Breaking the Working Memory Barrier: Introducing a Novel Digital Tool to Improve Understanding of Mathematical Texts

Abstract

With the digitization of academic material, there exists opportunity to utilize external tools to improve understanding of notation-heavy text. Prior research has shown a connection between working memory limits and conceptual learning. This study examines the creation and efficacy of a digital tool (nicknamed ‘Ender’) that acts as a crutch for working memory, through saving and resurfacing variable definitions across texts.

Hypotheses

H1. The Ender tool will increase efficiency of reading through notation-heavy text.
H2. The Ender tool will improve understanding of equations encountered in notation-heavy text.
H3. Through improving understanding of equations, the Ender tool will increase overall comprehension of notation-heavy text.
H4. The Ender tool will have a greater effect on those who have less experience reading through notation-heavy text.

Methods

46 Harvard students in STEM concentrations
2 economics passages by Nobel laureate George Akerlof (randomized tool and passage order)
Questions after each reading: main idea, support, parallel topics and ability to connect to external situations, detailed recall of equations and variables

Mechanical Turk grading of responses
Three per response; median value taken

Results (By Exp)

When grouping responses by previous experience (none vs. some; with 18 and 28 people respectively), steeper increases were found for those with no outside experience reading mathematically-heavy text (12% increase for understanding, 38% increase for equation recall, both significant at the 5% level). Results for participants with prior experience showed either an insignificant minimal increase or slight decrease when grouped.

Conclusion & Next Steps

Ender was created as a crutch for working memory, in hopes of improving understanding of mathematical text. Although no relationship was found in overall and bigger-picture comprehension, self-reported understanding of the text and detailed understanding of equations were improved through the usage of the tool, especially for participants with little background in similar text.

For next steps, there exists a tradeoff between time and understanding when using the tool; automating this process through NLP may increase efficiency and overall performance. This tool can also be analyzed outside of an economics and university context, such as in reviewing academic journals, or in English literature when many characters are introduced.