Perceptual Structure Facilitates Spatial Filtering

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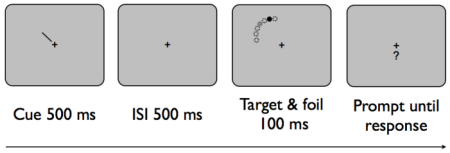
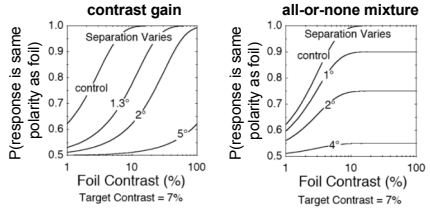
Introduction

We used a spatial filtering paradigm (Palmer & Moore, 2008) to measure the effect of perceptual structure on selective attention.

Filtering paradigm: Observers were asked to detect stimuli at a cued location (targets), while ignoring otherwise identical stimuli presented at nearby locations (foils). They reported whether the target was darker or lighter than the background. In the figure, open circles (not shown in the actual displays) represent possible stimulus locations.



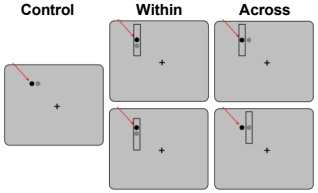
Target and foil contrast were varied to obtain psychometric functions for both the target and the foil at different spatial separations. Different attentional mechanisms predict different effects on the foil psychometric function. A contrast gain model predicts an effect on the threshold (left), whereas an all-or-none mixture model predicts an effect on the asymptote (right).



Results from previous studies using this task and method were inconsistent with a contrast gain model and consistent with an all-or-none mixture model (see Yigit, Palmer & Moore, poster # 23.405)

Current Study

We added a rectangle to the basic display of the spatial filtering paradigm and measured the extent to which the foil can be ignored depending on where it is relative to the rectangle. If perceptual structure affects spatial selection we should see differences in how well the foil can be ignored. Importantly, the rectangle provided no information about the target location and thus no information about which stimulus was the target.



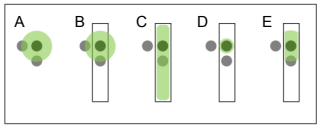
Red arrows (not shown in actual displays) indicate cued position

Conditions:

(1) *Control*: no rectangle

(2) *Within Object:* the target and foil are presented within the rectangle

(3) *Across Boundary*: either target or foil are presented in the rectangle, the other stimulus is presented outside the rectangle



Hypotheses: Perceptual structure may

(1) have no effect (panel B).

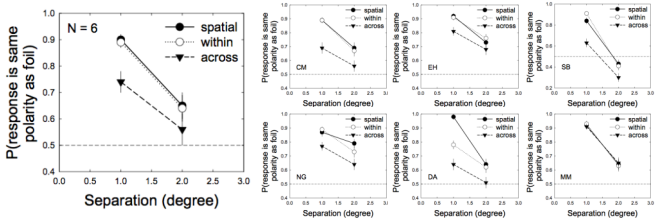
(2) cause a spread of selection within the object (panel C).

(3) cause a narrowing of selection (panel D).

(4) cause a truncation of selection (panel E).

Results

Responses to targets (not presented) were overall very accurate, indicating that observers had no problem detecting high-contrast targets in the context of a rectangle. The figures show proportion of responses with the same polarity as the foil as a function of separation.



Experimental details: two target-foil separations (1º and 2º) and two kinds of trials: trials, in which the target had a high contrast (90%) and the foil had a low contrast (7% near threshold) and trials, in which the foil had a high contrast (90%) and the target had a low contrast (7% near threshold).

Conclusions

Perceptual structure does affect selective attention in the filtering paradigm.

(1) Selection was sharpened at the boundary of an object, despite the fact that the object provided no information about the relevant location.

(2) However, there was no evidence of greater spread of attention within an object than that which occurs without object structure. This appears to contrast with other studies of object based attention (e.g. Egly, Driver & Rafal, 1994).

Together these findings are consistent with the truncation hypothesis (see panel E).

Open Questions

(1) Can spatial filtering in the context of perceptual structure also be accounted for by a all-or-none mixture model?

(2) Does the failure of attentional spread reflect differences between filtering tasks and cuing tasks where locations other than the cued location are relevant (see Yigit, Palmer & Moore, poster # 23.405)?

References

Palmer, J., & Moore, C. M. (2008). Using a filtering task to measure the spatial extend of attention. *Vision Research*.

Egly, R., Driver, J., Rafal, R. D. (1994). Shifting visual attention between objects and locations: Evidence from normal and parietal lesion subjects. *Journal of Experimental Psychology: General, 123*,161-177.

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