Stimulus Saliency Modulates Attentional Capture as Evidenced by Event-related Potentials and Alpha Oscillations

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Introduction

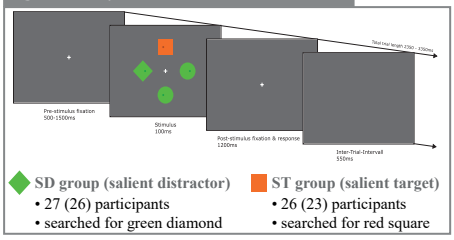
It is debated whether relative distractor saliency affects capture and how this is reflected electrophysiologically. This study manipulated the relative saliencies of the target/distractor and explored their relationship to the Pd component and alpha activity – two measures proposed as neural signatures of distractor suppression.

Methods

Participants

53 subjects (28 female, Age: M = 23.7 [18 - 40])

Figure 1 - Experimental Procedure



Task

- 18 blocks of ~2 min
- discrimination of side of dot within target shape
- target shape assigned randomly
- recording of EEG and keyboard presses

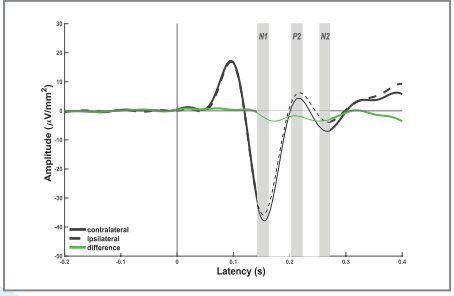
Analysis

- current source density (CSD) transformed EEG dynamics and different time windows of averaged ERP
- four cardinal conditions:
  - TLDV: target lateral - distractor vertical
  - DLTV: distractor lateral -target vertical
  - TL: target lateral alone
  - DL: distractor lateral alone

Measures of attentional deployment:

1. Distractor interference: reaction time difference when the distractor is present vs absent
2. Event-related potentials (ERP)
   - difference potentials contralateral PO8/7 minus ipsilateral PO8/7: N1/2pc, Pd (see Fig. 2)

Figure 2 - Grande-average ERP and anaylsis time-windows



3. Alpha-band oscillations
   - extraction of amplitude timecourse via Gabor-filter (filter bandwidth: $FWHM_{frequency}$: ±1.4 Hz; $FWHM_{time}$: ±157.6 ms)

