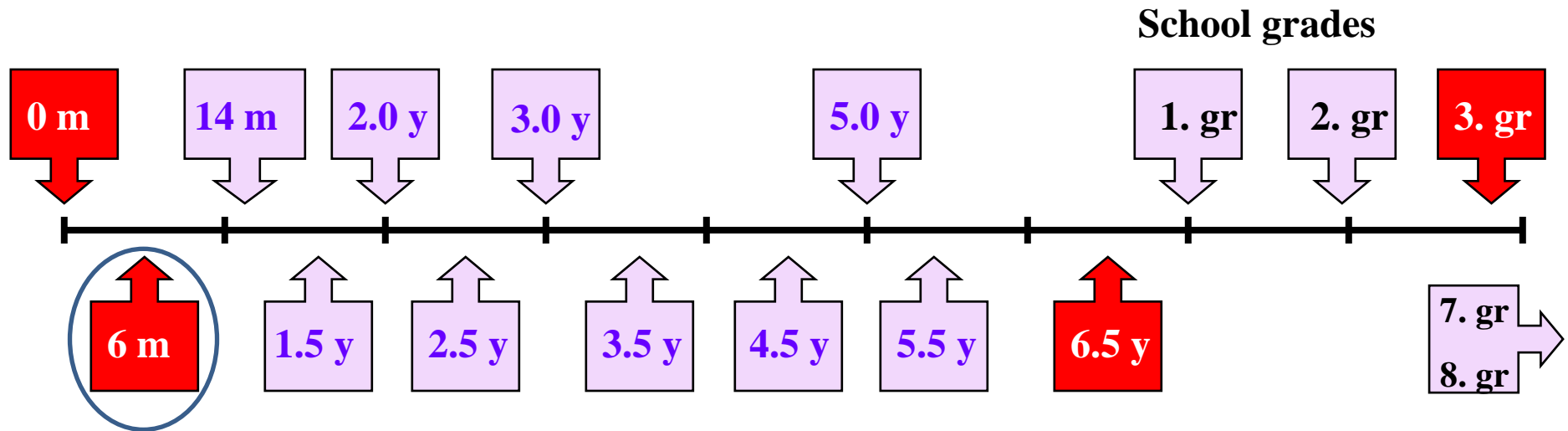
100 children at familial risk for dyslexia
100 control children with no family history of dyslexia



Behavioural measures



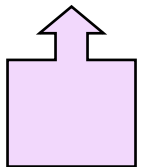
Jyväskylä Longitudinal Study of Dyslexia (JLD) - measurement phases



EEG measures



100 children at familial risk for dyslexia
100 control children with no family history of dyslexia



