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When the Eyes Disappear: Neural Dynamics of Emotion Recognition under Eye Occlusion

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Introduction

Facial emotion recognition relies on the rapid integration of visual cues, with the eye region playing a central role in both perceptual decoding and emotional appraisal. Neurocognitive models distinguish early face-sensitive processing, indexed by components such as the N170 (Bentin et al., 1996; Eimer, 2011), from later stages associated with emotional relevance and evaluation, reflected in the Early Posterior Negativity (EPN; Schupp et al., 2004) and the Late Positive Potential (LPP; Hajcak et al., 2010).

While the eye region is known to influence emotion recognition and attention (Adolphs, 2002; Calvo & Nummenmaa, 2008), different forms of eye occlusion (e.g., closed eyes vs sunglasses) are often treated as equivalent, despite evidence suggesting distinct effects on appraisal and attentional allocation (Granja & Burra, in prep).

This pilot study examines the feasibility of dissociating early perceptual and later evaluative effects of eye occlusion using EEG.

Aim

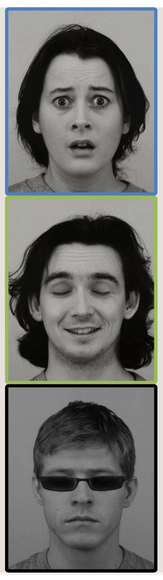
- Characterise how eye occlusion modulates the temporal dynamics of emotional face processing.
- Identify whether occlusion effects emerge at early perceptual or later evaluative stages.
- Explore changes in the organisation of neural processing associated with eye occlusion.

Method

Behavioural Task

Ten bachelor students (M = 22.9 years, SD = 4.61; 8 women) viewed emotional faces varying in emotional expression (fear, happiness, neutral) and eye visibility (open, closed, sunglasses). Two participants were excluded due to unsuccessful ICA decomposition.

Each participant was presented with 4 blocks of 180 trials, presented randomly within each block. On each trial, participants were instructed to identify the expressed emotion using a keyboard response.



Trial Structure

All stimuli were selected from the KDEF database (Lundqvist et al., 1998) and were luminance-matched.

Each trial began with a fixation cross presented for a random duration between 500 and 1000 ms, followed by the presentation of a face stimulus for 300 ms. A forced response delay of 800 ms was then imposed, after which participants were allowed to respond. A 500 ms inter-trial interval preceded the onset of the next trial.

EEG Recording & Processing

- EEG recorded with a 64-channel BioSemi ActiveTwo system.
- Data were filtered (0.1–40 Hz; 50 Hz notch), average-referenced, and resampled to 512 Hz.
- Ocular artefacts were corrected using ICA.
- Data were epoched from −200 to 800 ms relative to stimulus onset and baseline-corrected.
- Residual artefacts were rejected using automatic amplitude-based criteria.

ERP ROIs

N170 (140–200 ms): ROI mean over P7, PO7, P9, P8, PO8, P10

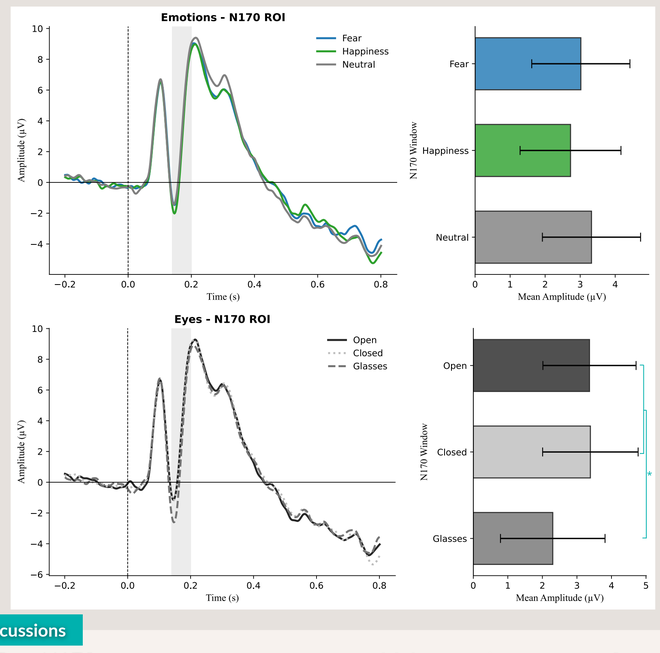
EPN (200–300 ms): ROI mean over PO7, O1, P7, PO8, O2, P8

