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Curiosity optimises learning in a simulated infant categorisation task

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Background

A fundamental cognitive skill, categorisation, is present from birth and highly sensitive to environmental structure. However, how this structure affects learning is unclear. While some studies indicate that maximally complex input supports learning, others argue for simpler stimuli, and still others show that intermediate difficulty optimises learning (*Goldilocks effect*). Importantly, in these paradigms stimuli are selected *a priori*. Infants, in contrast, are curious, and drive their own development by actively selecting stimuli. Understanding how infants structure their own learning environments is therefore critical.

Method

Using a connectionist network we simulated a recent novelty preference study in which 10-month-olds (n = 24) learned categories from maximally, but not minimally, complex stimulus sequences. In a second simulation the network chose its own sequences based on "curiosity", calculated using its internal states as well as environmental structure.

Findings

With proportion test error as a proxy for looking time, our first simulation showed strongest categorisation after maximally complex sequences (M = 0.99, p < .0001), capturing the empirical data. However, our curious network learned equally well (M = 0.97, p < .0001, maximum vs. curiosity: p = 0.28), and critically, selected stimuli of intermediate complexity, exhibiting a Goldilocks effect.

Discussion

These simulations represent the first computational investigation of curiosity-based categorisation, making the novel prediction that infant-driven exploration can optimise learning with stimuli of intermediate complexity. Overall, this work illustrates development as a system in which learning is driven by dynamic interactions between learner and environment.