Behavioural measures

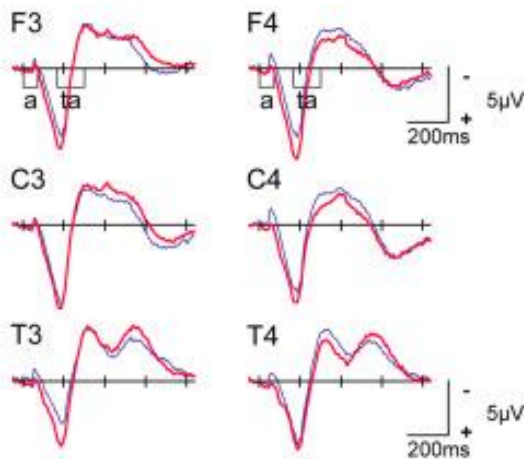


ERPs to pseudowords at 6 months



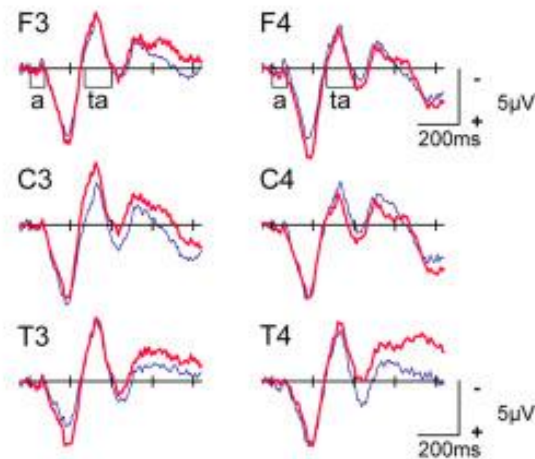
a Frequently repeated /ata/ 300 ms

— Control group N = 22
— At-risk group N = 26



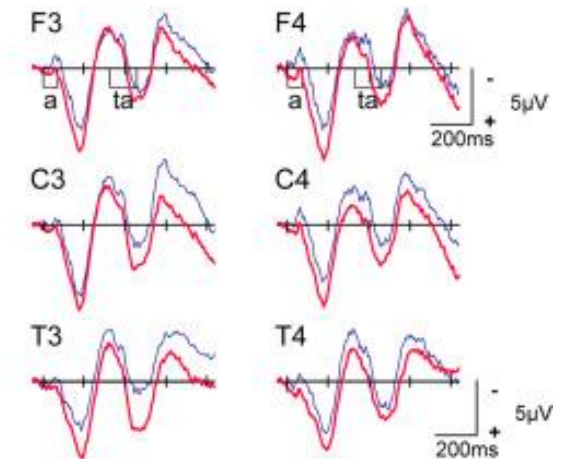
b Rarely-presented /at:a/ 400 ms

— Control group N = 22
— At-risk group N = 26

