Recombinant building: the ability to generate and recombine navigation structures is difficult to acquire through just reinforcement learning

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Abstract

Humans build novel tools, external knowledge structures (markers, maps etc.), and internal structures (analogies, mental models etc.) to facilitate cognition. Humans also recombine these building strategies to suit any task. Other organisms generate such structures as well, but they use them to optimize single tasks. This suggests that the human species' cognitive advantage stems from the capability to recombine built structures, and the resulting extended mind. Chandrasekharan & Stewart (2007) hypothesized that this capacity could emerge from reinforcement learning. We tested this proposal, by studying three foraging models, which examined whether novel recombinations of building (external and internal navigation structures) emerged in reactive agents, from just reinforcement learning. Results showed that recombination does not emerge with just reinforcement. This was because the building of external structures provided a very high reward profile, including free riding, thus acting as an attractor, blocking the recombination strategy. We discuss the implications of these results.