Improved Color Sensitivity during Smooth Pursuit Eye Movements

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Introduction

Movements of the eyes do have negative effects on visual perception. During saccadic eye movements, for example, suppression has been reported for stimuli being processed in the magnocellular system[1], while at the same time the visual world is compressed towards the saccade target[2]. We explored the possibility that similar effects would surface during smooth pursuit eye movements.

The sensitivity for peripheral luminance stimuli is suppressed during pursuit, probably because of the binding of spatial attention to the pursuit target[3]. Here we investigate the sensitivity for chromatic stimuli.

References:

[1] Burr, D.C., Morrone, M.C. & Ross, J. Selective suppression of the magnocellular pathway during saccadic eye movements. *Nature* 371, 511-513 (1994).

[2] Ross, J., Morrone, M.C., & Burr, D. C. Compression of visual space before saccades. *Nature* **386**, 598-601 (1997).

[3] Schütz, A.C., Delipetkos, E., Braun, D.I., Kerzel, D., & Gegenfurtner, K.R. Temporal contrast sensitivity during smooth pursuit eye movements. *Journal of Vision*, in press (2007).

[4] Schütz, A.C., Braun, D.I., & Gegenfurtner, K.R. Contrast sensitivity during the initiation of smooth pursuit eye movements. *Vision Research*, in press (2007).

Methods

We measured the sensitivity for color and luminance stimuli during pursuit and fixation. Subjects had to track a spot target that was stationary (fixation) or moved horizontally (pursuit) with a velocity of 10.57 deg/s. Contrast sensitivity was measured by means of a blurred 0.3 deg wide horizontal line that appeared for 10 ms 2 deg above or below the pursuit trajectory. The line was defined by an increment or decrement in luminance or in isoluminant red-green color. A staircase procedure was used to find the contrast level at which the subjects could either just tell whether the line was presented above or below the pursuit target (detection), or at which they could just indicate whether the line appeared black, white, red or green (discrimination).

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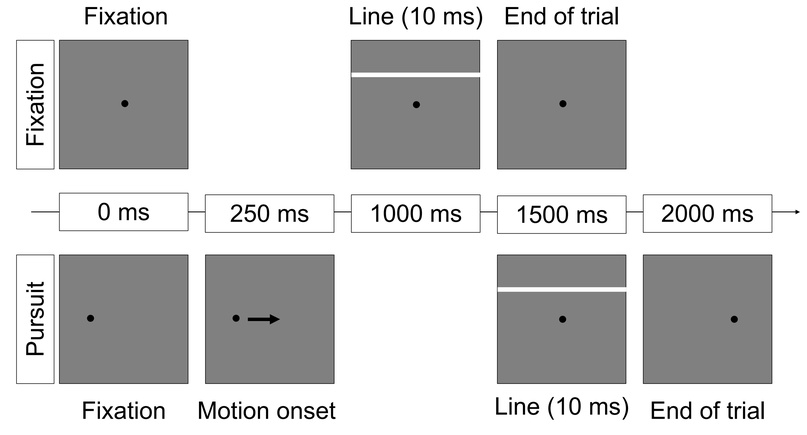
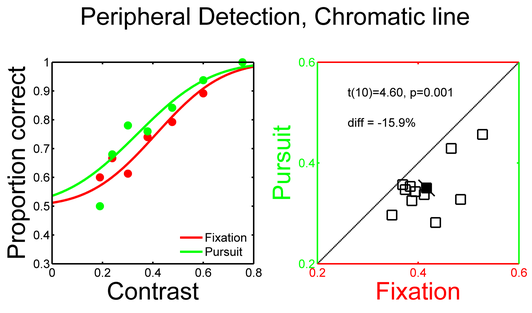
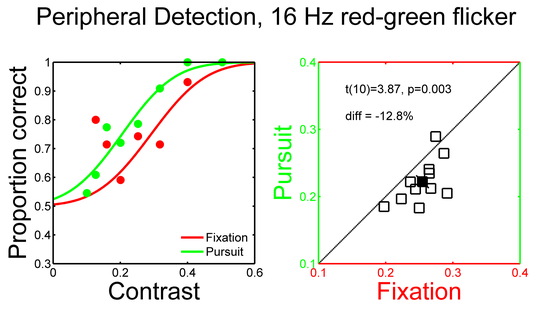
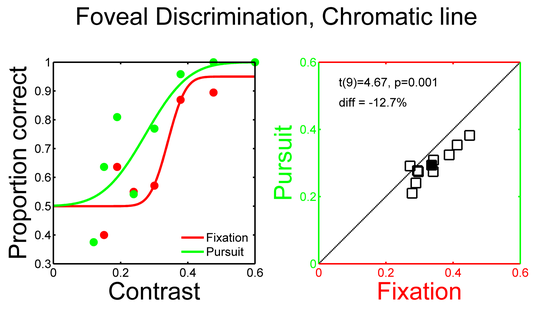
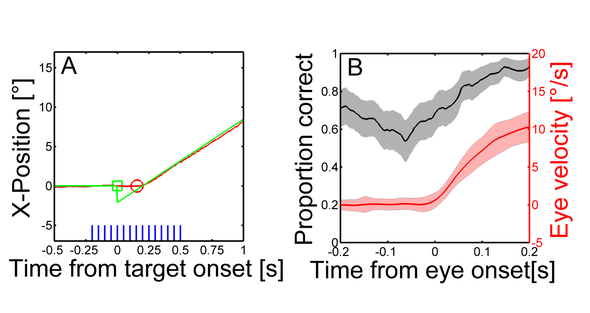


