Stimulus and task-based modulations of ERPs and gamma oscillations

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Introduction

Previous studies have identified an ERP signature of contour integration—Contour Integration Negativity (CIN) that is elicited regardless of attention, awareness, or task-relevance.

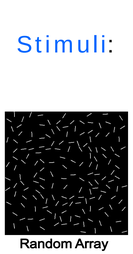
More recent experiments suggest that only the early phase of this CIN reflects contour integration while subsequent phases reflect attentional and task-related processes.

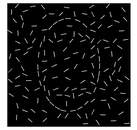
Previous studies showed that when the stimulus is task relevant, the CIN is followed by subsequent ERP components (SN & P3) as well as induced gamma oscillations (40 Hz; 300-400 ms).

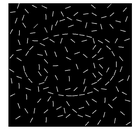
Here, by manipulating the target status of individual contour shapes, we tested whether the functional characteristics of the gamma oscillations matched those of the SN or P3.

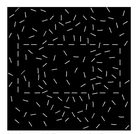
Methods

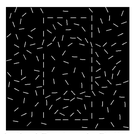
Stimuli:


Random Array


Vertical Ellipse Pattern


Horizontal Ellipse Pattern


Horizontal Rectangle Pattern

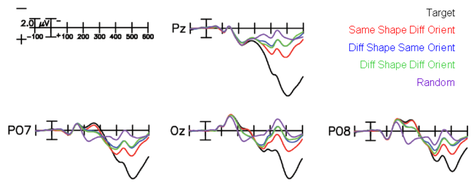

Vertical Rectangle Pattern

Example:
Subject #1

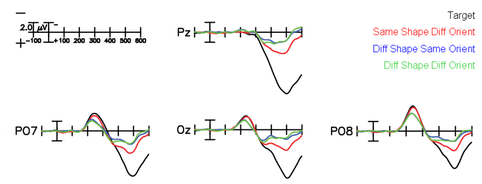
Vertical Ellipse	Horizontal Ellipse	Vertical Rectangle	Horizontal Rectangle
Target	Same Shape Diff Orient	Diff Shape Same Orient	Diff Shape Diff Orient

Current Results

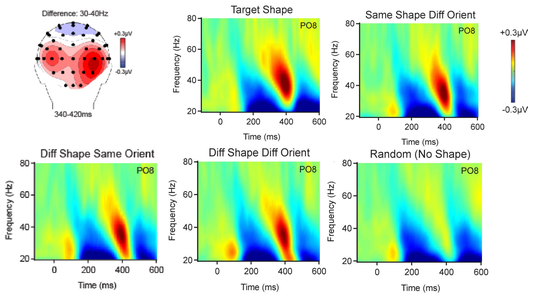
Grand-averaged ERPs:



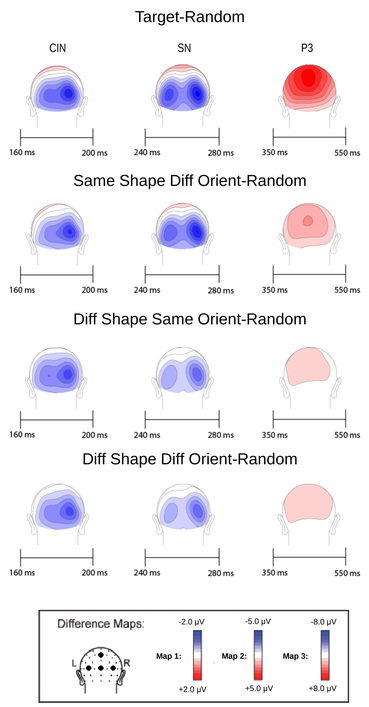
Difference Waves (Shape - Random):

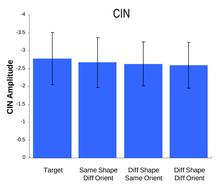


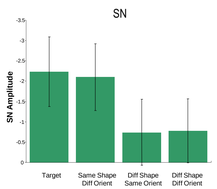
Time-Frequency Results:

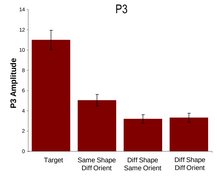


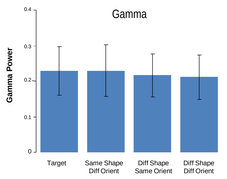
Difference Scalp Maps (Shape - Random):





