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Are Hindu-Arabic Numerals Concrete or Abstract Symbols?

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Abstract: Much recent experimental work has investigated the comparative merits of concrete versus abstract instantiations of to-be-learned concepts for promoting learning and transfer in complex domains. A critical question, however, is what exactly counts as a concrete instantiation. Using a design similar to that of Sloutsky, Kaminski, & Heckler (2005), the current experiments provide findings that suggest that Arabic numerals have effects that parallel those of perceptually concrete instantiations when used to illustrate the domain of modular arithmetic. Specifically, numerals can be used to speed initial learning within the domain, but impede transfer relative to more abstract instantiations of the same underlying content. Moreover, these effects can be moderated by subtle warm-up tasks that affect the degree to which these numerals activate prior arithmetic schemas. These results suggest that the current conception of "concrete" should be expanded to include representations typically thought to lie outside of the realm of concrete.