Change blindness for changes in 3D structure

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Change blindness for 3D scenes?

Searching for scene changes in immersive VR, performance can be poor[1].

Effect of attention/memory?

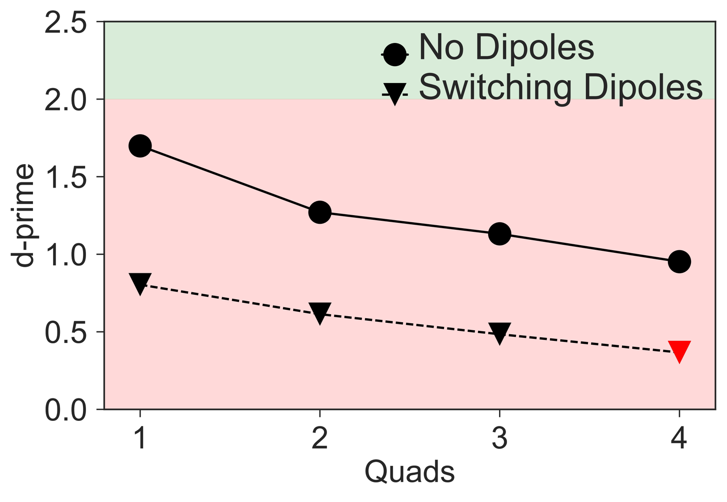


Figure 1: Detection of movement in a VR scene.

Change detection when the target is known

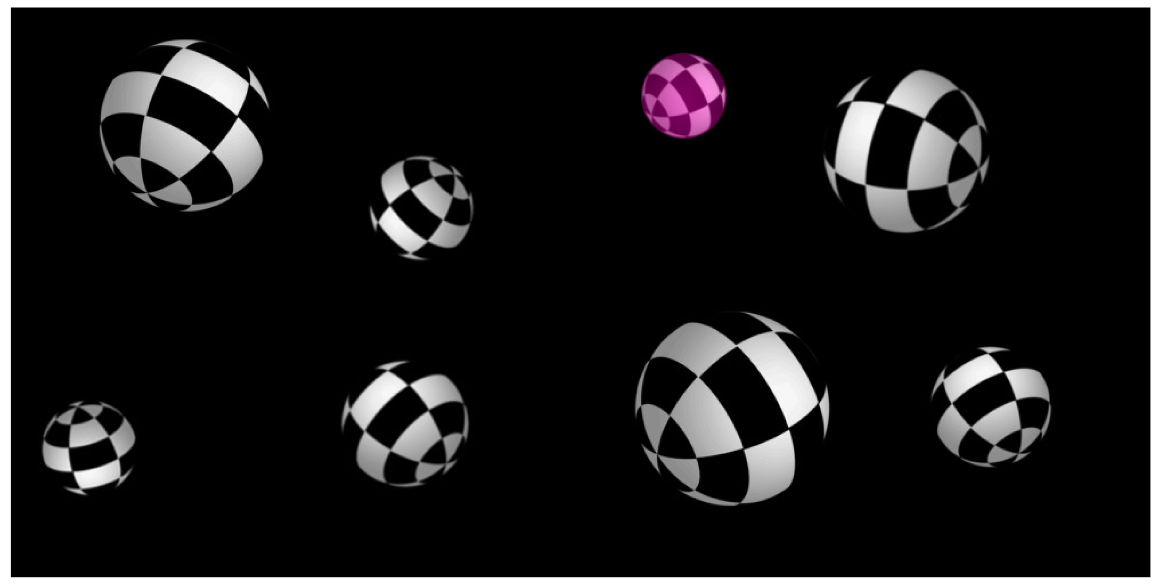


Figure 2: Stimuli were presented in immersive VR. Participants could move in a 3x3m area.

