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How past experiences inform future choices

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Researchers at MIT's Picower Institute for Learning and Memory report for the first time how animals' knowledge obtained through past experiences can subconsciously influence their behavior in new situations.

The work, which sheds light on how our past experiences inform our future choices, will be reported on Dec. 22 in an advance online publication of *Nature*.

Previous work has shown that when a mouse explores a new space, neurons in its hippocampus, the center of learning and memory, fire sequentially like gunpowder igniting a makeshift fuse. Individual neurons called place cells fire in a specific pattern that mirrors the animal's movement through space. By looking at the time-specific patterns and sequences recorded from the firing cells, researchers can tell which part of the maze the animal was running at the time.

In the current work, research scientist George Dragoi and Susumu Tonegawa, Picower Professor of Biology and Neuroscience and director of the RIKEN-MIT Center for Neural Circuit Genetics, found that some of the sequences of place cells in mice' brains that fired during a novel spatial experience such as running a new maze had already occurred while the animals rested before the experience.

"These findings explain at the neuronal circuit level the phenomenon through which prior knowledge influences our decisions when we encounter a new situation," Dragoi said. "This explains in part why

different individuals form different representations and respond differently when faced with the same situation."

When a mouse pauses and rests while running a maze, it mentally replays its experience. Its neurons fire in the same pattern of activity that occurred while it was running. Unlike this version of mental replay, the phenomenon found by the MIT researchers is called preplay. It occurred before the animal even started the new maze.

"These results suggest that internal neuronal dynamics during resting organize cells within the hippocampus into time-based sequences that help encode a related experience occurring in the future," Tonegawa said.

"Previous work largely ignored internal neuronal activities representing prior knowledge that occurred before a new event, space or situation. Our work shows that an individual's access to prior knowledge can help predict a response to a new but similar experience," he said.

More information: "Preplay of future place cell sequences by hippocampal cellular assemblies," by George Dragoi and Susumu Tonegawa. *Nature*, 22 December, 2010.

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