Anisotropies of smooth pursuit gain and perceptual coherence sensitivity

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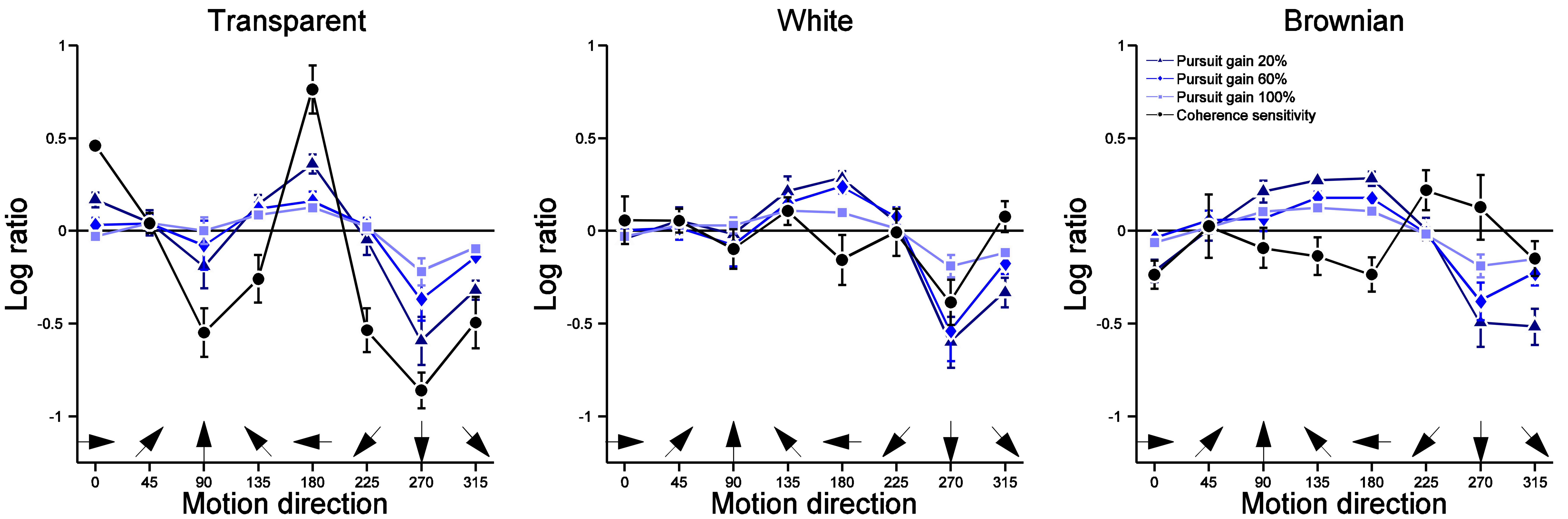
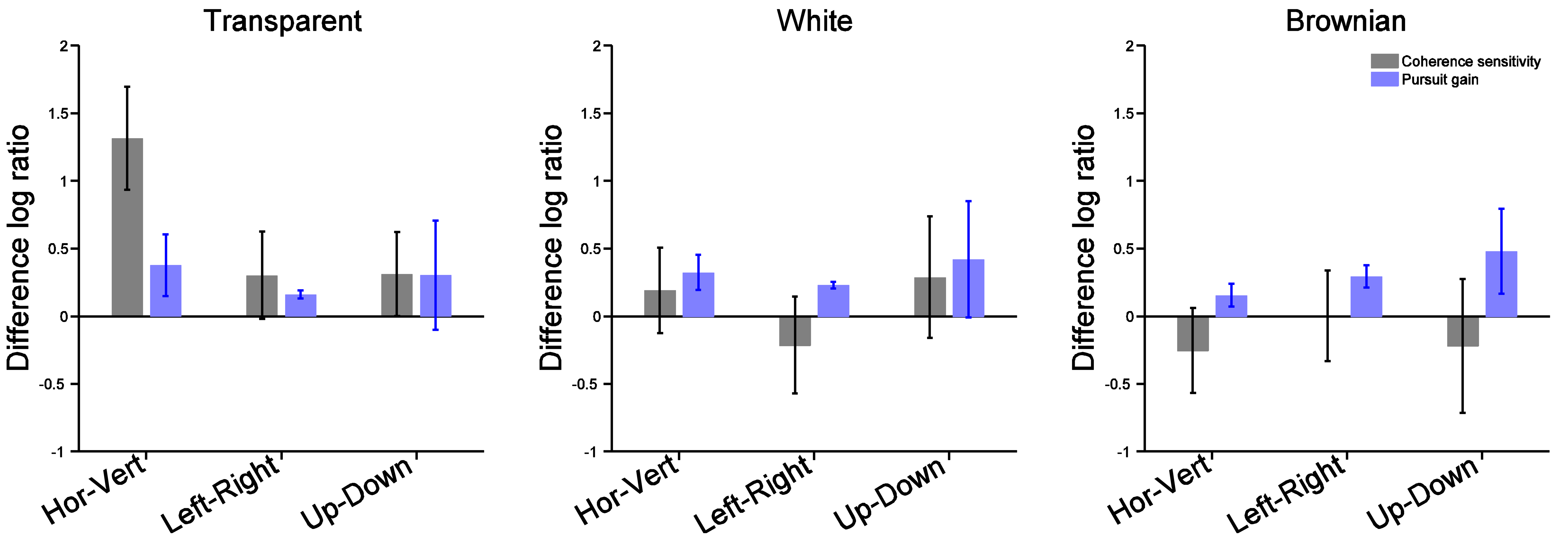
Introduction

