Object-Based Attention Measured with SSVEPs

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Introduction

Feature-based attention has been demonstrated to have a non-spatial component. When attention is directed to a target, it extends to other targets with similar features (e.g., color or direction of motion) anywhere in the visual field. We tested whether this non-spatial property also holds for object-based attention where attention to one target superimposed on another may extend to other similar but task irrelevant targets elsewhere in the visual field.

Methods

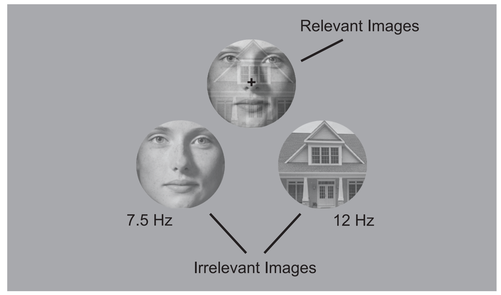
We used Steady State Visually Evoked Potentials (SSVEPs) with high-density EEG. While maintaining central fixation, participants were cued to pay attention to one of two superimposed images, either a house or a face (task-relevant images), presented below a fixation mark. The orientation of one of the two images briefly changed (zero to three times) and the participant had to report this by pressing a key.

A copy of each of the two superimposed images was presented separately (task-irrelevant images), one on the left and one on the right side of fixation, flickering at different frequencies (7.5Hz and 12Hz).

The difficulty of the task was adapted by changing the magnitude of the tilt angle so that the average performance was 80%.

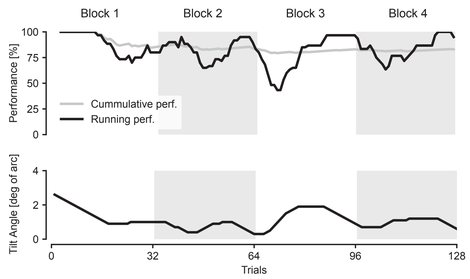
Eight different exemplars of each category were randomly paired and one pair was shown in each trial.

Paradigm



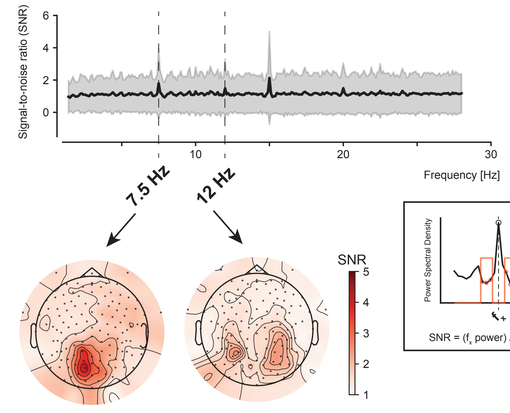
Single Subject

Behavior



Cummulative performance: average performance across all the previous trials
Running performance: average performance across the previous ten trials

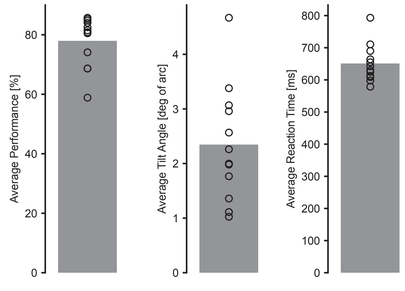
EEG



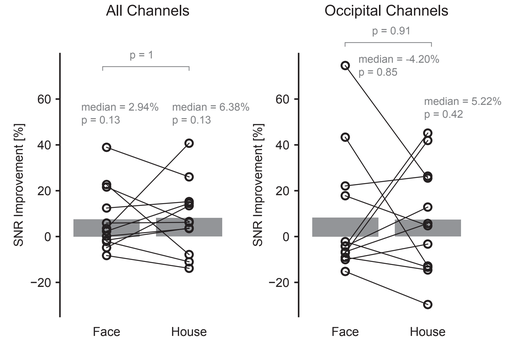
Population

N = 12

Behavior



EEG



SNR Improvement = $(SNR_{Attended} - SNR_{Unattended}) / SNR_{Unattended} * 100$

Conclusion

Although we did see a trend towards an SNR improvement for faces in our average across participants, this did not reach significance for either of the two object categories.

Our current design might not have had enough power to capture the small signal enhancement due to an object-based attention.

Next steps:
- investigate the existence of the effect at the fovea
- reduce the distance of the peripheral images
- increase the contrast of the peripheral images
- increase the number of peripheral images

Further Reading

The Architecture of Object-Based Attention
Cavanagh et al. (2023, Psychonomic Bulletin & Review)

Tuning Attention to Object Categories: Spatially Global Effects of Attention to Faces in Visual Processing
Störmer, Cohen, Alvarez (2019, J Cog Neurosci)

Effects of Feature-Selective and Spatial Attention at Different Stages of Visual Processing
Andersen, Fuchs, Müller (2011, J Cog Neurosci)

Top–Down Attention Is Limited Within but Not Between Feature Dimensions
Adamian, Slaustaite, Andersen (2019, J Cog Neurosci)

Feature-Based Attention Has a Spatial Gradient
Adamian, Andersen (2023, VSS abstract)
Wednesday, May 24, 10:45 am – 12:30 pm, Talk Room 1

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