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Brain implant tested in human patients found to improve memory recall

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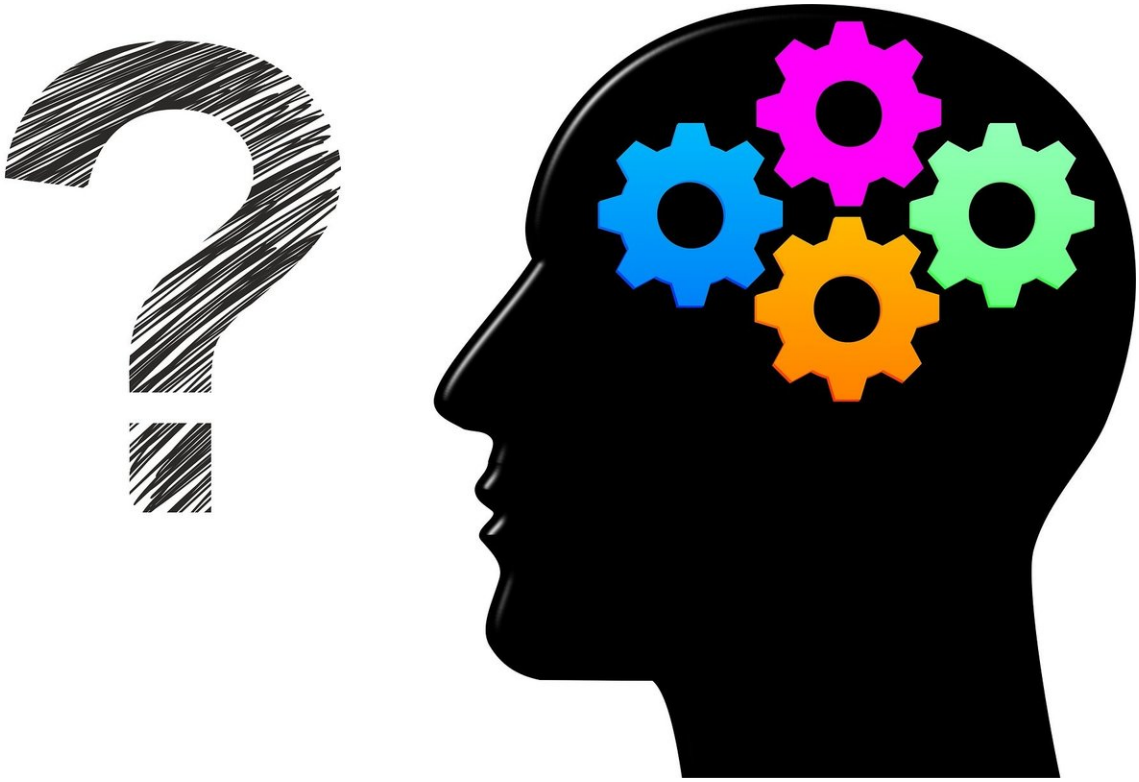

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(Medical Xpress)—A team of researchers with the University of Southern California and the Wake Forest School of Medicine has conducted experiments involving implanting electrodes into the brains of human volunteers to see if doing so might improve memory recall. The

group gave a presentation at this year's Society for Neuroscience meeting recently outlining the study and what they found.

Prior research has shown that inserting electrodes into the brains of animals can improve memory recall—in this new effort, the researchers discovered the same is true for humans.

To test the idea that sending tiny electrical pulses to parts of the brain involved in memory recall might improve memory, the researchers worked with doctors treating epilepsy patients—each of the patients was scheduled to have a brain electrode implanted as a treatment option. The researchers got 20 of the patients to agree to having another similar electrode implanted into their brains at the same time.

The experiment consisted of two parts. The first was to use the implant to listen for and record electrical activity in the brain while the volunteers engaged in memory exercises. The second part involved mimicking the signals that had been recorded in the first part—sending tiny pulses of electricity to parts of the brain involved in memory retention and retrieval. The experiments sought to measure two kinds of memory, short-term and working memory. The first, as the name implies, is the ability to remember something that happened recently. Working memory, on the other hand, is used to keep track of things as they are happening.

In looking at all the data from all of the patients, the researchers reported that they found brain stimulation via implants led to an average 15 percent improvement in short-term memory and a 25 percent improvement in working memory across all the volunteers—similar to the results found in test animals. They noted that applying random bursts of electrical stimulation, on the other hand, tended to make memory recall worse.

While the experiments were conducted to learn more about memory retention and recall in general, the research is aimed specifically at helping people with memory loss due to ailments such as dementia and Alzheimer's disease.

More information: Abstract: 168.18 / SS45 - Fixing broken memory: Facilitation of delayed match to sample working memory in human subjects via a neural prosthetic for human memory, www.abstractsonline.com/pp8/in … 6/presentation/11106

Abstract
Development of a neural prosthetic for human memory requires intervention to correct dysfunctional hippocampal circuitry - i.e. the interconnected neuronal ensembles which organize the CA1 and CA3 subfields into hierarchical networks to process sensory inputs into working memory. Prior investigations by the WFBMC-USC DARPA RAM project team have demonstrated that correct recall of information within a delayed-match-to-sample (DMS) task is contingent upon the robustness of initial encoding of the task stimuli within hippocampus. These studies have yielded a prosthetic system that restored DMS task-related memory in rodents and nonhuman primates, and is now extended to successful memory facilitation in humans.
Human subjects undergoing Phase II invasive monitoring for intractable epilepsy were implanted with macro-micro depth electrodes targeting the hippocampal CA1 and CA3 cell layers. In the initial (training) session, subjects performed a visual DMS memory task in which they remembered screen images during Sample presentation, then recalled those images in the subsequent Match phase of the task after an interposed delay of 1 to 75 sec. Neural recordings from the training session were modeled via a multi-input/multi-output (MIMO) sparse nonlinear model of CA3 and CA1 neuron firing predicted activation of likely connected CA3-to-CA1 cells during Correct Trial performance. During a second (stim test) session, subjects received MIMO model-

driven microelectrical stimulation of the CA1 cell layer during the encoding (Sample) phase for approximately 30% of trials within the DMS task. Cognitive task performance on MIMO stimulated trials was compared with non-stimulated and random pattern-stimulated trials. MIMO stimulation resulted in a 15-25% improvement in DMS task performance in five patients, demonstrating successful implementation of a new neural prosthetic system for the restoration of damaged human memory.

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