Mapping the Visual Field Using Neurophysiological Measures

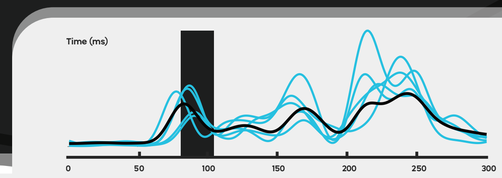
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Introduction

Traditional visual field testing methods rely on subjective responses. EEG offers an alternative objective approach to visual field mapping.

Prior studies have demonstrated that stimuli presented at different locations result in different brain patterns and signal properties.

Despite these findings, exactly how much and what information about visual field position these signals contain remains unknown.

Research Question

Can we adapt fMRI population receptive field (pRF) methods to map the visual field with EEG and identify simulated visual field defects?

Methods

- 5 participants (age 21-45).
- A viewing task where 16 sectors in the visual field were stimulated (~100 trials each). Two conditions: full Field and simulated scotoma.
- EEG signal was recorded.

Full Field



Simulated Scotoma

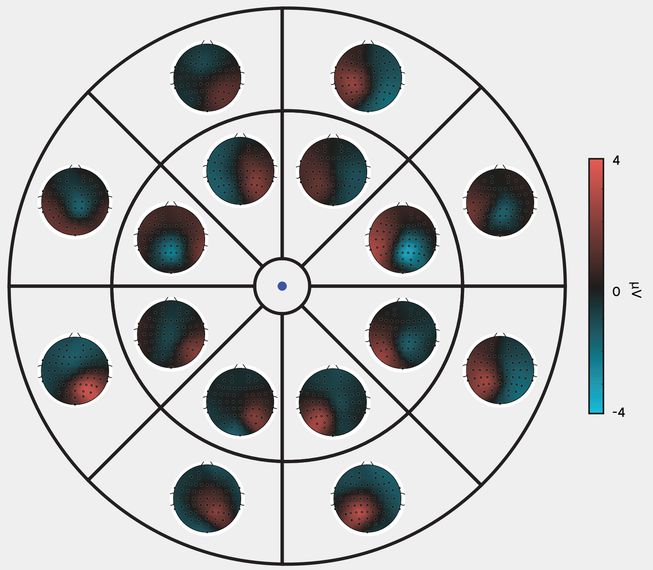


- Reverse correlation population receptive field analysis (Urale et al., 2022)

Results

Sensor-level Topography (1)

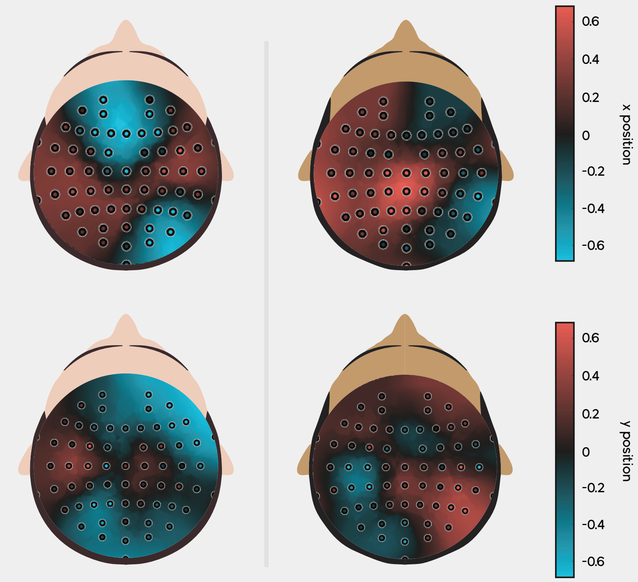
P03 Full Field 80 ms



Electrode Receptive Fields (2)

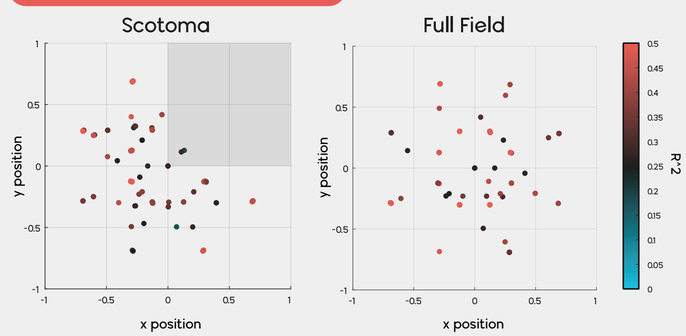
P03 Full Field 80 ms

P07 Full Field 80 ms



pooled pRF positions (3)

Time window: 80 ms



With neural signal at 80 ms:

1. Scalp activity associated with each stimulus location in the visual field can be estimated.
2. pRF analysis revealed the visual field position each electrode maximally responds to.
3. pRF visual profile identified the quadrant of the simulated scotoma.

Discussion

The pRF method revealed the optimal time window for capturing visual field information. The brain activity during this time can identify the scotoma's location. Nevertheless, the current map of the visual field is still coarse. Future iterations of the stimulus paradigm would help improve the mapping resolution of the visual field.

References Electrode