EYE & VISION RESEARCH WITH PLYMOUTH UNIVERSITY

Higher internal noise is associated with lower sensitivity to slower speed

UNIVERSITY OF PLYMOUTH
Faculty of Health and Human Sciences

Mahesh R Joshi, Charlotte Barsdell
Correspondence: mahesh.joshi@plymouth.ac.uk

GCU Glasgow Caledonian University

Anita J Simmers, Seong T Jeon

Introduction

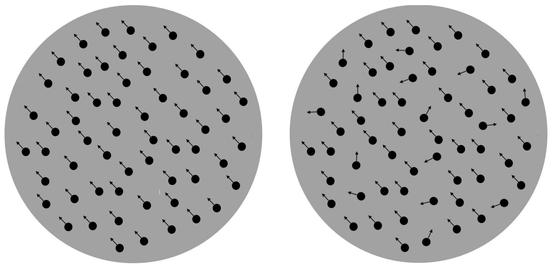
Humans have better sensitivity to faster speeds compared to relatively slower speeds. The difference in sensitivity suggests the presence of independent processing channels for slow and fast speeds or a single channel tuned to differential sensitivity at varying speeds.

In this study, we employ motion coherence and equivalent noise paradigms to investigate if differences in sensitivity to slow and fast speeds are due to varying internal noise or sampling efficiency.

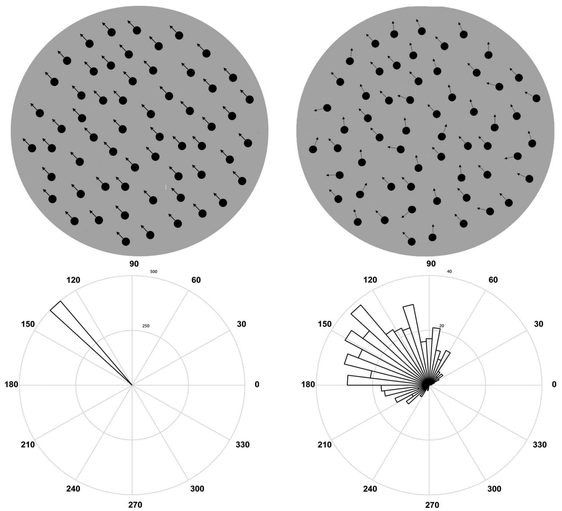
Methods

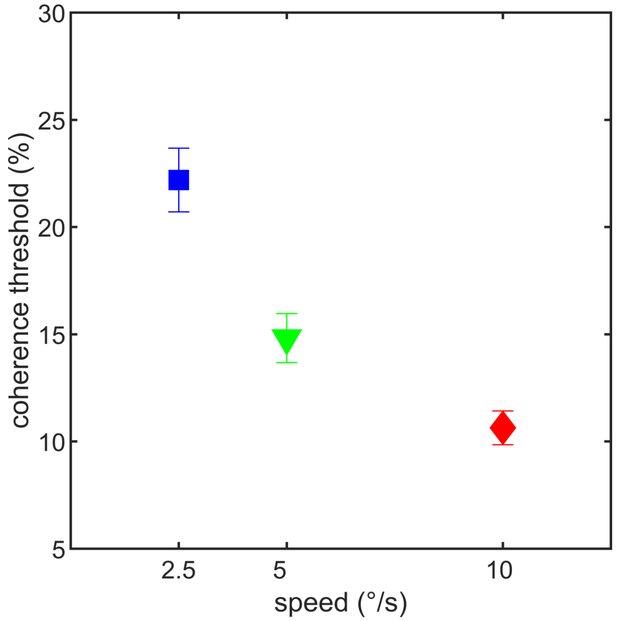
Observers: 8 (6 females), normal or corrected to normal VA.
Mean age: 31 (SD 8) years.
Stimuli: Random dot kinematograms at 3 speeds (2.5°/s, 5.0°/s & 10 °/s)

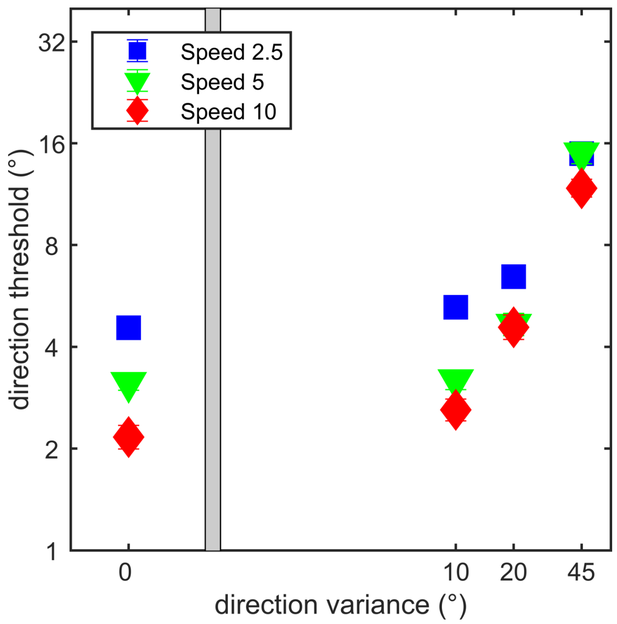
Motion coherence:



