Role of Early Visual Experience in Learning Environmental Regularities

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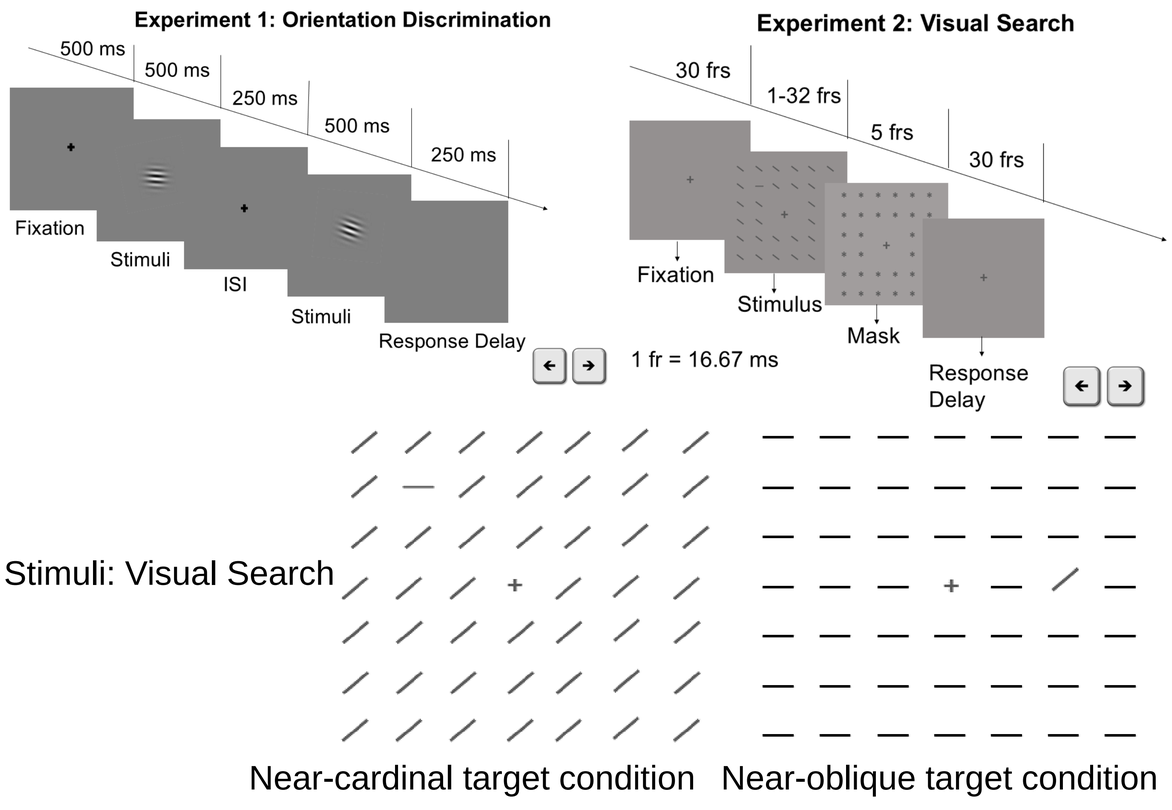
Introduction

- Early exposure plays a crucial role in visual development, and deprivation during this period may have long-term consequences (Lewis & Maurer, 2009).
- Previous studies have primarily focused on the development of specific visual functions, but it remains unknown whether early deprivation impacts the ability of perceptual functions to adapt to environmental regularities.
- To address this gap, we examined orientation judgments for highly prevalent (cardinal) and oblique orientations (Girshick et al., 2011) in both sight-restored and typically sighted individuals.
- Orientation judgments were assessed in a basic discrimination task (Exp. 1) and an orientation search task (Exp. 2), which required processing orientations in a more complex, cluttered environment.
  - In the orientation discrimination task, statistical regularities are reflected in the oblique effect—where discrimination performance is higher for cardinal (~90º and ~0º) orientations compared to oblique (~45º) orientations.
  - In a visual search task for orientation, statistical regularities are reflected in orientation search asymmetry, where oblique targets are detected faster among cardinal distractors than vice versa.

