Does automatic word highlighting improve reading speed and comprehension?

Cognitive Psychology

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Christian Pickett
Student no: 2816112
c.d.pickett@student.vu.nl

Toni Kendel
Student no: 2797438
t.kendel@student.vu.nl

Sajani Ghosh
Student no: 2816904
s.ghosh2@student.vu.nl

Fei Huang
Student no: 2818760
f.huang4@student.vu.nl

1 INTRODUCTION

Reading is an essential skill that serves as the gateway to knowledge and information in our modern world. However, for individuals with dyslexia, a neurodevelopmental disorder that affects reading and language processing, the act of reading can be a daunting and challenging task. Dyslexia is characterized by difficulties in accurate and fluent word recognition, often leading to impaired reading comprehension, vocabulary development, and learning. This condition can have profound and long-lasting effects on an individual's educational and professional opportunities. In this assignment, we will explore the theoretical underpinnings of dyslexia, the challenges it poses to reading, and the potential benefits of simulated reading aids as a remediation strategy. We will also examine the existing research on the effectiveness of word highlighting and its impact on reading comprehension and reading fluency for individuals with dyslexia. One of the papers[2] in question has led a similar research on Japanese children using a mix of narrated text combined with different fonts and backgrounds. In it, they have found that reading with the aid of specific coloured bands, be it per word or sentence, made it easier to read. Given the results they have noticed that reading capabilities can be improved with specific colours like yellow and blue. The assumption is that given a more mellow color behind the words lessens the strain on the readers eyes but also helps in focusing more attention on each word in turn making it easier to read. This would be attributed to the exogenous stimulus that could be suppressing other neurons and in turn removing noise from the reader. With this in mind we decided to go with the help of the specific colour highlighter which would try and emulate text to speech and a web application which would be incorporating it. Like this we would be able to increase the sample size of participants but also at the same time collect more data on various aspects. In contrast to their restrictive approach, which involved a study with a limited sample size of only seven children, our research employed a within-subject design that encompassed both dyslexic and non-dyslexic participants, thus enhancing the generalizability of our experiment. In the research [2] they performed multiple setups of of different aid while reading which included, blue, yellow, underlined highlighting and narrated reading and they have noticed an improvement in the ease of reading. The findings of this research guided our selection of highlighter colors, as it revealed that the most favorable outcomes were achieved when employing a blue highlighter on a white background.

By examining the intersection of reading and dyslexia through the lens of simulated reading aids, we aim to contribute to a deeper understanding of this innovative approach and its potential to improve the reading experience and outcomes for individuals with dyslexia. Through this research, we hope to shed light on new strategies that can empower those with dyslexia and enable them to access the world of knowledge and information more effectively.

The experiments independent variable will be in the form of per-word highlighting where the goal is to speed up the participants' reading capabilities and understanding of the presented text. Having the randomly be turned on or off we will be measuring a plethora of dependent variables in the form of reading time, error rate in questions, and age to name the more important ones.

1.1 Research Question

In order to try and test our experiment, the following research question has been raised: *Does highlighted reading improve reading speed and comprehension?*
Section 2.4 will provide an explanation of the employed approach and techniques, while section 3 and 4 will present the findings of this research and analyze those, respectively.

1.2 Hypotheses

We hypothesis that by highlighting words as if simulating reading it will improve reading speed but are unsure about comprehension. We believe that the effect will be present with both the non dyslexic and dyslexia group. The reason for that is an exogenous stimuli in the form of highlighting with which we should be able to help the participants focus better on the words that they are reading. We also expect to see the user to read the paragraphs faster than the non highlighted ones. The exogenous meaning an outside distractor that takes over our attention with the help of inhibitory signals being sent by the neurons to "guide" the reader.

2 METHOD

2.1 Participants

The study involved 28 adult participants, comprising both males and females. Four individuals had a prior diagnosis of dyslexia,

while the remaining 24 did not have a dyslexia diagnosis. Within the dyslexic group, half specified English as their primary language, and among the non-dyslexic participants, 15 identified English as their primary language.

2.2 Apparatus

The experiment was conducted through a custom website created using Streamlit, an open-source framework for building web applications. Dyslexic participants completed the experiment on their mobile phones, while 10 out of 24 non-dyslexic participants also used mobile devices. The website tracked reading duration for both highlighted and non-highlighted texts, as well as response times for subsequent questions.

2.3 Stimuli

The study utilized short texts, each consisting of 3-4 sentences, generated by ChatGPT in response to the prompt: "Generate a 3-sentence short story and a simple multiple-choice question for the text, along with the answer." Short stories were chosen to ensure that participants could not rely on prior knowledge to answer the questions. A total of 14 paragraphs and associated question pairs were collected. These texts were designed to be at a high school reading level to avoid unnecessary complexity. Only 12 of the paragraphs were randomly selected for use. When choosing a text, it was randomly determined whether it would be presented as plain text or augmented with automatic highlighting at the speed specified by the participant. To ensure variety, if two consecutive texts were of the same type, the third text would be of the opposite type. During the calibration process, the speed scale ranged from 0.5 to 7.0, with units indicating the delay between words. Given that the average word length in English is approximately 5 characters [1], a speed of 1 corresponds to highlighting at an average rate of 1 word per second or a reading speed of 60 Words per Minute (WPM). Consequently, the scale was set at 30 to 420 WPM. Blue highlighting was chosen based on the finding from [2].

The calculation for time per word was determined using the formula: $timePerWord = \frac{wordLength}{5}$, and the word delay was calculated as: $wordDelay = \frac{timePerWord}{speed}$.

2.4 Procedure

Participants received a link to the experiment and were presented with initial instructions. They were informed that paragraphs would be presented one at a time, with both plain and highlighting types, and that there would be a total of 12 paragraphs to read. On the next page, participants calibrated their desired highlighting speed. After choosing their speed, participants proceeded to the first trial, where each trial consisted of one paragraph and one question screen pair. To initiate a trial, participants were presented with a screen featuring a start button, which would then display either the plain text or the text with automatic highlighting. After completing the reading, participants clicked the "done" button to access the comprehension question. Once they submitted their answers, the trial concluded. After all 12 trials, a survey collected participants' demographic information, including their age, primary language, dyslexia status, and whether they completed the experiment on a mobile phone.

3 RESULTS

3.1 Results can go here like plots and statistical data

Figure 1: frog placeholder

Figure 2: frog placeholder

Add conclusion on statistical data

4 DISCUSSION

Discussion goes here

5 CONCLUSION

Conclusion goes here

REFERENCES

[1] Vladimir Bochkarev, Anna Shevlyakova, and Valery Solovyev. 2012. Average word length dynamics as indicator of cultural changes in society. *Social Evolution and History* 14 (08 2012), 153–175.

[2] Toyoshi Morioka Hanae Ikeshita, Sho Yamaguchi and Takashi Yamazoe. 2018. Effects of Highlighting Text on the Reading Ability of Children with Developmental Dyslexia: A Pilot Study. *iJET* 13, 9 (2018), 239–251. https://core.ac.uk/download/pdf/234942024.pdf