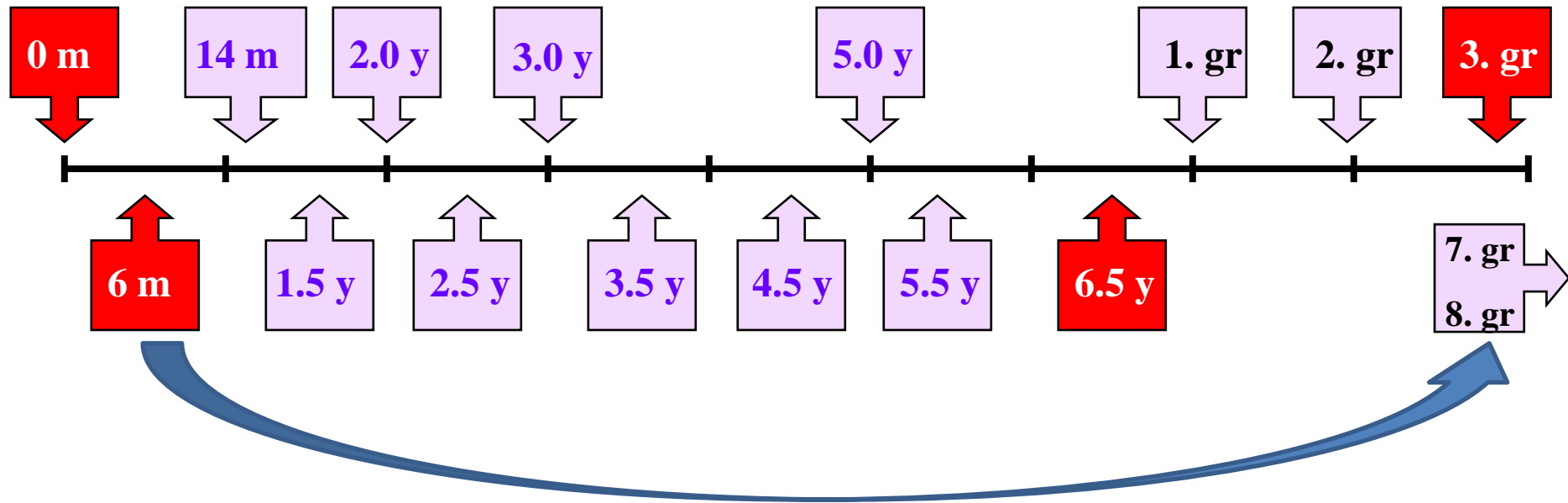


c Rarely-presented /at:a/ 460 ms

— Control group N = 22
— At-risk group N = 26



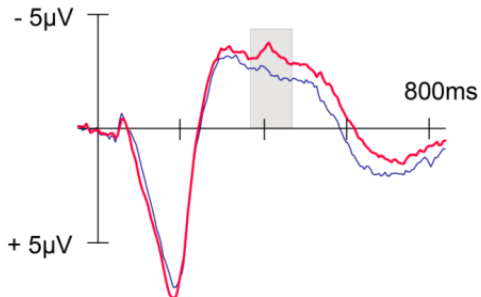
ERPs to pseudowords at 6 months



Response to /ata/

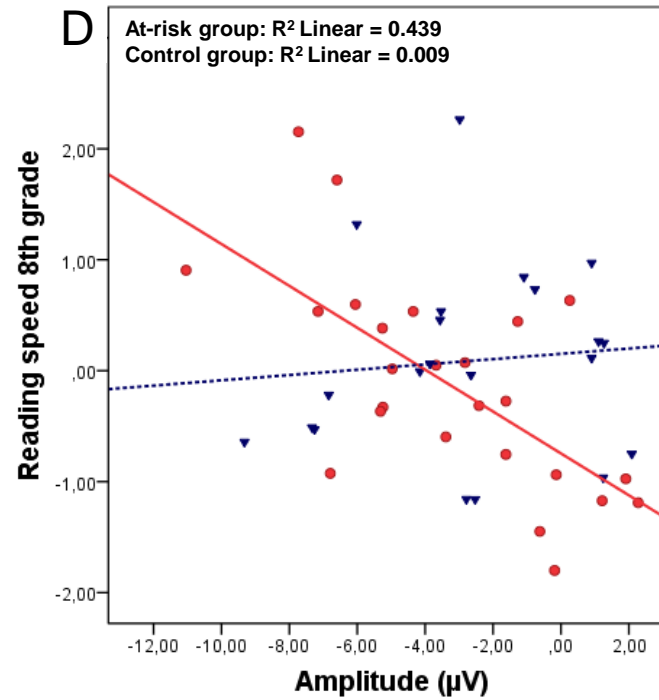
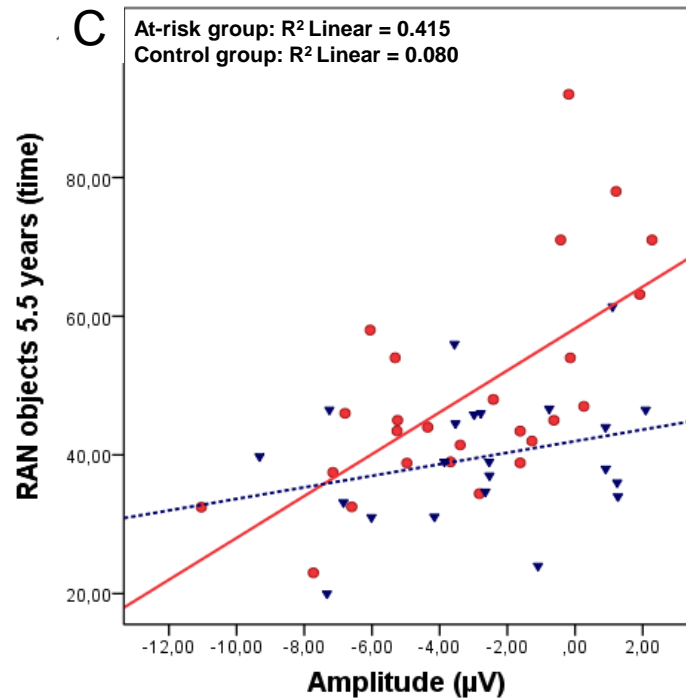
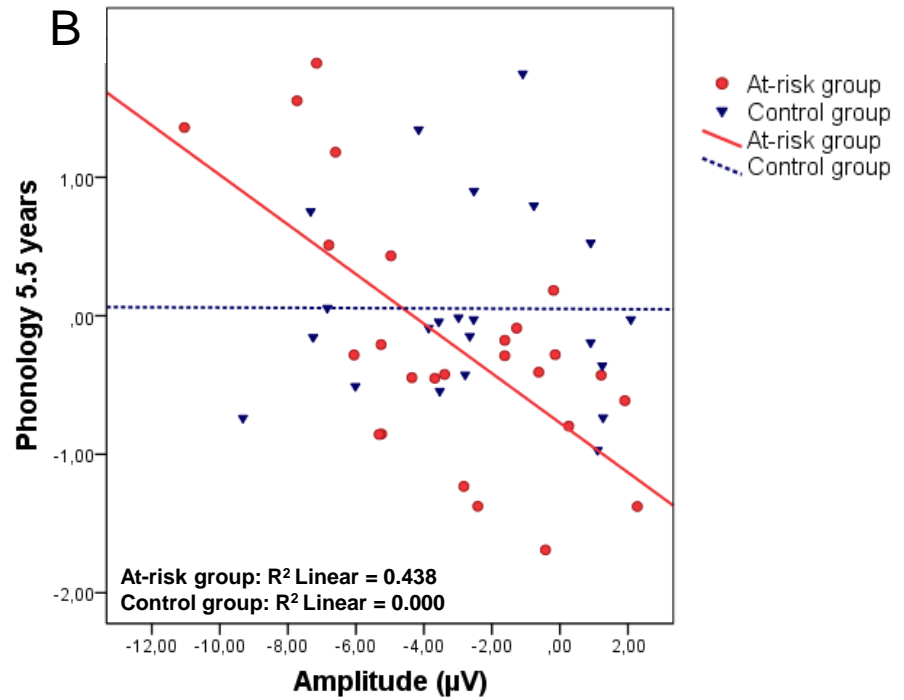
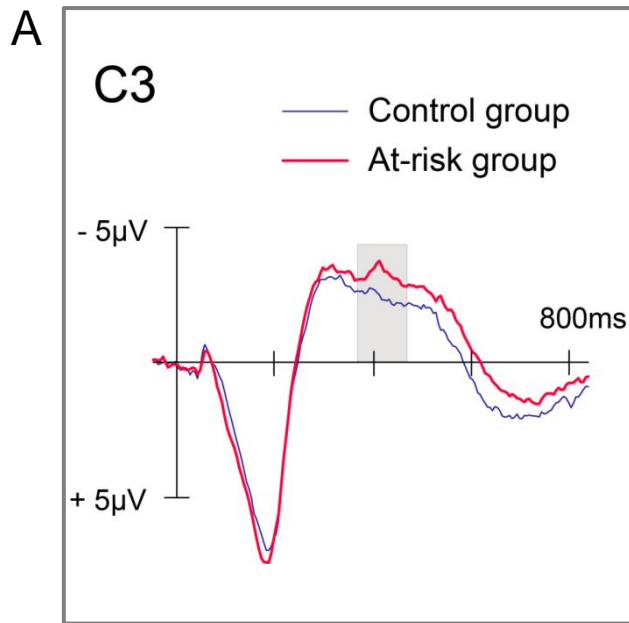
C3