LPP (400–700 ms): ROI mean over CP1, P1, CP2, P2

Pilot results

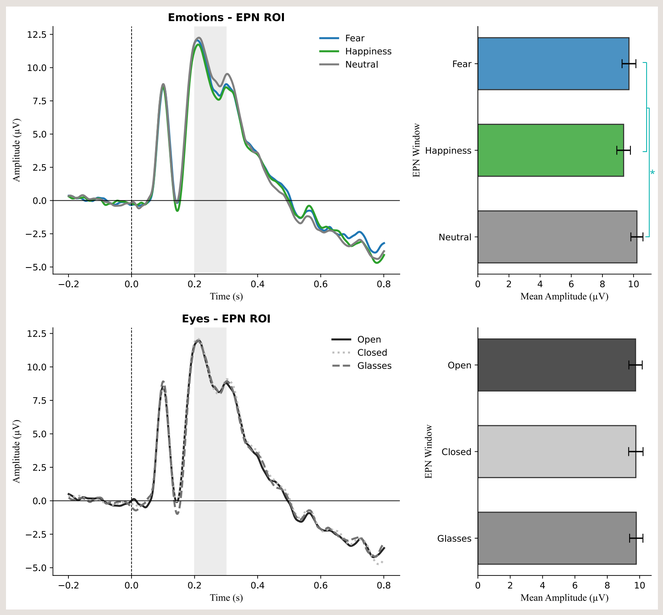
N170

A Greenhouse–Geisser corrected rmANOVA showed a main effect of Eyes ($p<.001$) and an Eyes × Emotion interaction ($p=.048$), with larger amplitudes for Open and Closed eyes than for Glasses ($p<.001$), while Emotion main effect was not reliably observed at this stage ($p=.21$).



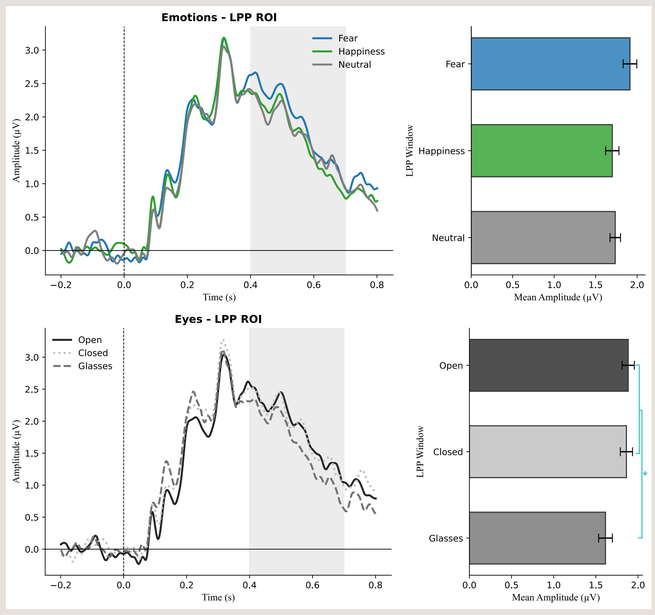
EPN

A Greenhouse–Geisser corrected rmANOVA showed a main effect of Emotion ($p=.010$), no main effect of Eyes ($p=.99$), and no reliable Eyes × Emotion interaction ($p=.085$). Follow-up contrasts indicated larger amplitudes for emotional (Fear & Happiness) than Neutral stimuli ($p<.001$), independently of eye visibility.



LPP

A Greenhouse–Geisser corrected rmANOVA showed no reliable main effect of Eyes ($p=.10$), no main effect of Emotion ($p=.59$), and no Eyes × Emotion interaction ($p=.20$). However, follow-up contrasts revealed a significant difference between Natural conditions (Open & Closed) and artificially occluded eyes, with larger amplitudes for Natural eyes relative to sunglasses ($p=.036$), while emotion-related contrasts remained non-significant.



Discussions

The N170 patterns may suggest sensitivity to the nature of eye-related information, with natural eye states (open and closed) differing from artificial occlusion (sunglasses). This distinction could indicate that early face processing differentiates biologically plausible variations from externally imposed obstructions, impacting later processes.

The EPN pattern seems consistent with previous literature, showing sensitivity to emotional content while appearing largely unaffected by eye occlusion. This suggests that early emotional relevance detection relies on information that remains available despite reduced visibility of the eye region.

The LPP pattern seems to indicate that closed eyes and sunglasses are not processed equivalently, despite both limiting access to the eye region. Across components, natural eye states (open or closed) appear to differ from artificial occlusion, suggesting that the visual system distinguishes between biologically plausible and externally imposed eye obstruction.

Conclusion

Taken together, these patterns suggest that eye occlusion is not processed uniformly. Even when visual access to the eyes is reduced, natural eye states may remain informative, whereas artificial occlusion may introduce ambiguity, highlighting the importance of distinguishing how eyes are occluded rather than whether they are visible.

This pilot study provides a basis for a more formal investigation.

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