



Do More Difficult Tests Potentiate More New Learning?

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The Forward Effect of Testing

Retrieval practice has been shown to be more effective than restudy or no-interim practice to enhance subsequent learning of new information.¹

Taking a test enhances encourages participants to sustain effort and attention while encoding new information.^{2,3}

The **encoding effort hypothesis** posits that experiencing retrieval difficulty enables participants to see that their previous encoding was insufficient and dedicate more effort to subsequent learning.^{2,3}

Research Question

Based on the encoding effort hypothesis, more difficult tests should produce greater subsequent learning of new material than easier tests.

This hypothesis was supported in research with relatively simple materials (Swahili-English translations, unrelated word pairs).⁴

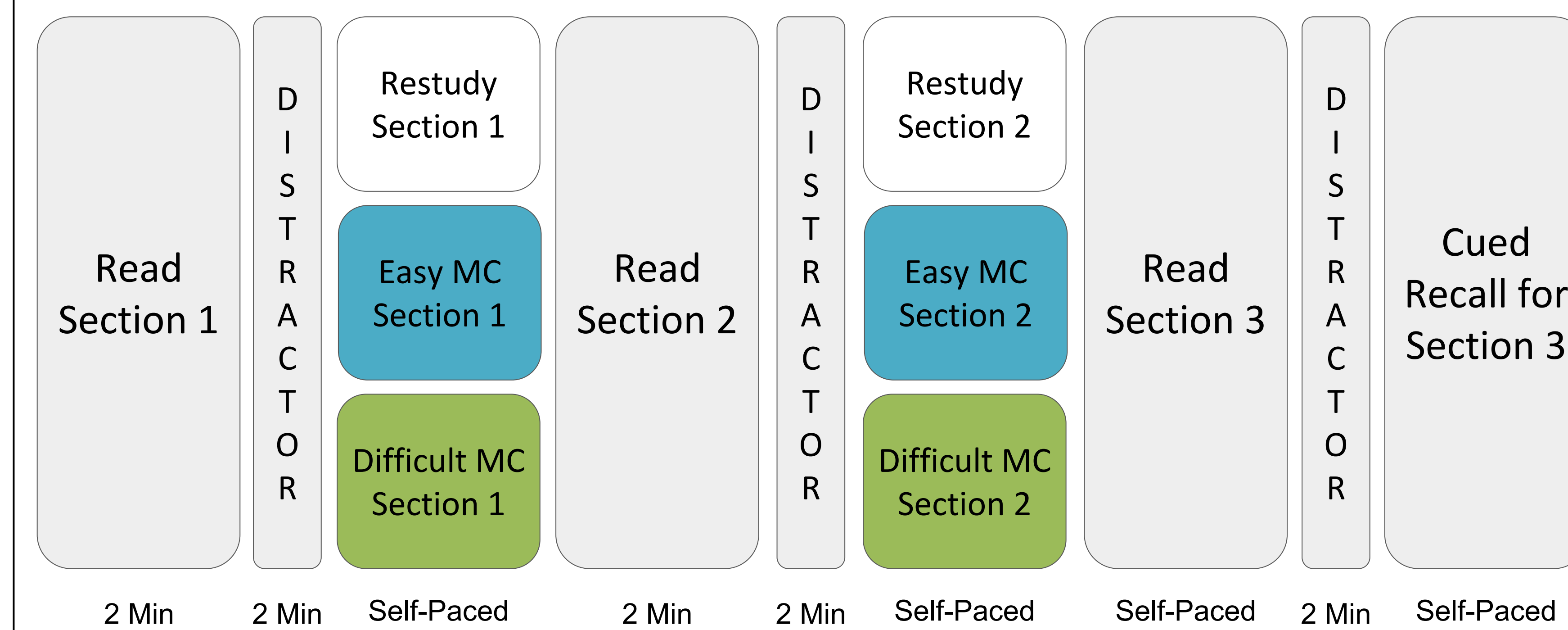
Do more difficult tests produce a greater forward effect of testing with educationally relevant materials?

Procedure

288 fluent English speakers were recruited online through Prolific.

3 (Interim Review Condition) x 2 (Topic) factorial design
Interim Review Condition: Restudy, Easy Multiple Choice, Difficult Multiple Choice
Topic: Ferrets vs. Solar System⁵

Multiple choice difficulty was mediated via lure similarity.⁵



Sample Interim Review

Restudy: Aristarchus was the first to propose that the sun was the center of the solar system (rather than the Earth)

Easy MC: Who was the first to propose that the sun was the center of the solar system (rather than the Earth)?

