Memory is stored in cells throughout the body, not just the brain

Scientists discovered that memory formation isn't limited to the brain. Non-brain cells can activate memory genes, responding to signals.

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For a very long time, we have been under the impression that memory and learning are solely the brain's forte. Central to this belief is the fact that our brains, particularly our brain cells, store memories.

However, an innovative team of researchers begs to differ, suggesting that cells in other parts of the body partake in this memory function too.

The ability of non-brain cells to learn and form memories is a riveting discovery.

This thought-provoking study provides us with a new understanding of memory's mechanisms and paves the way for potential advancements in learning and memory-related afflictions treatment.

Understanding memory — the basics

Memory is like your brain's personal filing system. When you experience something new — like meeting a friend or learning a fact — your brain encodes that information by turning it into patterns of neural activity.

These patterns get stored in different parts of your brain, depending on what type of information it is. For example, visual memories might be stored in areas responsible for processing images, while facts and numbers find their way into regions that handle language and logic.

Retrieving memories happens when your brain needs to access those stored patterns. It's similar to searching for a file on your computer.

If you want to remember your friend's birthday, your brain activates the relevant neural pathways to bring that information back into your conscious mind.

Sometimes, this process is seamless, but other times memories can be a bit fuzzy or mixed up, especially if they're not accessed frequently. That's why you might struggle to recall something you haven't thought about in a while.

Your memory isn't perfect, and it can change over time. Each time you recall a memory, your brain might update it with new information or emotions, which can make the memory stronger or slightly different from the original event. Factors like sleep, stress, and even nutrition can influence how well your memory works.

Memory formation and cells

"Learning and memory are generally associated with brains and brain cells alone, but our study shows that other cells in the body can learn and form memories, too," explains New York University's Nikolay V. Kukushkin, the lead author of the study.

The goal of the research was straightforward — to investigate if non-brain cells contribute to memory. To do this, the scientists deployed the time-honored neurological property, known as the massed-space effect.

This principle asserts that our retention capacity is better when information is studied in spaced intervals rather than crammed into a single, intensive session.

Does this strike a chord? We have all experienced the futility of last-minute cramming before tests.

Memory test in non-brain cells

In this study, the scientists simulated the process of spaced learning by examining two types of non-brain human cells — one from nerve tissue and one from kidney tissue — in a laboratory setting.

These cells were exposed to varying patterns of chemical signals, akin to the exposure of brain cells to neurotransmitter patterns when we learn new information.

The intriguing part? These non-brain cells also switched on a “memory gene” – the same gene that brain cells activate when they detect information patterns and reorganize their connections to form memories.

So, how exactly did the scientists gauge the memory and learning process?

They ingeniously engineered the non-brain cells to generate a glowing protein, which indicated whether the memory gene was active or dormant.

Memory cells, learning, and pulses

The results of this innovative research were nothing short of astounding.

It turned out that these cells were able to discern when the chemical pulses (simulating bursts of neurotransmitters in the brain) were repeated rather than simply prolonged — much like neurons in our own brains when we opt for break-filled studying instead of continuous cramming.

When the pulses were delivered at intervals, they activated the "memory gene" more intensely and for a longer duration than when the same treatment was administered all at once – a perfect demonstration of the massed-space effect.

"This reflects the massed-space effect in action," says Kukushkin, a clinical associate professor of life science at NYU Liberal Studies and a research fellow at NYU's Center for Neural Science.

"It shows that the ability to learn from spaced repetition isn't unique to brain cells, but, in fact, might be a fundamental property of all cells."

Understanding how memory works

Not only does this research on non-brain cells introduce fresh perspectives to study memory, but it also holds promise for potential health-related benefits.

"This discovery opens new doors for understanding how memory works and could lead to better ways to enhance learning and treat memory problems," notes Kukushkin.

"At the same time, it suggests that in the future, we will need to treat our body more like the brain — for example, consider what our pancreas remembers about the pattern of our past meals to maintain healthy levels of blood glucose or consider what a cancer cell remembers about the pattern of chemotherapy."

Implications of this research

As we explore this fascinating new research on non-brain cells, the pressing question remains – how will this impact our understanding of memory formation?

What implications does this discovery hold for the future of learning and memory-related treatments? Only time will tell.

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The research team also included Thomas Carew, a professor in NYU's Center for Neural Science; Tasnim Tabassum, an NYU researcher; and Robert Carney, an NYU undergraduate researcher. The study was funded by a grant from the National Institutes of Health (R01-MH120300-01A1).

The study is published in the journal *Nature Communications*.

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