

A Gaze-Enabled System for Tracking the Reading Progress of Second Year Children in a Primary School

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Abstract:

We have developed a system for monitoring reading progress of children in a school classroom using the child's eye position. The data can be used to detect words that the child may be having difficulties reading. This allows automatic supportive action to be taken to help the reader with that word. The data can also be shared with the teacher in close to real-time, so that he or she has a summary of the individual words in the passage being read that are causing problems for several children. It also provides a summary of the children who are having multiple problems, so that the teacher could provide specific support for them.

Extended Summary:

A lot is known about how the reading skills of children develop. In the early stages they make more and longer fixations, and have shorter saccades than experienced readers (Schroeder, Hyönä, & Liversedge, 2015). However, there is huge individual variance: while some children already know how to read when they start school, and most learn to read by Christmas of their first school year, some still struggle at the end of the second school year. Even if their teacher becomes aware of their challenges in reading, the reasons and characteristics of the problems may be difficult to pinpoint just from reading time and from errors in read-aloud tests. It has been argued that eye tracking can be used to provide deeper insight (Blythe, 2014).

We have developed a system for monitoring reading progress of children in a school classroom using the child's eye position. The data can be used to detect words that the child may be having difficulties reading. This allows automatic supportive action to be taken to help the reader with that word. The data can also be shared with the teacher in close to real-time, so that he or she has a summary of the individual words in the passage being read that are causing problems for several children. It also provides a summary of the children who are having multiple problems, so that the teacher could provide specific support for them.

There have been several challenges in creating a working solution. First is the question of whether eye position can be tracked sufficiently well in a classroom environment over the course of a lesson with low cost eye trackers. We worked together with a second-grade class in an elementary school to test this and, subsequently, our tool. All children in the class volunteered to take part in our research. All testing was carried out during normal classroom activities, with two children at a time using our equipment in the class (Figure 1).



Figure 1. Testing two eye trackers in school class.

A low-cost eye tracker was compared in an extensive classroom test with a middle range tracker and its performance was found to be sufficient for the purpose of tracking reading. However, to compensate for shifts in calibration, innovative mapping algorithms have been developed in the project that map fixations to words on the screen (Figure 2). This heuristic mapping can either be undertaken while the passage is being read, or immediately after the whole page has been read.



Figure 2. Testing two eye trackers in school class.

We made simple assumptions about how a passage is read: reading starts on the first line of text, and at least three fixations progressing in the reading direction (left to right) signal that a line is being read. With this basis mapping accuracies of about 95% can be obtained automatically for the end of page option. The baseline for comparison are judgements made by human observers about which words were being fixated upon. The list of fixated words and durations of these are saved automatically into a cloud database, and can be retrieved

and displayed in a web application or browser. A summary display has been produced that allows a teacher to select some or all of the children in the class, and their reading progress through the passage can be displayed and compared. Words that have caused difficulties to individuals are colour-coded (Figure 3).

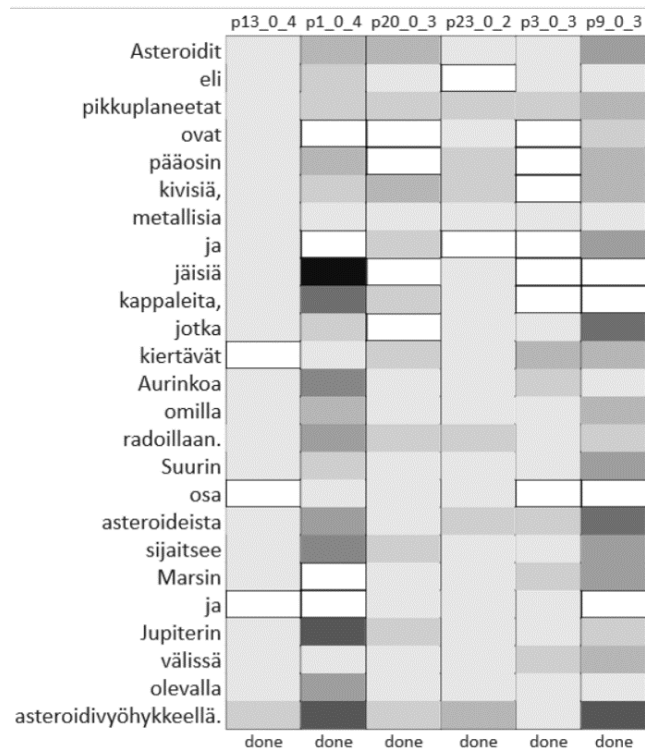


Figure 3. Visualization of time spent on each word.

The response of teaching staff to the potential value of the system in a classroom has been very favourable. This can be summarized into three main points: assisting with reading difficulties; providing motivation through gamification; and supporting reading assessments.

The system can provide active intervention if the pupil is found to be struggling with a word. For children with reading difficulties, the system could provide automatic highlighting of the line currently being read. For unfamiliar words detected by gaze events, such as cumulative fixation duration, the system can provide support activities, such as a picture quiz shortly after reading a word for re-enforced comprehension. Also it would allow the teacher to investigate the types of words causing problems and provide specific help, e.g. for Finnish words containing double consonants. The summary display was likely to be very useful for checking the progress of children after a lesson, although the teacher would probably not have time to look at the display in real-time during the lesson. Nevertheless, close to real-time summaries of problematic words and/or children having difficulties could be provided to the teacher via, say, a digital wrist watch.

As the gaze position provides the basis for evaluating individual reading performance, it also provides the basis for gamifying individual progress. Children can be motivated by a reward system and given achievements based on their improvements over time. Gaze position can also be used to monitor whether the pupil is paying attention. If the gaze position indicates a pupil is not, then an automatic intervention, such as a game activity related to the reading task can be used to try to re-engage the pupil with the exercise. This helps the teacher in

classroom management, a challenge especially for beginning teachers (Blomberg & Knight, 2015).

All children in school have a reading assessment twice a year. This is carried out by special educators and is quite time consuming. This system could be used by these specialist teachers to speed up the process so that more assessments could be made during the course of the year. This information could also be shared with parents.

References

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