— Control group
— At-risk group



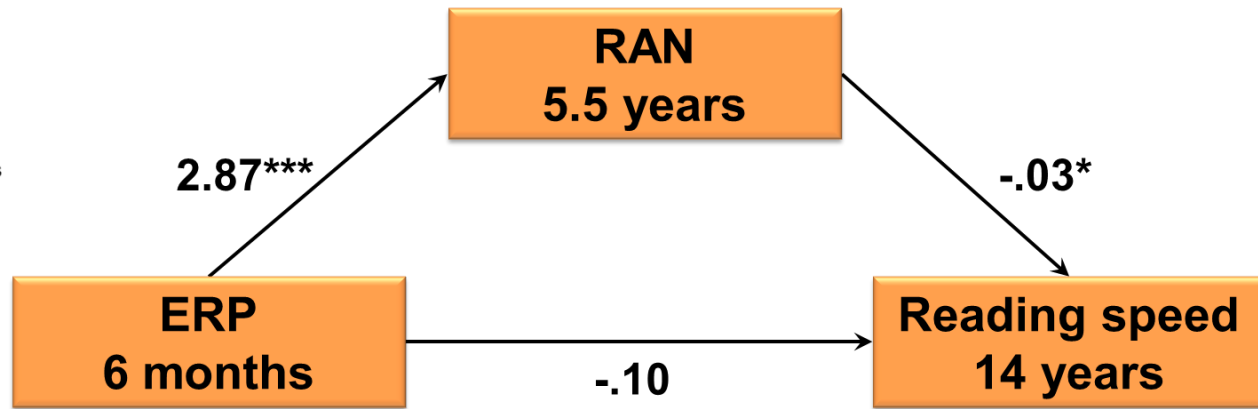
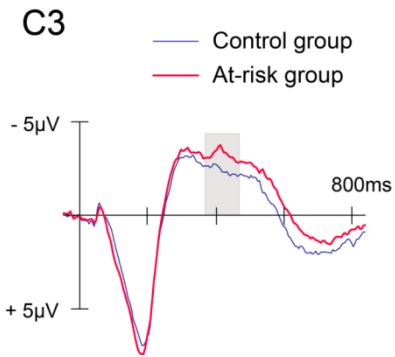
Reading speed

$R^2 = 0.44$



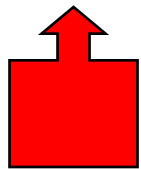
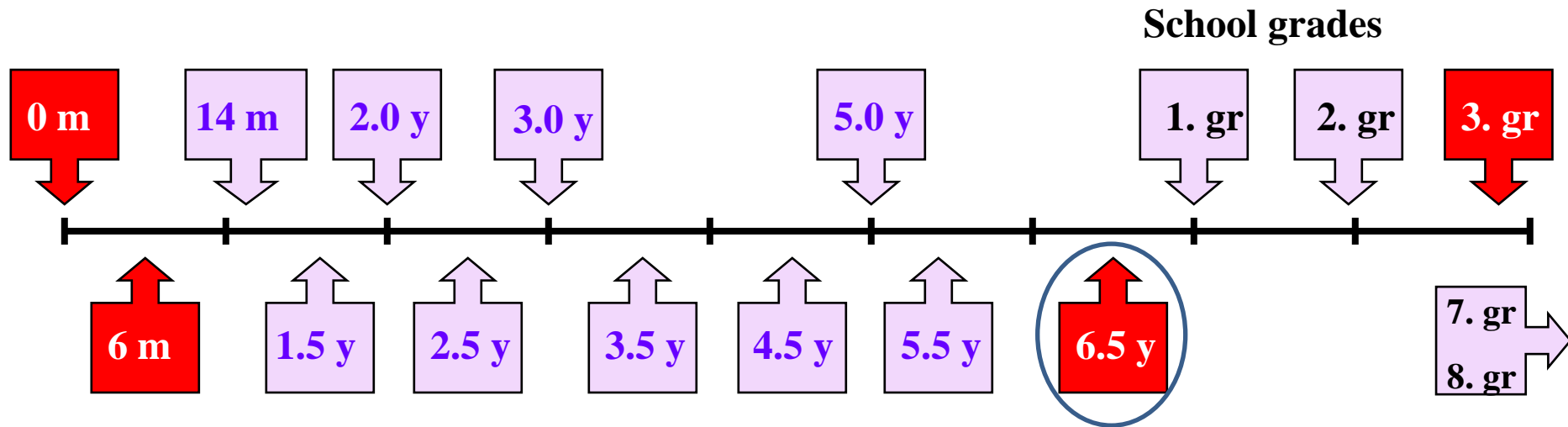
ERPs at 6 months and associations to 8th grade reading