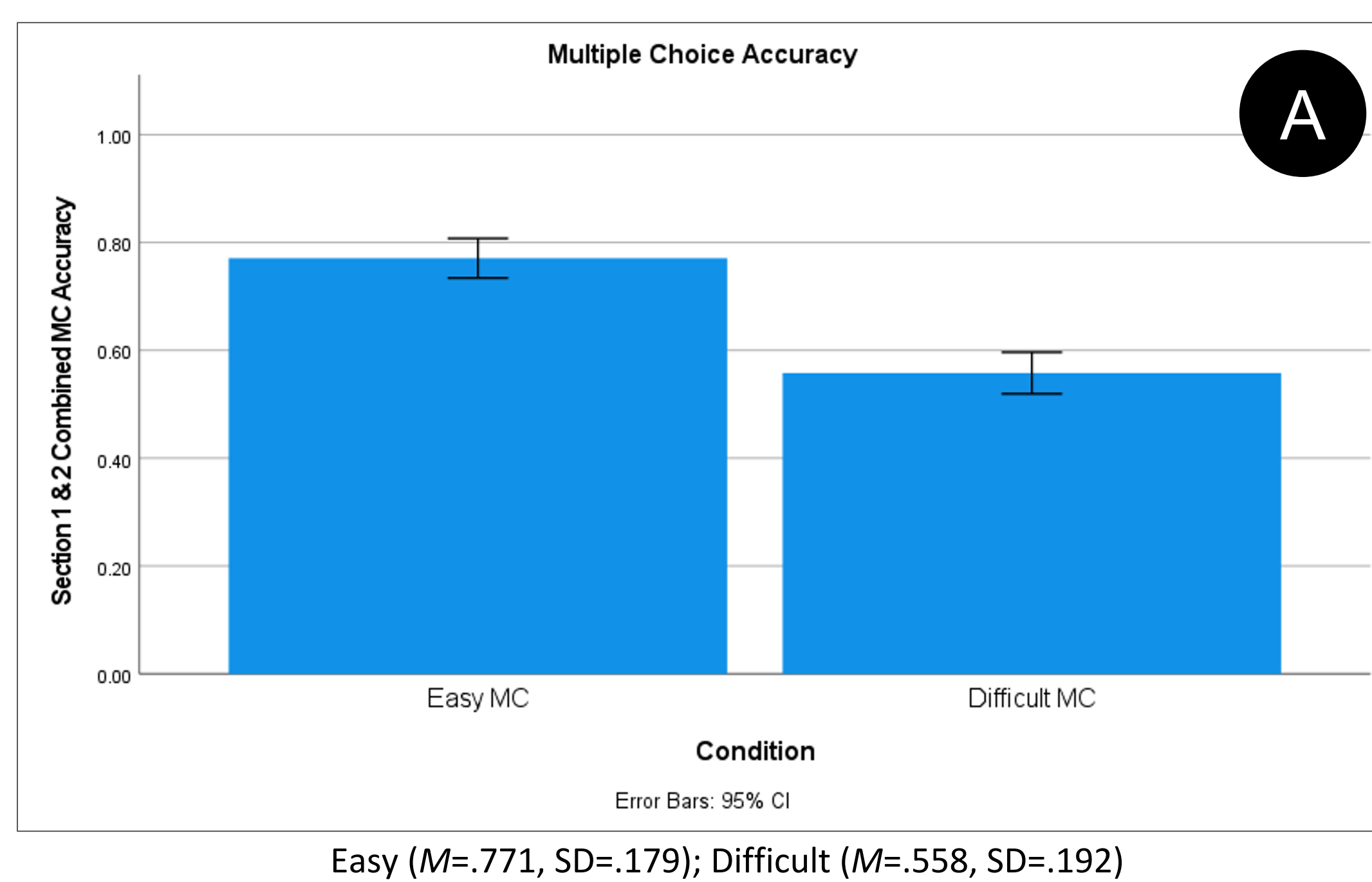
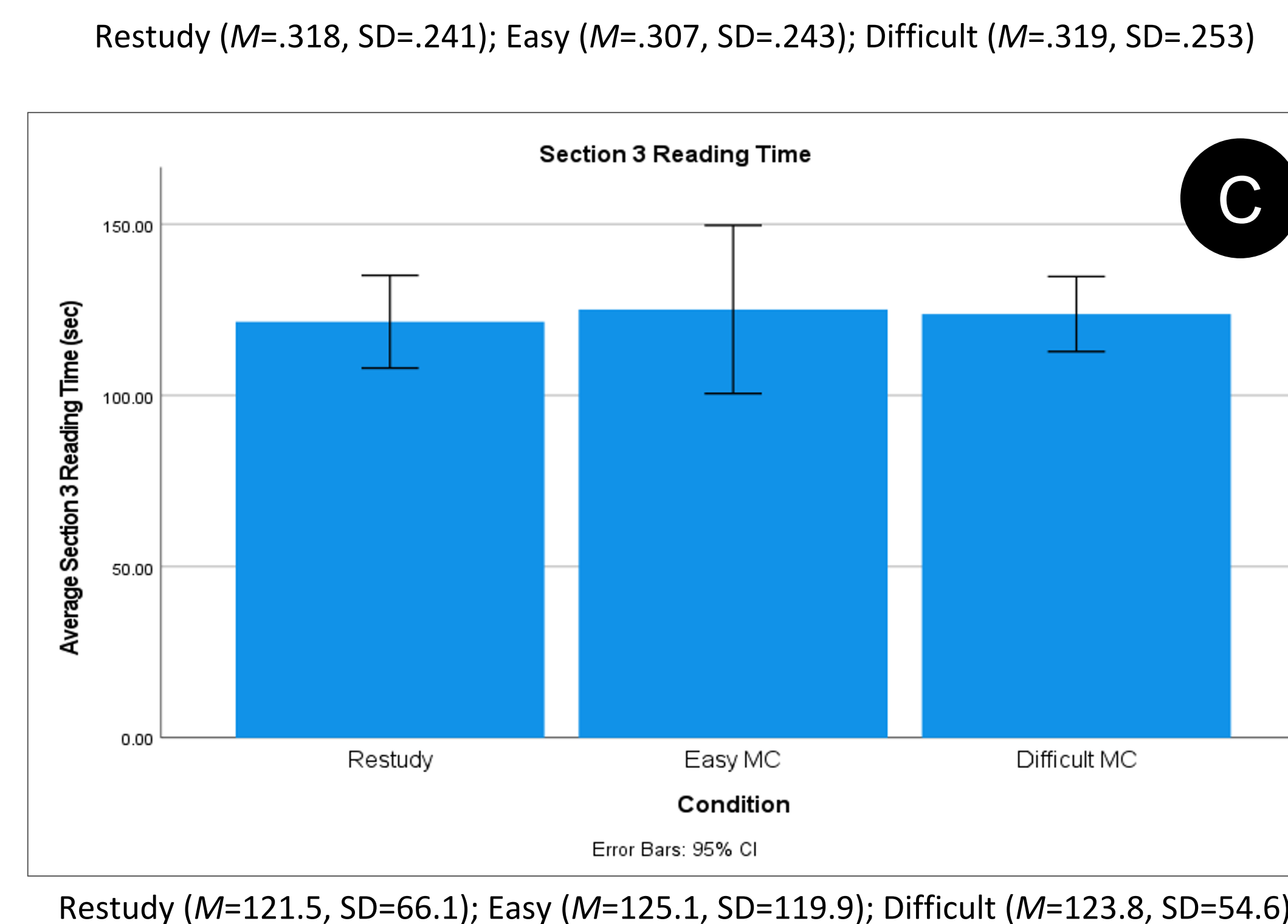
