

Offline Replay Supports Planning: fMRI Evidence from Reward Revaluation

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Presentation Abstract Summary We offer fMRI evidence for the idea of planning as learning from replay. Learning to make advantageous decisions in sequentially structured tasks, like mazes, requires integrating information across multiple episodes. This is a challenge for learning approaches that work fully "online" and summarize ongoing experience. A proposed mechanism for such challenging integration is to replay and piece-together experiences "offline". A key question for this account is how the brain prioritizes whether or which experiences to replay. Based on research in machine learning, we hypothesize that the brain should preferentially replay experiences 'tagged' with prediction errors, signaling increased uncertainty that may have consequences for other states and decisions. To test this, we acquired fMRI data as participants performed a sequential decision task with retrospective revaluation and control trials. During revaluation, participants integrated initial experience about a task with later experience about a change in its goals. We used multi-voxel pattern analysis (MVPA) to measure replay during intermittent rest. We found that replay (a) predicts revaluation during test, and (b) correlates with earlier fronto-striatal sensitivity to prediction errors during learning (corresponding to prediction error tagging). These findings further our understanding of how the brain leverages offline mechanisms in planning and goal-directed behavior.

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