

Unlocking the mysteries of memory

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Stop and think for a moment. What do you remember about your breakfast this morning? One part of your brain will recall the smell of coffee brewing, while another will remember your partner's smile while walking out the door. How does the brain weave together these fragments, and how does it bring them back to conscious life?

Researchers led by Prof. Itzhak Fried, a neurosurgeon at Tel Aviv University's Sackler Faculty of Medicine, are proving scientifically what scientists have always suspected — that the neurons excited during an experience are the same as those excited when we remember that experience. This finding, reported in the prestigious journal *Science* in October, gives researchers a clearer picture of how memory recall works and has important implications for understanding dementias such as Alzheimer's, in which fragments of the memory puzzle seem to disintegrate over time.

A Rare Glimpse Inside Your Brain

"This is a rare opportunity to see how neurons, the basic units of cognition, work during the act of recall," says Prof. Fried from the University of California Los Angeles (UCLA), where he is also a full professor. "It's unique because we're able to look at single cells in the brain when people spontaneously retrieve something from inside their memory without any cue from outside."

The research was challenging and could only be done on human subjects — other animals lack the ability to verbalize their memories. "Taking a

look at individual neurons can only be obtained under special circumstances," he says. "This is what we've managed to achieve."

Monitoring the subjects' brain activity as electrodes recorded individual neurons, Prof. Fried and his Israeli colleagues, were effectively able to "see" real human memory recall in action, in real time. This is unprecedented, say his peers, who laud this research as "foundational."

Where We Lose Our Minds

Prof. Fried located these neurons in the hippocampus of the brain, an important finding in the study. This is the area of the brain affected in Alzheimer's patients, critical for memory formation and recall. A small part of the brain shaped like a sea horse, the hippocampus stores short-term "episodic" memories: not long-term memories of your childhood, but short-term memories like what you ate for breakfast.

Loss of function in this area of the brain in Alzheimer's patients explains why they become disoriented in familiar surroundings. "This is the structure in which people lay down new memories and process them," says Prof. Fried, noting that in his recent study cells were very active in this area. These same cells spring back to life when this new memory is spontaneously recalled in experimental subjects.

From Proust to George Costanza and Homer Simpson?

In the study, Prof. Fried observed the neural activity in the brains of 13 epilepsy patients, as the patients watched clips from TV shows like Seinfeld and The Simpsons. A short while after, the test subjects were asked to describe what they remembered from the video clips. During recall, the exact same neurons that had fired while viewing a clip fired

once again while the subject was recalling it. Soon, the researchers were able to predict what clip the subjects would recall just by looking at the neurons that lit up seconds before the recall experience was vocalized.

Prof. Fried, who is associated with Israel's Ichilov Hospital, plans to continue research that will give science a better understanding of how memories are formed. Prof. Fried says that "the emergence of memory, a trace of things past, into human consciousness is one of the greatest mysteries of the human mind." Prof. Fried believes that memories are formed by associations. and is curious to discover exactly how these associations are formed and then retrieved from the hippocampus.

Source: American Friends of Tel Aviv University

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