# Parametric study of N170 sensitivity to diagnostic facial information during face identification

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## Context

- Studies have suggested that the face-sensitive N170 indexes a face or an eye detection process. However, such studies have often explored N170 sensitivity in a dichotomic way, i.e., presence or absence of different facial features, either alone or within a facial context[1].
- Other studies have proposed that the N170 could reflect in-depth integration of task-relevant (i.e., diagnostic) information[2].
- The goal of the present study was to parametrically probe the visual system with variable diagnostic information and investigate whether the N170 is sensitive to these variations.

## Method

- We randomly created sparse facial stimuli with Bubbles[3], and used previously published classification images[4] to calculate the amount of available diagnostic information on a stimulus basis (See Figure 1).
- To equalize energy across stimuli, we simultaneously filtered faces with inverse bubbles (Fig. 2C), and applied discrete wavelet transform to the output (for procedure, see Figure 2).
- Stimuli were then divided into twelve bins covering a range from 0.01% to 100% information. A 0% (fully scrambled face) condition was also adjoined at the extremity of the information spectrum (See Figure 3).
- Ten (10) participants (3 males, $M_{age}$ = 24) first completed a learning phase (1500 trials), which consisted of a face identification task (10 identities).
- EEG was then collected during a face identification task (same IDs) that varied the amount of diagnostic facial information (1300 trials/100 per bin) (See Figure 4).

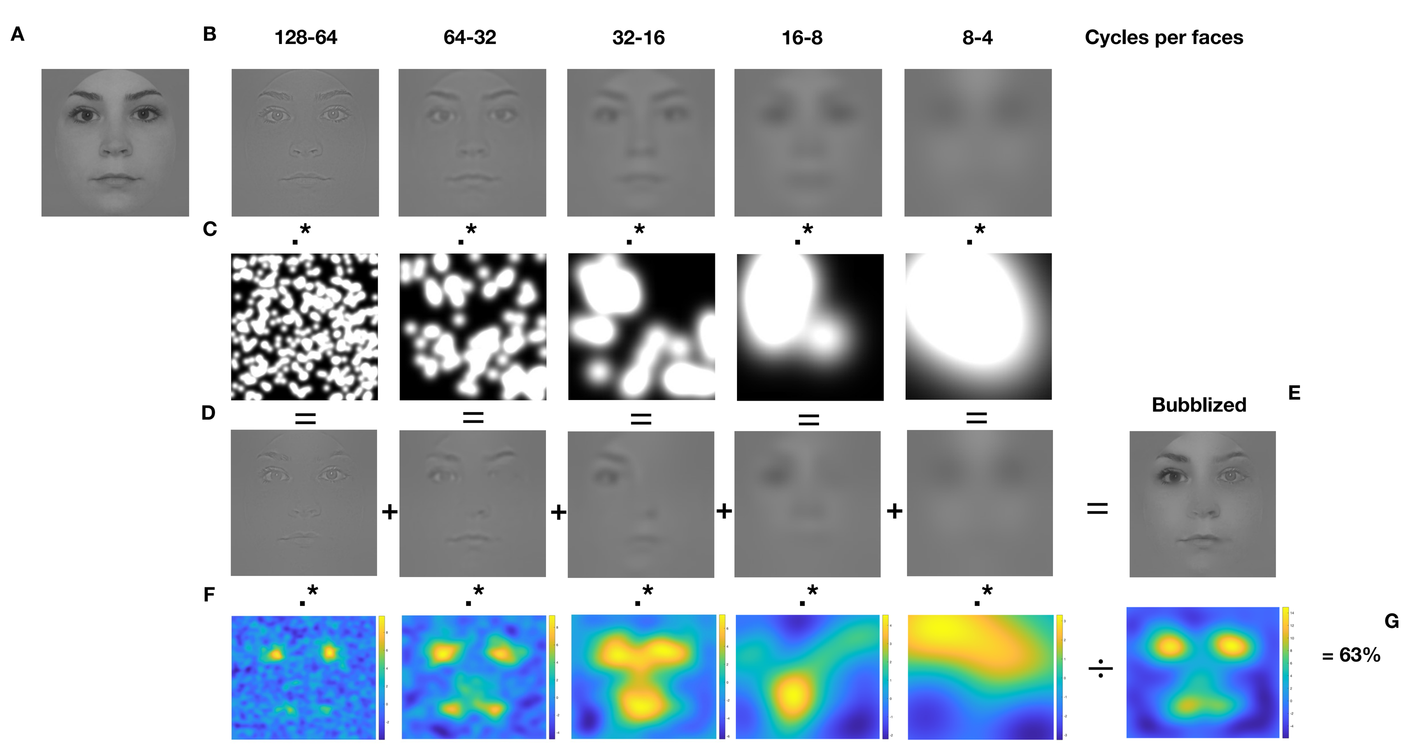


*Figure 1.* Procedure to create stimuli with the Bubbles method and to calculate the quantity of diagnostic information.

