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Early facilitation and perceptual merging: the role of alpha band power and neuronal dynamics in exogenous orienting

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Exogenous orienting is characterized by faster responses to targets presented at validly cued locations with a short cue-target onset asynchrony (CTOA). Recently, two non-attentional accounts were proposed to explain early facilitation as a result of **perceptual merging** of the cue and target onset times (Krüger et al., 2014) and as a by-product of **response inhibition** (Albares et al., 2011). We suggest that variability in responses observed in the cueing paradigm might be associated with individual neuronal dynamics. We examined both alpha amplitude and long-range temporal correlations (LRTC) in alpha oscillations recorded in a resting state and their predictive role in the expression of cueing effects.

Methods

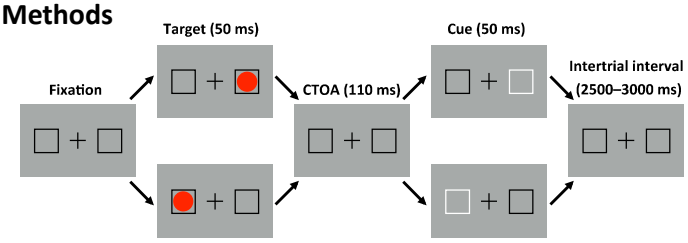

Figure 1. A structure of a trial (the post-cue condition). Proportions are not preserved.

- Manual Reaction Time (MRT) task (Krüger et al., 2014)
- eye position controlled with eye tracking
- resting session: α-activity (8–12 Hz)
- 2x2 design: Validity x Cue Order
- Detrended Fluctuation Analysis (Hardstone et al., 2012)
- Spearman correlations corrected with the permutation test

Results

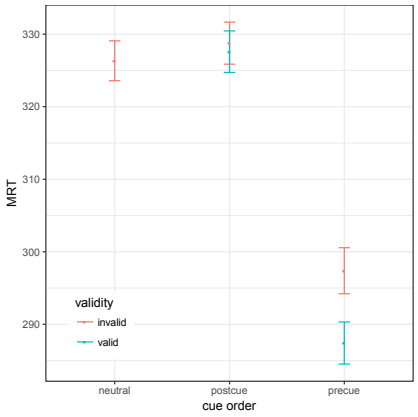

Figure 2. MRT results.
- valid pre-cues are 9.2ms faster (*SE* 2.7) than the baseline
- no significant differences between no-cues and post-cues ($t < 1$).
- a high mean rate of false positives in catch trials (12.06%)

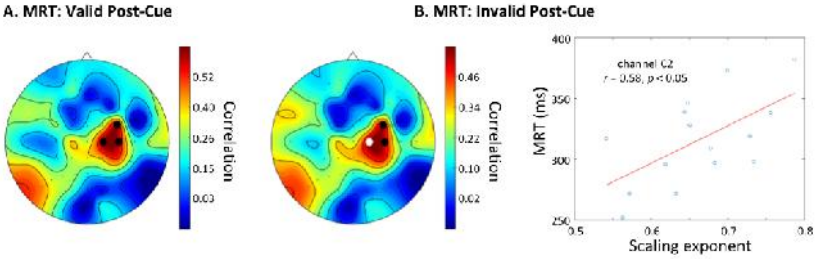

Figure 3. Topographies and correlations between LRTC and MRTs in the 8–10 Hz α-band. Dots represent significant channels ($p < 0.05$).

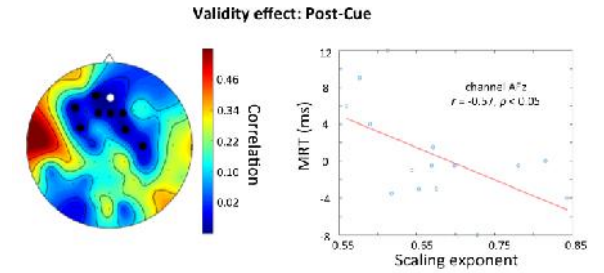

Figure 4. The topography and correlations between LRTC and validity effect (invalid MRTs – valid MRTs) in the 8–10 Hz α-band. Dots represent significant channels ($p < 0.05$).

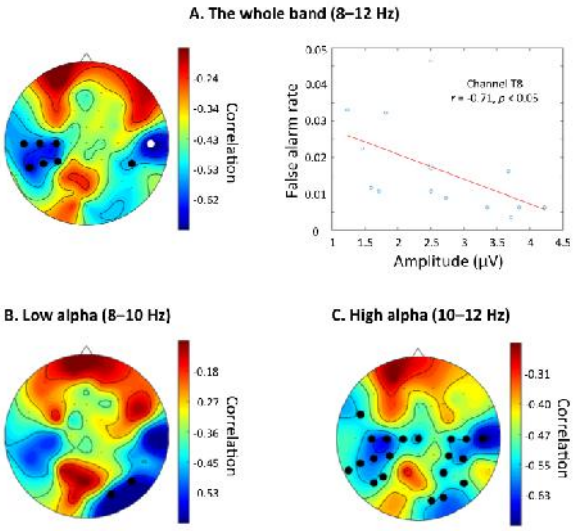

Figure 5. Topographies and correlations between false alarms and alpha amplitudes in the whole α-band (A) and its lower (B) and upper (C) sub-bands. Dots denote significant channels ($p < 0.05$). No effects were observed for LRTC.

Discussion

- Alpha power reflects inhibitory processes associated with smaller false alarm rate (e.g., Worden et al., 2000; Sauseng et al., 2005)
- **Perceptual merging**
  - ✓ Robust facilitation but no behavioral evidence of **perceptual merging**
  - ✓ The higher LRTC are and the less distractible the neural network is, the higher is the probability of detecting and merging both stimuli
  - ✓ Lack of perceptual merging might be caused by a high alert state that facilitates the selection of salient visual information at a price of quality: the response could be given before the final "perceptual hypothesis" is confirmed
- **Response inhibition**
  - ✓ Behavioural post-cue results match the predictions of the **response inhibition** hypothesis (Albares et al., 2011): early facilitation could be a result of the disinhibitory effect of the cue that releases an inhibitory task-set
  - ✓ Evidence for the regulatory interhemispheric inhibition over the response-related brain areas under the post-cue condition: an inhibitory task-set contributes to the speed / accuracy trade-off

References
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