There are directional anisotropies for slow-phase gain of the optokinetic nystagmus [1,2] as well as for motion perception [3]. Here we investigated whether anisotropies in smooth pursuit gain are caused by sensory or motor effects. To this end we measured smooth pursuit gain and coherence sensitivity for three different types of random-dot kinematograms [4]. Pursuit gain was measured at three different coherences (20, 60 & 100 %). We would attribute anisotropies to sensory effects, if they are present in both, pursuit gain and coherence sensitivity. On the other hand, we would attribute anisotropies to motor effects, if they are not present in coherence sensitivity, but in pursuit gain for all three kinematogram types.

Results



In general, anisotropies were strongest in the transparent motion. Especially the difference between horizontal and vertical motion was large in this condition and fulfilled both criteria for the definition of a sensory anisotropy. For white and Brownian motion there were no systematic anisotropies in coherence sensitivity, but in pursuit gain: For white motion there were significant pursuit anisotropies between horizontal and vertical motion as well as between leftward and rightward motion. For Brownian motion there were significant pursuit anisotropies for horizontal and vertical, leftward and rightward and for upward and downward motion. Interestingly there was no oblique effect [3] in coherence sensitivity or pursuit gain.



Methods

First, we asked seven observers to pursue three different types of random-dot-kinematograms [4] at three different coherence levels (20, 60 & 100%). The kinematograms were presented in a circular aperture of 10 deg radius, at a dot density of 1 dots/deg². The types of kinematograms differed in the way the noise was displayed:

Kinematogram type	Noise
Transparent	Constant speed and direction throughout lifetime
White	Varying speed and direction
Brownian	Constant speed and varying direction (random walk)

We analyzed pursuit gain in a time interval from 400 to 500 ms after motion onset. Only those trials were used, in which the observer indicated the correct direction at the end of the trial.

Second, we asked observers to indicate the direction of the kinematograms. The coherence level was adjusted by a staircase procedure to estimate the coherence threshold.

Discussion

These results suggest that the different kinematogram types reveal different anisotropies. The horizontal-vertical difference was most pronounced in transparent motion and has presumably a strong sensory component, since it was also present in coherence sensitivity. The large anisotropy in coherence sensitivity might point to a prior for horizontal motion vs. vertical motion.

The left-right and up-down differences were stronger in the White and Brownian motion and occurred only in pursuit gain. Thus they are most likely caused by motor effects.

References:

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Acknowledgments:

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