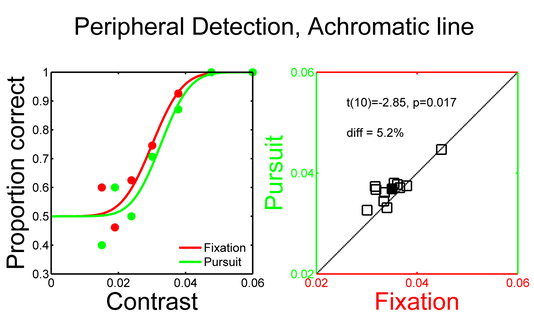
Results

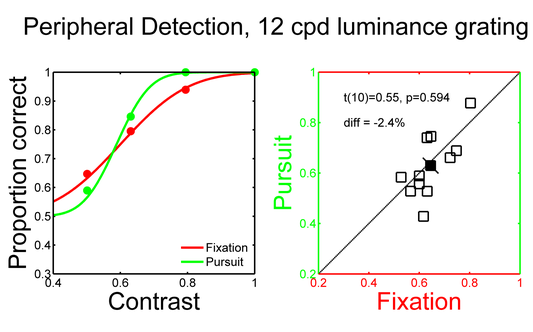


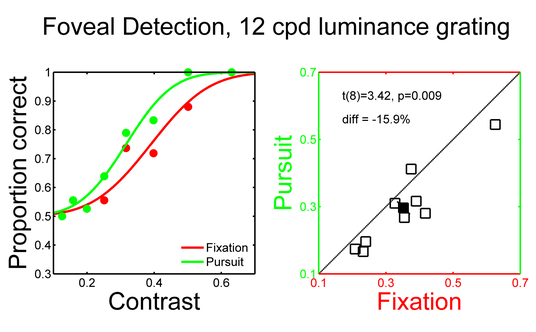


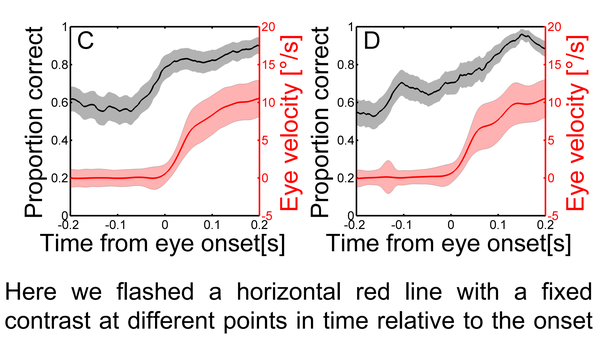












The detection threshold for chromatic stimuli (top) was lowered during smooth pursuit by **16%** compared to fixation. For achromatic stimuli (bottom) in contrast the thresholds were on average **5%** higher during pursuit than during fixation. The discrimination thresholds followed the same pattern.

Here we used a 16 Hz red-green flicker (top) and an achromatic square wave pattern of 12 cpd (bottom) as detection stimulus. The threshold for the chromatic flicker was lowered by **13%** during pursuit. The threshold for the achromatic square wave pattern was not significantly different between pursuit and fixation.

To investigate foveal sensitivity, we presented the chromatic line (top) and the luminance square wave pattern (bottom) vertically centered on the pursuit trajectory. The chromatic sensitivity was improved by **13%** during pursuit. The sensitivity for the high-spatial frequency pattern was improved by **16%** during pursuit.

Here we flashed a horizontal red line with a fixed contrast at different points in time relative to the onset of a step-ramp target (A). By means of a sliding weighted histogram we calculated the detection rate over the time course of pursuit initiation[3].

The results show an increase of the detection rate even before the onset of smooth pursuit. This indicates an extra-retinal source of the sensitivity enhancement.