

Contributions of Suppression to Object Based Selective Attention

Abstract

Object-based attention studies have shown that facilitation spreads across objects (Egley, Driver, and Rafal, 1994), enhancing processing of unattended locations on attended objects. More recently, a pilot study suggested that suppression of unattended distractor objects within an attended object may limit the spread of attention (Couperus 2014). However, these initial findings did not account for how the cue location might influence this interaction as the cue location was confounded with the distractor location in several conditions. Thus, this study sought to clarify the role of cue location and distractor suppression in object based attention. Twenty-two adults ($x=24.57$) completed an object-based attention task similar to Egley et al. (1994). Participants were asked to identify the shape 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. As in previous studies, results show the spread of attention across the attended object when no distractor was present ($F(2,42)=7.41, p=.004$). Moreover, a similar spread of attention was seen in the presence of a distractor when the distractor was not confounded with the cue location ($F(3,63)=5.12, p=.007$). However, when the cue and distractor location were confounded the difference in reaction time between targets on the same and different objects was reduced to the point that no significant difference remained ($t(21)=-.897, p=.381$) These data indicate that suppression does not affect object based attention as attention does spread across objects in the presence of distractors, although the confounding of cue and distractor locations can obscure these effects.

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. Egley, 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). Moreover,

- **A recent pilot study of object based attention suggests suppression may interact with facilitation during object based selection** (Couperus, 2014).

However, the previous pilot confounded the cue and distractor locations in some conditions making interpretation of the findings difficult. Therefore, this study examines facilitation and suppression during object based selection under additional conditions to explore the role of this confound and better examine how suppression of distractor information occurs during object based selection.

Jane. W. Couperus, PhD
Hampshire College

Colin Quirk
Hampshire College

Methods

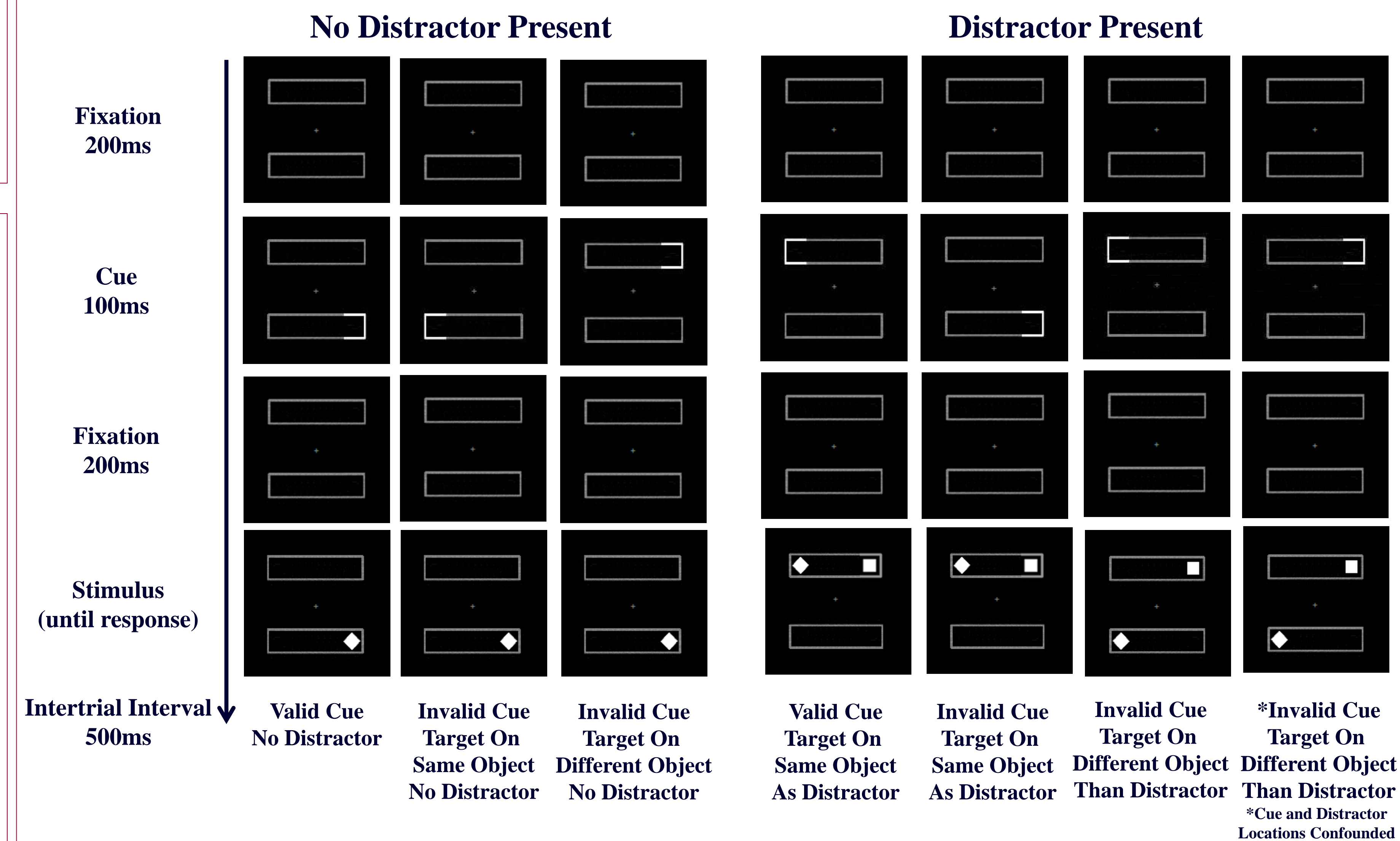
Twenty-two adults ($x=24.57, SD=10.0$) participated in this study. Participants included 7 males, 14 females, and 1 genderqueer individual, 4 of whom were of mixed heritage (2 black/white, 1 black/hispanic, 1 asian/white). Participants were recruited from Hampshire College in Amherst, MA. Participants 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.

