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How to interpret cognitive training studies: a reply to Lindskog & Winman.

Cognition 150, 247-251 (2016).

Summary: In our previous studies, we demonstrated that repeated training on an approximate arithmetic task selectively improves symbolic arithmetic performance [the authors, “Training the approximate number system improves math proficiency”, *Psychol. Sci.* 24, No. 10, 2013–2019 (2013; doi:10.1177/0956797613482944); *Cognition* 133, No. 1, 188–200 (2014; ME 2014f.00485)]. We proposed that mental manipulation of quantity is the common cognitive component between approximate arithmetic and symbolic arithmetic, driving the causal relationship between the two. In a commentary to our work, *M. Lindskog* and *A. Winman* [ibid. 150, 243–247 (2016; ME 2016c.00595)] argue that there is no evidence of performance improvement during approximate arithmetic training and that this challenges the proposed causal relationship between approximate arithmetic and symbolic arithmetic. Here, we argue that causality in cognitive training experiments is interpreted from the selectivity of transfer effects and does not hinge upon improved performance in the training task. This is because changes in the unobservable cognitive elements underlying the transfer effect may not be observable from performance measures in the training task. We also question the validity of Lindskog and Winman’s [loc. cit.] simulation approach for testing for a training effect, given that simulations require a valid and sufficient model of a decision process, which is often difficult to achieve. Finally we provide an empirical approach to testing the training effects in adaptive training. Our analysis reveals new evidence that approximate arithmetic performance improved over the course of training in [the authors, loc. cit.]. We maintain that our data supports the conclusion that approximate arithmetic training leads to improvement in symbolic arithmetic driven by the common cognitive component of mental quantity manipulation.

Classification: F20 F30 C30

Keywords: cognitive training; training effect; transfer effect; math intervention

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