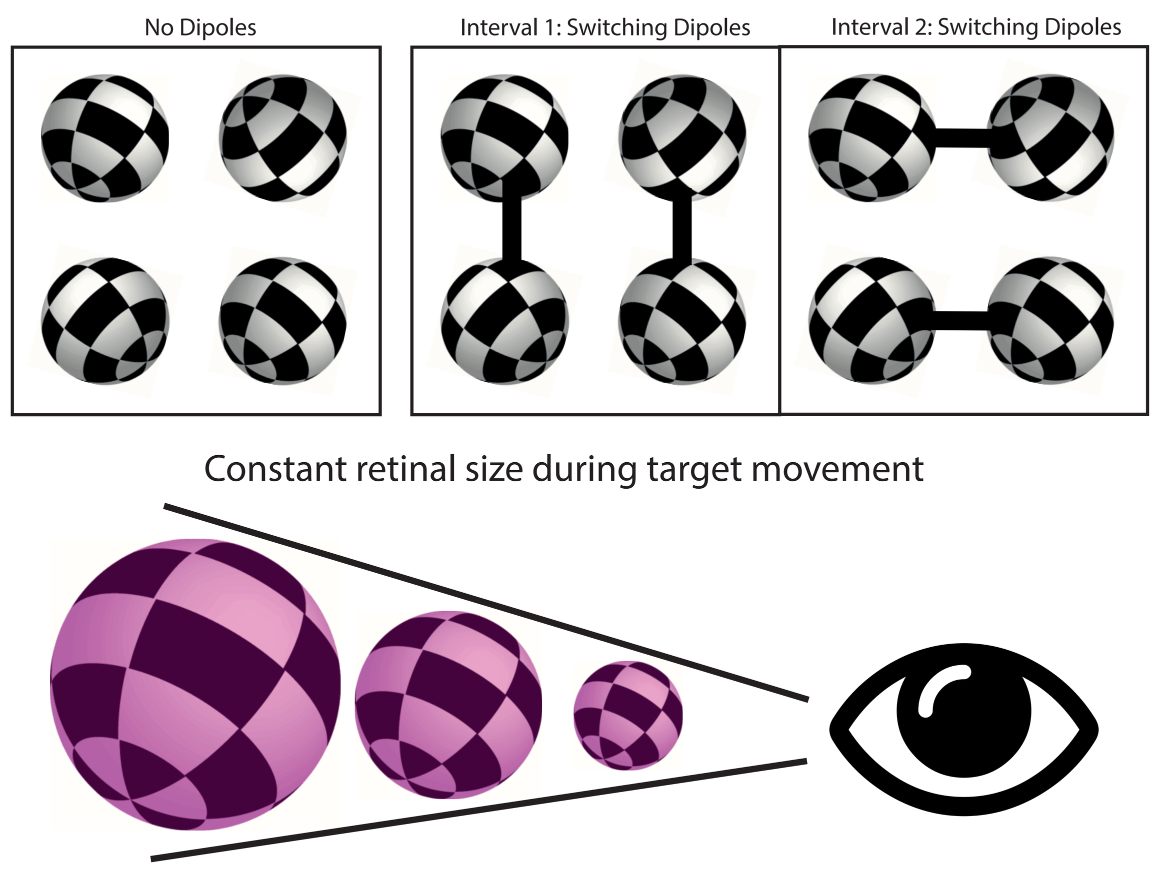


Figure 3: Scene comprised of 1-4 'quads' (clusters of 4 spheres) at distances between 2.5-7.5m. Target was colour marked and movement of either 2m or 30cm occurred in a half second ISI on 50% of trials. Target sphere maintained retinal size during movement. Participants reported whether the target moved or not.

