What's Captured in Binocular Capture: Carrier or Envelope?

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BACKGROUND

• The perceived visual direction of a monocular stimulus is displaced or "captured" in the direction of nearby disparate visual targets – Binocular Capture[1-5].

• For a given surround disparity, the magnitude of "capture" increases with vertical separation between the monocular targets[3-5].

• It has been suggested that this result may reflect the differences in susceptibility to capture by dichotomous position-encoding mechanisms processing the position of the monocular target[4,5].

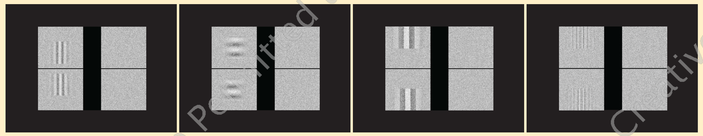
• We show that feature-based position mechanisms are highly vulnerable to capture and its vulnerability increases proportionally with alignment threshold.

METHODS

• Relative alignment bias and thresholds were measured for a pair of vertically separated monocular Gabors presented across a 10' Random dot Stereogram (RDS) depth edge.

• Gabors comprised either vertical cosine gratings (Carrier Only - CO), horizontal cosine gratings (Envelope only - EO), a vertical 1cpd square wave grating (SQ) or a 1cpd missing fundamental grating (MF).

• Relative offsets between the Gabor pair was created by shifting the carrier phase **only** (CO, SQ, MF), or the envelope **only** (EO) of the upper Gabor relative to the bottom Gabor.



CO condition **EO condition** **SQ condition** **MF condition**

• Within a block for a given vertical separation and carrier frequency, horizontal disparity (crossed and uncrossed) was randomly interleaved with the monocular Gabors.

• Capture magnitude = Difference in PSE between psychometric functions for crossed and uncrossed conditions

• Threshold = slope of fitted psychometric function

RESULTS

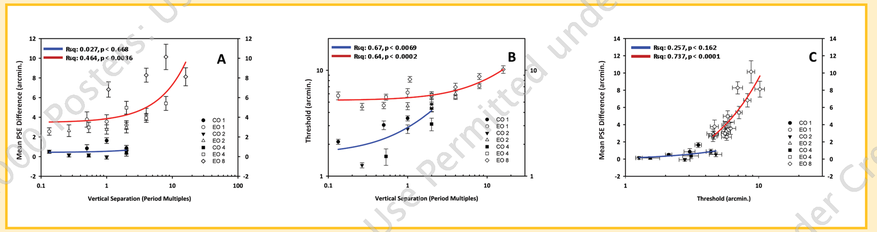


Figure A. Capture magnitude for EO and CO conditions (mean +/- 1 SE) vs. vertical separation expressed as period multiples of carrier frequency.
Figure B. Relative alignment thresholds (mean +/- 1 SE) for the same conditions as A vs. vertical separation expressed as period multiples .
Figure C. Capture magnitude vs. relative alignment threshold for respective EO and CO conditions (mean +/- 1 SE).

** Data pooled across 4 subjects, blue and red lines represent linear regression fits to data.*

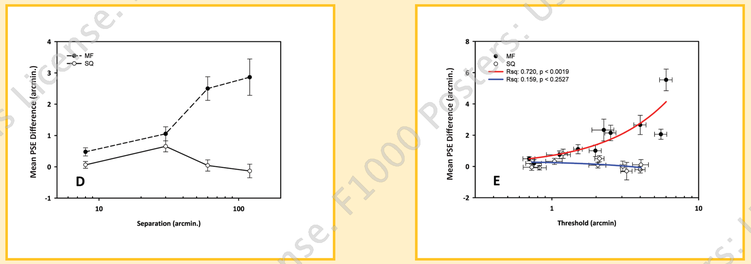


Figure D. Capture magnitude for 1 cpd MF and SQ conditions (mean +/- 1 SE) vs. vertical separation.
Figure E. Capture magnitude vs. relative alignment threshold for 1 cpd MF and SQ conditions (mean +/- 1 SE).

***Data pooled across 3 subjects. Blue and red lines represent linear regression fits to data.*

The Details

- *Carrier grating Frequencies (CO, EO): 1, 2, 4, 8 cpd*
- *Vertical Separation: 8, 30, 60, 120'*
- *Envelope Sigma (CO, EO): 30'*
- *Envelope sigma (SQ, MF): 40'*
- *Stimulus duration: 216ms*
- *Gabors and RDS temporally interleaved @124Hz*

SUMMARY & CONCLUSIONS

• Capture magnitude varied proportionally with positional uncertainty if alignment judgments were based on Gabor envelope information rather than carrier information.

• Capture magnitude varied proportionally with positional uncertainty for MF gratings compared to SQ gratings especially for separations beyond which the lowest harmonic in the MF carrier grating was incapable of providing a reliable position signal.

• The results cumulatively suggest that higher level feature-based position mechanisms are much more vulnerable to capture by surround disparity, while first order position mechanisms seem relatively immune.

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