Method

- To this aim, we tested two independent experiments.
  - Experiment 1: Orientation Discrimination (sight-restored n=36, typically sighted n=47)
  - Experiment 2: Orientation Search (sight-restored n=38, typically sighted n=47)
- Task:
  - Orientation Discrimination: Judging which Gabor is more clockwise; thresholds were measured along vertical, oblique and horizontal orientations.
  - Orientation Search: Localizing the hemifield of a target, oriented at 50° (near oblique condition) among 80° oriented (near cardinal condition) distractors, and vice versa; thresholds were measured in terms of stimulus-onset asynchrony (SOA).



Discussion

- Early deprivation does not impact basic orientation perception:
  - Oblique discrimination performance was comparable to typically sighted individuals.
- Early deprivation negatively impacts learning of environmental regularities.
  - Cardinal orientation discrimination performance was less sensitive compared to typically sighted individuals.
- Early deprivation also negatively impacts processing of more complex displays of orientation.
  - Orientation search performance was lower compared to typically sighted individuals.

Early visual exposure plays a role in the ability of the visual system to learn environmental regularities and process cluttered displays.

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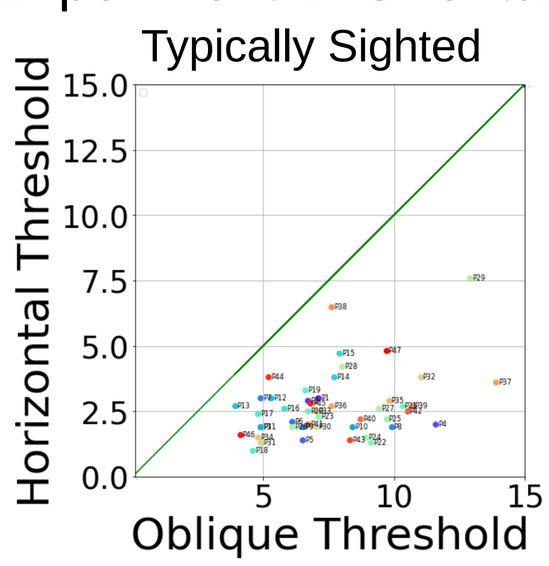
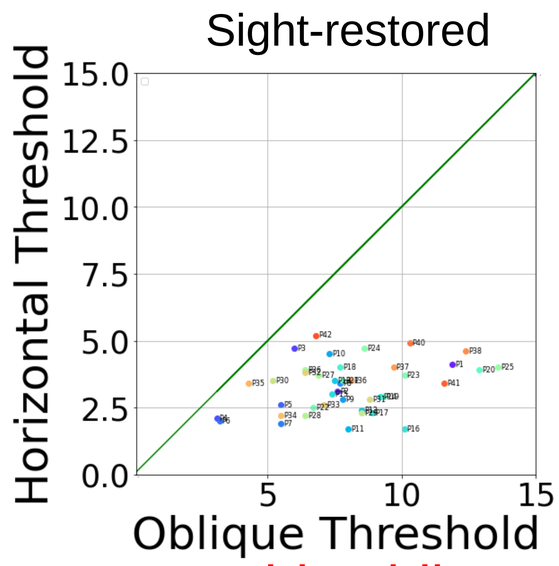
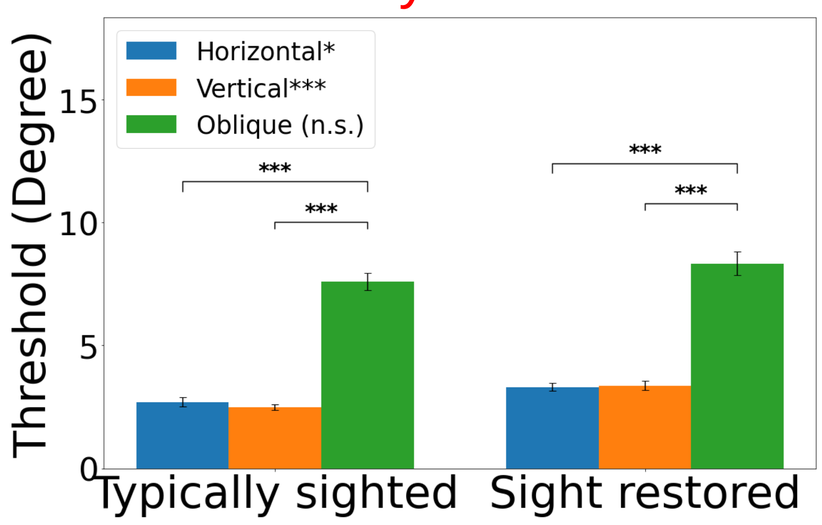
Results

