Medical Xpress

Researchers erase memories in mice with a beam of light

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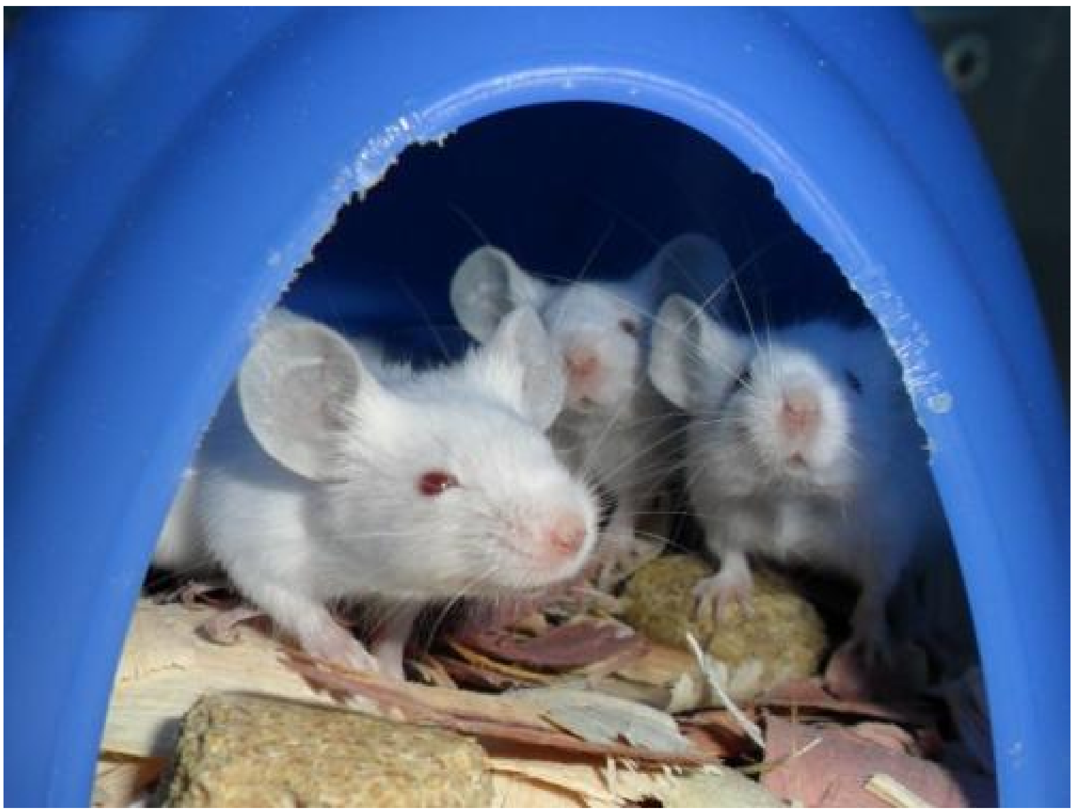

Credit: Martha Sexton/public domain

(Medical Xpress)—A team of researchers with member affiliations to several institutions in the U.S. and Japan has developed a new device that allowed them to alter the spines on a neural dendrite in a mouse brain that was first modified naturally by an event that caused a memory to form. As they explain in their paper published in the journal *Nature*, altering the spine caused a learned memory to be forgotten. Ju Lu and Yi Zuo both with the University of California, offer a News & Views piece on the work done by the team and offer suggestions on where such work is leading.

As part of trying to understand how the human (and other animal) brain works, scientists focus on subsets of its functionality, one of which is memory. How are memories created, stored, changed and manipulated? A lot of it is still a mystery, but as the work done by this latest team demonstrates, biomedical researchers are getting closer. In this new effort, the team taught a mouse to stay atop a rolling pipe, then shined a light on the part of its brain that had changed as it learned, causing the change to revert back to its pre-learned state and in so doing, causing the mouse to forget what it had learned. In order to make this bit of magic happen, the team had to first design and build a device that allowed for such manipulation—they call it AS-PaRac—it is an optoprobe that is capable of causing changes to spines that grow on the edges of dentrites, the listening or input part used by neurons to communicate with one another. Prior work has suggested that their tips grow bigger as part of storing a new memory.

With their new device in hand, the researchers first trained a mouse to stay on a pipe as it rolled, they then identified which dentrite was involved in storing that memory and which particular spine—they were actually able to see that its tip had grown in size. Then, they used the AS-PaRac to force the spine tip back to the size it was before the mouse learned to balance on the pipe. Doing so caused the mouse to forget what it had learned. To make sure the change was isolated, the team repeated the experiment, but the second time around, they taught the mouse another trick—reducing the same spine caused the mouse to once again forget how to do the first trick, but not the second.

Lu and Zuo note that this is just the beginning, they believe it will not be long before the researchers can go in and make the same spine bigger with the AS-PaRac, causing a mouse to learn how to stay atop a pipe without ever having been taught.

More information: Labelling and optical erasure of synaptic memory traces in the motor cortex, *Nature* (2015) DOI: 10.1038/nature15257

Abstract
Dendritic spines are the major loci of synaptic plasticity and are considered as possible structural correlates of memory. Nonetheless, systematic manipulation of specific subsets of spines in the cortex has been unattainable, and thus, the link between spines and memory has been correlational. We developed a novel synaptic optoprobe, AS-PaRac1 (activated synapse targeting photoactivatable Rac1), that can label recently potentiated spines specifically, and induce the selective shrinkage of AS-PaRac1-containing spines. In vivo imaging of AS-PaRac1 revealed that a motor learning task induced substantial synaptic remodelling in a small subset of neurons. The acquired motor learning was disrupted by the optical shrinkage of the potentiated spines, whereas it was not affected by the identical manipulation of spines evoked by a distinct motor task in the same cortical region. Taken together, our results demonstrate that a newly acquired motor skill depends on the formation of a task-specific dense synaptic ensemble.