Structural Brain Connectivity Differences of Children with and without Dyscalculia*

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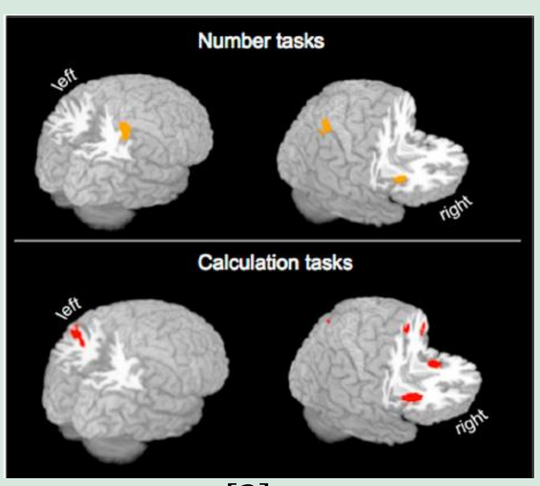
Introduction

Developmental dyscalculia (DD)

- Neurodevelopmental disorder specific for learning mathematics [2][4].
- Pure prevalence → 3-8 %, with comorbidities 14 % [10].
- Negative effects → from childhood through adulthood [1][5].

Studies in normally developing brains



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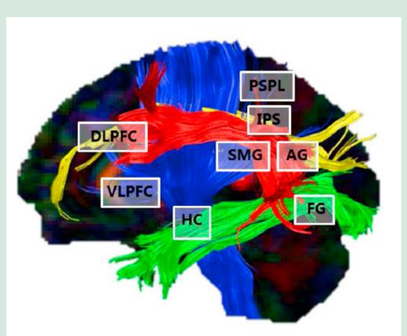


[9]

Origins → structural/functional brain connectivity differences ?

Methods

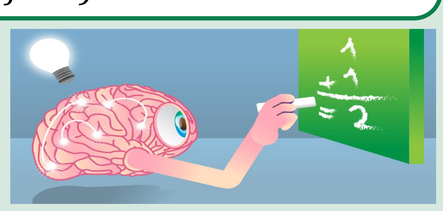
1) Screening 2058 Third Grade Students (7-9.5 y) *Mathematics Achievement and Arithmetic Performance Tests (MAT, APT), Raven Standard Progressive Matrices Test*

2) Determining DD and Control Candidates from screening results
25 % → DD, 35-75 % → Typically developing

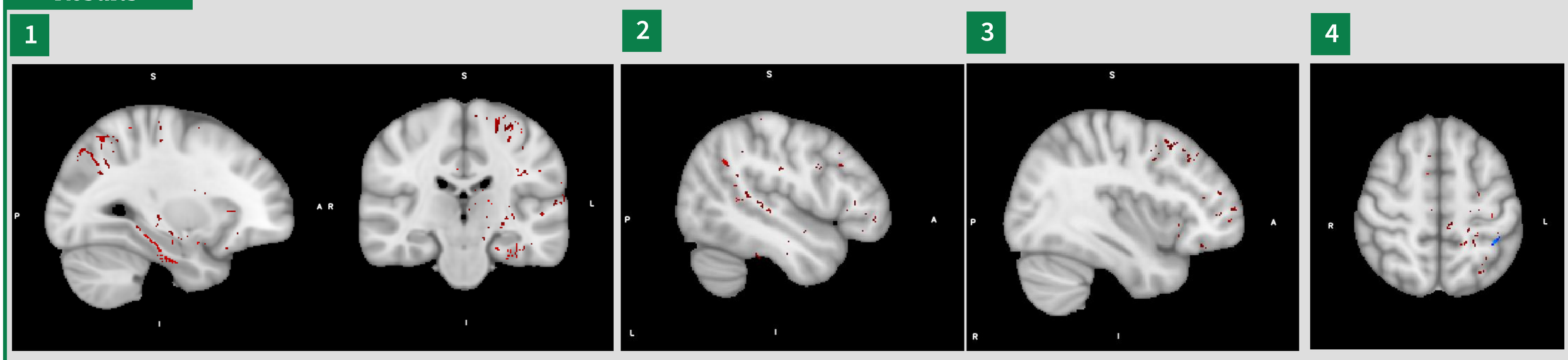
3) Determining DD and Control Children: Re-testing (mean age 11.2 y)
MAT, APT, WISCR-III, Reading, handedness, psychiatric evaluations
35 % → DD and Typically developing → Comorbidities excluded

4) Twelve DD + 16 Controls MRI data
Diffusion Tensor Imaging (DTI)
Resting State MRI (rs-fMRI)

5) Analyzing Brain Imaging Data
Diffusion Tensor Imaging (DTI) – Pre-processing and Group Analyses (TBSS)



Results



Maps of uncorrected p-values of white matter microstructure (fractional anisotropy) differences thresholded at $p<0.05$, shown in red for the contrast Controls>DD and in blue for the contrast DD>Controls. Regions are: 1) left inferior and 2) superior temporal and parietal parts of the pathways IFOF, ILF, SLF 3) right frontal parts of the pathways IFOF, ILF, SLF, ATR 4) left parietal region

Discussion

- Two studies examined brain white matter structural connectivity in dyscalculia found that SLF (parietal) and ILF (fusiform gyrus) might be the candidates of impaired structural connectivity in DD, [11][12], respectively.
- Studies in brain structural connectivity showed that there were significant positive correlations between mathematical abilities and connectivity of white matter pathways such as SLF, ILF, IFOF, CC, A-P-TR, CR, [7][8][9].
- In this study, we do not find differences in white matter connectivity between a sample of DD children compared to age-matched controls when correcting for multiple comparisons. Yet, qualitatively, we see a similar pattern of lower fractional anisotropy in the DD group as shown in published studies [11][12].
- In the future, we will use similar correction methods as in [11][12], a TBSS-ROI (Region of Interest) approach and probabilistic tractography analyses to further investigate the neural correlates of DD.
- Finally, we will use functional connectivity to test structure-function relationships in a complementary way.

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