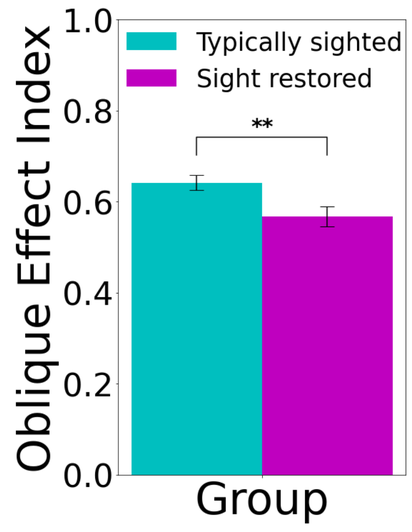
Experiment 1: Orientation Discrimination



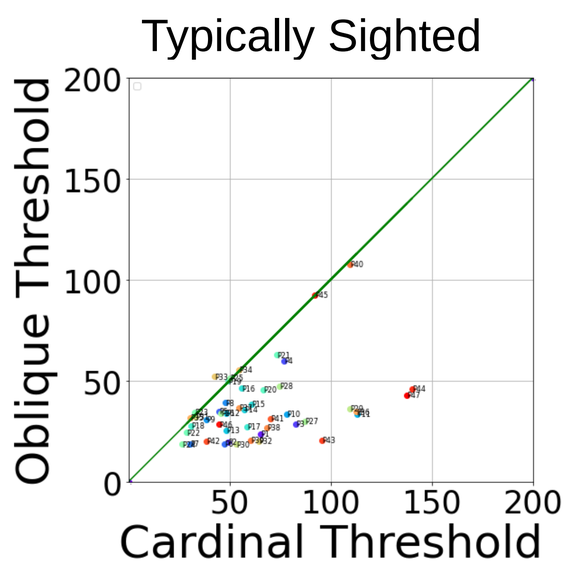


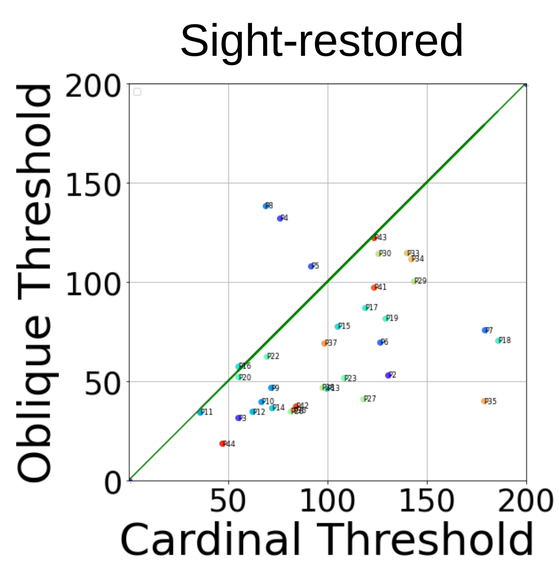
Sight-restored group shows a comparable oblique effect horizontally.



