Targeted brain stimulation to modulate memory in humans

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Background

Memory success depends on neural processes engaged at the time that items are encoded.

Encoding operations vary in their efficiency from moment to time that items are encoded.

We asked how direct electrical stimulation modulates brain states conducive to successful memory encoding.

Using stimulation of intracranial electrodes, we attempt to modulate neural activity and consequently memory performance (Halgren et al. 1985; Suthana et al. 2012).

How does stimulation’s effect on physiology predict its effect on memory?

Experimental Design

Stim Lists

25 Stim / 5 NoStim

Sessions

Record Stimulation

Encoding

Tape

Distractor

“Mole” “Flood”

Recall

Overall Effects of Stimulation on Behavior

Stimulation has modest behavioral effects across the group, but some larger effects within individual patients

Multivariate Analysis Discriminates Memory States

Within patient, classifier significantly discriminates successful and unsuccessful memory states

Classifier Predicts Behavioral Effects of Stimulation

Use classifier decoding to estimate brain state pre-stimulation

Stimulation increases memory performance and memory state estimates if delivered in low states

Summary

Stimulation increases memory performance if delivered in poor encoding states.

Evidence for the spectral tilt predicted stimulation’s effects on neural activity.

Suggests strategies for optimally applying stimulation to affect memory function.

References


This work was supported by the DARPA Restoring Active Memory (RAM) program (Cooperative Agreement N66001-14-2-4032). The views, opinions, and/or findings contained in this material are those of the authors and should not be interpreted as representing the official views or policies of the Department of Defense or the U.S. Government.