Past memory cues help people juggle numerous pieces of information

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Edward Ester, Ph.D., lead author, an assistant professor in the Department of Psychology in FAU's Charles E. Schmidt College of Science, and a member of the FAU Brain Institute. Credit: Florida Atlantic University

Many everyday tasks require people to represent and combine information from multiple sources. For example, when a person checks the rearview mirror while driving it is important that they maintain information about how far they are from the car in front of them. This information is stored in working memory, a limited-capacity system that allows humans to represent relevant information over short intervals. Information stored in working memory can be assigned different levels of importance. For instance, heavy traffic requires a person to maintain accurate representations of how far they are from other cars on the road. In addition, the relative importance of different sources of information might change at a moment's notice, like if a car suddenly cuts a person off or if they hear a horn.

This kind of re-prioritization is a critical component of many simple tasks, yet very little is known about how the brain does this or how re-prioritizing information changes how the brain represents it, if at all.

In a study published in *The Journal of Neuroscience*, scientists from Florida Atlantic University examined questions about these cues by using electroencephalography (EEG) to track brain activity while participants performed a task that required them to hold a set of positions in working memory. On some trials, participants were shown a cue that predicted which remembered location they would be asked to report at the end of the trial, giving them strong incentive to prioritize that location over the non-cued location.

Results from the study show that cues can influence the neural representation of the cued and non-cued locations, but the effect of the cue depends on when it appears. When no cue was given, the neural representation of each location gradually decayed with time. When the cue appeared immediately after the memory display, the neural representation of the cued location remained strong and constant throughout the remaining storage interval, while the representation of the

non-cued location was quickly washed away.

By using EEG to track the neural representations of each location, the researchers could see how those representations are influenced by the cues. They have demonstrated that the cues can have different effects on neural representations depending on when they're presented, suggesting that the brain has several different mechanisms that it can use to help boost memory performance following a sudden change in the priority or relevance of a given piece of information.

"It's been difficult to pinpoint exactly how the brain re-prioritizes information following changes in the environment, in part because earlier studies have relied on relatively slow measures of brain activity. The benefit of EEG is that we can track changes in brain activity on a scale of a few to tens of milliseconds—about an order of magnitude faster than other methods such as functional MRI," said Edward Ester, Ph.D., lead author, an assistant professor in the Department of Psychology in FAU's Charles E. Schmidt College of Science, and a member of the FAU Brain Institute. "Our findings suggest that the brain can use several different methods to re-prioritize mental representations depending on how long they've been stored. This would be difficult if not impossible to discover using methods with a slower temporal resolution."

A key insight from the study was the pattern of results that were observed when the cue was presented mid-way through the storage interval. During the first half of the storage interval, the neural representation of each location decayed with time. However, this decay was partially reversed for the relevant location after the cue had been presented, suggesting that the brain was able to "boost" the representation of the now-relevant location to help facilitate memory.

"Working memory capacity is strongly correlated with a person's

intelligence," said Asal Nouri, a student in FAU's Graduate Neuroscience Training Program working in Ester's lab, and a member of FAU's Brain Institute, who co-authored the paper with Laura Rodriguez, a student in FAU's neuroscience program. "Given that dysfunction in working memory is a major symptom in common psychiatric disorders such as schizophrenia and autism, it's important that neuroscientists gain a true understanding of how it works."

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