Investigating white matter tissue properties in dyslexia: A combined analysis of DTI and myelin water imaging

Maria Economou[1], Thanh Vân Phan[1,2], Thibo Billiet[2], Jolijn Vanderauwera[3], Jan Wouters[1], Pol Ghesquière[3], and Maaike Vandermosten[1]

[1]Experimental Oto-rhino-laryngology, Department Neurosciences, KU Leuven, Leuven, Belgium
[2]icometrix, Research and Development, Leuven, Belgium
[3]Parenting and Special Education Research Unit, Faculty of Psychology and Educational Sciences, KU Leuven, Belgium

BACKGROUND AND AIM

- Structural organization of **white matter** (WM) plays a crucial role in the **development of the reading network**.
- We can study changes in WM in (a)typical reading using **diffusion MRI**. Although very useful, dMRI indices such as fractional anisotropy (FA) are sensitive but not specific to several **tissue changes** including **myelination** or axonal growth.
- We aim to address this limitation by combining dMRI with **myelin water imaging (MWI)** an MRI technique that allows quantification of myelin water in the brain which can be used as a proxy for myelin content. We hypothesize that combining MWF with typical diffusion indices will be more informative than FA alone in characterizing white matter in dyslexia.

METHOD

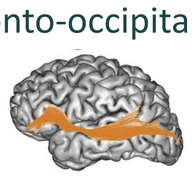
69 Dutch-speaking children in the 5th grade (9-10 years old) of whom 27 were classified as dyslexic

3T MRI → Myelin water imaging (based on multi-exponential T2 relaxation)

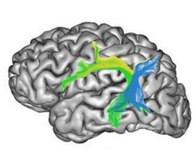
3T MRI → Diffusion tensor imaging



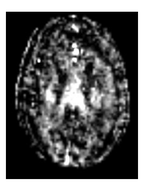
Whole brain tractography followed by bilateral delineations of the arcuate fasciculus (we chose to focus on the direct segment) and inferior fronto-occipital fasciculus



IFOF



AF segments (direct in green)

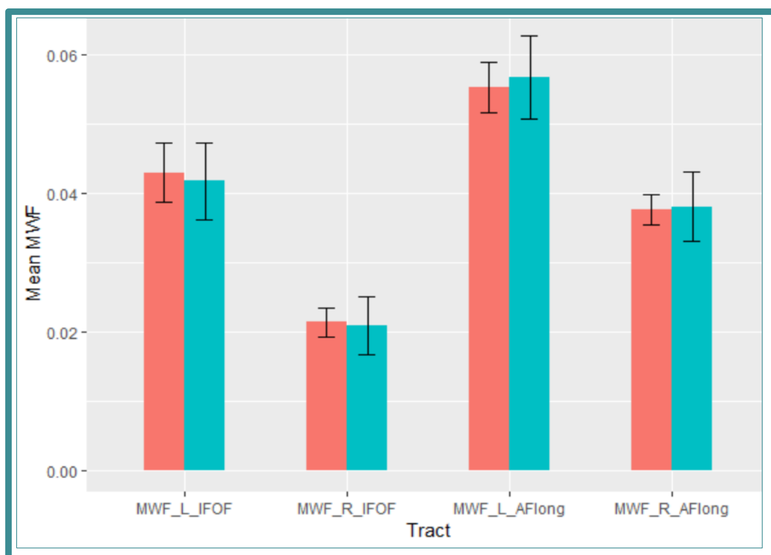


MWF map

Mean FA and MWF values within tract were calculated and used for group comparisons and associations with various behavioral phonological and reading scores.

RESULTS

- Correlation analyses showed some associations between vocabulary scores and metrics in the left IFOF of dyslexic readers which however did not survive appropriate testing corrections (FA: r_s=0.453, p=0.018; MWF: r_s=0.395, p=0.041). Reading scores also correlated positively with FA in left IFOF for the dyslexic group.



- MWF seems to be higher in left hemispheric tracts
- No significant differences between the groups in mean FA or MWF in any of the tracts
- General pattern of higher MWF in dorsal compared to ventral tracts

TAKE HOME

- We describe a novel multi-modal approach to characterize white matter in school-aged children with (a)typical reading abilities
- Lack of significant findings might suggest that white matter FA differences in dyslexia may less likely be driven by myelination.
- Both myelination and white matter tissue undergo dynamic changes during early years. It is therefore essential to study changes in MWF and FA in younger ages and throughout reading and literacy development before we can conclude on the specific contribution of myelin

maria.economou@kuleuven.be