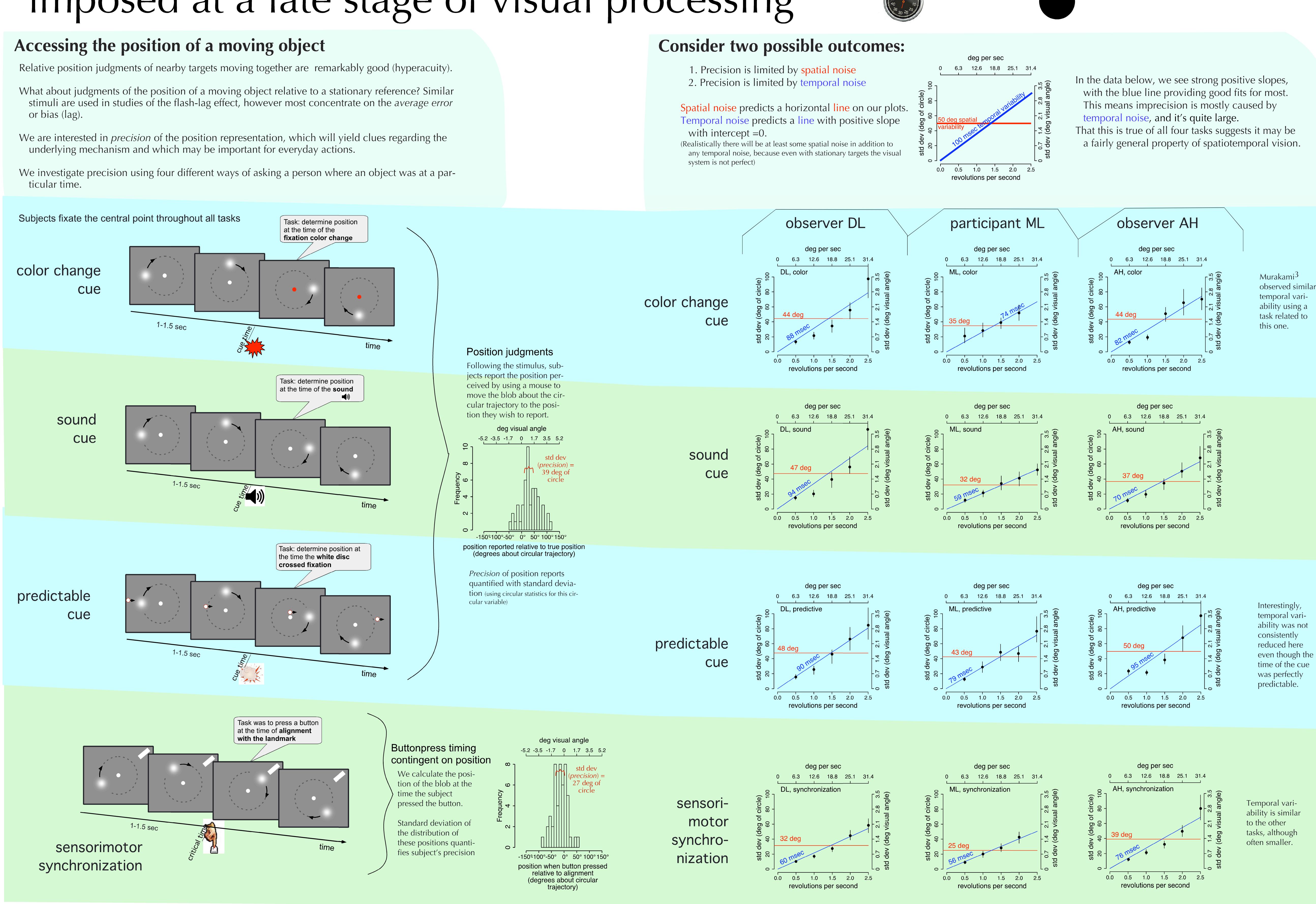
Poor temporal precision in judging the position of a moving object, imposed at a late stage of visual processing

