

Working memory as a predictor of word problem solving and arithmetic fluency

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Abstract

Several studies have examined the relationship between children's working memory and mathematics achievement. However, findings are inconsistent, and to what extent working memory is related to mathematics is still unclear (Destefano & Lefevre, 2004). Also, working memory has been found to have different roles in specific areas of mathematics (Peng, Namkung, Barnes, & Sun, 2016). Only a few longitudinal studies have examined the role of working memory in arithmetic fluency and word problems when controlling for prior achievements. Findings suggest that of the three components of working memory, only the central executive predicts word problem solving once other factors known to affect mathematics performance (e.g., initial word problem skills) are controlled for (Wang, Fuchs, & Fuchs, 2016). Currently, there has not been any longitudinal studies investigating the predictive role of working memory in arithmetic fluency when controlling for prior achievement. Therefore, the aim of this study is to examine the predictive role of working memory in arithmetic word problems and arithmetic fluency in first and second grade students by answering the following research question:

To what extent can working memory predict achievement in arithmetic word problem solving and arithmetic fluency when controlling for prior achievement, non-verbal reasoning and word comprehension?

This study is part of a wider research project *Tracking individual differences in numeracy development. Interplay between skills, motivation and well-being (iSeeNumbers)*. A quantitative, non-experimental and longitudinal design are utilized to answer the research question. There were 212 children ($M_{\text{age}} = 6$ years, 8 months) participating in the study from first to second grade. Children's word problem solving, arithmetic fluency, working memory, non-verbal reasoning and word comprehension were measured in first grade, and word problem solving and arithmetic fluency in second grade.

Findings from this study suggest that the central executive can predict word problem solving performance in second grade students. There were three main results that emerged from this



study. First, the hierarchical regression analysis showed that of the three working memory components, only the central executive ($\beta = .17, p < .01$) predicted word problems when prior achievement, non-verbal reasoning and word comprehension were controlled for. Second, working memory did not predict achievement in arithmetic fluency when prior achievement and non-verbal reasoning were controlled for. Third, the strongest predictor of later achievement in both word problems and arithmetic fluency were prior achievement.

These findings support previous findings on the importance of central executive functions in word problem solving (Passolunghi & Pazzaglia, 2005; Swanson & Beebe-Frankenberger, 2004). Findings are also in line with the notion that prior achievement in mathematics is an important factor in children's later performance (Lee & Bull, 2016). One implication for the educational field is that basic mathematical skills (e.g., arithmetic skills) during the early grades should be closely monitored as it could detect children at risk of mathematical difficulties.