

Unraveling the neural mechanisms of human memory decisions with magnetoencephalography

ABSTRACT:

Previous fMRI studies suggest that the retrieval-related activity observed in the left lateral intraparietal sulcus (IPS) might reflect a neural accumulator of evidence for memory-based decisions. In the present MEG study, we examined the dynamics of oscillatory activity in a set of previously defined cortical regions to identify potential markers of mnemonic evidence accumulation. Healthy human subjects (N=22) participated in a memory retrieval experiment that employed the manipulation of evidence for old/new decisions. Magnetic activity was estimated in six regions of interest (IPS, prefrontal cortex, caudate nuclei, bilaterally) derived from our previous fMRI study. We estimated several properties (peak amplitude, peak latency, duration, rising and falling speed) of event-related synchronization/desynchronization (ERS/ERD) in six oscillatory bands (δ , θ , α , low- β , low- γ , high- γ). A 3-way repeated measures ANOVA with region, memory status and evidence as factors was conducted on each property/band. The analysis revealed a significant main effect of memory status on the duration [$p=0.044$] and peak amplitude [$p=0.013$] of the alpha ERD. Since we observed a main effect of the region on several properties of the alpha ERD, we next directly tested whether the amount of decision evidence affected the oscillatory dynamics in left IPS. A main effect of evidence was observed on alpha ERD duration [$p=0.042$] and, crucially, on the ERD falling speed [$p=0.050$], meaning that the higher the evidence, the faster the ERD reached its peak. These findings are highly consistent with a mnemonic accumulator, as hypothesized by decision-making accounts of parietal activity during memory retrieval.

Keywords

Magnetoencephalography, Episodic memory, Decision evidence, Cortical dynamics

Published Work:

Spadone, S., Betti, V., Sestieri, C., Pizzella, V., Corbettam M., & Della Penna, S. (2021). Spectral signature of attentional reorienting in the human brain. *NeuroImage*, 244, 118616. doi: 10.1016/j.neuroimage.2021.118616

Spadone, S., Tosoni, A., Penna, S. & Sestieri, C. (2022). Alpha rhythm modulations in the intraparietal sulcus reflect decision signals during item recognition. *NeuroImage*, 258, 119375. doi: 10.1016/j.neuroimage.2022.119345

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