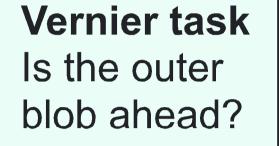


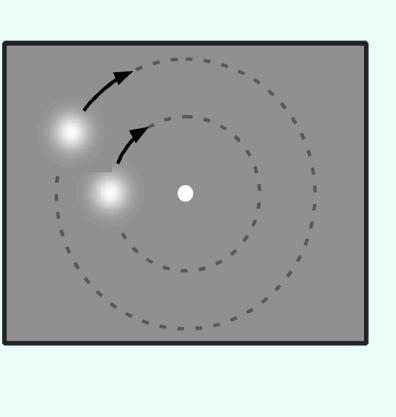
Alex O. Holcombe, Alex L. White, & Daniel Linares

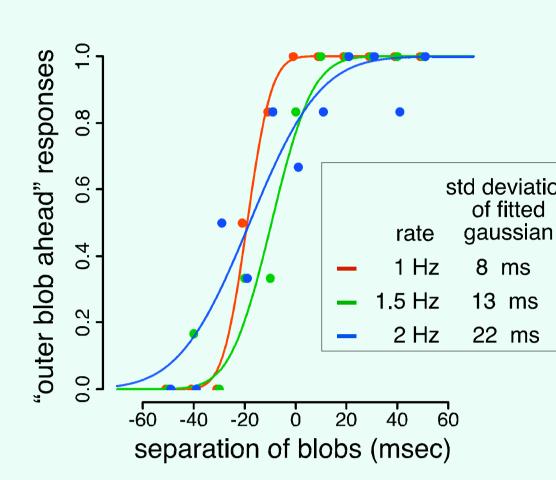
School of Psychology, University of Sydney

A high-level limit on position judgments

- Where in the visual system is this ≥60 ms temporal noise intro-
- It cannot be at the earliest stages such as the retina, because Vernier acuity, even radial Vernier acuity shows only a few ms of temporal noise^{1,2} We have verified this by testing our stimuli with a **Vernier task**:

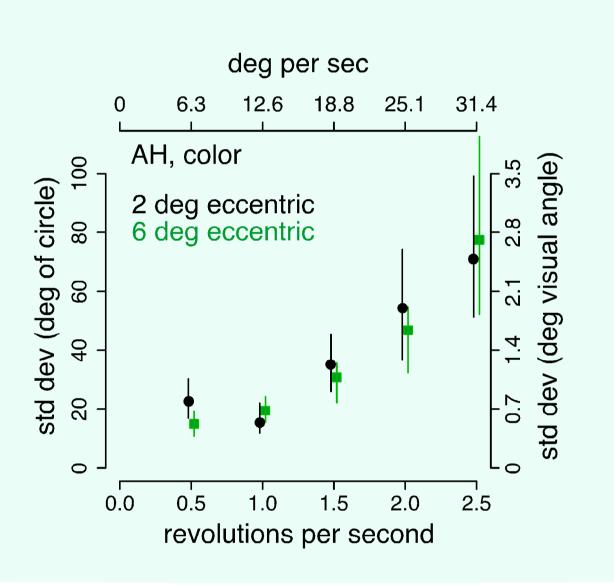


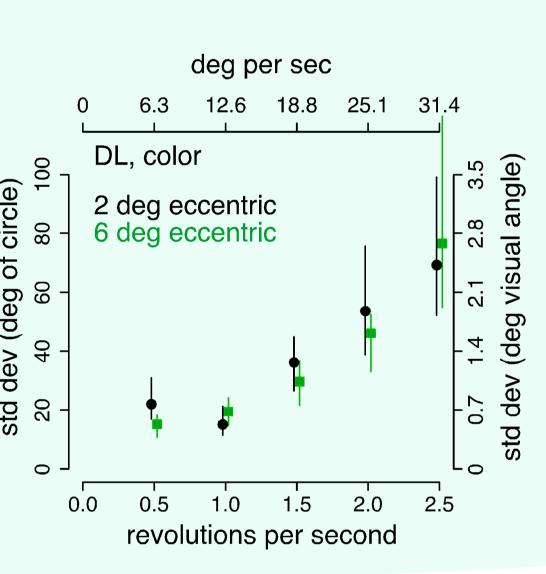




The standard deviations of than those of our main tasks.

