

Developmental dyslexia is a brain-based difficulty in acquiring fluent reading skills that affects around 10% of children. Although anatomical and functional brain networks involved in typical and atypical reading are increasingly well characterized, the underlying neurochemical bases of developmental dyslexia are almost unknown.

Similarly unknown is the etiology of reading impairment and consequently multiple theories have been proposed by researchers. Two of them are linked to the level of neurotransmitters in the brain. The first suggested that dyslexia might be a consequence of neuronal hyperexcitability, which might contribute to learning deficits by heightened noise and instability in information processing. On the level of neurotransmitters, the theory would predict heightened level of Glutamate (Glu) in dyslexia. The second theory suggests that the cause of reading disorder may be a deficit of neuronal synchronization oscillation. While some authors (Goswami 2011) showed synchronization deficits in dyslexic individuals in the frequency range of 2-10 Hz (low theta), which corresponds with the processing of syllables, others (Lehongre et al. 2011) found impairments in the low gamma band 25-35 Hz, which corresponds to the strongest modulation frequency when processing phonemes. It is known that gamma-aminobutyric acid (GABA) drives modulation of gamma band (Buzsáki & Wang 2012), whereas glutamic acid and choline are considered to be dominant neurotransmitters in the theta oscillations. Since the oscillation studies are inconclusive it would be crucial to determine which neurometabolites - in particular glutamic acid (Glu), choline (Cho), and gamma-aminobutyric acid (GABA) can be biomarkers of specific reading disorder (developmental dyslexia). For that purpose we plan to use magnetic resonance spectroscopy (MRS), which is a relatively novel technique that provides researchers with a non-invasive way to identify neurotransmitter levels.

There is good ground for such study since recently, Pugh et al. (2014) using MRS found an inverse relationship between the level of two neurometabolites: glutamate and choline and reading proficiency in a group of children with variable reading skills. What they did not observe though was the hypothesized relation with GABA concentration. The study suffered however from a number of drawbacks, that the proposed project tries to avoid. First of all, only few children (less than 10) could be classified as dyslexic. Second, due to technical reasons they chose a voxel in the primary visual cortex, which is not specifically related to reading and was not characteristic of neuroanatomical and neurofunctional differences in dyslexia. Third, since the method is still quite new, the analytic pipeline can be much improved with currently available tools.

For the purpose of the present project 40 young children (third grade of primary school) will be selected: 20 with dyslexia diagnosis and 20 controls closely matched on age, gender, IQ and parental socioeconomic status. A battery of reading and phonological tests will be employed together with MRS MEGA-PRESS sequence. This method allows for quantitative analysis of chemical composition of the specific region in-vivo. Hydrogen spectrum provides information about majority of the metabolites in the brain including neurotransmitters - GABA and glutamate (Glu). Both group analyses and regressions with behavioral measures (reading and phonological awareness) are planned. Before MRS, all children will be familiarized with the scanner environment in a mock scanner.