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Wang, Jinjing (Jenny); Odic, Darko; Halberda, Justin; Feigenson, Lisa

Better together: multiple lines of evidence for a link between approximate and exact number representations: a reply to Merkley, Matejko, and Ansari.

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Summary: The results of our recent experiments suggest that temporarily modulating children's approximate number system (ANS) precision leads to a domain-specific change in their symbolic math performance [the authors, *ibid.* 147, 82–99 (2016; ME 2016d.00527)]. We interpreted these results as evidence for a causal relationship between ANS precision and symbolic math. In a commentary on our work, *R. Merkley et al.* [*ibid.* 153, 163–167 (2016; ME 2016f.00832)] argue that our methodology limits the interpretation of our results, primarily because our experiments did not meet the criteria for an intervention study as set out by What Works Clearinghouse and others. Here, we clarify the goals and limitations of our study and emphasize the variety of approaches to demonstrating causality. We argue that our goal was not to design and test an intervention or to compare the effectiveness of different treatments. Instead, we aimed to experimentally manipulate one variable (i.e., ANS acuity) and, in a randomized sample of children, observe whether this manipulation had any statistically significant effect on a dependent variable (i.e., performance on a set of symbolic math questions). We provide further analyses to support our assertion that a temporary manipulation of ANS performance does lead to a change in math performance. These results point to a causal relationship between ANS precision and math, and they suggest that further investigation of this relationship will be fruitful.

Classification: F21 C31 F31

Keywords: approximate number system; symbolic math; causality

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