

Neuroscientists identify how the brain remembers what happens and when

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New York University neuroscientists have identified the parts of the brain we use to remember the timing of events within an episode. The study, which appears in the latest issue of the journal *Science*, enhances our understanding of how memories are processed and provides a potential roadmap for addressing memory-related afflictions.

Previous research has shown the brain's medial temporal lobe (MTL) has a significant role in [declarative memory](#)-that is, memory of facts and events or episodes. Past studies have shown that damage to the MTL causes impairment in memory for the timing of events within an episode. More specifically, declarative memory is impaired in patients suffering from Alzheimer's Disease. However, little is known about how individual structures within the MTL remember information about "what happened when" within a particular episode, such as the order of the toasts at a wedding reception or what preceded a game-winning hit in a baseball game.

The NYU researchers-Yuji Naya, an associate research scientist, and Professor Wendy Suzuki, both of NYU's Center for Neural Science-focused their study on the MTL.

To conduct the study, the researchers ran animal subjects through a temporal-order memory task in which a sequence of two visual objects were presented and the subjects were required to retrieve that same sequence after a delay. In order to perform the task correctly, the subjects needed to remember both the individual visual items ("what") and their temporal order ("when"). During the experiment, the researchers monitored the activity of individual brain cells in the subjects' MTL.

Their results showed that two main areas of the MTL are involved in integrating "what" and "when": the hippocampus and the perirhinal cortex. The

hippocampus, which is known to have an important role in a variety of memory tasks, provides an incremental timing signal between key events, giving information about the passage of time from the last event as well as the estimated time toward the next event. The perirhinal cortex appeared to integrate information about what and when by signaling whether a particular item was shown first or second in the series.

"One of the Holy Grails of neuroscience is understanding exactly how our brains encode and remember episodic memories, including those of weddings, graduations, and other meaningful events in our lives," explained Suzuki. "These are rich memories that contain a lot of items with specific temporal contexts. We already knew the medial temporal lobe was critical for these complex memories, but what our new findings provide is insight into the specific patterns of brain activity that enables us to remember both the key events that make up our lives and the specific order in which they happened."

Provided by New York University

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