Scientists create "memories" in isolated brain slices

Dec. 27, 2009
Courtesy Case Western Reserve University and World Science staff

Researchers report that they created apparent "memories" within slices of rodent brains kept alive in the laboratory.

The findings are published in the February issue of the journal Nature Neuroscience.

Neuroscientists often classify memory into three types: declarative memory, such as storing facts or remembering specific events; procedural memory, such as learning how to play the piano or shoot basketballs; and working memory, a type of short-term storage like remembering a phone number.

In the study, Ben Strowbridge and Phillip Larimer of Case Western Reserve University in Cleveland aimed to identify the brain circuits behind working memory.

Using isolated pieces of rodent brain tissue, Larimer found a way to recreate a type of working memory in the lab. He was studying a type of brain cell, or neuron, called mossy cells, which are often damaged in people with epilepsy and are part of a structure in the brain called the hippocampus.

"Seeing the memory deficits that so many people with epilepsy suffer from led me to wonder if there might be a fundamental connection between hippocampal mossy cells and memory circuits," said Larimer.

Mossy cells are unusual because they maintain much of their normal activity even when kept alive in thin brain slices. The spontaneous electrical activity Larimer and Strowbridge found in mossy cells was critical to their discovery of

memory traces in this brain region.

When stimulating electrodes were inserted in the brain slice the spontaneous activity in the mossy cells remembered which electrode had been activated, the researchers reported. The "memories" lasted about 10 seconds, about as long as many types of working memories studied in people.

"This is the first time anyone has stored information in spontaneously active pieces of mammalian brain tissue. It is probably not a coincidence that we were able to show this memory effect in the hippocampus, the brain region most associated with human memory," said Strowbridge.

The scientists measured the frequency of synaptic inputs—or the strength of the brain's electrical signals—onto the mossy cells to determine whether or not the hippocampus had retained memory.

"Memory was not evident in one cell but it was evident in a population of cells," said Strowbridge.

"Like our own memories, the memories we created in isolated brain slices were stored in many different neurons or cells, that's why we had to watch several different cells to see the stored information," added Strowbridge.

Larimer and Strowbridge also said they found the brain circuit that enabled the hippocampus to remember which input pathway had been activated. The memory effect, they explained, occurred thanks to a rare type of brain cell called semilunar granule cells, described in 1893 by the father of neuroscience, the Spaniard Ramón y Cajal. But the cells have been little studied since then. The semilunar granule cells have an unusual form of persistent activity, allowing them to maintain memory and connect to the mossy cells, according to the group.