Spatial attention control mechanism modulated by subliminal stimuli: An Electroencephalography Study
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Introduction
Tushima et al. (2006) found that task-irrelevant visual stimuli, when not consciously perceived, led to a stronger disturbance in task performance compared to consciously seen stimuli. This finding has become a foundational piece of evidence for a series of emerging perceptual learning models and attention control theories (e.g., Attention Schema Theory).

Metaccontrast Masking
A type of backward masking where a stimulus is followed by a mask in which the contour of the mask fits neatly around the stimulus (Koster et al., 2020). Manipulations of stimulus-mask intervals (SDA) yields a U-shaped curve: Intermediate SDA (>40-100ms) yields the lowest visibility. - Very short (<30ms) or very long (>150ms) SDA yields the highest visibility.

Neural Markers of Spatial Attention Modulation
(Jongen et al., 2007; Meyberg et al., 2017)
Anterior Directing Attention Negativity (ADAN): 300–500ms after cue onset, reflects the initiation of spatial attention control mechanisms.
Late Directing Attention Positivity (LDAP): 500ms–700ms after cue onset, reflects a selectivity preparatory biasing of neural activity in visual sensory areas in anticipation of the target.

Objectives: What is the effect of subliminal primes on visual-spatial attention control?

Method
Quest Algorithm:
To determine invisibility threshold of individual’s prime-cue SOA

Behavioral Results

Results: lateralized cue-ERP activity

<table>
<thead>
<tr>
<th>Prime-Cue Congruency</th>
<th>Awareness of the Prime</th>
<th>ADAN (µV)</th>
<th>LDAP (µV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congruent Prime-Cue</td>
<td>Aware</td>
<td>4.5</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Unaware</td>
<td>-0.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>Incongruent Prime-Cue</td>
<td>Aware</td>
<td>-3.0</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Unaware</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Summary
- In all conditions, we observed the ADAN and LDAP components consistent with previous research (McDonald & Green, 2008).
- ADAN amplitude was modulated by congruency and awareness of the prime.
- These results suggest that a subliminal task-irrelevant prime can disrupt attentional control mechanisms, possibly due to a failure to establish inhibitory control over the influence of the unseen prime.
- An exploratory analysis of early time-windows (200–600ms post-cue) in the incongruent condition suggested that attention may have initially followed the unseen prime before inhibitory mechanisms were able to control attention based on the seen cue.

Reference