A closed-loop eye-behavior paradigm reveals residual visual processing in cortical blindness

Diana Gamboa[1*], Heaven Dixon[1*], Sharif I. Kronemer[1], Catherine Walsh[1], Aria Wang[1], Marlene Smith[1], Marly Rubin[1], Tina T. Liu[2], & Peter A. Bandettini[1,3]

[1]Laboratory of Brain and Cognition, National Institute of Mental Health (NIMH), National Institutes of Health (NIH), Bethesda, Maryland (MD), United States of America (USA), [2]Visual Perception and Plasticity Lab, Department of Neurology, Georgetown University, D.C., United States of America (USA), [3]Functional Magnetic Resonance Imaging Core Facility, National Institute of Mental Health (NIMH), National Institutes of Health (NIH), Bethesda, Maryland (MD), United States of America (USA)

*Co-first authors

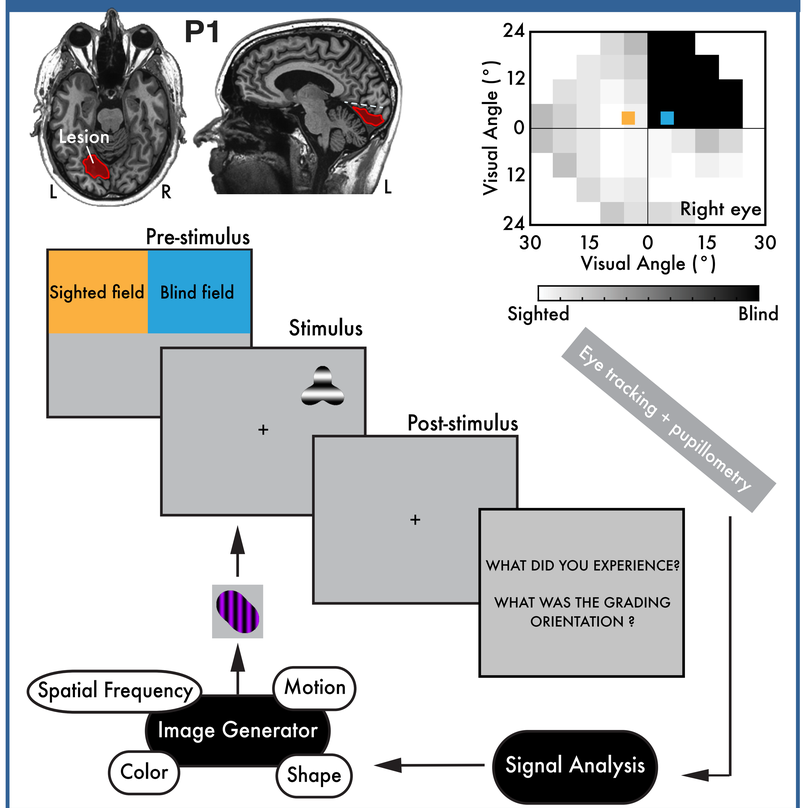
Introduction

- Cortical blindness is the full or partial loss of vision following damage to visual cortex.[1]
- People with cortical blindness can maintain residual visual processing which may or may not correspond to visual conscious perception and visual behavior.[2]
- Prior studies have shown that eye measures reflect conscious and unconscious processing, including in cortical blindness.[3]
- In a recent study, eye behaviors distinguished cortically blind people with and without conscious perception in the blind field.[4]

