Oscillatory desynchronization during source memory retrieval

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Introduction

Summary

- EEG desynchronization in the **alpha** (lower: 8–10 Hz; upper: 10–12 Hz) and **beta** (12–28 Hz) bands is correlated with memory retrieval (Hanslmayr et al., 2009, 2012; Khader & Rösler, 2011).
- Prior studies have not correlated oscillatory desynchronization with recognition memory processes.
- We used a source monitoring experiment to examine desynchronization in relation to information retrieval.

Previous findings

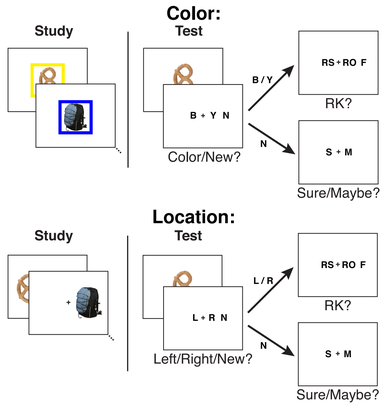
- **Source information** is the spatiotemporal context in which an item is encountered (Johnson et al., 1993).
- Typical dual-process framework of recognition memory:
  - *Familiarity*: recognition of items; no retrieval of source details.
  - *Recollection*: retrieval of item with source information.
  - These processes dissociate behaviorally and in ERPs (Rugg & Curran, 2007), as shown for the present experiment (Mollison & Curran, 2012).

Questions and Hypotheses

- Correlating successful and unsuccessful source recognition with oscillatory activity could lead to an association with familiarity and recollection.
  - Familiarity and recollection might have different oscillatory signatures, either in different bands, temporally, or topographically.
- Is it possible to distinguish between familiarity and recollection in oscillations, particularly in alpha and beta desynchronization?
- Does remembering different types of material involve different oscillatory effects?

Experiment

- In each of 2 sessions, 4 blocks of 100 pictures of common objects were studied with source information.
- Source information was either a color (blue or yellow border) association or spatial (presented on left or right). Source modality was presented in blocks.
- At test, images were shown without source. Participants completed a source recognition task using Remember/Know (RK) judgments. Response hands and fingers were counterbalanced.

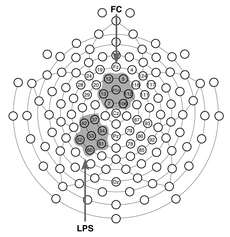


Scalp EEG

- 128-channel 500-Hz EGI scalp EEG system; 200 MΩ high-impedance amplifier; EEG preprocessed; average reference.
- EEG preprocessing:
  - ICA-based eye blink artifact correction
  - Baseline correction (-300 to -100 ms pre-stimulus)
- 5 frequency bands:

