Science & Technology

How Our Most Meaningful Memories Are Made

Neuroscientists are closer to solving one of the mysteries of the human brain.

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One of the mysteries of the human brain is how it decides what information to encode into memory. A popular hypothesis is that the brain prioritizes our most emotionally resonant experiences, which would help explain why we often recall joyous, frightening, or sorrowful events more easily than mundane ones. Scientists have struggled to determine exactly how and where such neuronal calculations are made, however, as they rarely have the opportunity to peer deeply into the human brain as it performs cognitive tasks.

Now Columbia researchers have achieved a breakthrough in this area by observing the brain activity of people with epilepsy who already have electrodes implanted in their brains to monitor seizures. These cognitive experiments reveal that at times of heightened emotion, the brain’s emotional control center, the amygdala, communicates feverishly with the nearby hippocampus, which is the brain’s main memory system, in order to make sure the relevant information is prioritized for storage.

“We found that when people were asked to memorize emotional words, like ‘bomb,’ ‘knife,’ or ‘smile,’ a neuronal circuit that connects the amygdala and the hippocampus lit up with activity,” says Joshua Jacobs, a biomedical engineer who oversaw the research. He and his colleagues also observed that the intensity of this neuronal activity was positively associated with the person’s ability to later recall a term. “It seems the amygdala and the hippocampus work together to determine how much effort the brain ought to invest in encoding particular thoughts,” he says, noting that scientists are still unsure where in the brain memories are ultimately stored.

The Columbia researchers are now conducting follow-up experiments to map this amygdala–hippocampus circuit in finer detail. Whereas popular brain-imaging technologies such as functional magnetic-resonance imaging (fMRI) enable scientists to observe broad patterns of neuronal activity, the implanted electrodes that Jacobs and his colleagues are using can detect the firing of individual neurons. The researchers say that understanding the circuitry could eventually inform the development of new treatments for Alzheimer’s disease and other conditions that cause memory problems.

“Our emotional memories are among the most critical aspects of the human experience, and any steps we can take to mitigate their loss is hugely exciting,” says Salman E. Qasim ’21SEAS, a former graduate student in Jacobs’s lab and the study’s lead author.

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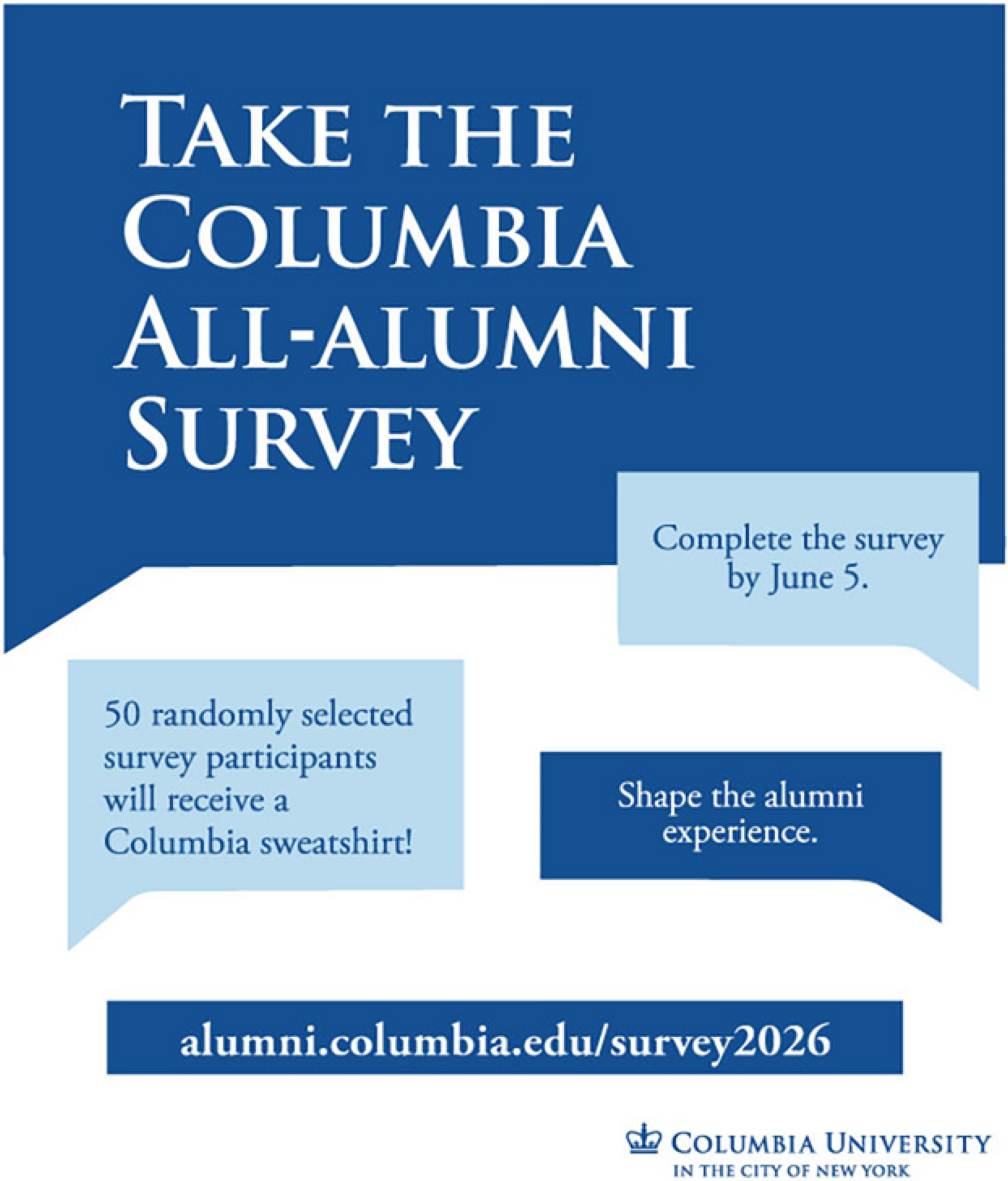

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