

Context

One of the most studied face-sensitive event-related potentials (ERP) is the N170. Multiple studies have already explored the specific visual information driving this component's response. For instance, the N170 has been linked to eye region and diagnostic information processing¹. However, little is known about the information that drives N250 amplitude, another component associated with face recognition, and more precisely, to transient activations of stored face representations². Therefore, the present study aims to better understand what visual information drives the N250.

Method

Four participants each completed 12,000 trials (48,000 trials total) of a 10 choices identification task. Facial information was randomly sampled with Bubbles, in which pixel sampling is performed independently over five nonoverlapping spatial frequency (SF) bands of one-octave width (120 bubbles, figure 1)³. EEG data were measured using a 64 electrodes G.Tec system.



Figure 1. Procedure to create a stimulus with the Bubbles method. The original stimulus (A) is filtered into five spatial frequency (SF) bands (B). For each SF band, a mask composed of Gaussian apertures is generated (C) and applied to the SF-filtered stimuli (D), which summed, produce a bubblized stimulus (E).



Figure 2. Example of one trial.

Analyses

- Data from PO7 and PO8 were submitted to a classification image (CI) analysis: at each timepoint (300 hz sampling frequency) and for each SF band, a weighted sum bubbles mask was computed, using standardized amplitudes (across trials) z-scores as positive/negative weights. Before being combined, individual CIs were standardized with the mean and SD of the null hypothesis (estimated using permutations analysis).
- Three regions of interests (ROI) were identified, based on their critical role in face recognition: the left eye, the right eye, and the mouth⁴ (figure 3A). The maximum value of each ROI was extracted at each timepoint and SF band.
- Statistical thresholds for a Pixel test were obtained using Stat4CI (*Zcrit* = 5.46; 5.19; 4.91; 4.61; 4.61, from finer to coarser scales, p < 0.05, two-tailed)⁵.

N250 amplitude is driven by the eyes in mid-to-high spatial frequencies

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Results



Figure 3. A. Time-course of the maximum z-scores for each ROIs, from finer to coarser scale, for PO7 (top) and PO8 (bottom). The ERPs' time windows were defined based on visual inspection of the grand averages: 140ms to 190ms for the N170, 200ms to 300ms for the N250 and 300ms to 400ms for the P300. B. CIs with SF bands combined, representing the time course of the association between information and PO7 (top) and PO8 (bottom) amplitude modulation.

Discussion

Replicating previous results⁶, we found an association between N170 amplitude and presence of the contralateral eye. The N250 amplitude was also linked to the presence of the contralateral eye from high to intermediate SF bands. Interestingly, the eye region is the most diagnostic feature for facial identity in high to intermediate SF bands⁷. Moreover, the eye region is also rich in horizontal structure⁸, an orientation band that has been both associated with face recognition and the N250⁹. Altogether, these results suggest that diagnostic information, especially from the eyes, drives the N250 component, allowing the retrieval and activation of stored face representations. Finally, P300 amplitude also showed sensitivity to task-relevant information (i. e., the left eye), replicating previous results¹⁰.

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• In the N170 time window, presence of the contralateral eye (i.e., left eye in the right hemisphere and vice versa) in all SF bands was negatively linked (i.e. increased negativity) to amplitude in both the left (PO7) and right (PO8) hemispheres. • In the N250 time window, presence of the contralateral eye was also linked to amplitude in both hemispheres. More precisely, the left eye was linked to PO8 amplitude in high (128-64 cpi) to intermediate (16-8 cpi) SFs, while we found an association between the right eye and PO7 amplitude only in high SFs.

• Interestingly, in the P300 time window, presence of the left eye from high to intermediate SF bands was positively linked (i.e. increased positivity) to amplitude in both hemispheres.

