Direct electrical stimulation of the human amygdala enhances recognition memory for objects and not scenes

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Background

Emotional events are often better remembered than neutral events – a benefit that requires the amygdala.[1] The basolateral amygdala (BLA) in particular, modulates memory-consolidation processes via interactions with downstream brain regions such as the hippocampus.[2]

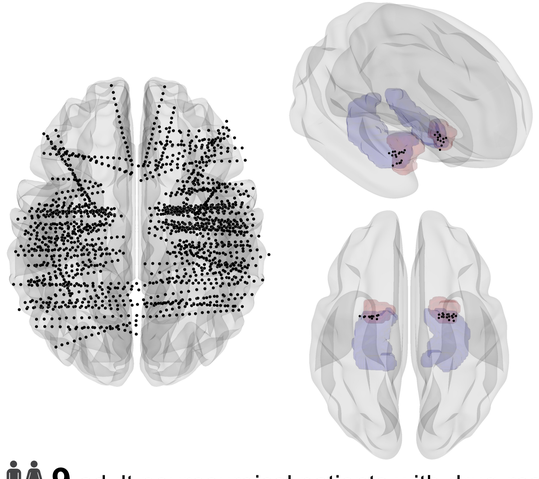
Direct electrical stimulation of the BLA in humans enhances declarative memory, even for non-emotional events, and this memory enhancement is marked by oscillatory interactions between the BLA and hippocampus.[3] However, the BLA disproportionately projects to the anterior hippocampus compared to the posterior hippocampus[4], regions that process non-spatial information about objects and spatial information about scenes, respectively.

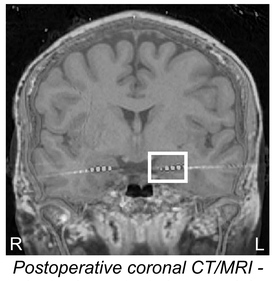
The premise that the BLA prioritizes some kinds of memories over others has not been directly tested in humans.

We tested whether brief electrical stimulation to the BLA could differentially enhance declarative memory for objects and scenes.

The present study also leveraged the electrical stimulation of the BLA to determine how **subregions of the medial temporal lobe interact with the amygdala to favor memory for objects compared to scenes.**

Participants & Intracranial Stimulation





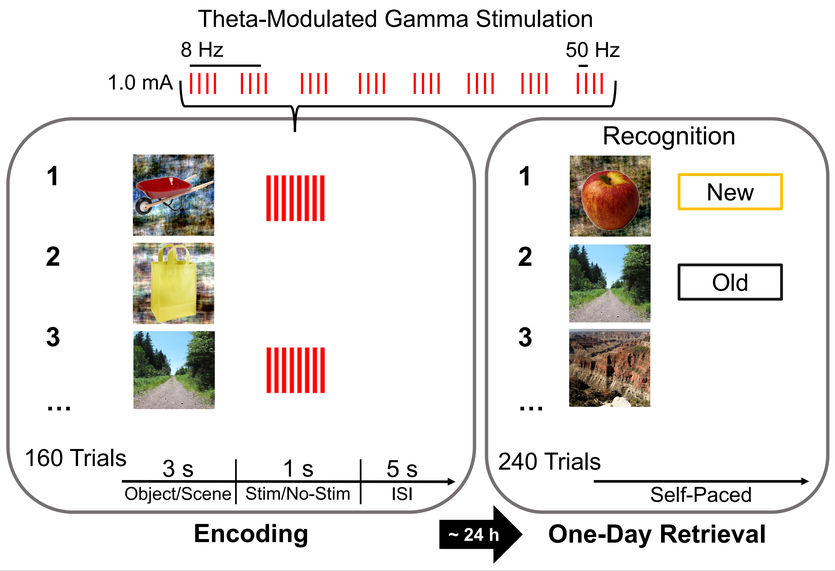
Postoperative coronal CT/MRI - electrode contacts in amygdala

