Simultaneous oblique effects in human pursuit and perception.

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The “oblique effect,” higher direction discrimination thresholds for motion in oblique directions, is well established. A recent study failed to find an oblique effect for pursuit and argued that the anisotropic neural signal driving perceptual judgments is therefore separate from an isotropic signal driving pursuit (Churchland et al, 2003). To examine this question further, we compared simultaneous direction judgments and pursuit responses to the same stimuli. The stimulus was a red spot moving at 10?/s along a straight path tangential to an invisible circle ~5 deg in diameter, for either 200 or 750-850ms. Six observers (3 naïve) were presented with two sequential intervals of motion along one of 8 directions (4 cardinals & 4 primary obliques). Observers were asked to pursue the target and to report which interval contained motion in the more clockwise direction. An “oculometric” decision was determined on each trial by choosing the interval with pursuit in the more clockwise direction (Beutter & Stone, 1998). Probit analysis revealed that both the oculometric and psychometric uncertainties were, on average, higher for the oblique directions than for the cardinal directions, although this oblique effect appears smaller for steady-state pursuit. The mean oblique-to-cardinal ratios for perception were 1.5±0.2 (±SD across observers) and 1.8±0.4, for the short and long durations, respectively. The mean ratios for pursuit were 1.7±0.4 during initiation (150-350ms after motion onset) and 1.2±0.2 at the end of the trial (550-750ms), both significantly higher than 1 ($p < 0.005$ and < 0.04, respectively, paired one-tailed t-test). Our findings are consistent with a shared, anisotropic neural signal that encodes target motion direction and drives both perception and pursuit, albeit with additional unshared, isotropic neural noise downstream in the oculomotor pathways.

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