Self-directed gameplay reveals common and divergent patterns in human problem-solving

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Abstract

A central goal of cognitive science has been to find universal principles that explain the remarkable flexibility of human problem-solving. However, people display a diversity of problem-solving strategies, prior experience, domain-specific knowledge, and preferences. Which aspects of problem solving are shared across individuals, which are individual-specific, and which are adapted to particular domains? Most studies of human problem-solving rely on brief laboratory tasks in one or a few domains and coarse behavioral measures, making it difficult to robustly explain individual cognitive processing. We propose that longitudinal, self-motivated gameplay across multiple tasks—combined with detailed process-tracing—can help fill these gaps. We introduce mitpuzzles.com, a public platform hosting a suite of constraint-based logic puzzles (e.g., Minesweeper, Sudoku, and Nonograms), instrumented to collect detailed behavioral data including mouse-tracking. We present preliminary analyses of large-scale data (N=85,919 games played by 2,258 users) collected from this website to characterize common and variable problem-solving behaviors across both individuals and games. Among other findings, these analyses reveal stable individual differences and effects of learning. First, abstract features of subproblem complexity predict accuracy and speed across puzzle types. Second, most players avoid complex subproblems, even when those subproblems are more globally informative, but the fastest solvers are less avoidant. Third, players search more efficiently with experience. Our results highlight the promise of studying self-motivated participants engaging with hard, naturalistic tasks to understand both the shared structure and individual variability of human problem-solving.