# Early repetition suppression for face identity is caused by the eyes

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## Context

It has been suggested that the N170 indexes a structural encoding process starting with the eye region[1]. A useful method to unveil the nature and the timing of visual information processing in faces is neural repetition suppression (RS), which refers to a reduction in neural activity in stimulus-sensitive regions following repetition, suggesting the same neurons have been recruited[2]. Here, we combined RS with Bubbles[3], first to replicate previous results regarding the N170 using a novel approach, and secondly to investigate identity effects for RS in the N170 time window.

## Method

Twelve (12) participants first completed a learning phase, which consisted of a face identification task (10 identities). Once 95% of accuracy was achieved, participants completed a same/different task, where a trial consisted of a presentation of a "bubblized" adaptor face (65 bubbles, **figure 1**), followed by the presentation of an unfiltered target face (**figure 2**). The two stimuli represented the same identity in half of the trials (3000 trials/participant). EEG data were measured using a 64 electrodes G.Tec system.

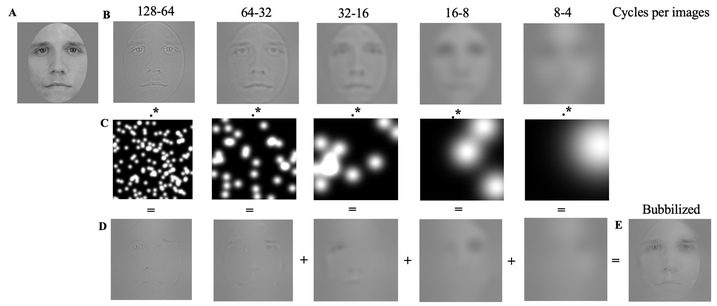


**Figure 1**. Procedure to create a stimulus with the Bubbles method. The original stimulus (A) is filtered into five spatial frequency (SF) bands (B). For each SF band, a mask composed of Gaussian apertures is generated (C) and applied to the filtered stimulus (D). This spatially filtered information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

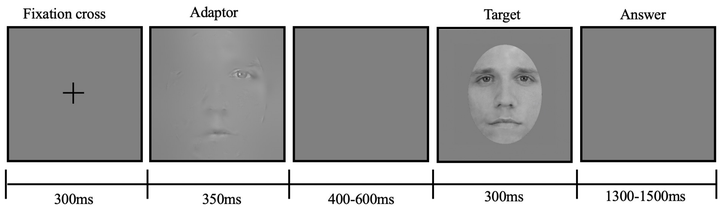


**Figure 2**. Example of one trial.

## Analyses

- Data from PO8 was submitted to a classification image (CI) analysis: at each timepoint, a weighted sum of the adaptors' bubble masks was computed, using the amplitude transformed into z-scores as positive/negative weights. Before being combined, individual CIs were transformed into z-scores with the mean and SD of the null hypothesis. This procedure was done separately for the adaptor and target stimuli in both experimental conditions.
- To determine which features were statistically associated with adaptor amplitude modulations, the adaptor's CIs of both conditions from 101ms to 215ms were combined and pixels exceeding the 99th percentile were considered significant (*Zcrit* = 10.72).
- The mean z-score of these regions of interest (ROI) was then computed for the CIs of every timepoint, for the adaptor and the target in both experimental conditions. The statistical threshold was obtained with a Pixel test[4] (*Zcrit* = 3.7, $p < 0.05$, two-tailed).

## Results

- The left eye was the only feature significantly associated with the adaptor's amplitude modulations (**figure 3**).
- More precisely, presence of the left eye was negatively linked (i.e. increased negativity) with amplitude in the adaptor's N170 time window (**figure 4A**: left)**.**
- Presence of the left eye in the adaptor stimuli was then positively linked (i.e. decreased negativity) with amplitude in the target's N170 time window (**figure 4A**: right)**.**