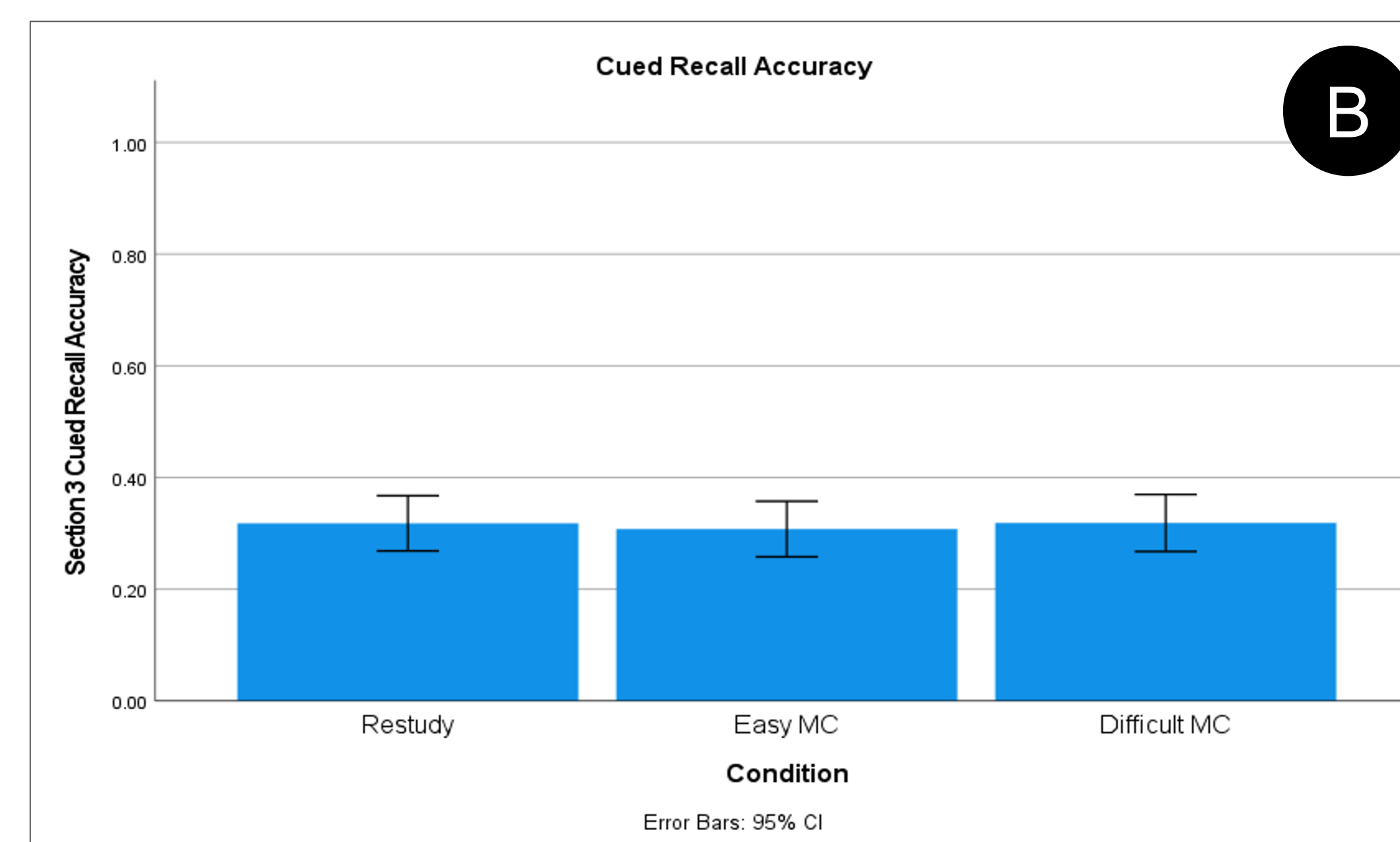
- a. Newton
- b. **Aristarchus**
- c. Kepler

