Start-up of a longitudinal study on the neurological and behavioral profiles in multiplex versus simplex dyslexia

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Heritability in dyslexia



Heritability of dyslexia: +/- 40%

⇒ Higher chance of developing dyslexia when at familial risk

- **Multiplex dyslexia:** children with a familial risk of dyslexia, i.e. having a first-degree relative with a dyslexia diagnosis
- **Simplex dyslexia:** children without a familial risk of dyslexia

Autism research: distinct genetic processes in multiplex and simplex cases
- Multiplex: shared susceptibility genes (Virkud et al., 2009)
- Simplex: spontaneous 'de novo' mutations (Sebat et al., 2007; Turner et al., 2017)

Intergenerational multiple deficit model: cause of dyslexia is multifactorial and probabilistic, in which risk and protective factors interact (van Bergen et al., 2014)

It is plausible that the distinct patterns of inheritance in multiplex versus simplex dyslexics also affect their neurobehavioral profile

Predictors of dyslexia

Previous longitudinal studies were able to identify neurological and behavioral predictors for developing reading problems later on:

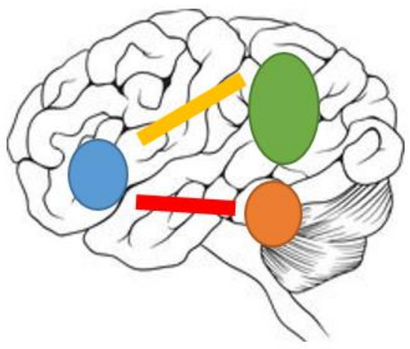
1. **Behavioral predictors**

   - Reading-related cognitive deficits: phoneme awareness (PA), rapid automatized naming (RAN) and letter knowledge (LK) (Boets et al., 2010)

   - Basic perceptual deficiencies:
     - Impaired temporal processing of slowly varying auditory signals (Vanvooren et al., 2017)
     - Impaired speech perception in noisy conditions (Boets et al., 2007)

2. **Neural predictors:** specific structural and functional anomalies (Ozernov-Palchik & Gaab, 2016; Vandermosten et al., 2016)

   - Reduced gray matter volume in left temporo-parietal regions
   - Hypoactivation in left temporo-parietal and occipito-temporal regions
   - Hyperactivation in right posterior regions and in bilateral inferior-frontal regions
   - White matter anomalies in the left dorsal arcuate fasciculus (AF) and ventral inferior fronto-occipital fasciculus (IFOF)



⇒ Development of dyslexia is determined by the dynamic interaction between cognitive and neural risk and protective factors

However, some perceptual and neural differences seem to be **driven by family risk (multiplex)** rather than reading outcome:
- Impaired basic auditory processing (Hakvoort et al., 2015)
- Structural and functional anomalies in temporal regions (Beelen et al., under review; Vanderauwera et al., 2018; Vandermosten et al., under review)

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Research objectives

Previous studies identified behavioral and neural precursors of dyslexia

⚠ Strong bias towards children with familial risk

Are the known predictors of multiplex dyslexia also applicable to simplex dyslexia?

Methodology

- Longitudinal design: follow up of 76 at-risk pre-readers at behavioral and neural level until third grade
  - Cognitive risk + family risk: N = 18
  - Cognitive risk – family risk: N = 58
  - Exclusion criteria: low non-verbal IQ, hearing loss, multilingualism, high risk for ADHD, history of brain damage or vision deficits

- Integration with data from previous longitudinal study of DYSCO (n = 87)

		Familial risk	
		No	Yes
Dyslexia	Yes	Simplex dyslexic *Previous: n = 3* *Extend up to n = 25 (aim)*	Multiplex dyslexic *Previous: n = 16* *Extend up to n = 25 (aim)*
	No	Simplex typical *Previous: n = 39*	Multiplex typical *Previous: n = 29*

- Data collection:

3rd KG
- September: cognitive testing
- December: perceptual testing
- July: MRI

1st grade
- September: cognitive and perceptual testing

2nd grade
- September: cognitive and perceptual testing
- July: MRI

3rd grade
- September: cognitive and perceptual testing



Child-friendly protocol
(Theys et al., 2014)

Implications

Relevance:
- Expand current knowledge on:
  - Pre-reading risk factors for multiplex and simplex dyslexia
  - Development of cognitive, perceptual and neural characteristics prior to and throughout reading acquisition
- Facilitate detection of children at risk and development of targeted intervention programs

References: Beelen et al., under review Cortex; Boets et al., 2010 BJDP; Boets et al., 2007 Brain Lang; Hakvoort et al., 2015 Cortex; Ozernov-Palchik & Gaab, 2016 Wiley Interdiscip Rev Cogn Sci; Sebat et al., 2007 Science; Theys et al., 2014 PLoS One; Turner et al., 2017 Cell; van Bergen et al., 2014 Front. Hum. Neurosci; Vanderauwera et al., 2018 Cereb. Cortex; Vandermosten et al., under review Dev. Sci.; Vandermosten et al., 2016 Curr. Opin. Behav. Sci.; Vanvooren et al., 2017 RDD; Virkud et al., 2009 AJMG

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