Hippocampus plays bigger memory role than previously thought

November 1 2011

Human memory has historically defied precise scientific description, its biological functions broadly but imperfectly defined in psychological terms. In a pair of papers published in the November 2 issue of The *Journal of Neuroscience*, researchers at the University of California, San Diego report a new methodology that more deeply parses how and where certain types of memories are processed in the brain, and challenges earlier assumptions about the role of the hippocampus.

Specifically, Larry R. Squire, PhD, a Research Career scientist at the VA Medical Center, San Diego and professor of psychiatry, neurosciences, and psychology at UC San Diego, and Christine N. Smith, PhD, a project scientist, say that contrary to current thinking the hippocampus (a small seahorse-shaped structure located deep in the center of the brain and long associated with memory function) supports both recollection and familiarity memories when these memories are strong.

Recollection and familiarity memory are two components of recognition memory – the ability to identify an item as having been previously encountered. Recollection memory involves remembering specific details about a learning episode, such as where and when the episode occurred. Familiarity memory refers to remembering an item as previously encountered, but without any recall of specific details, such as recognizing someone's face but recalling nothing else about that person (For example, where you met the person.).

Prevailing research posits that recollection and familiarity memories involve different regions in the brain's medial temporal lobe: the hippocampus for recollection, the adjacent perirhinal cortex for familiarity.

"But given the connectivity in that part of the human brain, that separation seemed too clean, too neat," said Squire, a leading expert on the neurological bases of memory. "The idea of distinct functions was unlikely."

Recollection-based memories are typically associated with higher confidence and accuracy than familiarity-based decisions. Accordingly, in the past, comparisons between recollection and familiarity have also involved a comparison between strong memories and weak memories. So the question is how the brain accomplishes recollection and familiarity when the effect of memory strength is taken off the table.

Squire, Smith and John T. Wixted, PhD, professor of psychology and chair of the UC San Diego Department of Psychology, developed a novel method for assessing not just how recollection and familiarity memories are formed, but also their strength. The scientists combined functional magnetic resonance imaging of the brain with a test in which study participants looked at a series of words and judged on a 20-point confidence scale if each word had been studied earlier or not. If the word was deemed old (the upper half of the scale), participants were asked to decide if it was "remembered," which denotes recollection, "known," which denotes familiarity, or simply "guessed."

Not surprisingly, recollected items had a higher accuracy and confidence rating among participants than did familiar items. Previous studies have produced similar results. But when the UC San Diego scientists compared recollected and familiar items that were both strongly remembered, the data showed that the hippocampus was actively

involved in both, contrary to earlier research.

The discovery peels away another layer of complexity in human memory , said Squire. "If we really want to know how the brain works, the best guide is to think of it in terms of neuroanatomy. Psychological descriptions got us started, but a fundamental map and understanding will require a deeper biological foundation."

In practical terms, Squire said, the findings may help in diagnosing and treating patients with memory problems. "If you have better constructs, you have a better way of knowing what's going on in a patient's brain. You can be more precise in your thinking about what's happening and what to do."

First-author Smith said their research may prompt other scientists to re-think some of their studies. "This was the first study to re-do earlier research with these controls. We hope it will encourage others to reassess the potential effect of strength of memory in studies of this kind."

In the second paper, Squire, with co-authors Zhuang Song, PhD, a postdoctoral researcher, and Annette Jeneson, a graduate student, used a novel combination of neuroimaging with other tests to also show that the hippocampus is related to encoding of familiarity-based item memories, not just recollection-based memories.

Provided by University of California - San Diego