Predictive processing of upcoming scene views in immersive environments: evidence from continuous flash suppression

DARTMOUTH

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Background

As we look around the world, we operate with a limited field of view. How do we overcome this limited field of view to interact effectively in 360° space? Past work suggests that memory for a visual stimulus can impact how quickly it enters perceptual awareness [1,2]. Here, we used breaking continuous flash suppression (bCFS) [3] to test whether memory for an immersive environment likewise impacts how quickly upcoming scene views enter perceptual awareness following a head turn.

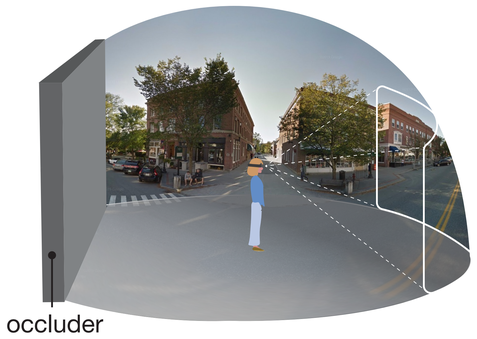
Question

In familiar places, do expected scene views enter perceptual awareness at a different rate than unexpected views?

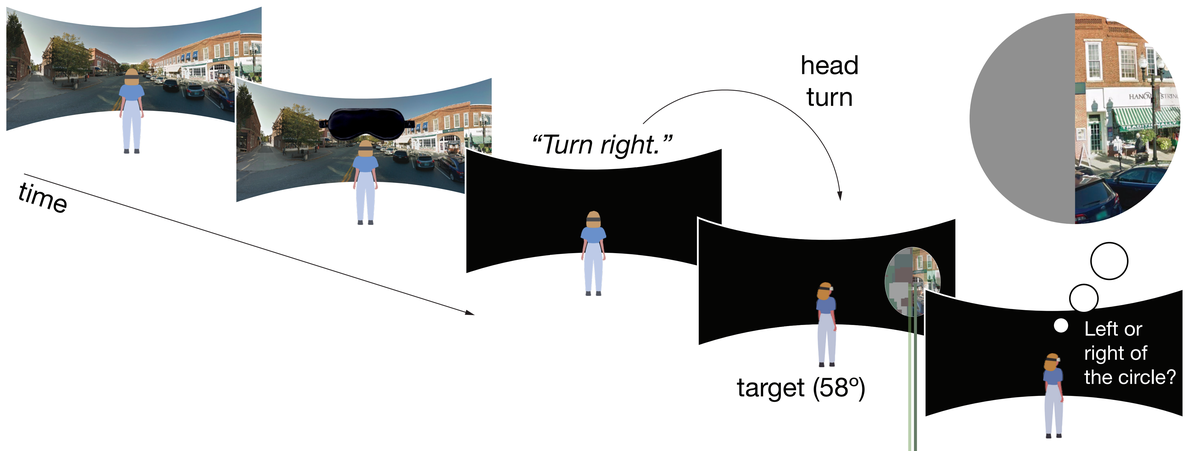
Methods

Training phase Participants (N=64) studied a set of immersive, panoramic scenes drawn from the local campus. Their instructions were, "look around like you normally would".

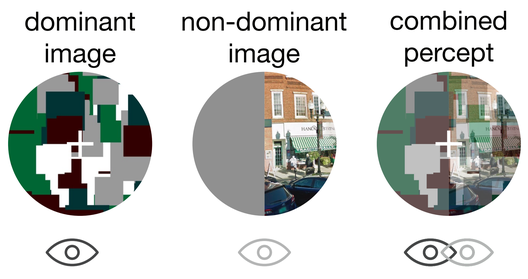
Test phase On each trial, participants were primed with a studied scene, which was then occluded. Next, they turned left or right to detect a target scene view that was initially masked using continuous flash suppression (CFS).



"Look around like you normally would."



