457.2 Feature-Based Attention Modulates Lateral Interactions

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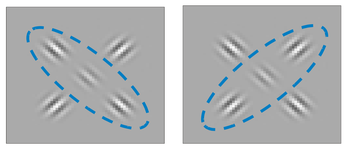
Introduction

1. Collinear flankers can facilitate the detection of a central Gabor target[1]. These lateral interactions may contribute to contour detection in early vision.

2. Freeman et al. recently reported that these lateral interactions are modulated by attention[2].



Observers attended to either the collinear or orthogonal flanker pair on identical visual displays. (Dotted lines were not physically present.)

Target detection was improved when the attended flankers were collinear.

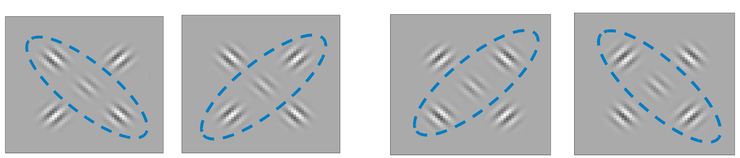
3. We propose that this facilitation is not limited to collinear facilitation, but rather is due to a feature-based attention. Attention to a stimulus feature may facilitate the processing of stimuli with matching features [3,4] (in this case, orientation).

4. To test this, we replicated the above experiment and added an additional condition in which the flankers were still co-oriented but not collinear (placed on the orthogonal axis).

The four conditions were:

Collinear display *(as in Freeman experiment)*

Noncollinear display *(new conditions)*



Co-oriented Cross-oriented Co-oriented Cross-oriented

We predicted that attention to co-oriented flankers on *either* axis would facilitate target detection.

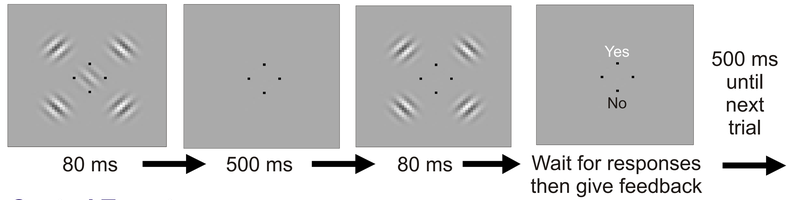
Gabor stimuli:
Gaussian window = wavelength = 0.15 deg
Spatial frequency = 6.7 cpd
Target-flanker distance = 4 wavelengths
Viewing distance = 60 cm

Methods

2-Interval Forced Choice Dual Task:

Task 1. Orientation Discrimination on Flankers:
In which interval were the flankers rotated clockwise?

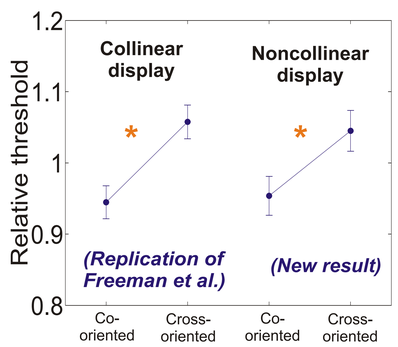
Task 2. Contrast Detection on Center:
In which interval was the central target present?



Central Target:
Contrast varied over 5 levels (1 - 16%)
Blocks of 75 trials used to determine psychometric functions
80% contrast detection thresholds were measured (method of constant stimuli)

Flankers:
Contrast fixed at 100%
Subjects instructed which flankers to attend at start of blocks
Orientation changes: flankers rotated in opposite directions away from diagonal across intervals (each pair rotated in unison).
Fixed 80% orientation change thresholds used for each subject (0.9-1.6 deg).

Group Results



Mean relative thresholds averaged across 6 subjects.

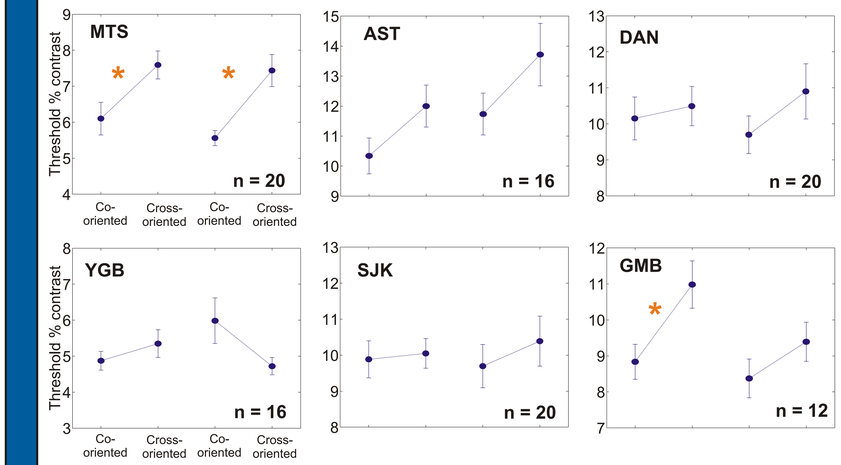
To normalize thresholds across subjects and displays, thresholds were divided by the subject's mean performance on that display.

Each data point determined by an average of 104 independent threshold measurements. (104 blocks, 7800 trials)

Significance levels: $p < 0.05$

Target detection was facilitated by attention to co-oriented flankers even when not collinear.

Individual Results



Each data point determined by an average of *n* independent threshold measurements. Error bars indicate SEM. * P<0.05

The facilitation effect (in both displays) was modest. Significant effects were not found in all subjects with number of trials used.

Conclusions

1. Target detection was facilitated by attention to co-oriented flankers. The attentional facilitation was not limited to the special case of collinearity.

2. Previous studies show that passively viewed co-oriented flankers on the orthogonal axis (like ours) facilitate Gabor detection much less than collinear flankers[5,6] or not at all[7]. Our results are *not* consistent with these collinear-specific lateral interactions.

3. Our results *are* consistent with an attentional mechanism that facilitates the processing of stimuli matching the attended feature. Such a mechanism could be mediated by enhancing the responses of neurons tuned to the attended feature[3,4].

References
1. Polat and Sagi, *Vision Research,* 33, 1993.
2. Freeman, Sagi, & Driver, *Nature Neuroscience,* 4(10), 2001.
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5. Polat and Sagi, *Vision Research,* 34, 1994.
6. Solomon and Morgan, *Vision Research,* 40, 2000.
7. Yu and Levi, *Journal of Vision,* 2, 2002.