Indirect effect via mediator

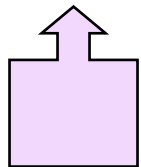


Model: $F(2, 22) = 15.41^{***}$ Adjusted $R^2 = .55$ $P_M = .47$

Jyväskylä Longitudinal Study of Dyslexia (JLD) - measurement phases



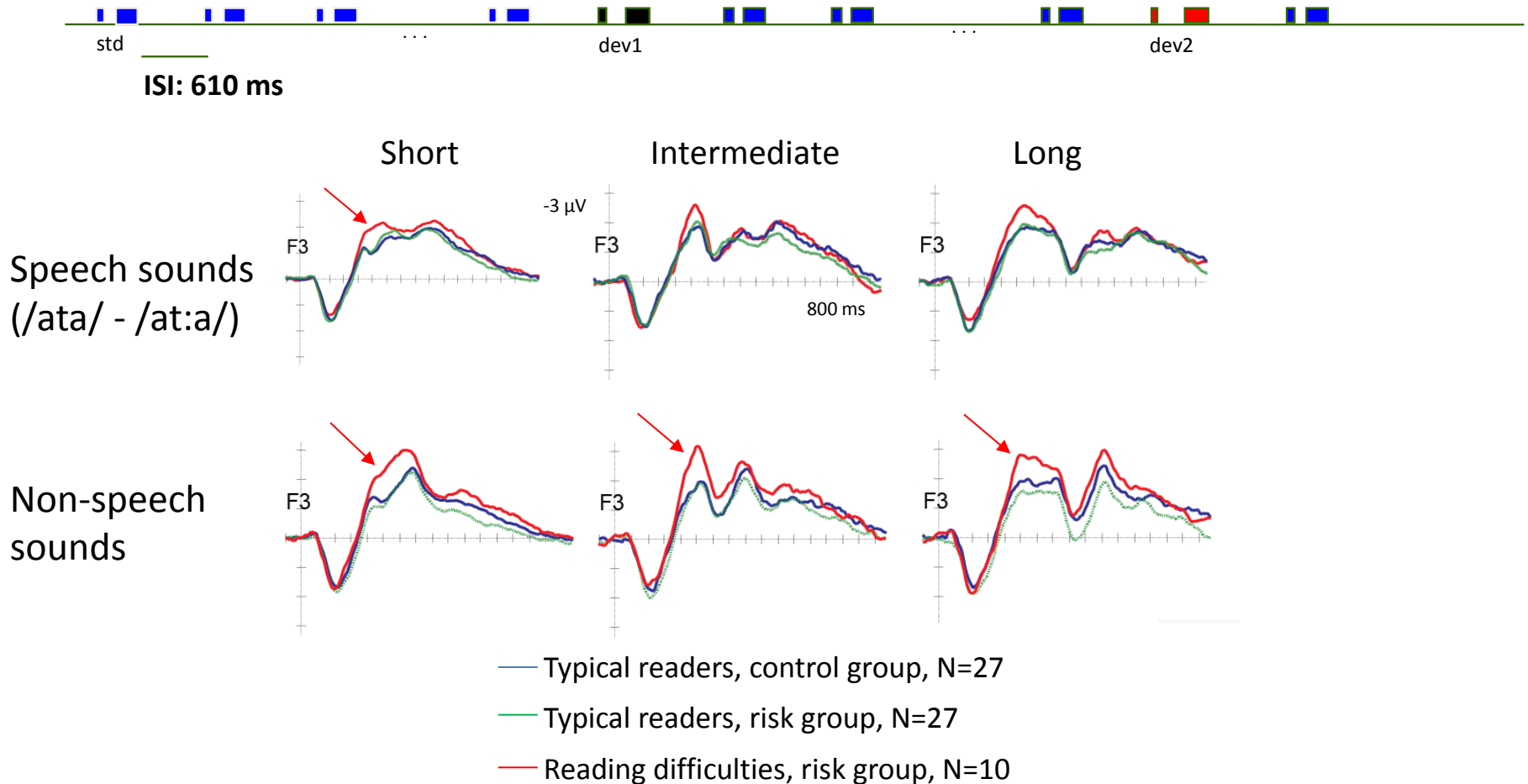
EEG measures



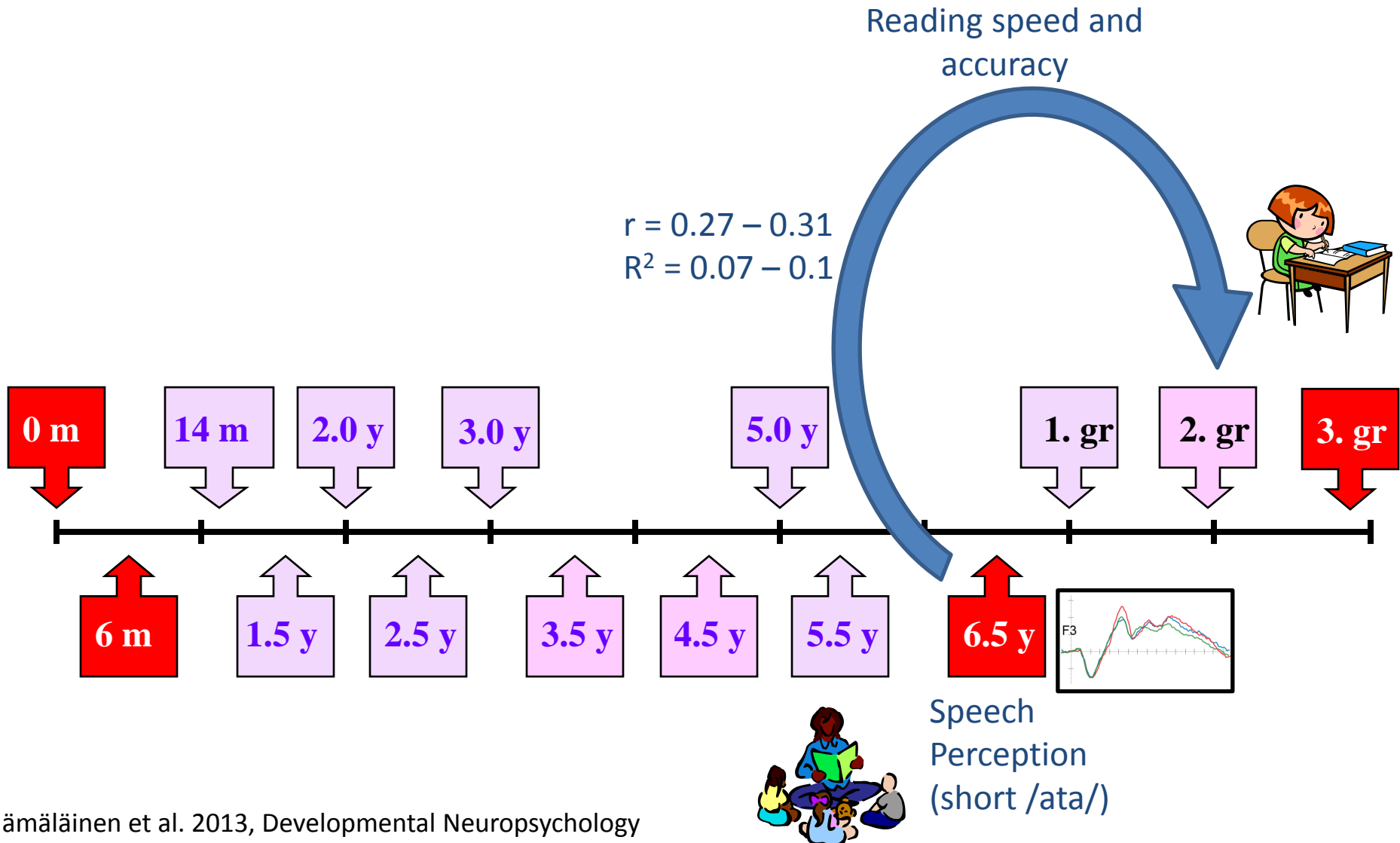
