Supplemental Data: When your eyes see more than you do

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Supplemental Experimental Procedures

Observers were seated in a dimly illuminated room facing a Viewsonic G225f monitor with a refresh rate of 120 Hz at a viewing distance of 100 cm. The active screen area subtended 22° of visual angle in the horizontal direction and 15° of visual angle in the vertical direction, and the screen resolution was 1,024×768 pixels. The screen was viewed binocularly, but only the movements of the right eye were monitored. The subject's head was stabilized by a chin rest and a support for the forehead. Visual stimuli were generated using a Cambridge Research Visage system under the control of Matlab.

The visual target consisted of a Gabor patch constructed with a vertically oriented sinusoidal grating with a spatial frequency of 1 cycle/° as the carrier, multiplied by a Gaussian window with an SD of 0.2° (Gegenfurtner et al. 2003). The Gabor was antisymmetric, and the phase was randomly changed between 0 and 180° from trial to trial. Each trial started with the subject fixating a Gabor patch located at the center of the screen. After a 0.5-s delay, the target would jump to ±5° along the horizontal meridian and start moving in the opposite direction. The direction of drift was randomized from trial to trial. The target drifted at a constant speed of 4°/s with a brief temporal perturbation (a single cycle of sinusoidal shape in velocity) was added after 1.5 s from the onset of the motion. Three temporal frequencies, {3, 5, 8} Hz, and various amplitudes were tested and produced similar results. The 5Hz condition is the one reported in the body of the paper, the two other conditions are shown in Supplemental Fig 1.

The two authors [males, age 31 (A.T.) and 44 yr (D.R.)], both trained psychophysical observers with normal (A.T.) and corrected to normal vision (D.R.), and two naïve observers [male, ages 70 (D.T.) and 20 (P.L.)], with normal vision but no prior psychophysical experience, participated in all the experiments. All the experiments were conducted with the approval of the Chancellor's Office for the Protection of Research Subjects at UCLA, with subjects providing their informed consent.

Eye movements were recorded by an SR-Research Eyelink-II system at a sampling frequency of 1 kHz. Each session consisted of 100 pursuit trials, with nine-point calibration stimuli interspersed every 25 trials. Each trial began with the Gabor patch centered on the screen and the subject indicating his readiness by pressing a button. Eye position data were sampled at 1 kHz and saved on disk for later processing. These traces were subsequently differentiated and subsampled at 120 Hz using Matlab's resample function. This brought both eye and target velocity signals to a common sampling frequency of 120 Hz. Saccades were automatically detected by thresholding the velocity trace at 4 SD of the average eye velocity fluctuations. Data segments from within 100 ms of detected saccades (either before or after) were excluded from analysis, as was the initiation of pursuit. All subjects were initially trained on the task by providing feedback on each individual trial. Observers trained for a number of sessions until their performance did not improve any further.

Finally, to test the idea that the perceptual system was impaired by masking of visual motion signals generated by the eye movements in response to the perturbation, we conducted a control experiment where the subjects performed the task in a condition where the moving Gabor target disappeared right at the end of the perturbation. Such trials were interleaved with trials where no blanking occurred to reduce the tendency for predictive deceleration of the eye in blocked conditions.

First, we measured the average eye responses for each perturbation types (peak-first and peak-last for a perturbation magnitude of 2 deg/s) to be able to compute oculometric performance. Then, we measured psychometric and oculometric performance for two perturbation magnitudes (0.5 and 1.0 deg/sec) based on a total of 100 trials in each condition. The results were similar to that of the original experiment (**Table S1**). For a perturbation magnitude of 0.5 deg/s, both subjects performed at chance in the blanking experiment while the oculometric performance was statistically higher than chance (77% correct for AT and 75% correct for DR, $p < 10^{-7}$). In contrast, note that original psychometric performance in the 0.5 deg/s case was clearly above chance in both subjects (**Figure 1,** in main article). This means that, if anything, blanking was detrimental in our task. This means retinal slip induced by the target's velocity perturbation is being used by the subjects in the non-blanking condition to achieve higher performance levels.

Supplemental Results

Results of the blanking experiments expressing the psychometric and oculometric performance for perturbation magnitudes of 0.5 deg/sec and 1.0 deg/sec is shown in **Table S1**

AT

Performance \ Perturbation Magnitude	0.5 deg/sec	1.0 deg/sec
Psychometric	52%	60%
Oculometric	77%	90%

DR

Performance \ Perturbation Magnitude	0.5 deg/sec	1.0 deg/sec
Psychometric	50%	75%
Oculometric	75%	93%

Table S1: Psychometric and oculometric performance in the blanking control experiment.