9 adult neurosurgical patients with drug-resistant epilepsy

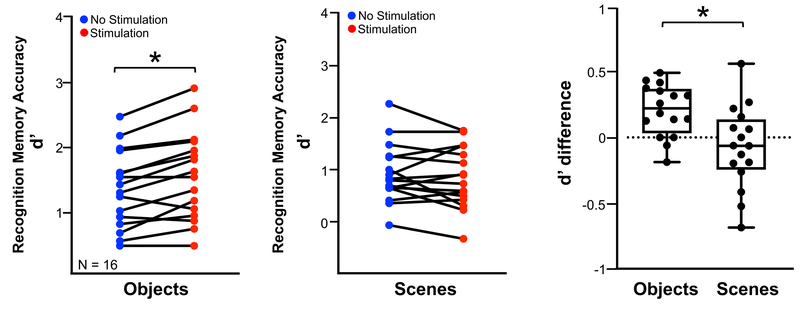
16 memory encoding (BLA stimulation) and retrieval sessions

Recognition-Memory Task

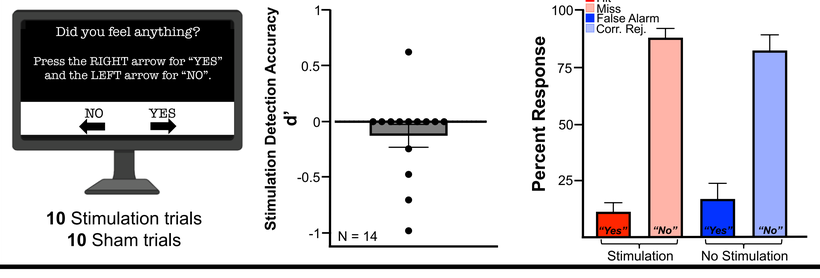
Behavioral paradigm



Recognition-memory test results

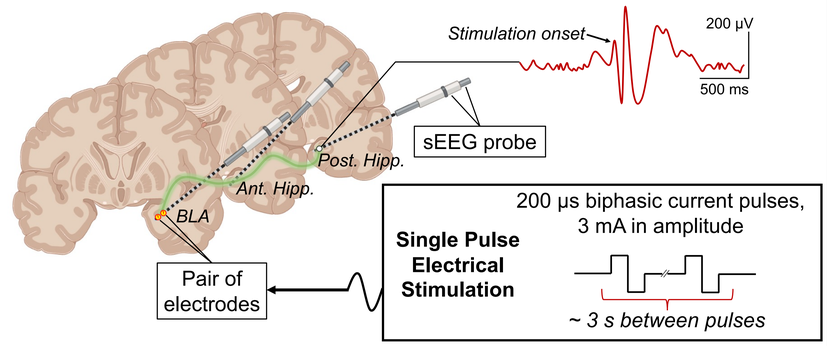


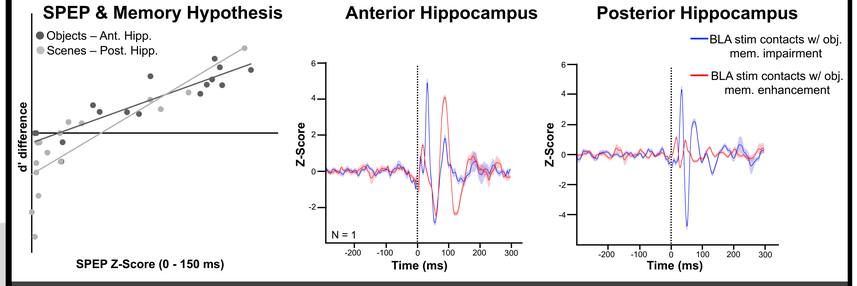
Stimulation awareness test results



Effective Connectivity

Single pulse evoked potentials (SPEP)





Conclusions & Future Directions

We leveraged direct electrical stimulation of the human brain to determine whether the BLA prioritizes some memories over others.

Our results suggest **amygdala stimulation elicits no subjective emotional response but enhances memory for object images** compared to control images when patients are given a recognition-memory test the next day.

BLA stimulation has no effect on memory for scene images.

Future analyses will continue to dissect the effective connectivity between the BLA and downstream brain regions, including the anterior and posterior hippocampus, to explore how the amygdala initiates memory prioritization processes for objects compared to scenes.

References

1. Hamann, *Trends Cogn. Sci.*, 2001
2. McGaugh, *Science*, 2000
3. Inman et al., *PNAS*, 2018
4. Wang & Barbas, *J. Neurosci.*, 2018

Acknowledgements

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