Study finds how brain remembers single events

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Single events account for many of our most vivid memories - a marriage proposal, a wedding toast, a baby's birth. Until a recent UC Irvine discovery, however, scientists knew little about what happens inside the brain that allows you to remember such events.

In a study with rats, neuroscientist John Guzowski and colleagues found that a single brief experience was as effective at activating neurons and genes associated with memory as more repetitive activities.

Knowing how the brain remembers one-time events can help scientists design better therapies for diseases such as Alzheimer's in which the ability to form such memories is impaired.

"Most experiences in life are encounters defined by places, people, things and times. They are specific, and they happen once," says Guzowski, UCI neurobiology and behavior assistant professor. "This type of memory is what makes each person unique."

It is well known that a brain structure called the hippocampus is critical to memory and learning, but many questions exist about how brief experiences trigger the physical changes necessary for memory. In his study, Guzowski set out to learn how neurons in the hippocampus react to single events - particularly in the CA3 region, which is thought to be most critical for single-event memory.

Guzowski and postdoctoral researcher Teiko Miyashita put groups of

rats on a rectangular track. Some rats took one lap; others did multiple laps. Inspecting the brains of rats that took one lap, they found that 10-15 percent of neurons in the CA3 region activated. The same percentage of CA3 neurons fired in the brains of rats that walked multiple laps.

Though previous computer simulations predicted that brief and repetitive experiences would activate CA3 neurons similarly, this is the first study to actually show that is the case.

Miyashita and Guzowski arrived at the percentages by examining the activation of a gene called "Arc" within hippocampal neurons. Past studies have shown that turning on Arc is required to convert experience into long-term memory.

"Together with our past findings, this study provides key insight into how fleeting experiences can be captured by the brain to form lasting memories," Guzowski says.

Arc activation is disrupted in mouse models of mental retardation and Alzheimer's disease.

"Our findings on Arc regulation in CA3 neurons should prove useful to researchers testing new therapies for Alzheimer's disease," Guzowski says. "If you understand how the hippocampus works, it is much easier to understand and potentially treat diseases that affect memory."

More information: UCI researchers Stepan Kubik, Nahideh Haghighi and Oswald Steward also worked on this study, published in *The Journal of Neuroscience*.

Source: University of California - Irvine