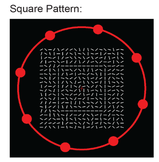




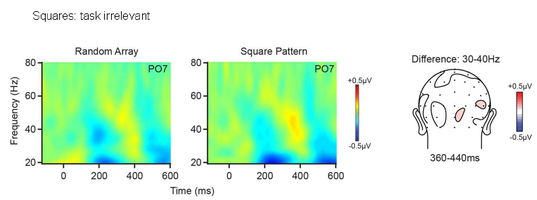


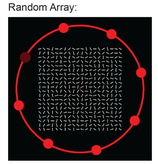
Previous Results

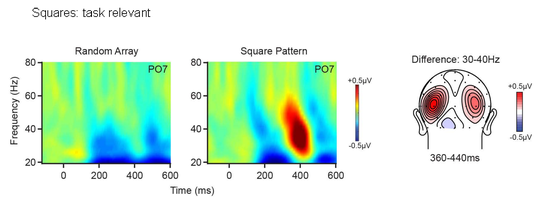
Experiment #1 Stimuli:


Square Pattern:

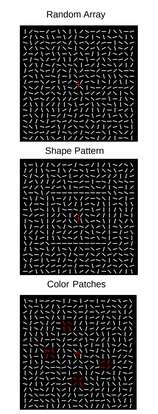
Experiment #1 Time-Frequency Results:



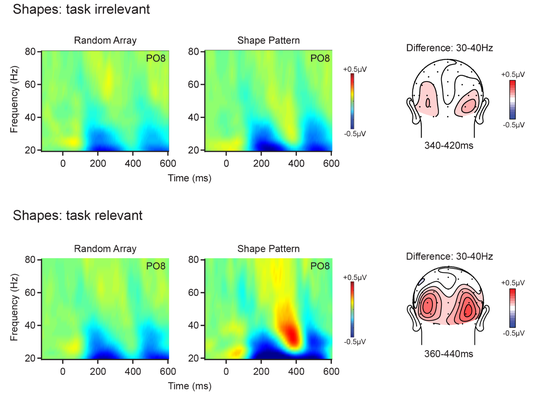

Random Array:



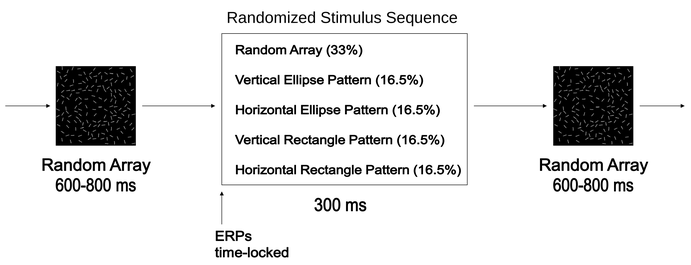
Experiment #2 Stimuli:



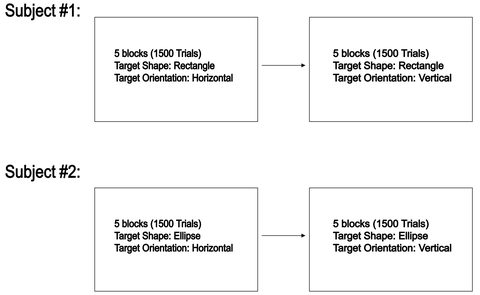
Experiment #2 Time-Frequency Results:



Procedure:



Example:



Number of Stimuli (per block):
- Random = 100
- Horizontal Ellipse = 50
- Vertical Ellipse = 50
- Horizontal Rectangle = 50
- Vertical Rectangle = 50

During each trial, all line elements changed orientation randomly once per second to either form a horizontal ellipse shape, a vertical ellipse shape, a horizontal rectangle shape, a vertical ellipse shape, or a random arrangement.

Target shapes and the order of target orientation were counterbalanced across subjects.

Discussion

A CIN of equal amplitude was elicited by all shapes regardless of which shape was the target.

The SN component was present for all shapes but significantly (and equally) enhanced for the target shape and non-target same shape stimulus compared to the non-target stimuli of different shape.

The P3 was largest for the target, decreased in amplitude for the non-target stimulus of the same shape, and was nearly absent for the non-target stimuli differing in shape.

Gamma oscillations of equal magnitude were elicited by all shapes

These results along with those from previous experiments suggest that the CIN component indexes an automatic grouping process, while subsequent posterior gamma oscillations reflect utilization of this information for task execution. Importantly, the current study confirms that the gamma oscillations reflect a process distinct from those indexed by the SN and P3.