Research team may have observed building blocks of memories in the brain

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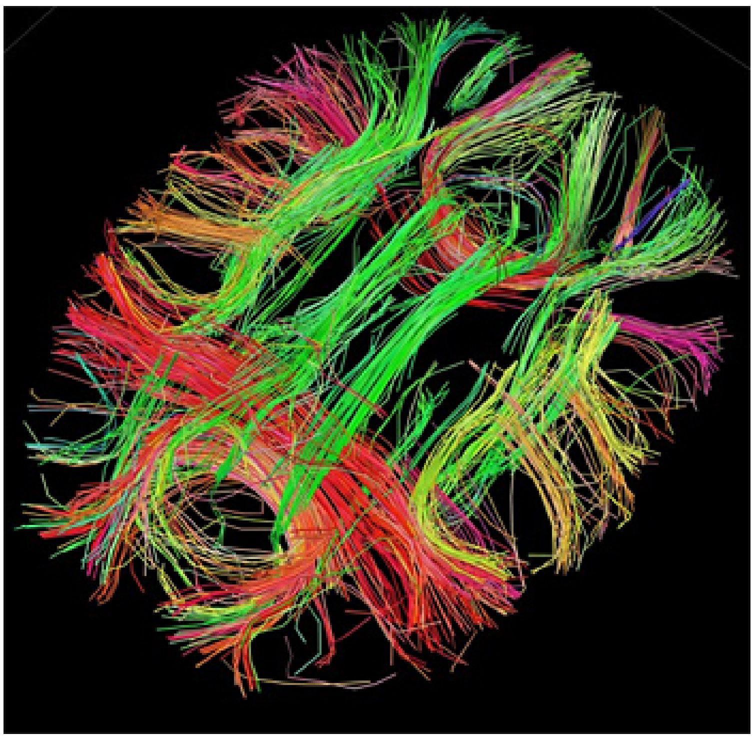

White matter fiber architecture of the brain. Credit: Human Connectome Project.

(Medical Xpress)—A team of researchers working at Aix-Marseille University in France has observed what they believe are the building blocks of memories in a mouse brain. In their paper published in the journal *Science*, the researchers describe how they caused certain neurons to become illuminated when they fired, allowing them to watch in real time as memories were made and then later as they were replayed while the mouse was sitting idle.

Figuring out which brain cells are involved in forming memories has been a difficult task, though researchers have made progress—prior research has suggested that the hippocampus is the main part of the brain that deals with formation and retrieval of events such as taking note of the environment while a person (or mouse) strolls from one location to another. But until now, it has not really been possible to actually see the formation of a memory at the neuron level. In this new effort, researchers believe they have done it by causing neurons in a mouse hippocampus to light up when they fired and then watching as a sequence of firings unfolded.

More specifically, the researchers caused the neurons to fluoresce when exposed to a flood of calcium ions indicating that the neuron was firing. This allowed them to monitor the activity of up to 1000 neurons as the mouse walked on a treadmill. Prior research has also found that cells in mouse brains trace how far a mouse has traveled—in this instance, as the mouse traveled on the treadmill, a sequence of neurons lit up (though they were not situated next to one another) just as predicted, revealing what the researchers believe was the formation of a memory. Additionally, the researchers continued to monitor the same cells after the mouse was allowed to rest and discovered that the same sequence of cells lit up, as if the mouse was reliving the activity in its head—but the sequence ran faster than it had during the initial observation and it happened in individual segments—as if the mouse brain was processing the data one chunk at a time.

The work by the team represents a clear advance in the study of memory, though more work will have to be done before it can be proven that what the team observed was truly the formation and replaying of a memory event.

More information: A. Malvache et al. Awake hippocampal reactivations project onto orthogonal neuronal assemblies, *Science* (2016). DOI: 10.1126/science.aaf3319

Abstract
The chained activation of neuronal assemblies is thought to support major cognitive processes, including memory. In the hippocampus, this is observed during population bursts often associated with sharp-wave ripples, in the form of an ordered reactivation of neurons. However, the organization and lifetime of these assemblies remain unknown. We used calcium imaging to map patterns of synchronous neuronal activation in the CA1 region of awake mice during runs on a treadmill. The patterns were composed of the recurring activation of anatomically intermingled, but functionally orthogonal, assemblies. These assemblies reactivated discrete temporal segments of neuronal sequences observed during runs and could be stable across consecutive days. A binding of these assemblies into longer chains revealed temporally ordered replay. These modules may represent the default building blocks for encoding or retrieving experience.