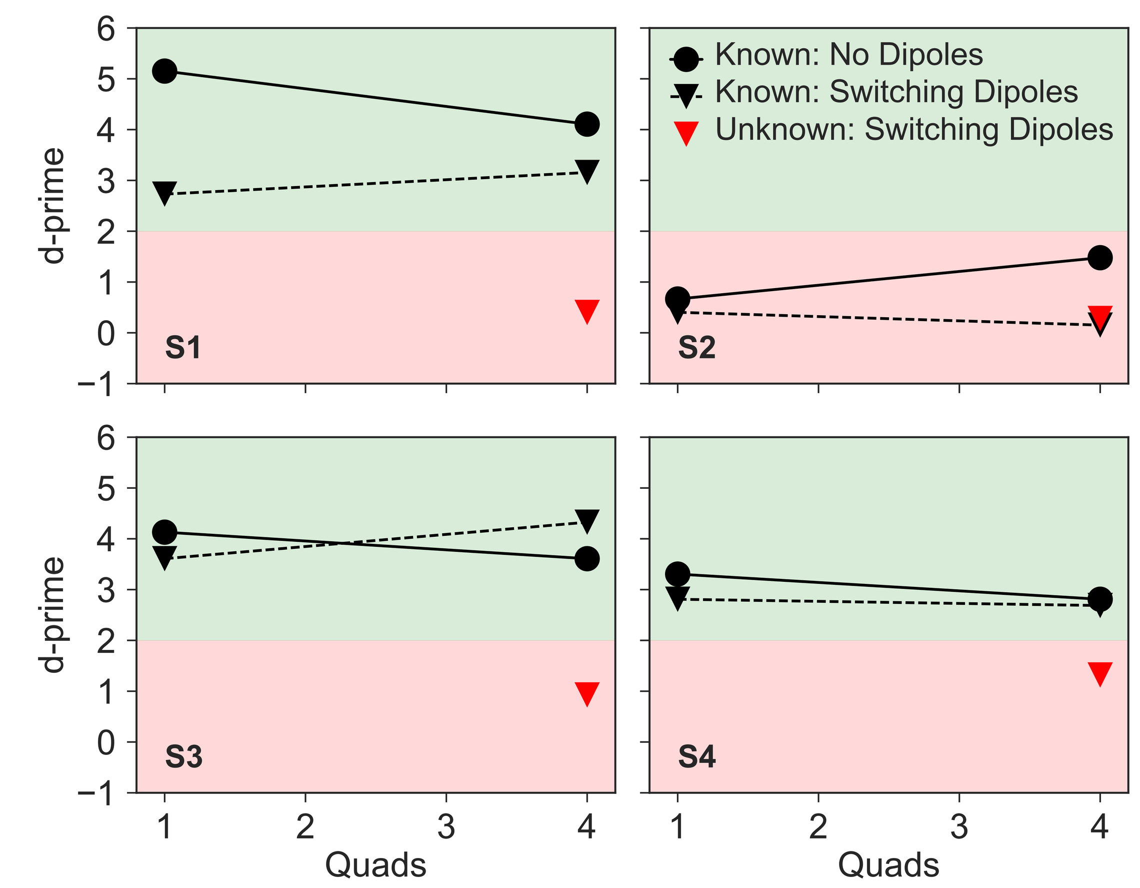


Figure 4: D-prime for the 2m movement across manipulations when the target is known. Also plotted is the unknown-target condition that previously led to the lowest performance.