Participants were asked to identify which of two shapes appeared with the third serving as a distractor. Shapes were a square, diamond, and circle.

- **Target location was validly cued for 70% of trials**
- **Remaining invalidly cued targets (30%) were located on the same or different object**

The ten conditions created by this can be divided into two groups, those without a distractor and those with a distractor. Additionally, while all displays without a distractor are pictured here, only 4 of the 7 possible distractor present displays are pictured. The remaining three conditions are variations of the following distractor present displays: valid cue target on different object than distractor, invalid cue target on different object than distractor, and *invalid cue target on same object as distractor. These three conditions were collapsed with their counterparts for analysis. The target in the example is the diamond and the square is the distractor, the circle is not displayed in the example.

*cue location confounded with distractor location.



Results

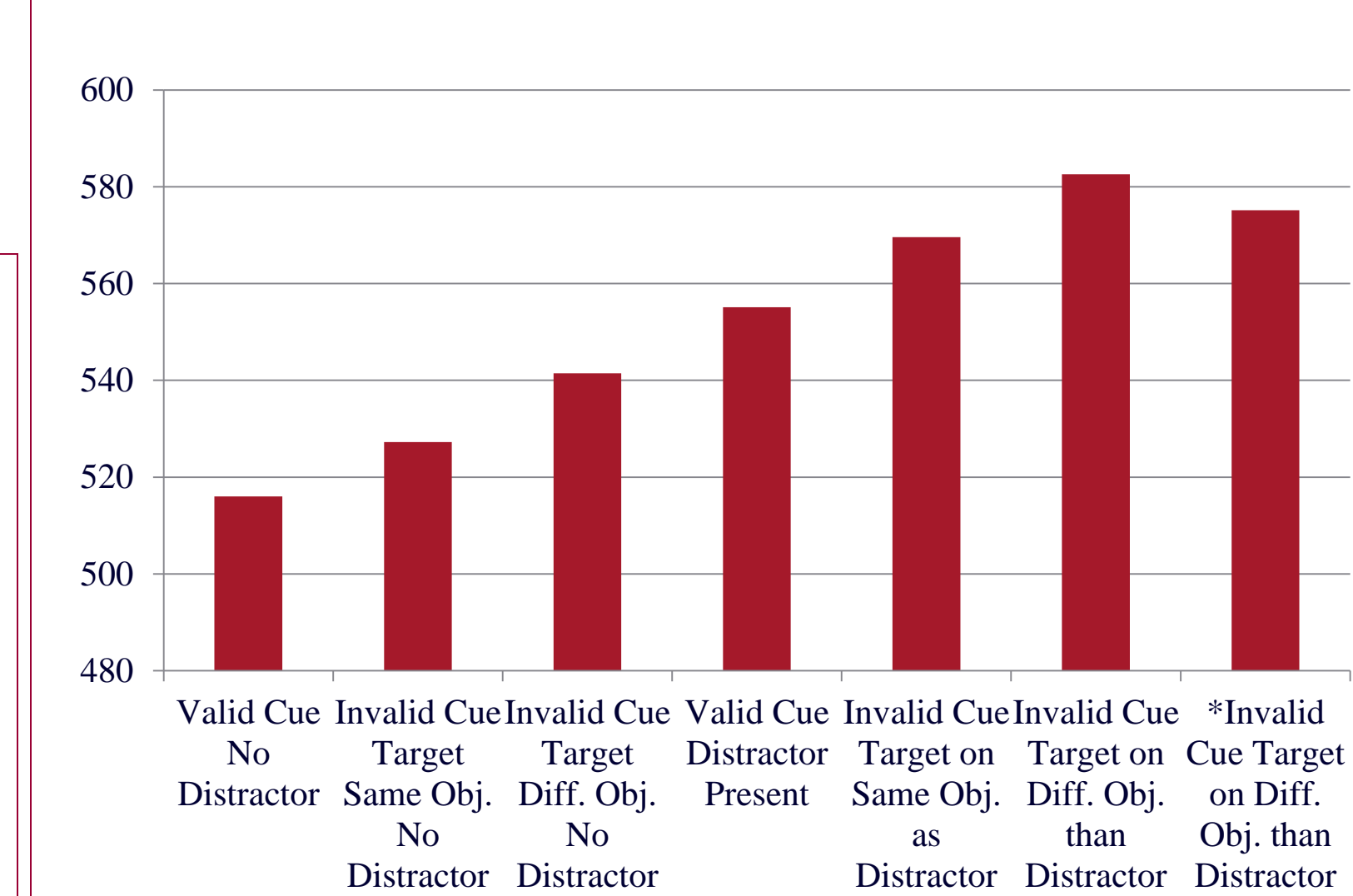
Overall Accuracy Results:

7(Condition) Repeated Measures Anova

- **No Significant Effect of Condition**

• $F(6,126) = 1.40, p=.259$

	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	Invalid Cue Target on Same Object as Distractor	Invalid Cue Target on Different Object as Distractor	*Invalid Cue Target on Different Object as Distractor
Mean Accuracy (SD)	92.6(11.3)	92.0(9.4)	92.4(10.7)	94.2(5.3)	91.7(9.0)	93.6(7.2)	91.6(9.6)



Overall Reaction Time Results:

7(Condition) Repeated Measures Anova

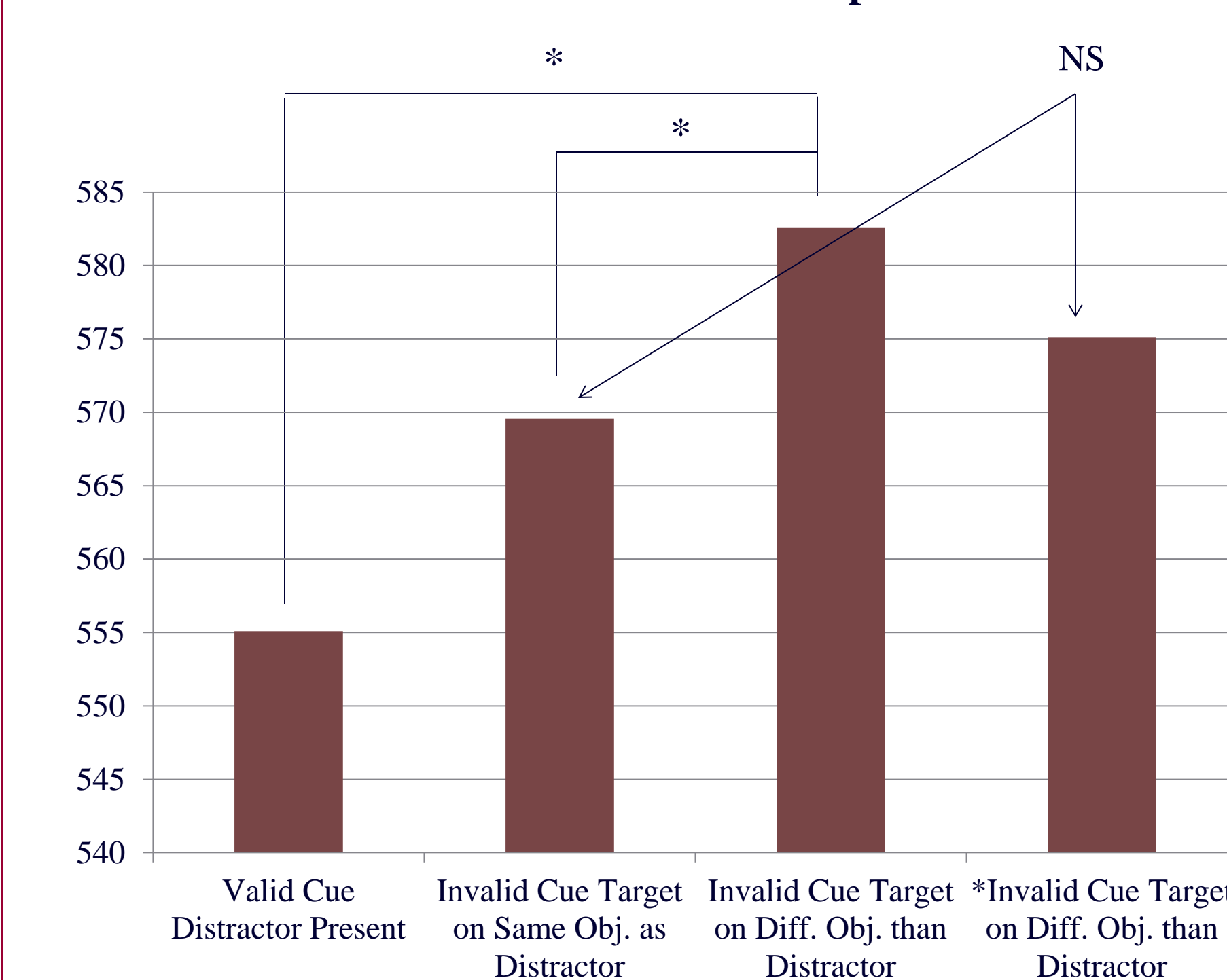
- **Significant Main Effect of Condition**