Difficult MC: Who was the first to propose that the sun was the center of the solar system (rather than the Earth)?

- a. Copernicus
- b. **Aristarchus**
- c. Aryabhata

Results

- A. Retrieval difficulty was effectively manipulated
t-test: $p < .001$; Cohen's $d = 1.145$
- B. No differences among interim review conditions on the section 3 cued recall test
One-Way ANOVA: $p = .94$
- C. No differences among interim review conditions on section 3 reading times, either
One-Way ANOVA: $p = .96$



Discussion

The encoding effort hypothesis was not supported.

Despite an effective manipulation of multiple-choice difficulty, no differences in subsequent effort or learning were observed.

Open Questions

- Can the lack of the FTE be attributed to a lack of differences in encoding effort (section 3 reading times)?
- Did experiences of difficulty not translate into more effort? Or, did our manipulation of difficulty not impact *perceived* difficulty?

Future Research

- Explore metacognitive and memory explanations why the forward effect of testing has been observed with text materials using interim free recall.⁶
- Use additional measures of subjective difficulty.
- Use additional measures of encoding effort.

References

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⁶Wissman, K. T., Rawson, K. A., & Pyc, M. A. (2011). The interim test effect: Testing prior material can facilitate the learning of new material. *Psychonomic Bulletin & Review, 18*, 1140-1147.

Abstract

Several studies have shown that retrieval practice is more effective than restudy or no-interim practice to enhance subsequent learning of new information. We intended to test the encoding effort hypothesis of this forward effect of testing (FET) through an empirical study analyzing the effect of question difficulty, and therefore encoding effort, on subsequent retrieval. In our study, we presented participants with educationally-relevant reading materials split up into three sections. After each of the first two sections, an interim practice on the previous section was given depending on their randomly assigned group: restudy, easy multiple choice or difficult multiple choice. After the third section, all participants were given cued recall questions. If the encoding effort hypothesis is indeed true, we expect to find a significant difference in the cued recall scores with difficult multiple choice assigned participants scoring better than easy multiple-choice participants scoring better than restudy participants.