Medical Xpress

Proteins necessary for brain development found to be critical for long-term memory

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A type of protein crucial for the growth of brain cells during development appears to be equally important for the formation of long-term memories, according to researchers at UC Irvine. The findings could lead to a better understanding of, and treatments for, cognitive decline associated with normal aging and diseases such as Alzheimer's.

The findings appear in the early online edition of the *Proceedings of the National Academy of Sciences*.

"This study presents strong evidence that a molecular process fundamental during development is retained in the adult and recycled in the service of memory formation," said Thomas J. Carew, Donald Bren Professor and chair of UCI's Department of Neurobiology and Behavior. "It is a striking example of how molecular rules employed in building a brain are often reused for different purposes throughout a lifetime."

The researchers have shown that proteins known as growth factors are as essential for the induction of long-term memory as they are for the development of the central nervous system. These growth factors, such as brain derived neurotrophic factor (BDNF), bind onto the brain cell through a specific type of receptor known as TrkB, much the same way a key fits into a lock. As an experimental strategy to determine the importance of BDNF-like growth factors in forming memories, the researchers used a "molecular trick" to keep the proteins from binding with the appropriate TrkB receptors.

For the experiment, the scientists used wild-caught Aplysia, a marine snail frequently studied in learning and memory because of its large brain cells. The Aplysia received a series of five tail shocks, spaced 15 minutes apart. The shocks cause the animals to exhibit heightened withdrawal reflexes days and weeks after the shocks are over.

When the animals are shocked, a brain chemical known as serotonin is released that promotes the formation of a long-term memory associated with the shocks. However, when Carew and his colleagues blocked the interaction between the BDNF-like growth factors and the TrkB receptors, they found that serotonin alone was not enough to retain the long-term memory of the shock. While short-term memory was retained, 24 hours later the snails -- which normally would remember the events of the previous day -- exhibited no memory of the shocks. Carew and colleagues went on to show that, when the actions of the growth factors were prevented, long-term enhancement of the connections between the brain cells in the reflex circuit normally induced by the shock treatment was also blocked.

"We would never have expected that the secretion of these growth factors in response to serotonin would be critical for long-term memory formation in this system," Carew said. "But it is apparent that without them, this process cannot happen."

According to Carew, these findings could open possible avenues for treatments relating to memory loss. "This gives us some strong clues as to what we should be looking into for therapeutic interventions," he said. "If we know that growth factors are important for long-term memory, then we can look at possible remedial roles they might play in diseases such as Alzheimer's and dementia."

Source: University of California, Irvine