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Research wrests partial control of a memory

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Scripps Research Institute scientists and their colleagues have successfully harnessed neurons in mouse brains, allowing them to at least partially control a specific memory. Though just an initial step, the researchers hope such work will eventually lead to better understanding of how memories form in the brain, and possibly even to ways to weaken harmful thoughts for those with conditions such as schizophrenia and post traumatic stress disorder.

The results are reported in the March 23, 2012 issue of the journal *Science*.

Researchers have known for decades that stimulating various regions of the brain can trigger behaviors and even memories. But understanding the way these brain functions develop and occur normally—effectively how we become who we are—has been a much more complex goal.

"The question we're ultimately interested in is: How does the activity of the brain represent the world?" said Scripps Research neuroscientist Mark Mayford, who led the new study. "Understanding all this will help us understand what goes wrong in situations where you have inappropriate perceptions. It can also tell us where the brain changes with learning."

On-Off Switches and a Hybrid Memory

As a first step toward that end, the team set out to manipulate specific memories by inserting two genes into mice. One gene produces receptors

that researchers can chemically trigger to activate a neuron. They tied this gene to a natural gene that turns on only in active neurons, such as those involved in a particular memory as it forms, or as the memory is recalled. In other words, this technique allows the researchers to install on-off switches on only the neurons involved in the formation of specific memories.

For the study's main experiment, the team triggered the "on" switch in neurons active as mice were learning about a new environment, Box A, with distinct colors, smells and textures.

Next the team placed the mice in a second distinct environment—Box B—after giving them the chemical that would turn on the neurons associated with the memory for Box A. The researchers found the mice behaved as if they were forming a sort of hybrid memory that was part Box A and part Box B. The chemical switch needed to be turned on while the mice were in Box B for them to demonstrate signs of recognition. Alone neither being in Box B nor the chemical switch was effective in producing memory recall.

"We know from studies in both animals and humans that memories are not formed in isolation but are built up over years incorporating previously learned information," Mayford said. "This study suggests that one way the brain performs this feat is to use the activity pattern of nerve cells from old memories and merge this with the activity produced during a new learning session."

Future Manipulation of the Past

The team is now making progress toward more precise control that will allow the scientists to turn one memory on and off at will so effectively that a mouse will in fact perceive itself to be in Box A when it's in Box B.

Once the processes are better understood, Mayford has ideas about how researchers might eventually target the perception process through drug treatment to deal with certain mental diseases such as schizophrenia and post traumatic stress disorder. With such problems, patients' brains are producing false perceptions or disabling fears. But drug treatments might target the neurons involved when a patient thinks about such fear, to turn off the neurons involved and interfere with the disruptive thought patterns.

More information:
www.sciencemag.org/content/335/6075/1513.abstract

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