Signal Detection Modelling

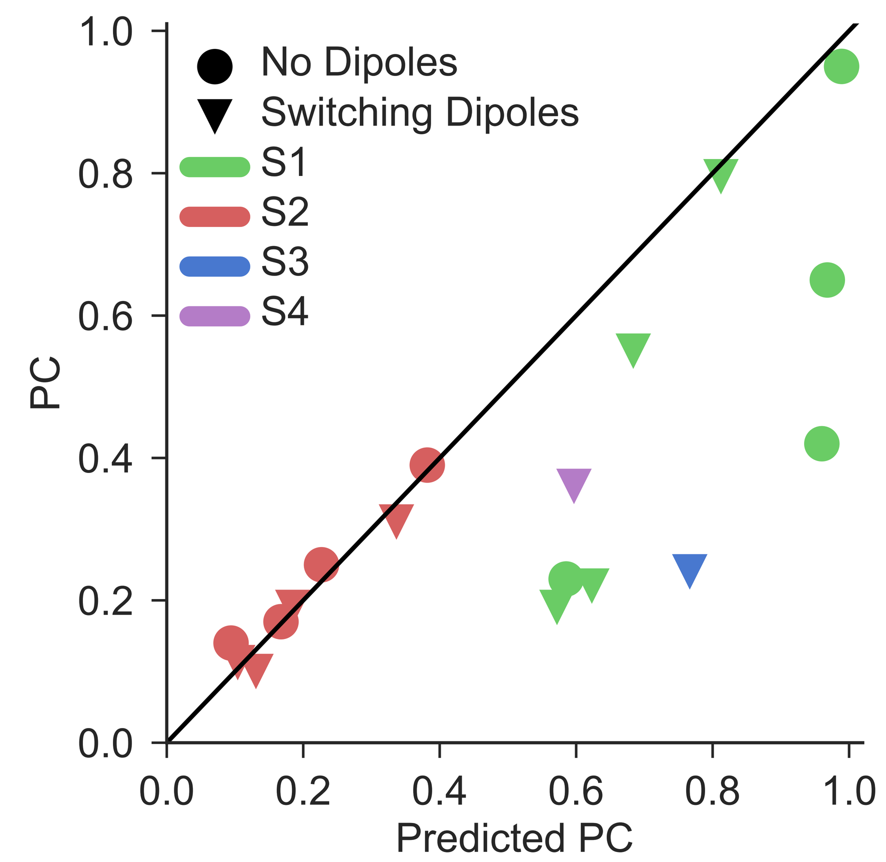
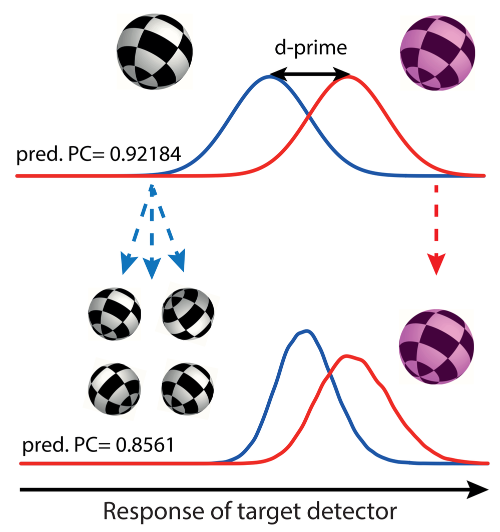


Figure 5: Modelling performance in an unknown-target task based on known-target performance.



Using a signal detection framework[2] we can predict performance in the unknown-target task from known-target performance. Deviations from the prediction suggest that attention/memory play an additional role.

