**Incomplete compensation for self-motion in the visual perception of object velocity during a visual-vestibular conflict**

**Björn Jörges, PhD and Laurence R. Harris, PhD**

**Center for Vision Research, York University**

When observing a moving target while an observer is moving, the same retinal speeds can correspond to vastly different physical object velocities. When an observer moves in the same direction as the target, the retinal speed corresponding to the object is partially cancelled out, and vice-versa. Observer thus must compensate for their own movement. Estimates of an observer’s speed should be facilitated when visual and vestibular cues are congruent. When self-motion is experienced only visually, compensation is likely to be incomplete, leading to biases in judgments of object speed (Hypothesis 1). Furthermore, it has been argued that self-motion information is noisier than retinal information concerning object motion, and more so in absence of vestibular cues. Subtracting noisy self-motion information from retinal motion should thus decrease precision (Hypothesis 2). To test these hypotheses, we presented two motion intervals in a 3D virtual environment and asked participants which motion was faster; one in which a target moved linearly to the left or to the right in the fronto-parallel plane, and one that consisted of a cloud of ­smaller targets travelling in the same direction. The single target moved at one of two constant speeds (6.6 or 8m/s, 6m from the observer), while the speed of the cloud was determined by a PEST staircase. While observing the single moving target, participants were moved visually either in the same direction, in the opposite direction, or remained static. In support of Hypothesis 1, we found differences in accuracy between static, congruent and incongruent motion, indicating inadequate compensation for the observer’s motion. Self-motion during target motion observation decreased precision compared to the static condition in support of Hypothesis 2. Further research is necessary to determine how the availability of vestibular cues can remedy accuracy or precision losses during self-motion.

**Acknowledgements**

LRH is supported by an NSERC discovery grant. BJ is supported by the Canadian Space Agency.

**References**

Dokka, K., MacNeilage, P. R., DeAngelis, G. C., & Angelaki, D. E. (2015). Multisensory self-motion compensation during object trajectory judgments. *Cerebral Cortex*, *25*(3), 619–630. https://doi.org/10.1093/cercor/bht247

Fetsch, C. R., Deangelis, G. C., & Angelaki, D. E. (2010). Visual-vestibular cue integration for heading perception: Applications of optimal cue integration theory. *European Journal of Neuroscience*, *31*(10), 1721–1729. https://doi.org/10.1111/j.1460-9568.2010.07207.x

Harris, L. R., Jenkin, M., & Zikovitz, D. C. (2000). Visual and non-visual cues in the perception of linear self motion. *Experimental Brain Research*, *135*(1), 12–21. https://doi.org/10.1007/s002210000504