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Title: Mice in a labyrinth: Rapid learning, sudden insight, and efficient exploration

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Abstract: Animals learn certain complex tasks remarkably fast, sometimes after a single experience. What behavioral algorithms support this efficiency? Many contemporary studies based on two-alternative-forced-choice (2AFC) tasks observe only slow or incomplete learning. As an alternative, we study the unconstrained behavior of mice in a complex labyrinth and measure the dynamics of learning and the behaviors that enable it. A mouse in the labyrinth makes ~2000 navigation decisions per hour. The animal quickly discovers the location of a reward in the maze and executes correct 10-bit choices after only 10 reward experiences – a learning rate 1000-fold higher than in 2AFC experiments. Many mice improve discontinuously from one minute to the next, suggesting moments of sudden insight about the structure of the labyrinth. The underlying search algorithm does not require a global memory of places visited and is largely explained by purely local turning rules.