Behavioural measures



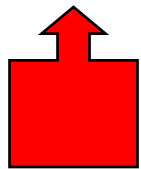
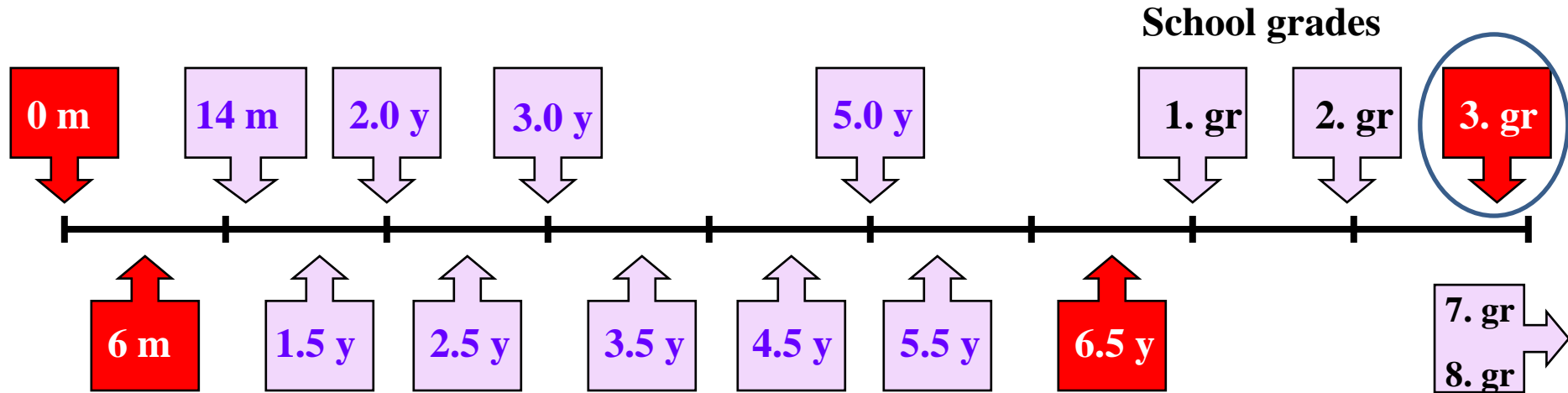
ERPs to pseudowords and complex tones at 6.5 years



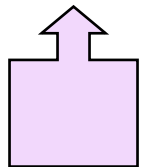
Auditory perception at kindergarten and school age reading performance