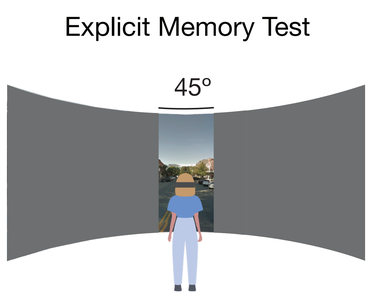
breaking Continuous Flash Suppression
during target presentation



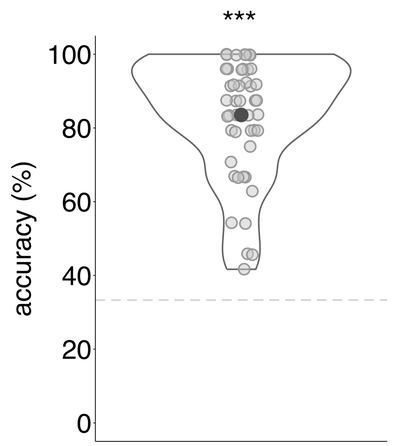
Experimental conditions

Results

Control Analysis, Explicit Memory Test: Participants learn the spatial layout of immersive scenes in VR



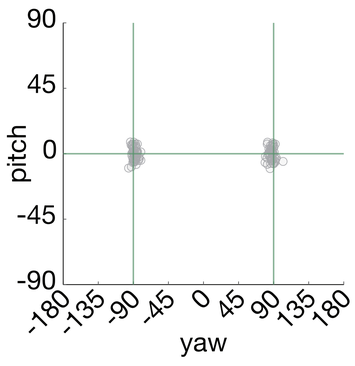
"Did this view appear to your left, right or center?"



On each trial of the Explicit Memory Test, participants responded whether a studied scene view had appeared on their (left/right/center) during the Training phase.

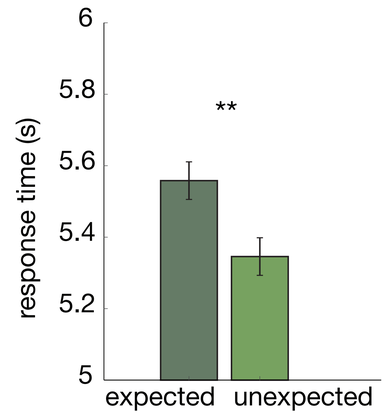
Accuracy was above chance (33%, dashed line) (p<.001).

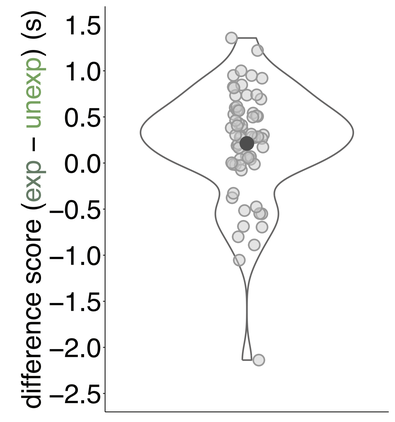
Control Analysis: Head position is maintained during bCFS presentation of target views



Mean head position during bCFS. Line intersections represent ideal head position following left/right head turns.

Main Result: Unexpected scene views enter perceptual awareness faster than expected views





Unexpected scene views entered perceptual awareness faster than expected views (p=.006). Bars represent mean target detection time. Error bars show repeated measures standard deviation. Scatter plot shows individual difference scores (expected - unexpected).

Conclusion

- **Unexpected scene views enter perceptual awareness faster than expected views.**
- **This result aligns with the predictive processing framework, which posits that expected sensory input may be suppressed to promote processing of prediction errors.**

REFERENCES: *[1] Jiang, Y., Costello, P., & He, S. (2007). Processing of invisible stimuli: Advantage of upright faces and recognizable words in overcoming interocular suppression. Psychological science, 18(4), 349-355. [2] Gobbini, M. I., Gors, J. D., Halchenko, Y. O., Rogers, C., Guntupalli, J. S., Hughes, H., & Cipolli, C. (2013). Prioritized detection of personally familiar faces. PloS one, 8(6), e66620. [3] Stein, T., Hebart, M. N., & Sterzer, P. (2011). Breaking continuous flash suppression: a new measure of unconscious processing during interocular suppression?. Frontiers in human neuroscience, 5, 167.*