DICHOPTIC MOTION WITHIN PANUM'S FUSIONAL AREA?

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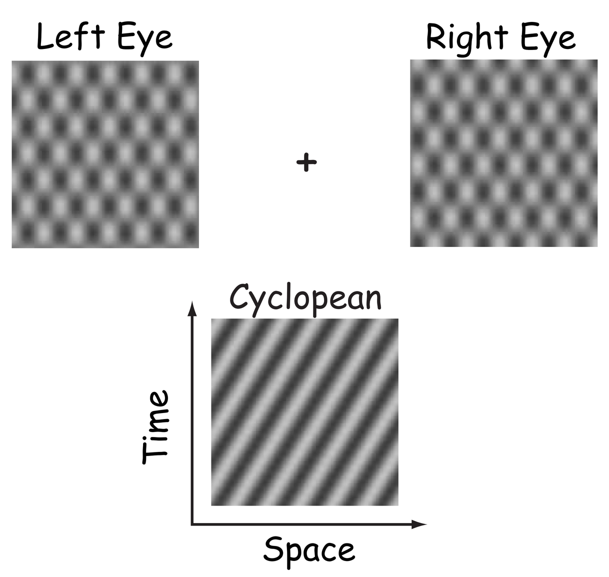
INTRODUCTION

Counterphase flicker in the left and right eye leads to the perception of motion (Shadlen & Carney, 1985).

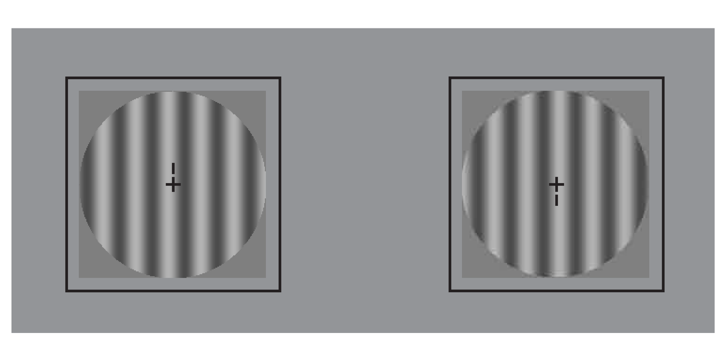


This phenomenon was explained by low-level binocular motion processing (Carney, 1997) and/or high-level feature tracking (Georgeson & Shackleton, 1989; Lu & Sperling, 1995).

EXPERIMENT

Can we perceive dichoptic motion on different depth planes?

STIMULUS AND APPARATUS
Stimuli were shown at 10% Michelson contrast on a calibrated CRT display with a refresh rate of 120 Hz in dichoptic view. Vertical sine-wave gratings of 1.1 c/deg were presented for 208 msec flickering in counterphase at 2.0 Hz.

