Oscillatory desynchronization during source memory retrieval

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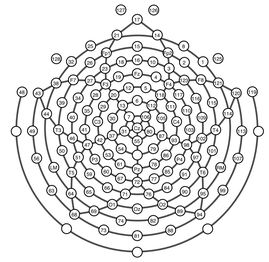


Band	Hertz
θ	4–8
Lower α	**8–10**
Upper α	**10–12**
β	**12–28**
γ	28–50

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), including the present experiment (Mollison & Curran, 2012).

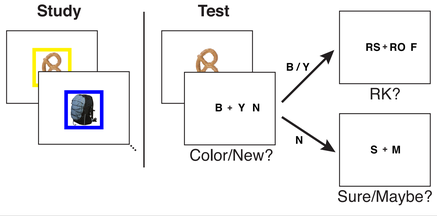
Hypotheses and Questions

- 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?

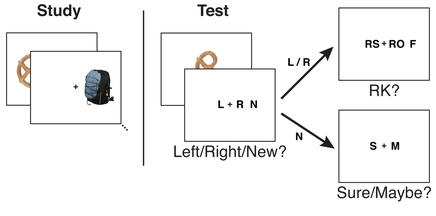
Experiment

- 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.

Color



Location



Scalp EEG

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

Analysis

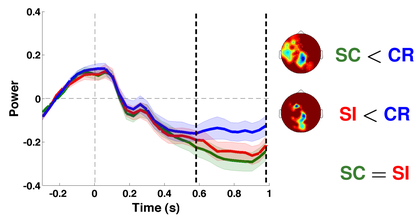
3 conditions analyzed: **Source correct** (SC), **source incorrect** (SI), **correct rejections** (CR).

- Nonparametric cluster permutation statistics (Maris & Oostenveld, 2007)
  - Across 0 to 1000 ms
  - Averaged frequency bins. Only alpha (8–10, 10–12 Hz) and beta (12–28 Hz) showed effects.
- EEG pattern interpretations:
  - *"Item familiarity:"* SC $=$ SI $<$ CR
  - *"Source recollection:"* SC $<$ SI $=$ CR

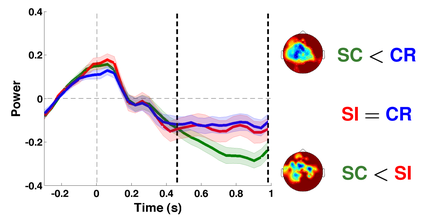
Oscillatory Results

- Bold vertical lines denote significant cluster effects across time.
- Scalp maps show contrasts between condition pairs.

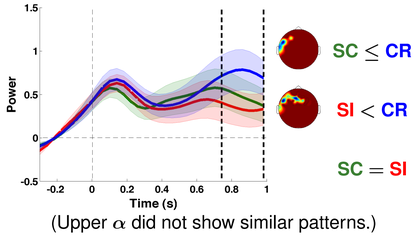
Color, β
"Item familiarity"



Location, β
"Source recollection"

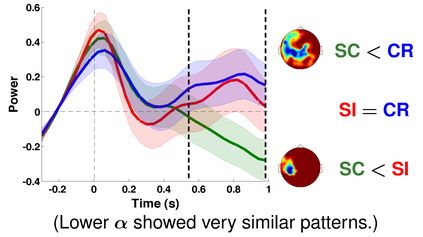


Color, lower α
Frontal "item familiarity"?



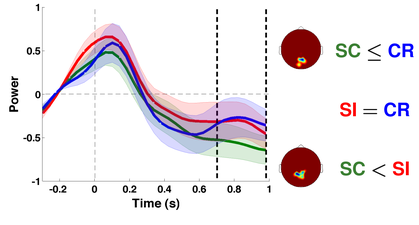
(Upper α did not show similar patterns.)

Location, upper α
"Source recollection"



(Lower α showed very similar patterns.)

Color, lower α
Posterior "source recollection"?



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

- *Beta*
  - Beta desynchronization is associated with location source recollection, but only item familiarity for color source information.
  - Effects are similar to those of Khader and Rösler (2011).
- *Alpha*
  - Upper alpha desynchronization is associated with location recollection. Lower alpha may show color recollection effects.
  - Upper alpha is not limited to retrieving semantic information, as previously hypothesized (e.g., Klimesch, 1999).
  - Lower alpha is similar to upper for location source, suggesting lower is also involved in retrieval.
- *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

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