Learning Artificial Grammar at Different Ages and Different Levels of Complexity: Comparison Between Typical and Dyslectic Readers

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Abstract

Readers with developmental dyslexia (DD) are considered to have deficits in their procedural learning mechanisms and in implicit learning processes. Implicit learning is a process by which knowledge of the regularities of the learning environment is acquired without awareness. In this PhD thesis, we focused on the performance of readers with developmental dyslexia on an artificial grammar learning task (AGL) as compared with typically developed (TD) readers of different ages. This study makes an important contribution to understanding implicit learning processes in typically developing children in general, and among children with DD, in particular.

Some studies which utilized the AGL task have demonstrated the importance of complexity as a factor affecting learners' performance. The present work focused on examining the role of level of complexity both at the graph and stimuli level in performance on the AGL task. The current work is divided into four experiments. The first experiment reviews the literature on complexity and its effect on implicit sequential learning, followed by a meta-analysis of research investigating the relationship between grammar complexity, as measured by Topological Entropy (TE) and accuracy rates on the AGL task. Performed on studies that tested typically developing participants, the meta- regression presents a reversed connection: as graph complexity rises, performance accuracy decreases and vice versa. The second experiment contributes to the discussion by focusing on the impact of graph complexity on AGL performance among children with and without DD. The results of this study indicate that age-matched control participants performed above chance on both the simple and complex grammar system. By contrast, dyslexic children and reading-level matched controls showed below chance performance (under 50%) for the complex grammar system, and slightly above chance performance on the simple grammar system. The third experiment delves more deeply into further aspects of AGL task complexity, reviewing past studies examining complexity and its effects on implicit sequential learning at the level of stimuli. It gathers studies performed on typically developing children, comparing the level of complexity of the stimuli, as measured by chunks strength (CS), to performance rates on the AGL task. Results showed a direct relationship between the level of complexity and participants' performance. As CS increases, participants perform better and vice versa.

The fourth experiment is a practical examination of the effect of complexity at the graph level (TE) compared to the effect of complexity at the stimuli level (CS), testing which

has a greater effect on AGL performance among children with and without DD**.** Findings show that age-matched control participants' performance is influenced by CS in the two topological entropy conditions. In contrast, dyslexic children and reading-level matched controls' performance reflected an ability to use chunk strength only under the low topological entropy condition.

The present study suggests that individuals with DD are impaired in their implicit learning ability. Implicit learning, as presented by earlier studies, is related to reading and writing processes which were found to be impaired in people with dyslexia. It is assumed that beginning readers tend to rely on implicit learning when they need to cope with complex stimuli requiring the decoding of complex statistical regularities such as the AGL task. The present study shows that the difficulties encountered by children with DD are expressed more in a complex environment.

Key words: developmental dyslexia, implicit learning, artificial grammar learning, topological entropy, complexity, grammar system, chunks strength