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Study identifies new patterns of brain activation used in forming long-term memories

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Researchers at New York University and Israel's Weizmann Institute of Science have identified patterns of brain activation linked to the formation of long-term memories. The study, which appeared in the journal *Neuron*, also offered an innovative and more comprehensive method for gauging memories. It asked subjects to recall the content of a television sit-com, which more accurately simulated real-life experiences because it required retrieving material that occurs in more complex settings than typically exist in a laboratory environment.

The study's principal investigator was Lila Davachi of NYU's Department of Psychology and its Center for Neural Science. Its co-investigators included Uri Hasson and Dav Clark, both of NYU's Department of Psychology and Center for Neural Science, and Orit Furman and Yadin Dudai of Israel's Weizmann Institute of Science.

Making sense of and recalling the complex, multi-sensory information encountered in everyday life--such as reading a newspaper while listening for a boarding announcement at the airport--is a fundamental task that the brain readily accomplishes. What is less clear is which regions of the brain are employed to encode these experiences. Previous research has examined neurological activity important for successful memory encoding, but the studies have not simulated the real-world settings in which long-term memories are typically formed. Instead, they often rely on recollection of single images or simple words.

By contrast, the NYU and Wiezmann Institute of Science researchers sought to replicate the every-day environment in which memories are typically created in order to offer a more realistic assessment of the relevant neurological activity. They did so by having subjects view an episode of a TV sitcom in its entirety (a 27-minute episode of HBO's "Curb Your Enthusiasm").

As the study's subjects watched the episode, the researchers used functional magnetic resonance imaging (fMRI) to examine the subject's brain function. Three weeks after the video was viewed, the study's subjects returned to answer a series of questions about its content. The researchers then used the memory performance of subjects to analyze their brain activity during movie viewing. Using a novel inter-subject correlation analysis (ISC), they revealed brain regions for which this correlation is greater during successful, or accurate, as compared to unsuccessful memory formation.

This technique allowed the researchers to identify brain networks whose activation waxes and wanes in a similar way across participants during memory formation as well as other regions where activation was important for memory formation but which showed individual variability. These different patterns may explain why it is that after experiencing something together, we can share aspects of memory for that event, but those memories also have an individual flavor or personal tone.

Traditional experiments, which relied on simple words or still images, have consistently revealed that the brain's medial temporal lobes (MTL) and inferior frontal gyrus (IFG) are active during memory formation and retrieval. These regions were also active in the NYU-Weizmann study. However, the researchers also found activity in new areas: the brain's temporal pole, superior temporal gyrus (STG), medial prefrontal cortex (mPFC), and temporal parietal junction (TPJ).

These regions have all been implicated in various aspects of social cognition: understanding the intentions of others, simulating experiences, language comprehension, and even person perception.

Source: New York University