Comparison with the literature

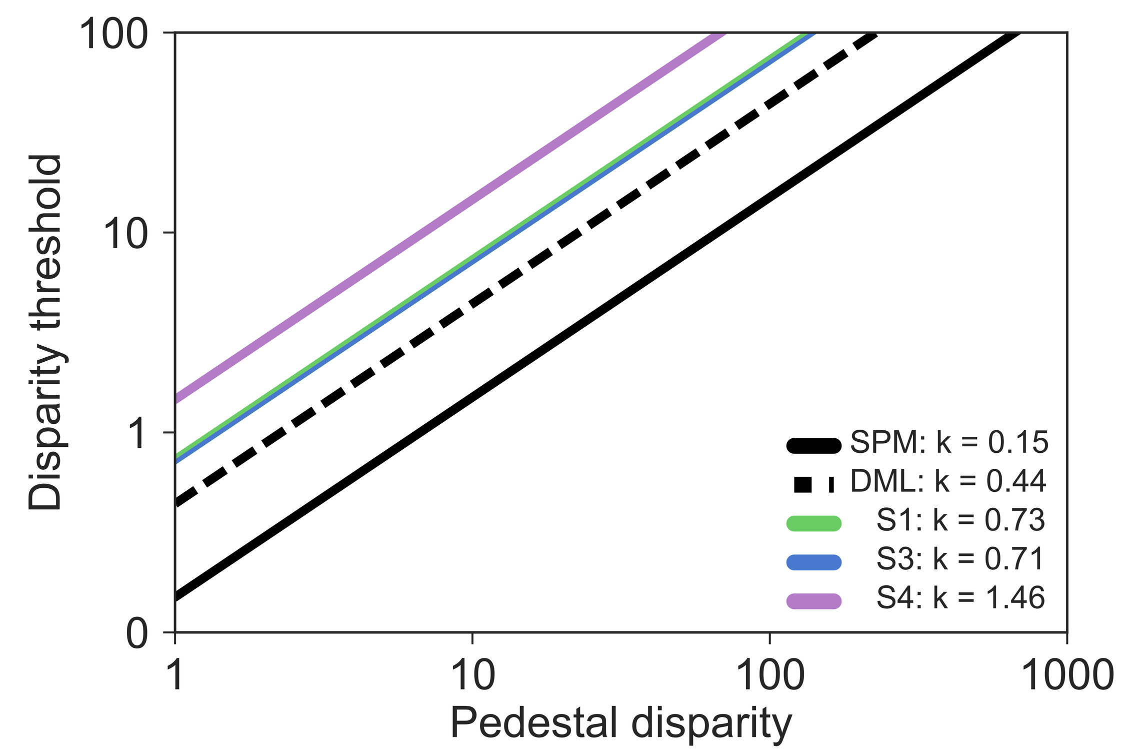


Figure 6: Relationship between pedestal disparity and disparity thresholds (84%) for the known-target conditions and data from the literature[3]. Fitting of parameter k failed for S2.

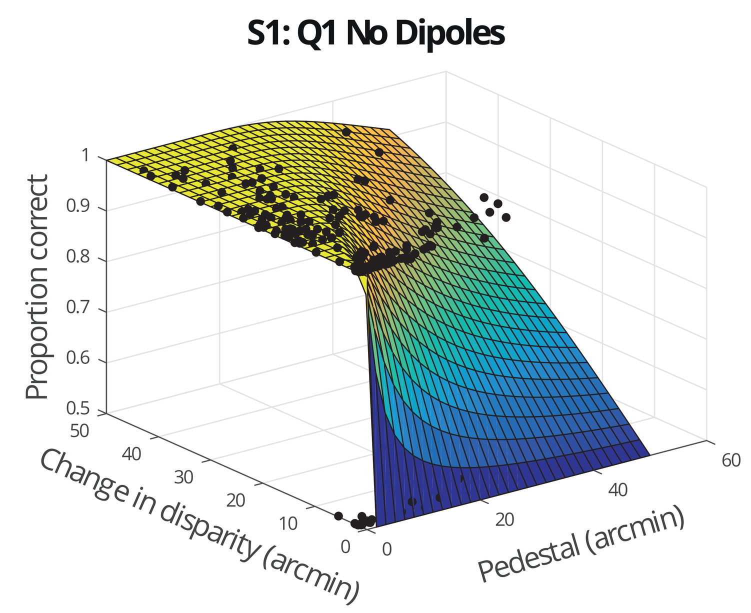


Figure 7: Predicting thresholds for different pedestals.

Thresholds for discrimination based on disparity are dependent on pedestal disparity[3], where

$$\sigma = k * pedestal \qquad (1)$$

For our stimulus, pedestal disparity is based on the nearest distractor within the target quad.

Conclusions

- Performance for the known target is comparable to the literature.
- When the target is unknown, performance deteriorates. Monitoring multiple channels can only account for some of this change.
- Limitations in attention or memory are not included in the model but are likely to contribute.

References

[1] Peter Scarfe and Andrew Glennerster. Sensory cues used to determine 3d world stability. *Journal of Vision*, 16(12):285–285, 2016.

[2] Preeti Verghese. Visual search and attention: A signal detection theory approach. *Neuron*, 31(4):523–535, 2001.

[3] Suzanne P McKee, Dennis M Levi, and Samuel F Bowne. The imprecision of stereopsis. *Vision research*, 30(11):1763–1779, 1990.