The compositional structure of exact number concepts: insights from representational similarity among small numbers

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Abstract

Novel theories of conceptual development in mathematical cognition propose a compositional origin for exact number concepts, whereby mental operations akin to addition and multiplication enable the acquisition and encoding of increasingly large numbers as algebraic combinations of smaller ones. Accordingly, number representations should not only be tied to numerical magnitude, but also exist in the form of expressions connecting compositionally-related numbers to one another. We provide a preliminary test of this hypothesis by investigating the compositional determinants of representational similarity among small number concepts (0-9) in five behavioural experiments (n = 204 adults). Beyond numerical magnitude, a set of algebraic properties (including factorial relationships, parity status, and primality status) contributed to subjective similarity judgments between numbers, as expected. Nevertheless, these effects were not consistently replicated using semantic priming across a series of numerical judgment tasks, suggesting that the representation of numbers' compositional features is contingent on task-specific demands.

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