HAMPSHIRE COLLEGE

Contributions of Suppression to Object Based Selective Attention

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Abstract

Object-based attention studies have shown that facilitation spreads across objects (Egly, Driver, and Rafal, 1994), enhancing processing to unattended locations on attended objects. However, less is known about suppression in object-based attention despite previous research suggesting suppression contributes to space-based attention (Couperus and Mangun, 2010). This investigated suppression during object-based attention. Twenty adults (ages 18-25) completed an object-based attention task similar to Egley et al. (1994). Participants were asked to identify the orientation of a target object at one of four ends of two rectangles. The target location was validly cued on 70% of trials. The remaining 30% of targets were located on either the same object or a different object. Participants completed 2 blocks of trials; one containing a target and a distractor on either the same or different object for 70% of trials and the other in which only 30% had a distractor. As in previous studies, results show the spread of attention across the attended object when no distractor was present ($F(2,38)=24.31$, $p<.001$). Moreover, participants were faster when no distractor was present during a block where distractors were frequent and the location of the target was validly cued ($F(2,38)=4.24$, $p=.023$). However, when a distractor was present, participants were faster to targets located on the different object as compared to the same object when invalidly cued to location ($F(3,57)=68.05$, $p<.001$). These data indicate that suppression within an object may be stronger than across objects, suggesting a biased competition model of visual selective attention for object-based attention.

Background

Selective attention modulates visual processing in adults. Moreover, much of this research suggests that selective attention operates spatially (e.g. Eriksen & Eriksen, 1974; Posner, 1980). However, selective attention has also been shown to modulate processing within the constraints of object boundaries, often termed object based attention (see Chen 2012 for a review). Studies of object based attention suggest:

- **Selective attention to one aspect of an object results in attention to all other aspects of the object** (e.g. Duncan, 1984).
- **Facilitation (i.e. increased processing as a function of attention) spreads across objects that are focus of attention** (e.g. Egly, Driver, and Rafal, 1994).

However, recent research on spatially based attention suggests that while facilitation doubtlessly plays a major role in selection, suppression of processing at unattended locations may also contribute to selection (e.g. Couperus and Mangun, 2010). However,

- **Studies of object based attention have not examined how suppression may interact with facilitation during object based selection.**

Therefore, this study will examine facilitation and suppression during object based selection. Specifically, it will examine how suppression of distractor information occurs during object based selection.

Methods

Participants

Twenty adults (x=19.90 SD=1.8) participated in this study. Participants included 7 males and 13 females 3 of whom were Asian, 1 was Hispanic, and 16 were Caucasian.

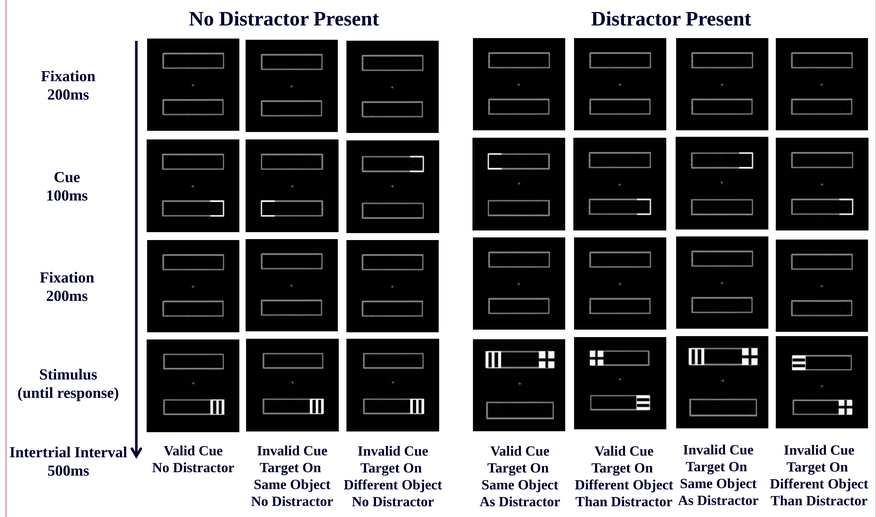
- Participants were recruited from Hampshire College in Amherst, MA. Participants were excluded from participation if they had visual impairments that could not be corrected with glasses/contacts, were currently on psychotropic medications, or if they were born premature (ie less than 36 weeks). Participants received course credit or were paid $10 for their participation.

Methods (cont.)

Participants were asked to identify the orientation of the bars following the cue with either a left or right mouse click.

