Theta and gamma activity during human episodic memory retrieval

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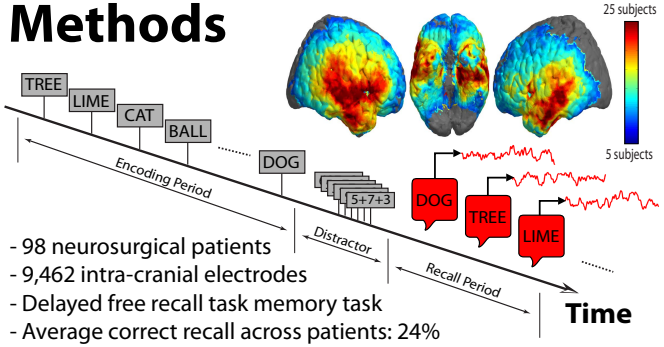
Introduction

Spectral power in gamma (**65-95 Hz**) and theta (**3-8 Hz**) frequency bands play a role in the episodic memory.[1]

Previous work has shown that gamma activations correlate with episodic retrieval, but not theta .[2]

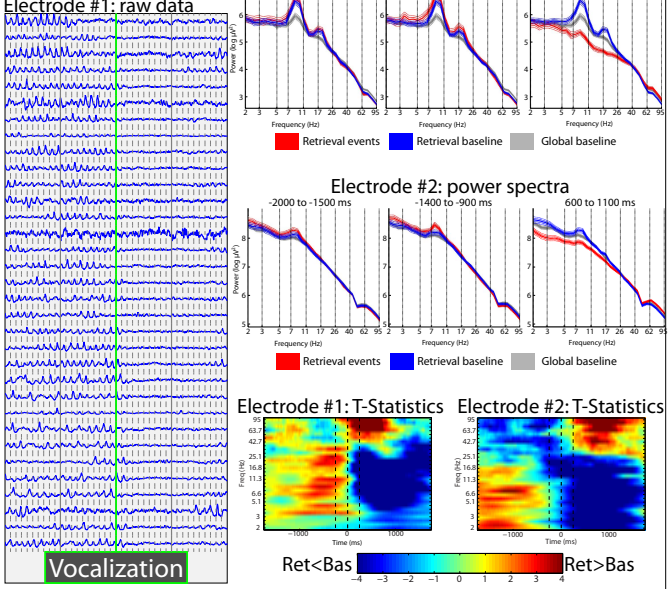
What is the precise relation between theta/gamma power and memory retrieval?

Methods

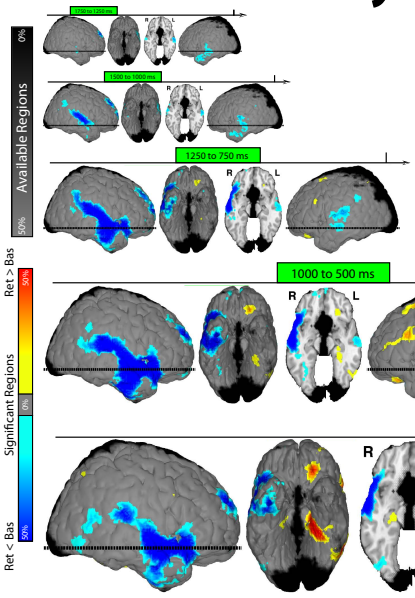


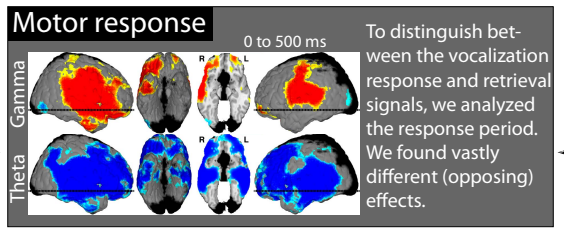
- 98 neurosurgical patients
- 9,462 intra-cranial electrodes
- Delayed free recall task memory task
- Average correct recall across patients: 24%

Examples



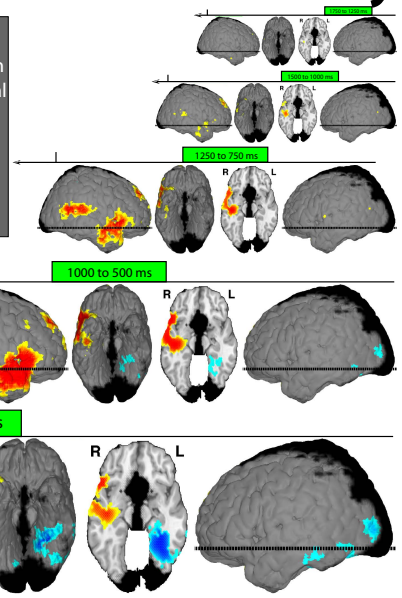
Gamma activity





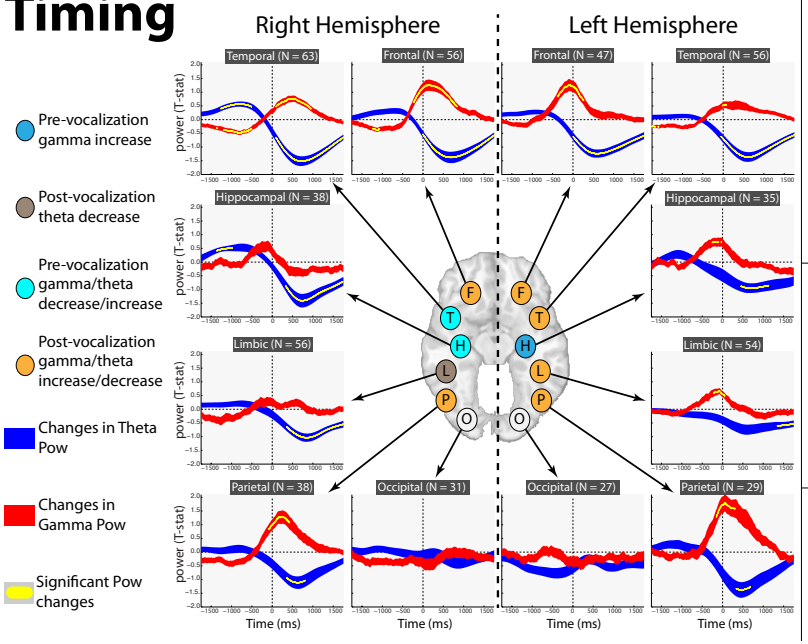
To distinguish between the vocalization response and retrieval signals, we analyzed the response period. We found vastly different (opposing) effects.

Theta activity



All patients: power in the gamma (65-95 Hz; left) and theta (3-8 Hz; right) during retrieval was compared to baseline. Regions showing increased (red) or decreased (blue) power during retrieval are rendered on the standardized brain.

Timing



Summary

1. The first electrophysiological marker of retrieval is an increase in theta power in the right temporal lobe.
2. This theta activity is followed by left hippocampal, pre-frontal, and lateral temporal gamma activity.
3. These effects are distinct from vocalization responses in polarity and spatial location.

Interpretation

1. Left neocortical gamma activity recapitualtes a semantic processing network[3], and likely represents hippocampal mediated semantic retrieval.
2. Right theta activity represents the first stage of memory retrieval, i.e. context search for recently encoded items.

References

1. E. Nyhus and T. Curran; *Neurosci Biobehav Rev*; **34**(7):1023-1035. 2010
2. P. B. Sederberg et al; *Psych Science*; **18**(11):927-932. 2007
3. B. T. Gold and R. L. Buckner; *Neuron*; 35(5):803-812. 2002

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