One is a dot, two is a pair, three is a trend: a computational model of Quinian bootstrapping

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Abstract

Conceptual development, both in childhood and across the history of science, is marked by moments of discontinuity: landmark events after which previously inexpressible thoughts and theories, *incommensurable* with the initial cognitive or scientific repertoire, become accessible. Despite longstanding interest, a computational account of these transitions that answers the deepest Fodorian nativist objections remains elusive. Here we present such an explanation by revisiting Carey's *Quinian bootstrapping*. Building upon models based on program induction, we develop an enriched paradigm in which discontinuous conceptual change becomes the invention of a *new type system*, related by *structural analogy* to the previous representation system, but also, crucially, generalizing beyond it. We instantiate our method in the classic domain of children's early mathematical development, modeling the acquisition of both *natural* and *rational number*. We find our model captures several previously unmodeled phenomena, and provides more parsimonious explanations for cross-linguistic universals and intervention effects in number learning.

In G. Boleda, I. Dautriche, M. Maldonado, C. Saldana and T. Torrent (Eds.), *Proceedings of the 48th Annual Conference of the Cognitive Science Society*