- Target location was validly cued for 70% of trials
  - Remaining invalidly cued targets (30%) were located on the same or different object
- Two blocks of 1000 trials (counterbalanced across participants)
  - Frequent Distractor Block (70% contain a distractor)
  - Infrequent Distractor Block (30% contain a distractor)

The seven conditions created by this can be divided into two group, those without a distractor, and those with a distractor as seen below



Results

Overall Accuracy Results:

2(Distractor Frequency) x 7(Condition) Repeated Measures Anova

- **Significant Main Effect of Condition**
  - $F(6,114) = 14.00$, $p<.001$

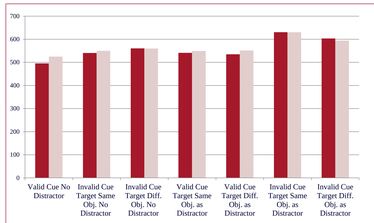
Effect of Distractor Presence & Validity:

- $t(19)=-1.23$, $p>.05$ & $t(19)=3.11$, $p=.006$

=>Lower accuracy when cue is invalid

=>Specifically accuracy is significantly lower when cue is invalid and the target is on the same object as the distractor (all contrasts $p<.001$)

	Valid Cue No Distractor	Invalid Cue Target on Same Object No Distractor	Invalid Cue Target on Different Object No Distractor	Valid Cue Target on Same Object as Distractor	Valid Cue Target on Different Object as Distractor	Invalid Cue Target on Same Object as Distractor	Invalid Cue Target on Different Object as Distractor
Frequent Distractors (70%)	93.1(3.8)	93.0(5.2)	93.2(4.9)	92.2(4.3)	95.2(4.1)	**88.9(6.9)**	94.4(5.3)
Infrequent Distractors (30%)	93.6(3.8)	94.1(4.4)	94.8(4.8)	94.0(3.2)	94.2(3.3)	**89.9(5.1)**	94.8(2.4)



Overall Reaction Time Results:

2(Distractor Frequency) x 7(Condition) Repeated Measures Anova

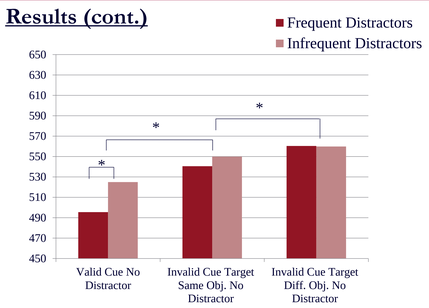
- **Significant Main Effect of Condition**
  - $F(6,114) = 54.29$, $p<.001$
- **Significant Interaction between Distractor Frequency and Condition**
  - $F(6,114) = 2.88$, $p=.025$

Effect of Distractor Presence & Validity:

- $t(19)=8.03$, $p<.001$ & $t(19)=-7.87$, $p<.001$

=>Slower overall RT when distractors present & when the cue is invalid

Results (cont.)



No Distractor Present:

2(Distractor Frequency) x 3(Condition) Repeated Measures Anova

- Significant Main Effect of Condition
  - $F(2, 38) = 24.31$, $p<.001$
- Significant Interaction between Distractor Frequency and Condition
  - $F(2,38) = 4.24$, $p=.023$

=> Replicates previous studies showing spreading of attention across objects

Distractor Present:

2(Distractor Frequency) x 2(Cue Validity) x 2(Distractor Location (same vs. diff. obj.) Repeated Measures Anova

- Significant Main Effects of Cue Validity and Distractor Location
  - $F(1,19) = 91.33$, $p<.001$ and $F(1,19) =30.75$, $p<.001$
- Significant Interactions between Distractor Frequency and Cue Validity as well as Cue Validity and Distractor Location
  - $F(1,19) = 5.74$, $p=.027$ and $F(1,19) =13.90$, $p=.001$

=>When distractor is present suppression SLOWS response when target is on the same object

Discussion

Results of the current study suggest several interesting features of object based attention. In particular, results replicate previous research that:

- **Object based attention spreads across objects when no distractors are present**

However, the functioning of object based attention becomes more complex when distractors are added to the picture. Here, results suggest:

- **If the location of a target is validly cued the presence of a distractor does not significantly impact reaction times,**
- **But, if the location is invalidly cued, reaction times are SLOWER to other parts of the cued object as compared to when the target is on the non-cued object**
  - **accuracy is also significantly lower when the cue is invalid and the distractor is on the same object as compared to all other conditions**

=>This suggests suppression of uncued locations on the object when distractors are present

These findings support biased competition models of selective attention in object based attention.

Further Information

Please contact Jane W. Couperus at jcouperus@hampshire.edu for more information and references for this poster. You can also find more information at http://dcnlabb.hampshire.edu.

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