Electrophysiological Evidence for Cross-Edge Competition During Figure-Ground Perception

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Introduction

Repetition Priming and Figure-Ground Perception

- The initial presentation of a stimulus facilitates later processing.
- With repetition, neural responses are **suppressed** for **familiar** stimuli and **enhanced** for **novel** stimuli (Gruber, 2005 ; Grill-Spector, 2006).
- Repetition effects stronger at zero and short lags than long lags.

Questions

1. Is repetition suppression evident for familiar shapes that are suggested, but not perceived, on the ground side of figures?

2. Does the time at which such effects are evident indicate when familiar shapes are accessed during figure-ground assignment?

Figure-ground perception

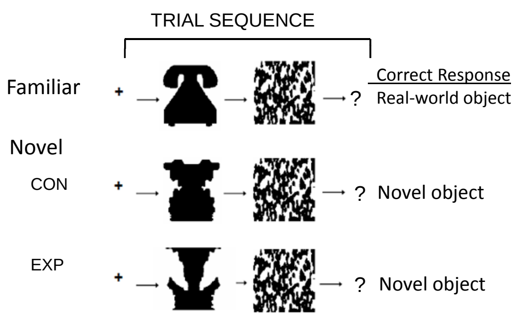
Figure (Shape) Assignment:
Competition between proto-objects (defined by Gestalt cues, memory, attention (Peterson & Skow, 2008)

Outcome:
Region with definite shape = **figure.**
Shapeless region that continues behind the figure = **background**.

Peterson and Skow (2008): familiar shapes in region eventually perceived as shapeless ground are nonetheless accessed.

Stimuli and Design

Silhouette figures biased toward center as figure: Area, enclosure, symmetry.
Familiar (N = 40) and Novel (N = 80) intermixed. Task: object decision
Two types of Novel (luminance, contour length, Gestalt properties matched)
CONTROL (N = 40): no competing configural cues on outside
EXPERIMENTAL (N = 40): competing familiar configuration cue on outside



Repetition (Grouping factor)
Short Lag: 5-9 intervening stimuli
Long Lag: 17-21 intervening stimuli

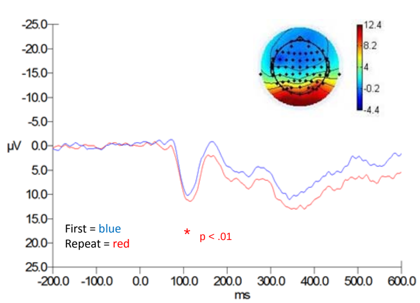
Methods

- N = 52 (31 female)
- 64 channel Synamps2, 500X amplification, 500 Hz sampling rate, band passed .01-100 Hz, impedances < 10 KΩ.
- Muscle artifact removed by visual inspection. Eye blinks corrected in Neuroscan.
- Stimulus-locked (ERPs) were computed by averaging trials separately for the first and second presentations of EXP and CON conditions for each subject.
- Analysis: GLM (Stimulus (EXP, CON), Repetition (1st, 2nd), Lag (short, long).
- "Seers" (of familiar shape on outside of EXP silhouettes) excluded by extensive post experiment questions. Data shown are from **Non-Seers** (N = 22, Short lag: N = 10). .

Results: Repetition Effects

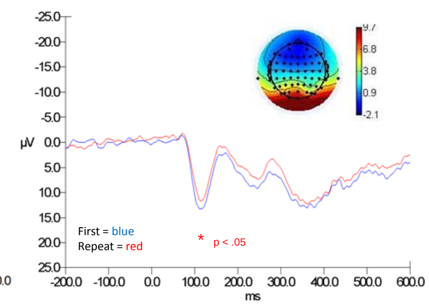
❖ No repetition effects found at long lags.

Control First vs Repeat



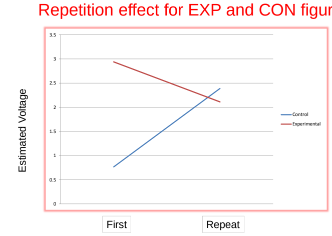
CON Repeat > CON First
Repetition Enhancement

Experimental First vs Repeat



EXP First > EXP Repeat
Repetition Suppression

Repetition effect for EXP and CON figures

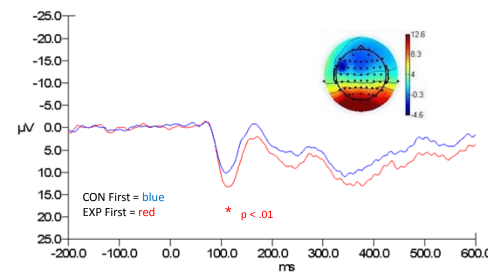


This is the first time repetition suppression effects have been found for familiar shapes that are not perceived as figures.

Repetition effects show that familiar configurations are accessed early in the course of figure assignment (EXP and CON stimuli differ only in presence vs. absence of a familiar configuration on the silhouette outside -- the groundside).

A direct comparison of EXP vs. CON confirms that the familiar configuration on the outside of EXP silhouettes is accessed early in perception (~120 ms post stimulus onset).

Results: CON vs EXP First



Replicates Trujillo et al (2010)

Discussion

❖ Familiar shapes were suggested in patently unshaped grounds.

Reduced P100 for EXP repeats
Consistent with hypothesis that repeated exposure to familiar shapes leads to sharper neural representations.

Enhanced P100 for CON repeats
Consistent with hypothesis that repeated exposure to novel stimuli leads to enhancement of newly formed neural representation.

Conclusions

1) The P100 ERP component indexes access to familiar representations during shape assignment.

2) Extends repetition priming effects to figure-ground perception, showing suppression effects for familiar figures that are not consciously perceived.

3) Consistent with view that memories of familiar configurations are accessed in the course of figure assignment.

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References
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