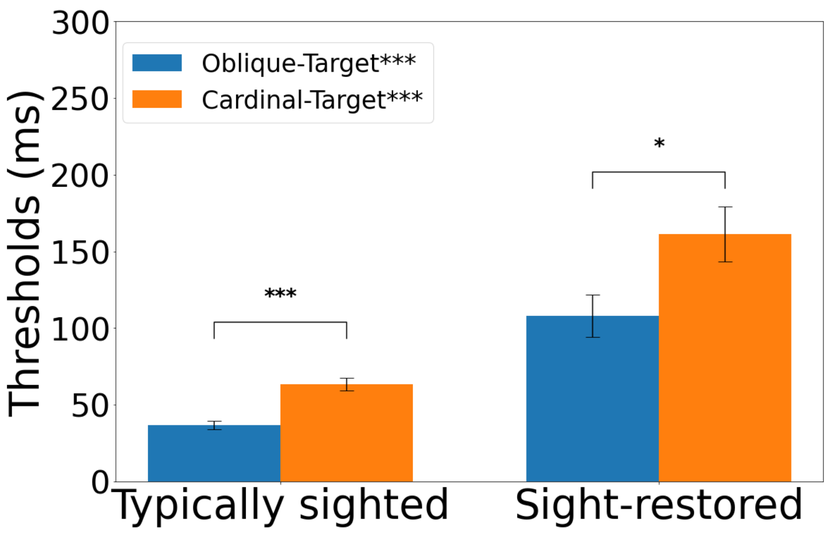


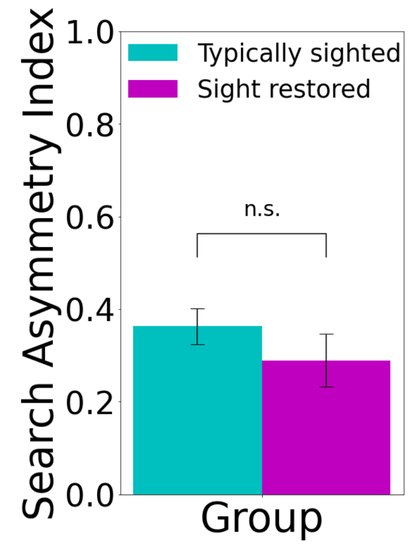
Experiment 2: Orientation Search

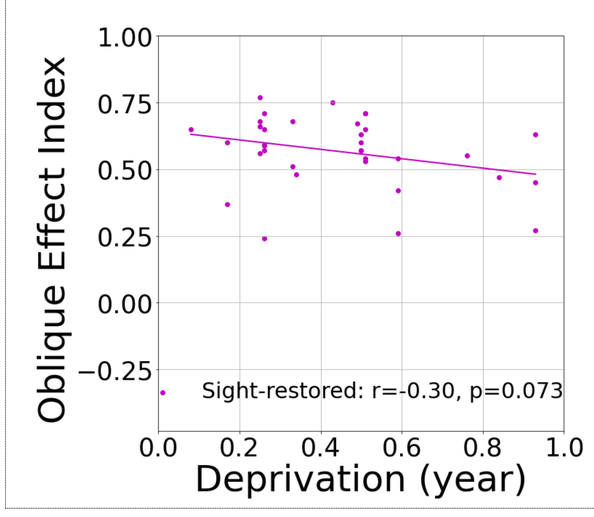


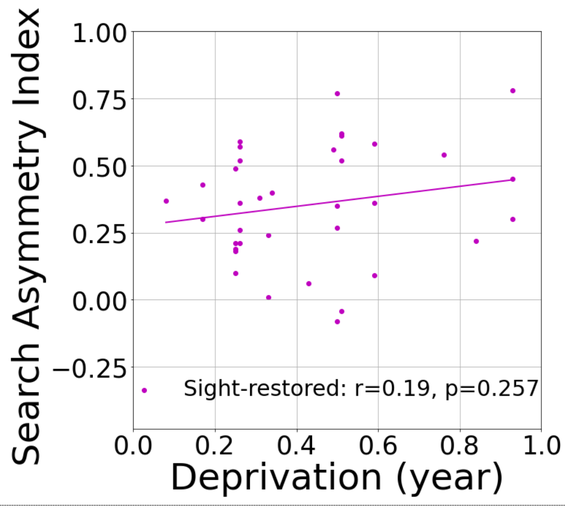


Sight-restored group exhibits overall difficulties in orientation search tasks.









*=p<0.05, **=p<0.01, ***= p<0.001

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