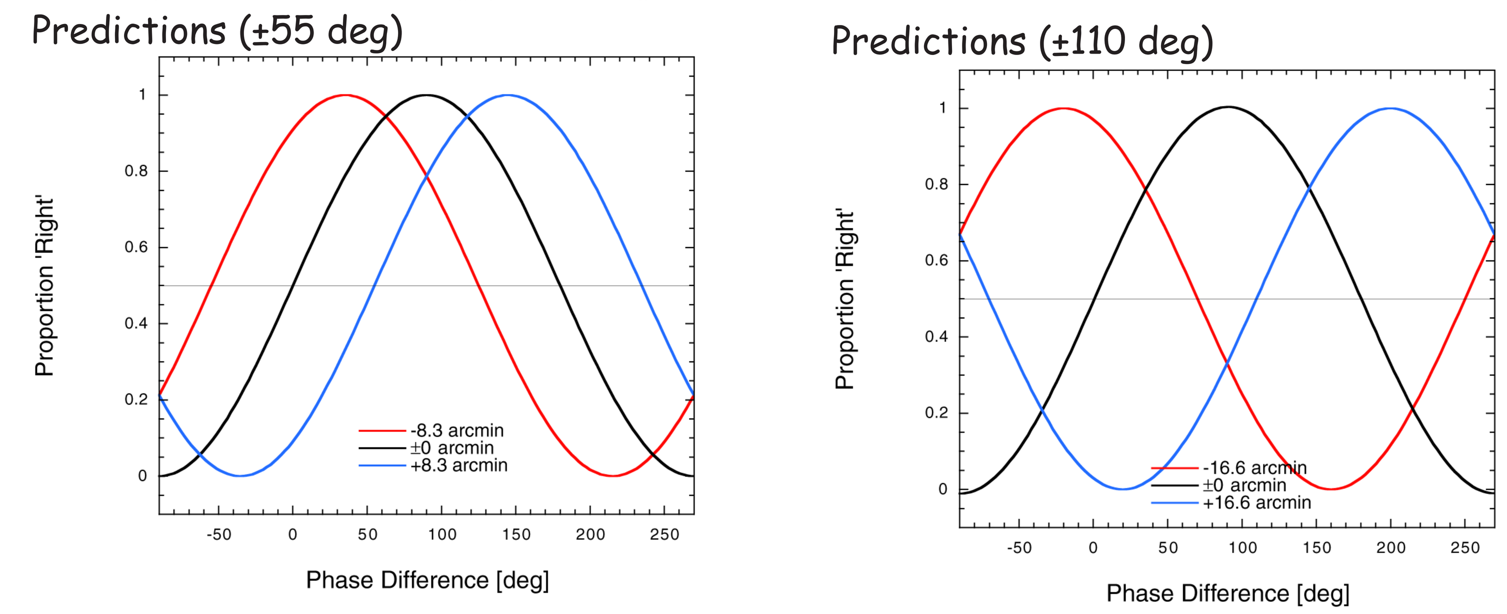


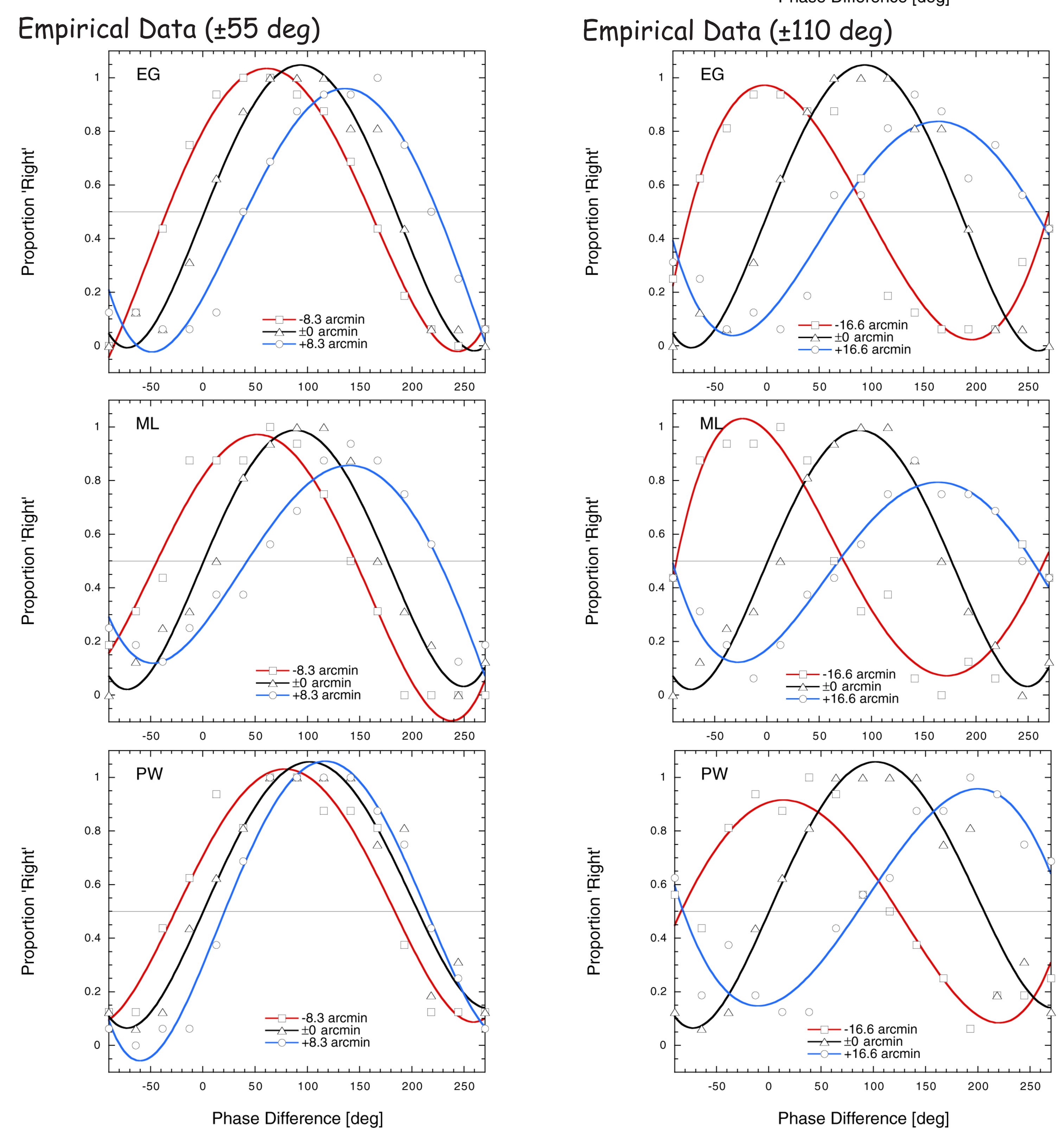
PROCEDURE
On each trial the observer verged on a fixation cross flanked by nonius lines. A surrounding frame and circular aperture indicated the depth of the stimulus. After each presentation the observer was asked to indicate direction of motion (left or right).