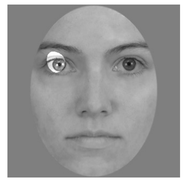

**Figure 3.** ROI

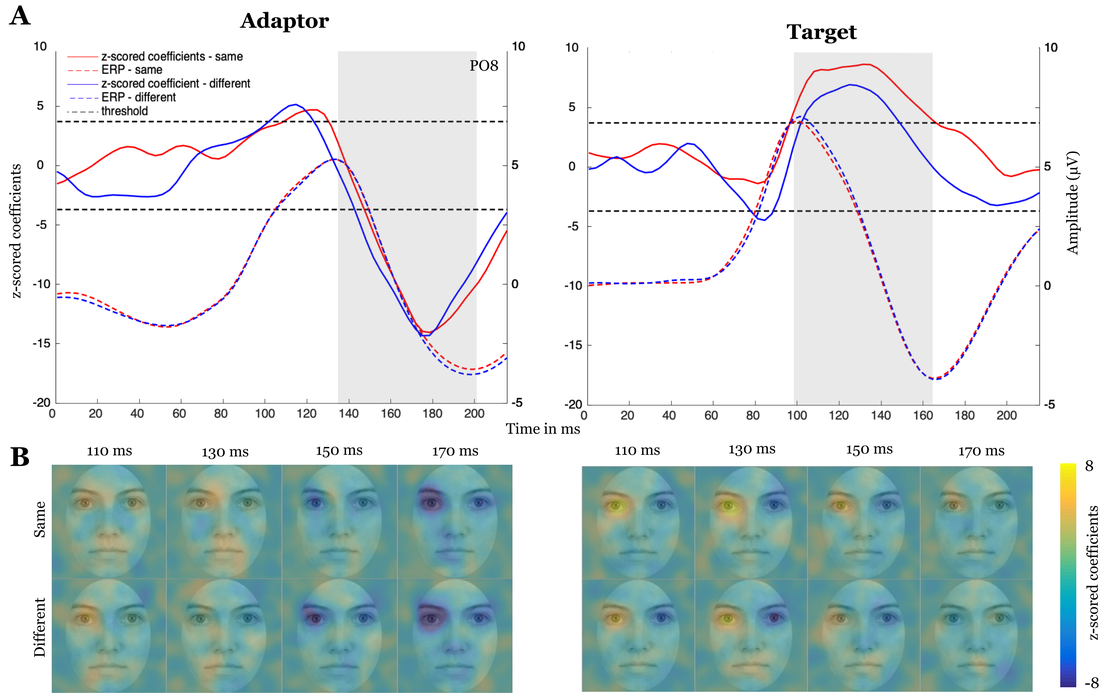


**Figure 4**. A. Time-course of the association between the presence of the left eye and amplitude modulations of the adaptors (left) and targets (right). For the adaptor, a negative association becomes significant at 148ms (same identity) and 145ms (different identity). For the target, a positive association is significant from 98ms to 165ms (same identity), and 104ms to 148ms (different identity). B. CIs representing the association between information and amplitude modulations at 110ms, 130ms, 150ms and 170ms.

## Discussion

We found an association between N170 amplitude at PO8 and presence of the left eye for the bubblized adaptor, whereby presence of the left eye increased amplitude, replicating previous results[5]. Moreover, presence of the left eye in the adaptor led to a RS effect in the target's N170 time window, i.e. a decreased negativity. Together, these findings suggest that a right hemisphere neural population sensitive to the left eye was solicited in the N170 window. Our results are thus in line with findings proposing that the N170 indexes a structural encoding process starting with the eye region[1]. Finally, no significant difference was found for the two experimental conditions, therefore our preliminary results don't suggest that the N170's RS effects are modulated by identity.

**References**
**(1)**Schyns, P. G., Petro, L. S., & Smith, M. L. (2007). Dynamics of visual information integration in the brain for categorizing facial expressions. *Curr Biol, 17*(18), 1580-1585. **(2)**Grill-Spector, K., Henson, R., & Martin, A. (2006). Repetition and the brain: neural models of stimulus-specific effects. *Trends in Cogn Sci, 10*(1), 14-23. **(3)**Gosselin, F., & Schyns, P. G. (2001). Bubbles: a technique to reveal the use of information in recognition tasks. *Vision Res, 41*(17). 2261-2271 **(4)**Chauvin, A., Worsley, K. J., Schyns, P. G., Arguin, M., & Gosselin, F. (2005). Accurate statistical tests for smooth classification images. *J Vision, 5*(9), 659-657. **(5)**Smith, M. L., Gosselin, F., & Schyns, P. G. (2004). Receptive Fields for Flexible Face Categorizations. *Psychol Sci, 15(11)*, 753-761

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