Jyväskylä Longitudinal Study of Dyslexia (JLD) - measurement phases



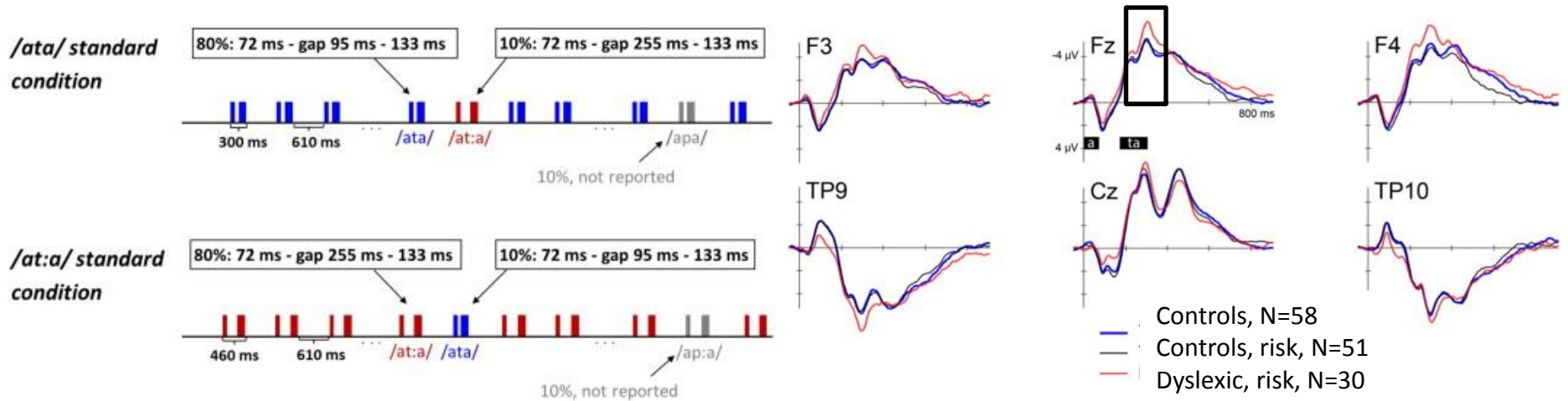
EEG measures



Behavioural measures



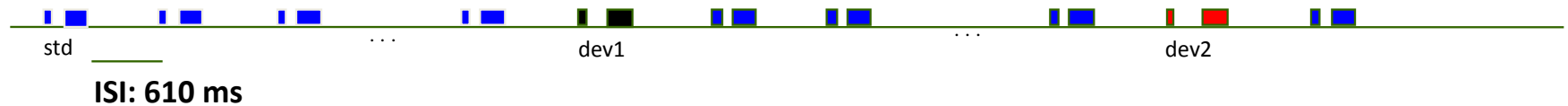
Speech perception differences persist into school age (9.5 years)



Correlation with concurrent reading skills within children with dyslexia: the larger the response the better the reading skills

Foreign language phoneme perception and reading

Finnish: /ata/-/atta/



English: /ba/, /da/, /ga/



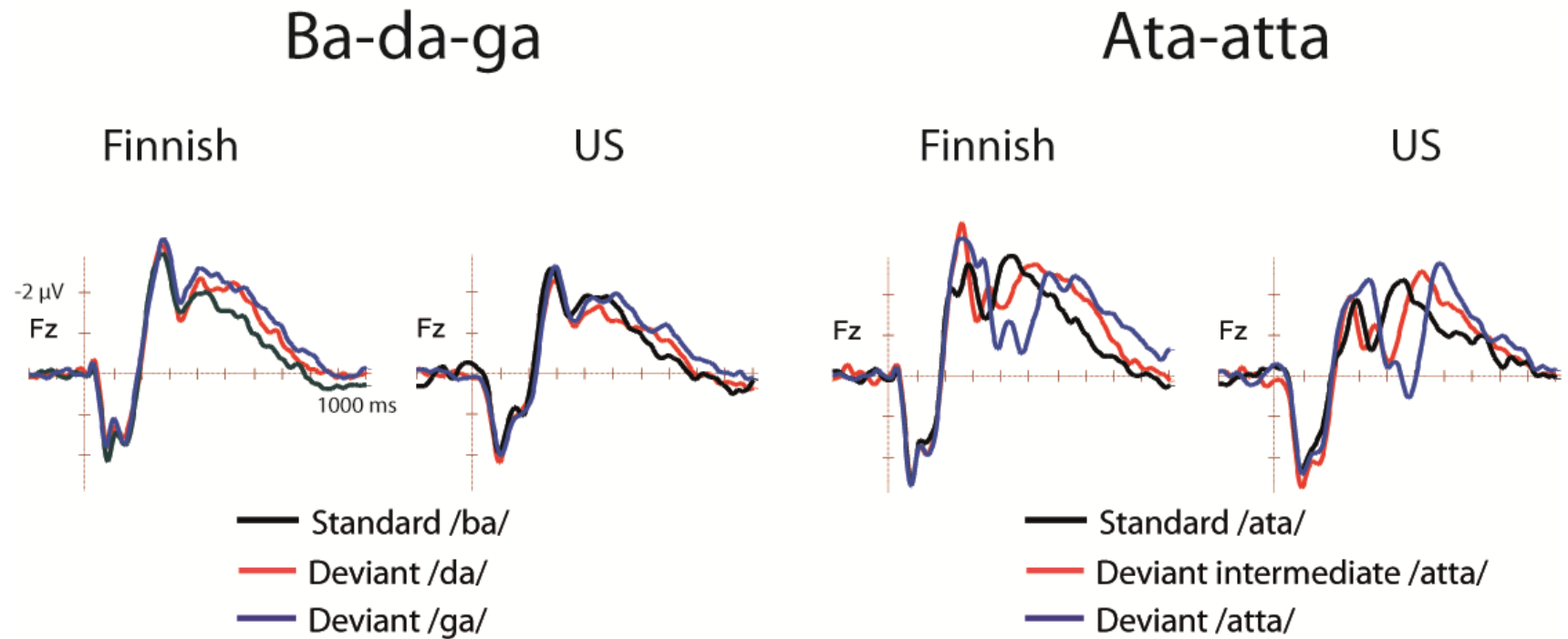
Data collected in

- Finland (N=34) from 10 - 12.5-year-olds
- the US (N=54 for English exp, N=44 for Finnish exp) from 5 - 11-year-olds