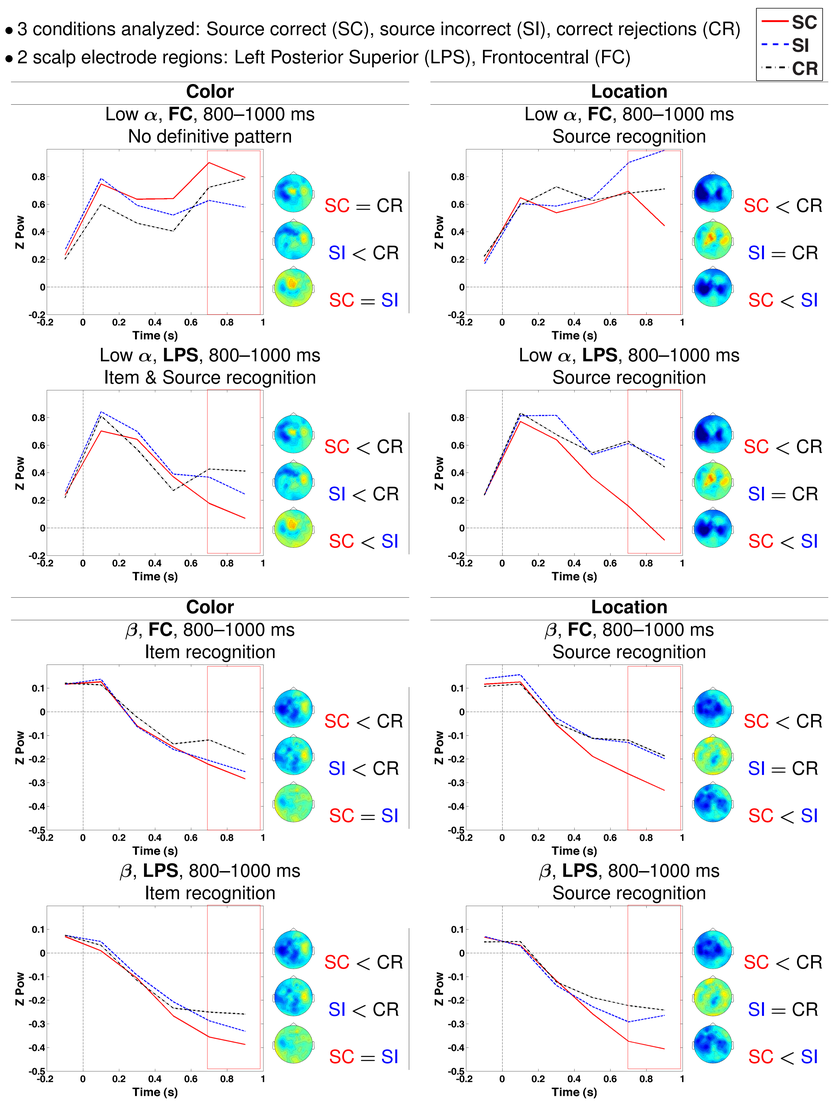
Band	θ	**Lower α**	Upper α	β	γ
Hertz	4–8	**8–10**	10–12	**12–28**	28–50

- EEG between 0 and 1000 ms averaged in 200 ms windows



Oscillatory Results

- 3 conditions analyzed: Source correct (SC), source incorrect (SI), correct rejections (CR)
- 2 scalp electrode regions: Left Posterior Superior (LPS), Frontocentral (FC)



Behavioral Results

- 26 right-handed adults (12 females; mean age: 20.7)
- Color Item *d'*: 1.54
- Color Source *d'*: 0.71
- Location Item *d'*: 1.35
- Location Source *d'*: 1.41

Summary of Results

Behavioral

- Source accuracy was above chance in all conditions.

Oscillatory desynchronization

- *Alpha*
  - Both source conditions showed greater late (800–1000 ms) posterior alpha desynchronization for source recognition (correct greater than incorrect source and new items).
  - Only the location condition showed this pattern over frontal electrodes.
  - Thus, alpha desynchronization is associated with recollection of both color and location source information.
  - Upper alpha showed the same pattern as lower alpha, only slightly weaker.
- *Beta*
  - Beta desynchronization is associated with location recollection, but when source information is defined by color it is only associated with item familiarity.
- *Conclusion*
  - The degree of desynchronization has implications for the richness of the memory, and the band and topography has implications for the contents of the memory.

Next Steps

- Connectivity between regions.
- Cross-frequency coupling.
- Effects modulated by RK confidence.

References

Hanslmayr, S., Spitzer, B., & Bäuml, K.-H. (2009). Brain oscillations dissociate between semantic and nonsemantic encoding of episodic memories. *Cereb Cortex*, *19*(7), 1631–1640.

Hanslmayr, S., Staudigl, T., & Fellner, M.-C. (2012). Oscillatory power decreases and long-term memory: the information via desynchronization hypothesis. *Front Hum Neurosci*.

Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin*, *114*(1), 3–28.

Khader, P. H., & Rösler, F. (2011). Eeg power changes reflect distinct mechanisms during long-term memory retrieval. *Psychophysiology*, *48*(3), 362–369.

Mollison, M. V., & Curran, T. (2012). Familiarity in source memory. *Neuropsychologia*, *50*(11), 2546–2565.

Rugg, M. D., & Curran, T. (2007). Event-related potentials and recognition memory. *Trends in Cognitive Sciences*, *11*(6), 251–257.

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