• $F(6,126) = 18.18, p<.001$

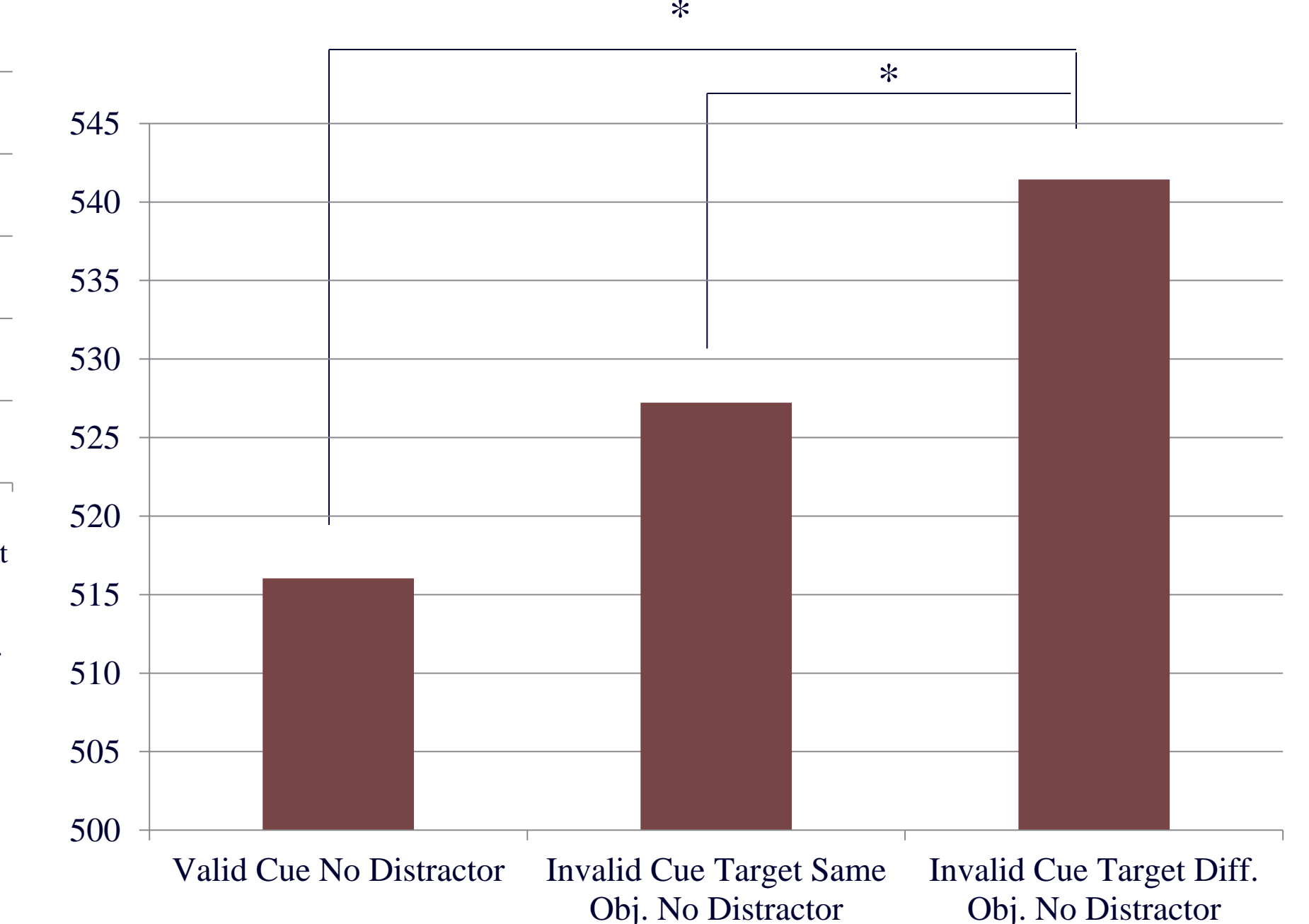
Effect of Distractor Presence (comparison of averages):

• $t(21)=-5.94, p<.001$

=>Slower overall RT when distractors present



Results (cont.)



No Distractor Present:

3(Condition) Repeated Measures Anova

- **Significant Main Effect of Condition**

• $F(2, 42) = 7.41, p=.04$

• Follow-up t-tests

• $t(21)=-1.80, p=.086, t(21)=-3.14, p=.005, t(21)=-2.72, p=.013$

=> **Replicates previous studies showing spreading of attention across objects**

Distractor Present:

4 (Condition) Repeated Measures Anova

- **Significant Main Effects of Condition**

• $F(3,63) = 5.12, p=.007$

• Follow-up t-tests

• $t(21)=-3.72, p=.001, t(21)=-1.89, p=.079, t(21)=2.32, p=.037, t(21)=-.897, p=.381$

=> **When a distractor is present attention still spreads, however, if the cue is confounded with the distractor location a benefit results in reaction times not significantly different than when the 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:

- **The presence of a distractor does increase reaction times, but does not alter the general pattern of the spread of activation**
- **But, if the cue is confounded with the distractor location reaction times are faster, suggesting a benefit of knowledge of the distractor location**

=> **This suggests suppression does NOT affect the spread of attention across objects when distractors are present but that the confounding of the cue and distractor location can obscure the effect of the target being on a different object.**

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://dclnlab.hampshire.edu>.

Acknowledgements

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