Equivalent noise:

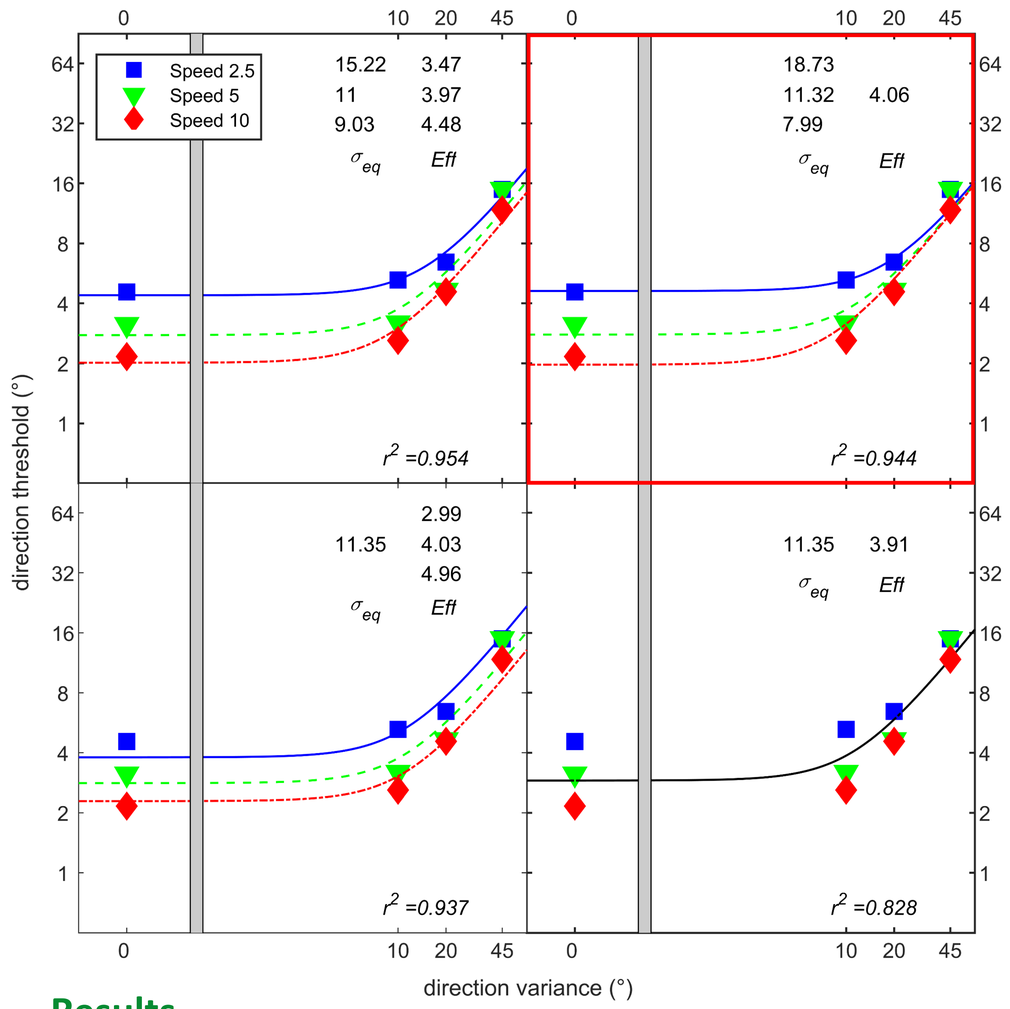






Equivalent noise paradigm: thresholds (τ) were related to external noise (σ_{ext}), equivalent internal noise (σ_{eq}) and sampling efficiency (Eff) through a *linear amplifier model*.

$$\tau = \sqrt{\frac{\sigma_{eq}^2 + \sigma_{ext}^2}{Eff}}$$



Results

The mean motion coherence thresholds were highest for dot speed of 2.5°/s, followed by 5°/s and 10°/s.
The thresholds showed similar pattern for equivalent noise paradigm at no noise level but converged towards higher noise levels. The nested modelling showed that the difference in threshold across noise levels were best described by change in internal noise (σ_{eq}).

Conclusion

The difference in sensitivity to faster and slower speeds is due to changes in internal noise within the speed processing channels, possibly arising at early cortical areas for motion processing such as V1.

This study was supported by College of Optometrist summer studentship.