Psychometric and oculometric performance for perturbations where the period of the sinusoid corresponded to 3Hz and 8Hz is shown for three subjects in Figure S1.

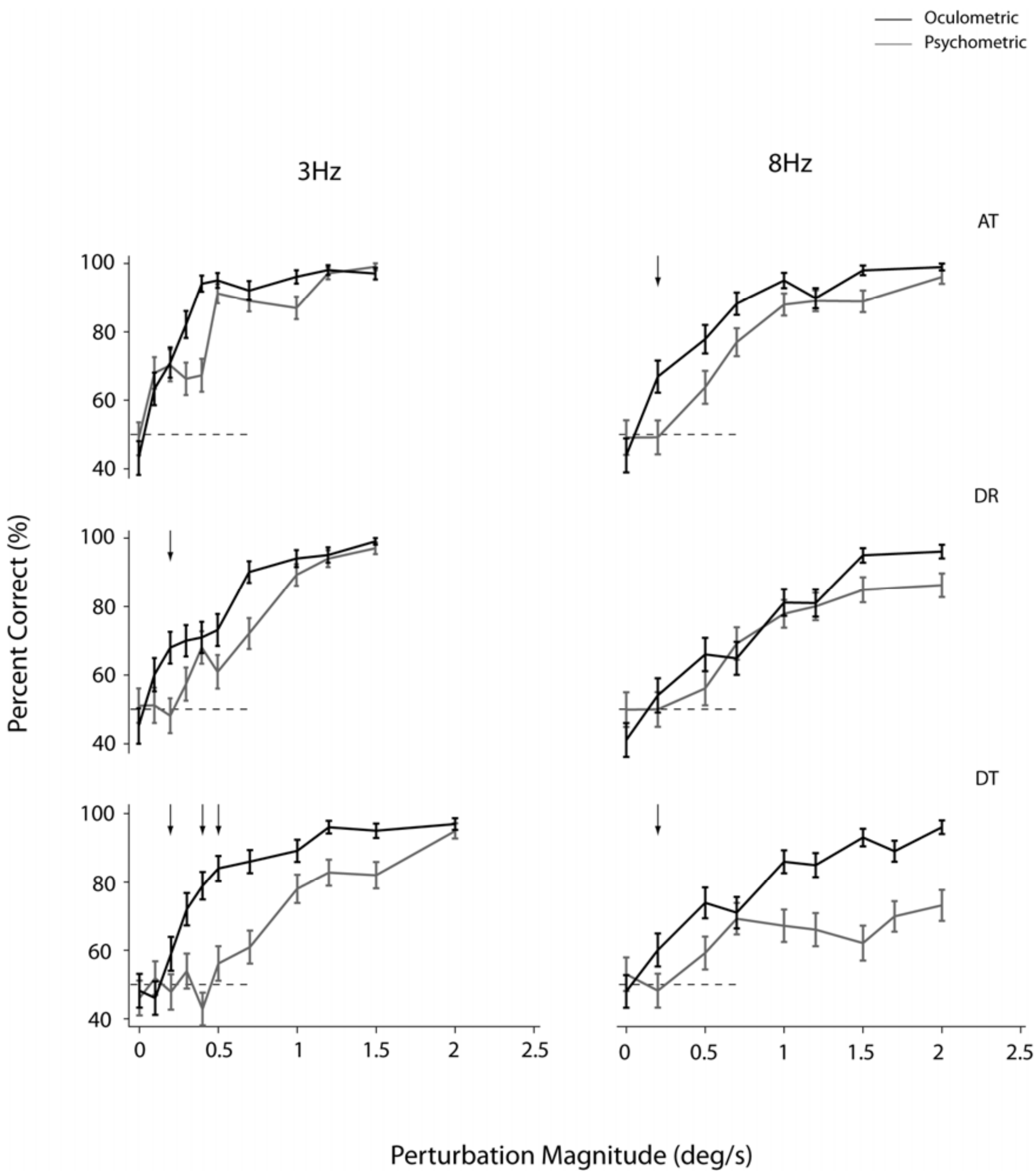

Figure S1: Psychometric and oculometric performance at 3Hz and 8Hz