Precision is similar when we triple the eccentricity of the stimulus (2 deg, 6 deg), again suggesting that the temporal noise is not caused by low-level factors.





Conclusions

- For localizing the position of a moving object, The three position judgment tasks are dominated by temporal noise (~73 ms) rather than spatial noise.
- Sensorimotor synchronization is also dominated by temporal noise, although perhaps reduced (~64 ms).
- The limits appear to be high-level as they do not afflict our control tasks.

Where in the system does the temporal noise originate?

- •Temporal uncertainty regarding the time of the cue? But we would have expected a great improvement in the collision task.
- Temporal uncertainty in the representation of the moving object itself? But this should also affect Vernier thresholds.
- Temporal imprecision in the process of binding the moving object with the cue? Possibly, as this is consistent with imprecision for binding flickering stimuli^{5,6,7}.

How is the amazing precision (3 ms)⁴ manifest in sport achieved? Do other cues to position, or practice allow one to overcome our ≥60 ms temporal noise? We don't know.

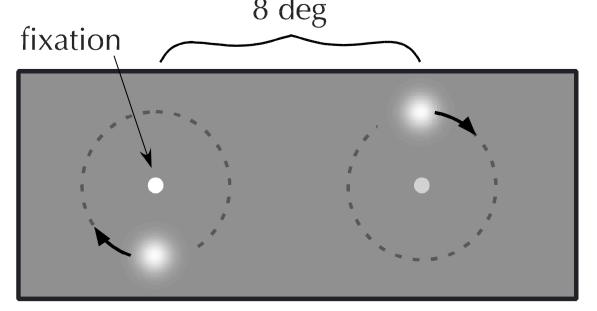
References

1. Levi, D. (1996). Pattern perception at high velocities. Current Biology, 6(8), 1020-102 Carnev. T., Silverstein, D. A., & Klein, S. A. (1995). Vernier acuity during image rotation and translation: visual performance limits. Vision Res, 35(14), 1951-1964. B. Murakami, I. (2001). The flash-lag effect as a spatiotemporal correlation structure. J Vis, 1(2), . McLeod, P. & Jenkins, S. (1991). Timing accuracy and decision time in high-speed ball games International Journal of Sport Psychology, 22, 279-295.

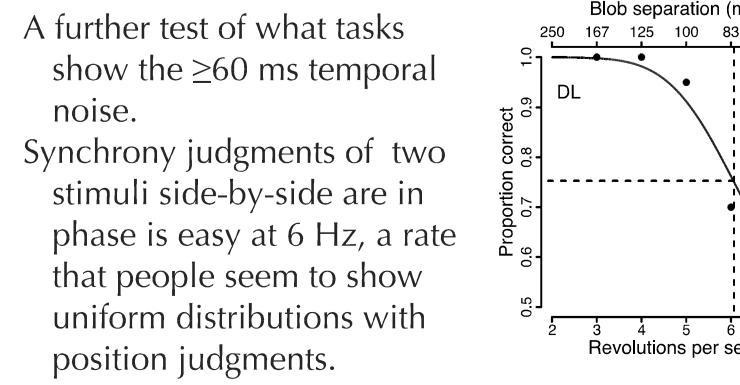
5. Holcombe, A. O. & Cavanagh, P. (2001). Early binding of feature pairs for visual perception. Nature Neuroscience, 4(2), 127-128. **6.** Holcombe, A. O. & Judson, J. (2007). Visual binding of English and Chinese word parts is limited to low temporal frequencies. *Perception, 36*(1), 49-74. 7. Fujisaki, W. & Nishida, S. (2007). Feature-based processing of audio-visual synchrony perception revealed by random pulse trains. Vision Res, 47(8), 1075-1093.

8. Arnold, D. H. (2005). Perceptual pairing of colour and motion. Vision Res, 45(24), 3015-3026. Supported by an Australian Research Council Discovery Project grant to AOH

Complication, to be investigated



Task: Are these rotating in phase or 180° out of phase?



However, 6 Hz = 83 msseparation when out of

But we suspect that these judgments actually reflect a process with better temporal precision than posi-

olds at 1-3 Hz to check.