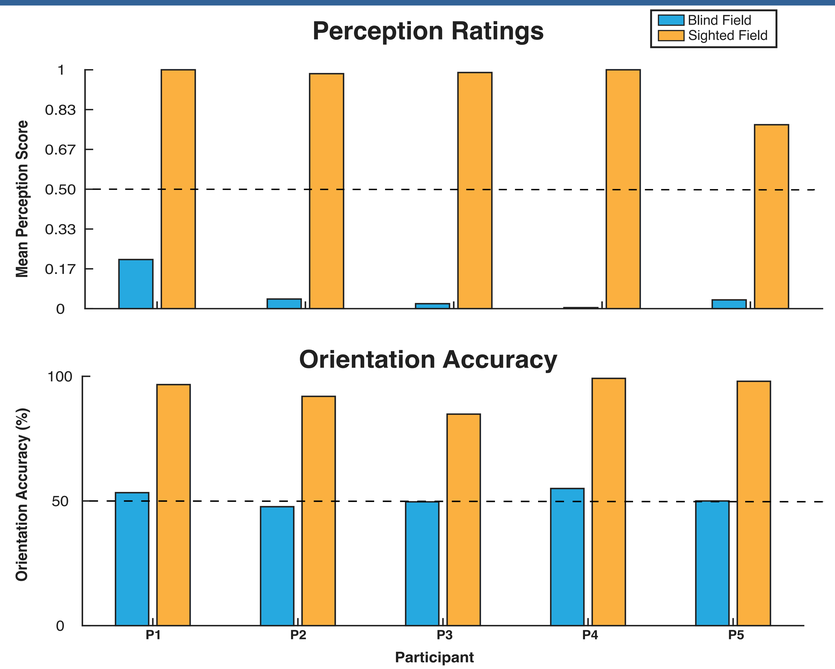
Main Question

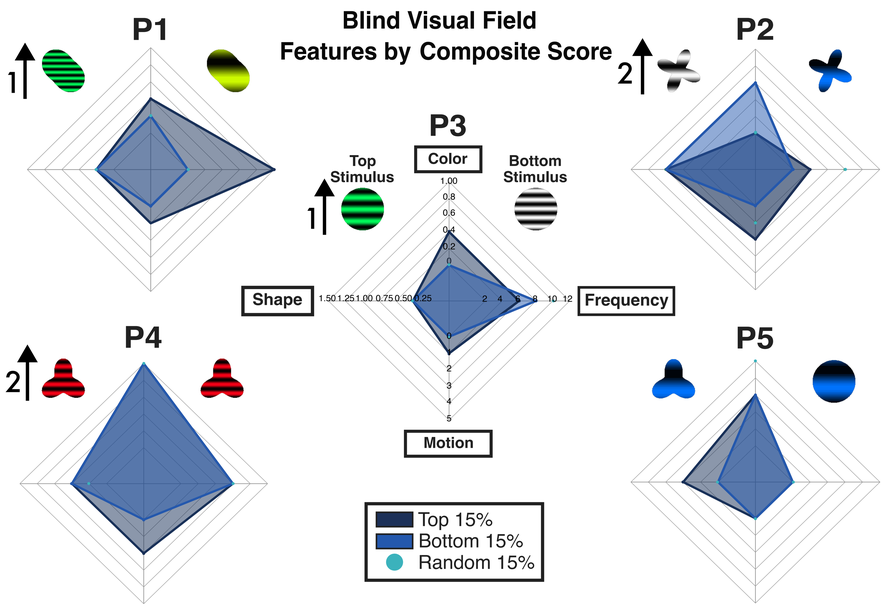
Do eye behaviors predict residual visual processing for specific image features in cortical blindness?

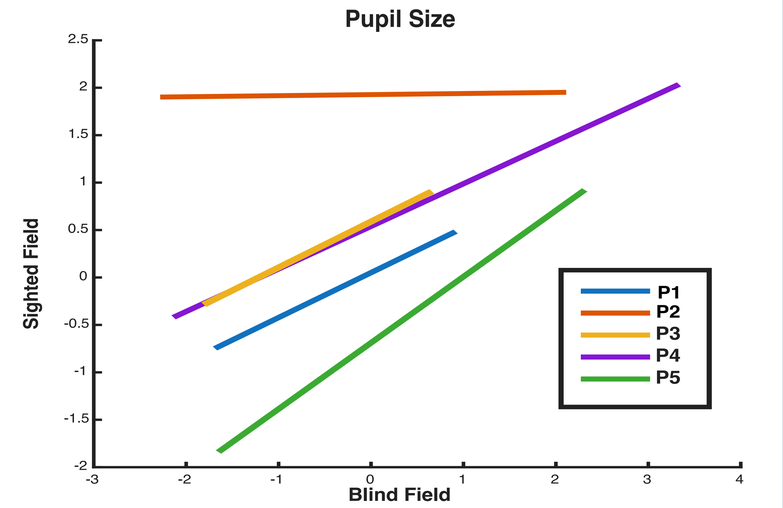
Methods

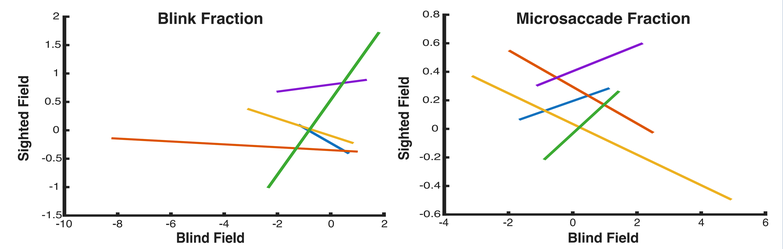


Results









- **Pupil size area under the curve** (AUC; absolute pupil size change): Positive correlation between conditions.
- **Blink fraction** (time spent blinking): No clear correlation.
- **Microsaccade fraction** (small, involuntary eye movements): No clear correlation.

Conclusions

- Most participants show little to no visual awareness in their blind field, and are at chance for indicating the blind field stimuli orientation.
- Blind field stiumlus-evoke blind behaviors were sensitive to movements across most subjects. Individual subject differences were also present (e.g., P1: spatial frequency; P5: shape).
- Participants showed similar stimulus-evoked pupillary responses in the blind and sighted field, but not for blink and microsaccade fraction.

References 1. Flanagan et al. (2009) *Int. Opthalmol. Clin.* 2. Pöppel et al. (1973) *Nature* 3. Weiskrantz et al. (1999). *Brain* 4. Kronemer et al. (2025). *Commun. Biol.*

Acknowledgements: This work was made possible by the Intramural Research Program atthe NIMH and the NIH SIP. Thank you to the patient and the nurses in OP4!

Contact: Diana Gamboa (dianamng@bu.edu) Heaven Dixon (dixonha@nih.gov) Sharif Kronemer (sharif.kronemer@nih.gov)