Researchers discover mechanism that determines when detailed memories are retained

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The levels of a chemical released by the brain determine how detailed a memory will later be, according to researchers at UC Irvine.The neurotransmitter acetylcholine, a brain chemical already established as being crucial for learning and memory, appears to be the key to adding details to a memory.

In a study with rats, Norman Weinberger, research professor of neurobiology and behavior, and colleagues determined that a higher level of acetylcholine during a learning task correlated with more details of the experience being remembered. The results are the first to tie levels of acetylcholine to memory specificity and could have implications in the study and treatment of memory-related disorders.

The findings appear in the November issue of the journal *Neurobiology of Learning and Memory*.

"This is the first time that direct stimulation of a brain region has controlled the amount of detail in a memory," said Weinberger, a fellow at UCI's Center for the Neurobiology of Learning and Memory. "While it is likely that the brain uses a number of mechanisms to store specific details, our work shows that the level of acetylcholine appears to be a key part of that process."

In their experiments, the researchers exposed rats to tones of various

frequencies. During some of the trials, they paired one tone with stimulation of a section of the rats' brains known as the nucleus basalis, which relays commands to the auditory cortex by secreting acetylcholine. During some experiments, the stimulation of the nucleus basalis was weak, whereas in other animals the stimulation was stronger. When the tones were replayed the next day, the scientists could measure how well they remembered the various frequencies by measuring changes in their respiration rates.

The results showed that a weak activation of the nucleus basalis, which resulted in a small amount of acetylcholine being released, did lead the rats to remember the tones but not specific frequencies. However, when the stimulation was greater (leading to the higher level of acetylcholine release), the rats also remembered the specific frequencies.

"We have always known that acetylcholine plays a major role in learning and memory," Weinberger said. "For example, the major treatments currently available for Alzheimer's disease work by making more acetylcholine available in the brain. Finding ways to control the levels of this key transmitter would be crucial for treating a number of memory-related disorders."

Weinberger is a pioneer in research in the field of learning and memory in the auditory system. In a study published in 2005, he discovered a neural coding mechanism that the brain relies upon to register the intensity of memories based on the importance of the experience. The study presented the first evidence that a "memory code" of any kind may exist. His laboratory also was the first to induce a specific memory by stimulating the system involving acetylcholine in the brain, setting the stage for the latest findings.

Source: University of California - Irvine