Results

Figure 3 - Distractor interference as measured by reaction time

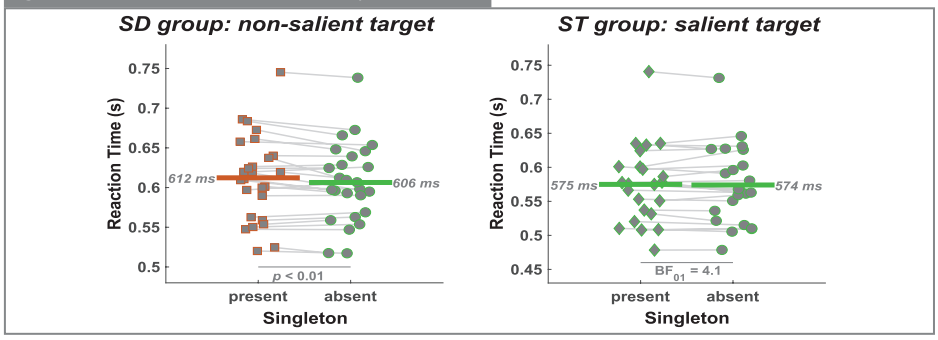


Figure 4 - Event-related lateralized potentials

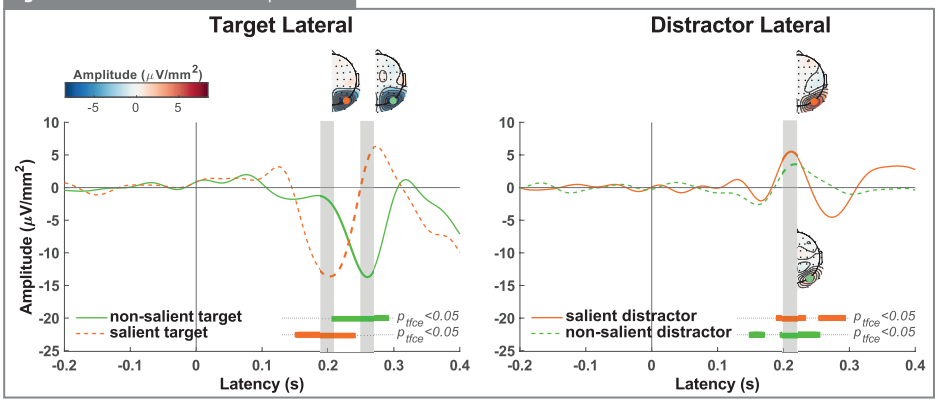
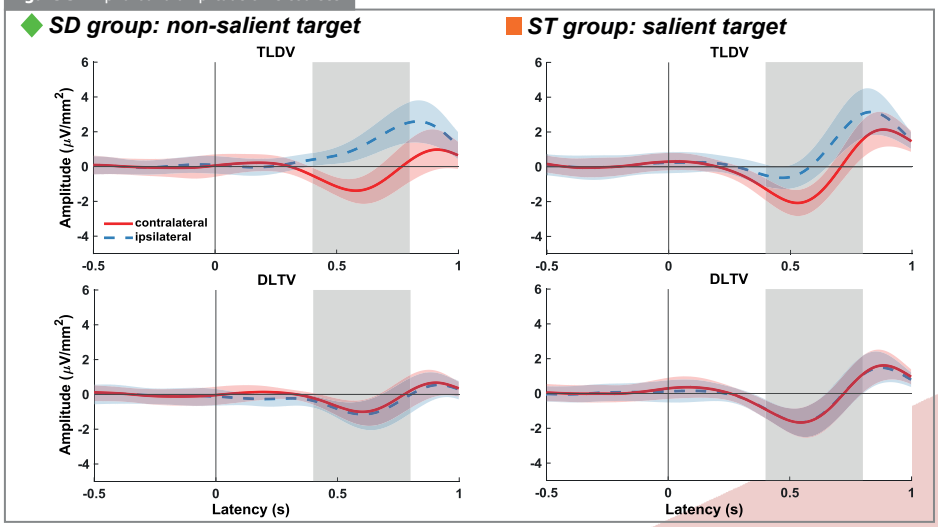


Figure 5 - Alpha-band amplitude time courses



Discussion

- Discrimination on salient targets was faster and resulted in faster N2pc latencies
- Salient but not non-salient distractors interfered with the task suggesting attentional capture by the singleton
- This capture was not resembled by Pd amplitudes and conflicts with the hypothesis that the Pd reflects proactive distractor suppression (Gaspelin et al., 2018)
- Alpha-band amplitudes decreased during target processing, but no amplitude enhancement was observed contralateral to distractors regardless of their saliency
- Results demonstrate different neural mechanisms for target and distractor processing and support the view of top-down guidance of attention can be offset by relative stimulus saliency (Lamy et al., 2004)

References

Forschack, N., Gundlach, C., Hillyard, S., Müller, M.M., 2022. Attentional capture is modulated by stimulus saliency in visual search as evidenced by event-related potentials and alpha oscillations. Atten Percept Psychophys.

Gaspelin, N., Luck, S.J., 2018. Combined Electrophysiological and Behavioral Evidence for the Suppression of Salient Distractors. Journal of Cognitive Neuroscience 30, 1265–1280.

Lamy, D., Leber, A., Egeth, H.E., 2004. Effects of Task Relevance and Stimulus-Driven Salience in Feature-Search Mode. Journal of Experimental Psychology: Human Perception and Performance 30, 1019–1031.

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Paper