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Compositional subgoal representations

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Abstract

When faced with a complex problem, people naturally break it up into several simpler problems. This hierarchical decomposition of an ultimate goal into sub-goals facilitates planning by reducing the number of factors that must be considered at one time. However, it can also lead to suboptimal decision-making, obscuring opportunities to make progress towards multiple subgoals with a single action. Is it possible to take advantage of the hierarchical structure of problems without sacrificing opportunities to kill two birds with one stone? We propose that people are able to do this by representing and pursuing multiple subgoals at once. We present a formal model of planning with compositional goals, and show that it explains human behavior better than the standard "one-at-a-time" subgoal model as well as non-hierarchical limited-depth search models. Our results suggest that people are capable of representing and pursuing multiple subgoals at once; however, there are limitations on how many subgoals one can pursue concurrently. We find that these limitations vary by individual.