Abstract

A wide-ranging conversation has taken place in research literature over the past few years concerning developmental dyslexia (DD), its characteristics, and the difficulties that lie at its root. The dominant claim of the past forty years - that dyslexia stems from phonological processing difficulties - has now been joined by other findings, which suggest that dyslexia may stem from more generalized cognitive difficulties. One cognitive skill that has been found to be related to reading acquisition is statistical learning, that is, the sensitivity to statistical patterns in sequential stimuli. There is evidence that readers with dyslexia have deficits in statistical learning tasks, found in tasks that involved implicit learning processes. These findings have led to the claim that learners with dyslexia will experience statistical learning challenges during implicit learning tasks but not under explicit instruction. And indeed, there is evidence that making learning tasks more explicit leads to improved statistical learning among adults with DD. Therefore, the goal of the current study is to examine statistical learning processes in both implicit and explicit learning tasks, while comparing learners with dyslexia to typically developed (TD) readers. It is important to compare implicit and explicit statistical processing among readers with dyslexia, since it can foster better understanding of the challenges they face. It can also advance our understanding of how these readers grapple with implicit, rather than explicit, statistical learning tasks. Additionally, the aim of the current study was to assess the learning characteristics of readers with dyslexia; this was done by measuring participants’ objective and subjective learning XXX, as they experienced during the task.

Recent research has addressed the question of assessing the differences between implicit and explicit statistical learning. The current study had participants complete both an implicit and an explicit task: In the implicit task, the participant was exposed to sequences without being aware of the shared structure of these sequences. In the explicit task, on the other hand, participants were told prior to the testing phase that there is some underlying rule governing each of the sequences, in order to raise their awareness of the regularities of the stimuli.

The distinction between implicit and explicit statistical processing has generally been assessed based on their performance during the sequence-sorting (task) phase, with the number of correct answers as an objective measure of participant’s ability. Some researchers have criticized the fact that objective performance tasks lose important information by ignoring participants’ thought processes and considerations during the test phrase, in other words the process that guides their choices in determining the patterns in the sequences. These same researchers have found that participants’ awareness of their own considerations and thought processes allows them to access higher levels of statistical learning during explicit tasks. Still, research has not yet been done on subjective measures among learners with dyslexia during explicit statistical learning tasks. This is especially true in the visual modality, in which the distinction between implicit and explicit statistical learning tasks is particularly important (because of the difficulties that readers with dyslexia face when performing these tasks).

Therefore, the current study measures both implicit and explicit statistical learning tasks among adults with dyslexia. It includes both objective and subjective methods of assessing the various learning processes employed during a visual artificial grammar learning task. The explicitness of the task was increased by a direct instruction to participants to search for rules; a questionnaire was also used in order to indicate the basis for their responses and assess the participants’ subjective thoughts and considerations during the task. Participants were divided into two groups: one included an implicit artificial grammar task with no direction to search for patterns, while the other included an explicit artificial grammar task and an instruction to search for patterns within the sequences. 32 high school graduates participated in the first group: 17 in the control group, and 15 in a group of learners with dyslexia. The second group was comprised of 27 high school graduates: 14 in the control group, and 13 in the group of learners with dyslexia. Participants’ ages ranged between 20 and 35.

The study’s results showed that in the objective measures - that is, participants’ success with artificial grammar tasks - readers with dyslexia were able to learn the statistical regularities during both implicit and explicit tasks. However, there were significant differences in their performance on the two types of tasks: their performance on explicit tasks was significantly higher than their performance on implicit tasks. On the other hand, readers without dyslexia showed no significant performance differences between implicit and explicit tasks. These findings indicate that readers with dyslexia have a difficulty with implicit statistical processing. Nevertheless, when instructed to search for rules, readers with dyslexia were able to complete this task at an accuracy rate higher than guessing. These findings support the claim that the main deficiency for readers with dyslexia lies in implicit, rather than explicit, statistical learning. They also support the theory that the statistical learning mechanism is not a domain-general mechanism, but rather a mechanism that combines separate learning processes. This is expressed in the differences between implicit and explicit learning as seen among learners with dyslexia.

Subjective measures about the learning task were collected by attributing each respondent’s answers about the type of knowledge that respondent used. The study’s findings yielded an interaction between the research groups, by attributing the responses from the two different task types. No significant differences were found between responses on implicit and explicit tasks among readers without dyslexia; in contrast, participants with dyslexia associated their responses with higher levels of explicitness during the explicit tasks than during the implicit task. In the explicit task, participants with dyslexia reported using the ‘rules’ type of knowledge to a greater extent, which is an explicit type of knowledge. On the other hand, in the implicit task they reported more ‘guessing.’ These subjective findings strengthen the results of the objective measures; both the objective and the subjective measures indicate that readers with dyslexia utilize an explicit type of knowledge (rules) during explicit statistical learning tasks than during implicit statistical learning tasks. This demonstrates that a direct instruction to search for rules allows learners to access greater awareness of patterns in an artificial grammar task. This helps them increase their awareness of patterns, compensate for difficulty, and perform as well as typical readers.

Difficulty in implicit learning of underlying regularities during an artificial grammar task, as found in the present study, shows that even though readers with dyslexia are capable of learning statistically patterned sequences, their learning is limited and reflects a failure to develop automaticity. This stems from a difficulty to monitor for focus and internalize rules. On the other hand, explicitly increasing the awareness of rules for readers with DD can compensate for this struggle during implicit tasks.

The present study is important because it underlines the need to distinguish between implicit and explicit learning tasks as they relate to statistical learning among readers with dyslexia. It also emphasizes the importance of using subjective measures to raise participants’ awareness during artificial grammar tasks, as these measures can deepen understanding of statistical learning among learners with dyslexia. The results of this study underscore the challenges that readers with dyslexia face during implicit statistical learning tasks; they also broaden our understanding of the importance of accessing readers’ subjective experiences during learning. These findings emphasize the need for intentionally directed learning, in order to compensate for the challenges faced by readers with dyslexia and assist them in acquiring an awareness of statistical patterns while learning to read.