

In the present project we will examine neural underpinnings of statistical learning abilities of children with specific learning impairment (SLI). Statistical learning refers to the ability to extract repetitive patterns in the environment, in particular, the statistical regularities in sequences of environmental events. This Learning is procedural without the explicit knowledge of accumulated experiences and is based on the probability. Importantly, environmental regularities are highly relevant for language structure and thus language acquisition largely relies on the ability to extract and learn statistical rules. For example, in Polish language the syllable /wie/ is more likely to be followed by /dza/ than by /na/. Perceiving this kind of statistical events is relevant for learning phonology and word structure. It is also important for acquisition of syntax and semantics. While listening to the speech in the environment the child is exposed to words and “extracts” their meanings and grammatical forms from the natural contexts.

Specific language impairment is a developmental disorder that is manifested in a diminished ability to acquire and make use of language – the abilities that are guided by central nervous system. The prevalence of SLI has been estimated at around 7%. The impairments present in SLI may refer to all aspects of language abilities. Language development is generally delayed among children with SLI, however, the difficulties are not only quantitative in nature. In many cases the deficits are not compensated among child’s maturation and some of the language functions are more impaired than other. Specifically, the deficits may include phonology, vocabulary, morphology and syntax. SLI is defined by a set of criteria of inclusion that are based on standardized tests of language fluency and grammar ability. It is also defined by a set of criteria of exclusion, one of which is non-verbal IQ below a critical level. Additionally the exclusion of other possible sources of language impairment is necessary, including hearing disabilities or autism spectrum disorders. One of the theories that offers explanation of SLI symptoms is Ullman et al’s. (2005) Procedural Deficit Hypothesis (PDH). They suggested developmental deficits of brain structures that underlie the procedural memory system. Within this system a network of inter-connected brain regions, including frontal lobe and basal-ganglia structures, underlie processes of procedural learning. In the PDH, Ullman proposed that a large number of individuals with SLI could suffer from deficits in this brain network. Manifested abnormalities in the linguistic and non-linguistic functions would be a consequence of this basic neurocognitive impairment.

Previous research findings confirmed on a behavioral level lower statistical learning abilities among children with SLI. Results referred to verbal and auditory but also visual tasks in which children learned sequences of abstract symbols. In the present project we will verify PDH hypotheses on the neuronal level. Using method of functional magnetic resonance imaging we will examine neural activity of specified brain structures among SLI children and control group during visual statistical learning. Children will undergo two fMRI sessions. They will be tested during first performance of statistical learning task and after structured training, when the task will be already familiar. Subsequently, we will observe brain mechanisms of statistical learning process among SLI children comparing to typically developing control group. Results of the project will bring new insight into neuronal mechanism of statistical learning impairment in SLI. They will also help future design of diagnostic protocols and rehabilitation programs based on neurophysiological proofs.