Neural and cognitive basis of spelling impairment

Reading and writing are one of the most important skills learned at the beginning of a formal education process. In Poland around 10% of children have difficulties in learning reading and spelling – they are diagnosed with the developmental dyslexia. What's more around 4% of children struggle with learning good spelling skills. They suffer from so called *isolated spelling deficit*.

According to the psychologist Uta Frith children with isolated spelling deficit have low-quality of the orthographic representations that are sufficient for the simpler process of reading but not for a more difficult process of adequate spelling. Most of previous fMRI studies aimed to discover the neural basis of dyslexia and neural reading network. In this project we want to focus on orthographic deficit that is common for dyslexia and isolated spelling deficit. We aim to establish neural patterns of word processing in children with isolated spelling difficulties and in children with dyslexia. We want to test if the neural basis of spelling deficit is associated with the lower quality of orthographic or phonological representations (that are responsible for processing sounds of words), and what are similarities and differences with the reading deficit (present in dyslexia). We expect to better understand the neural basis of both spelling and reading deficits and their relationship.

We want to test three groups of school-aged children: with dyslexia, isolated spelling deficit or typical readers and spellers. In the fMRI scanning session they will be presented with the carefully selected group of words. We want to check if the orthographic and phonological deficit is associated with inadequate differentiation of visually and auditory similar words on the neural level. In the data analyses we plan to focus on brain regions that were previously found to be responsible for orthographic processing (ventral occipitotemporal cortex) and phonological processing (superior temporal gyrus). We will also test differences between groups in the artificial orthography learning paradigm. We will teach children a new script (letters that they never saw) and associated pronunciation (set of phonemes). We want to check if children with isolated spelling difficulties will struggle more than typical readers and spellers with learning more complex rules of new orthography. On the other hand we expect that children with dyslexia, due to the more general deficit in audiovisual integration will have a difficulty in learning even simpler rules of a new orthography.

In result, we will know if spelling deficit is based on the altered neural pattern of word processing. Also, if it is associated with the difficulties in combining phonological and orthographic information, especially in case of more complex rules of integration. In consequence we will be able to better understand the nature of spelling deficit, present in isolated spelling deficit as well as in dyslexia. We hope that in the longer term the results of the project will help to create an effective treatment for affected groups of children.