DESIGN
Interocular spatial phase difference was varied between -90 and +270 deg and presented in randomly intermixed order across trials. In four conditions stimulus and frame was shifted by ±8.3 and ±16.6 arcmin within and outside Panum's fusional area, respectively.

EMPIRICAL RESULTS

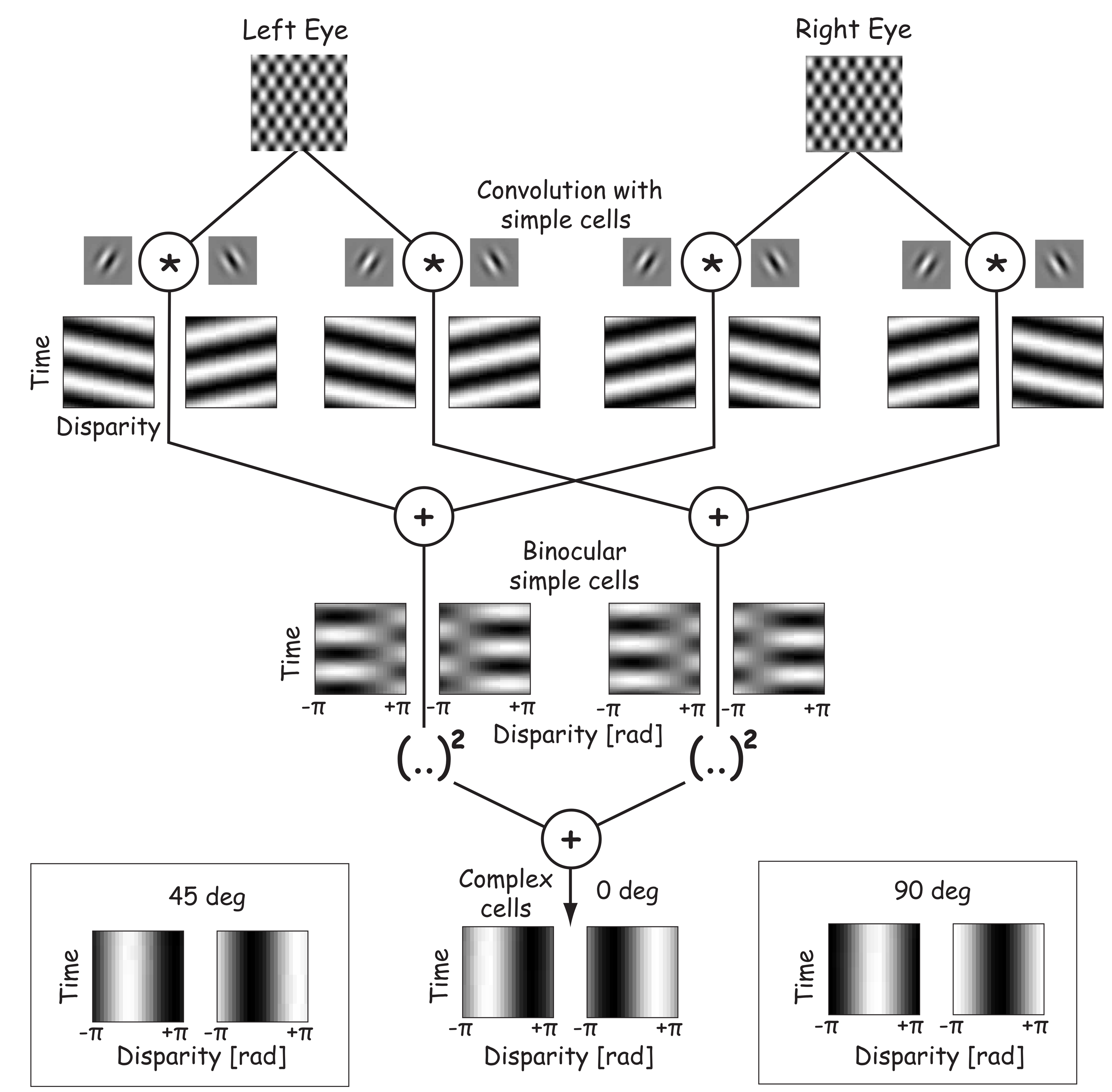
Proportion of 'right motion' responses are plotted against spatial phase difference. If dichoptic motion is perceived at zero depth only then psychometric curves should shift by ±55 and ±110 deg phase angle (±8.3, ±16.6 arcmin).





SIMULATIONS

Counterphase flicker with spatial phase difference of 0, 45 and 90 deg served as input to Qian's (1994) model. Input is described as space-time plots whereas subsequent images show activation over time (y-axis) for simple, binocular and complex cells tuned to different disparities (x-axis) and opposite motion.



Sinusoidal flicker can be understood as the sum of two opposite motions. As a consequence the flicker stimulus activates left and right motion detectors at different depths.

SUMMARY OF RESULTS

Phase difference 0 deg: Left motion at -π/2 and right motion at +π/2 disparity.
Phase difference 45 deg: Left motion at -π/4 and right motion at +3π/4 disparity.
Phase difference 90 deg: Left motion at 0 and right motion at +π disparity.

RESULTS

EMPIRICAL RESULTS
Shifts of psychometric curves indicate that dichoptic motion is best perceived near zero depth. Observers seem to ignore stimulus disparity. However, shifts were generally smaller than predicted.

Additional data for horizontal stimuli (not shown) show no shift of psychometric curves in line with our predictions.

SIMULATION RESULTS
The hybrid energy model predicts motion activation for opposite directions in different depth planes.

CONCLUSIONS

Dichoptic motion is limited to low spatial and temporal frequencies, and low contrast. The present result restricts the phenomenon to the fixation plane.

It is possible to reconcile our empirical data with the simulation results if we assume that motion away from the fixation plane is increasingly suppressed.

We cannot rule out feature tracking but short presentation times and the failure to attend to different depth planes makes this unlikely.

ACKNOWLEDGEMENTS
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