EGI EEG amplifier with 128 channels used in both countries

Data analysis pipelines identical for all data

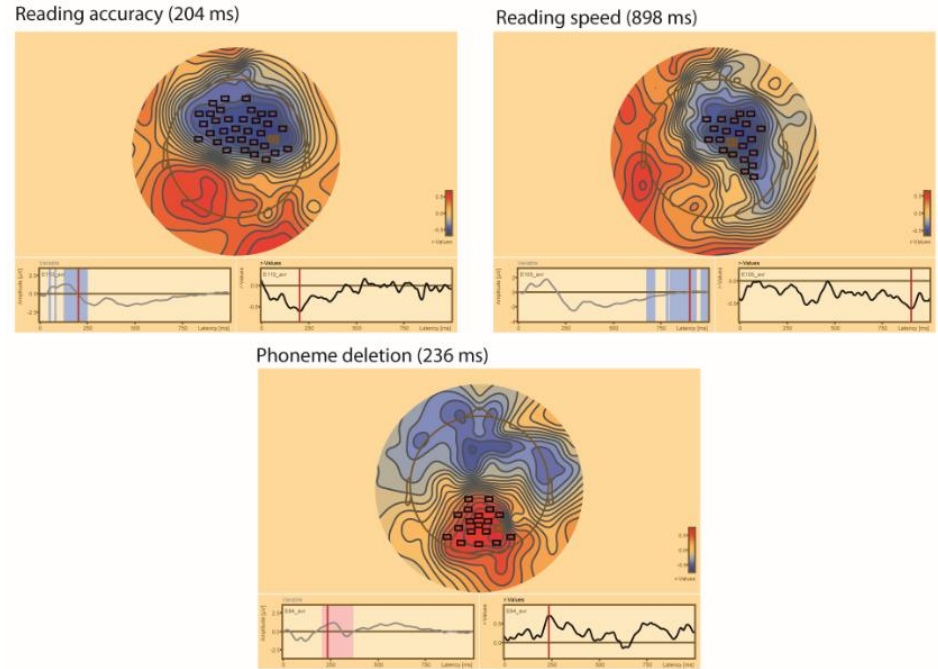
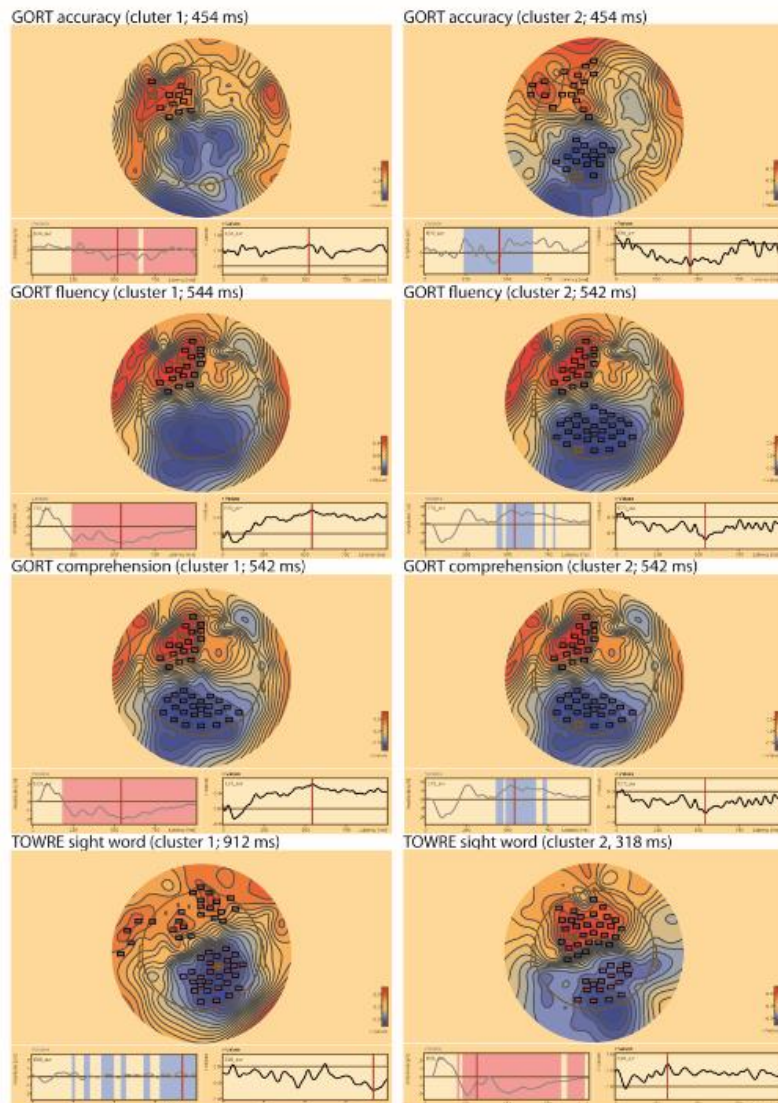
ERPs to speech sounds in Finland and the US



Correlations to reading

US children, deviant /atta/ sound

Finnish children, deviant /ga/ sound



Conclusions

- Brain responses to speech sounds are predictors of school-age reading skills
- Differences in brain responses to speech sounds between children with and without dyslexia persist into school-age
- Larger brain responses to foreign phoneme contrasts are associated with poorer reading skills
- Adaptation to native language could be one mechanism behind these associations

Thank you for your attention!

In collaboration with

At Jyväskylä: Kaisa Lohvansuu, Heikki Lyytinen, Paavo Leppänen, Timo Ahonen, Kenneth Eklund, Kirsti Eklund, Tomi Guttorm, Jarkko Hautala, Marja-Leena Laakso, Otto Loberg, Paula Lyytinen, Annamaija Oksanen, Anna-Maija Poikkeus, Anne Puolakanaho, Paula Salmi, Ulla Richardson, Minna Torppa

At Haskins Laboratories: Nicole Landi, Kenneth Pugh



ADVANCING BRAIN RESEARCH IN CHILDREN'S
DEVELOPMENTAL NEUROCOGNITIVE DISORDERS



Jyväskylä Centre for
Interdisciplinary Brain Research



UNIVERSITY OF JYVÄSKYLÄ