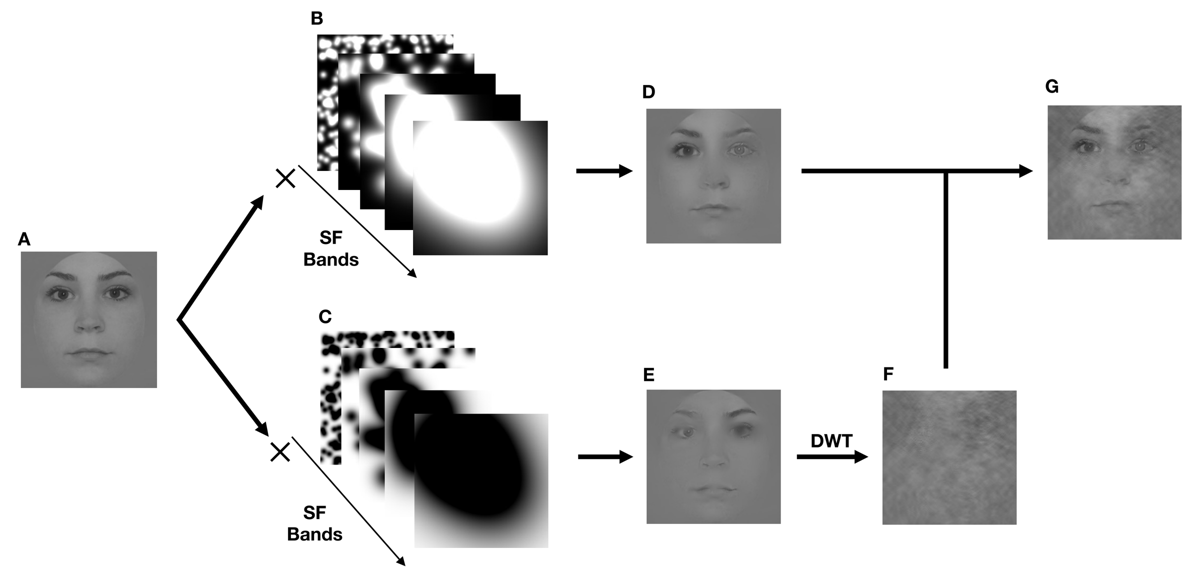


*Figure 2.* Procedure to equalize energy across stimuli using the Discrete Wavelet Transform.

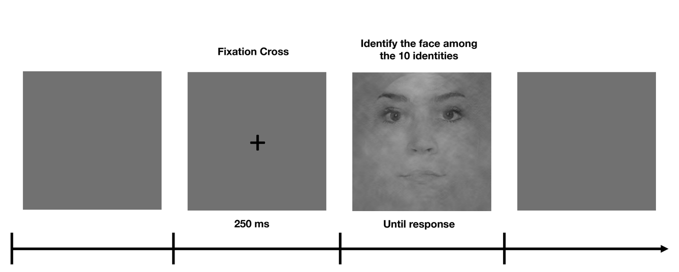


*Figure 4.* Sequence of events on each trial.

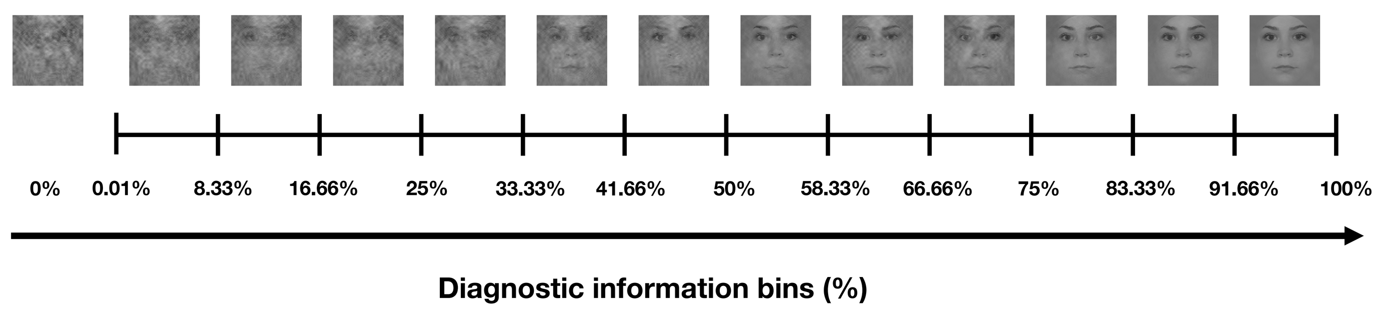


*Figure 3.* Diagnostic facial information spectrum.

## Analyses and results

- Mean ERPs were computed at PO8. To isolate electrophysiological activity produced by diagnostic information variations, we measured ERPs by subtracting the 0% condition from each subsequent bins (See Figure 5).
- Mean N170 peak amplitudes showed a strong relationship with diagnostic information, with N170 amplitude linearly increasing as diagnostic information was increased. Furthermore, several one sample t-test revealed that N170 peak amplitude was significantly different from null amplitude (0 μV) from the second bin (16.67-25% diagnostic information) onward, $t(9)$ = -3.47, $p$=0.007 (See Figure 7).
- At the group level, bin-averaged N170 amplitudes strongly correlated with behavioral recognition accuracies, $r_{Spearman}$ = -0.98, 95% CI [-0.81, -1], p < 0.001 (See Figure 6). This also held on an individual basis, $r_{Spearman}$ = [-0.61, -0.98].

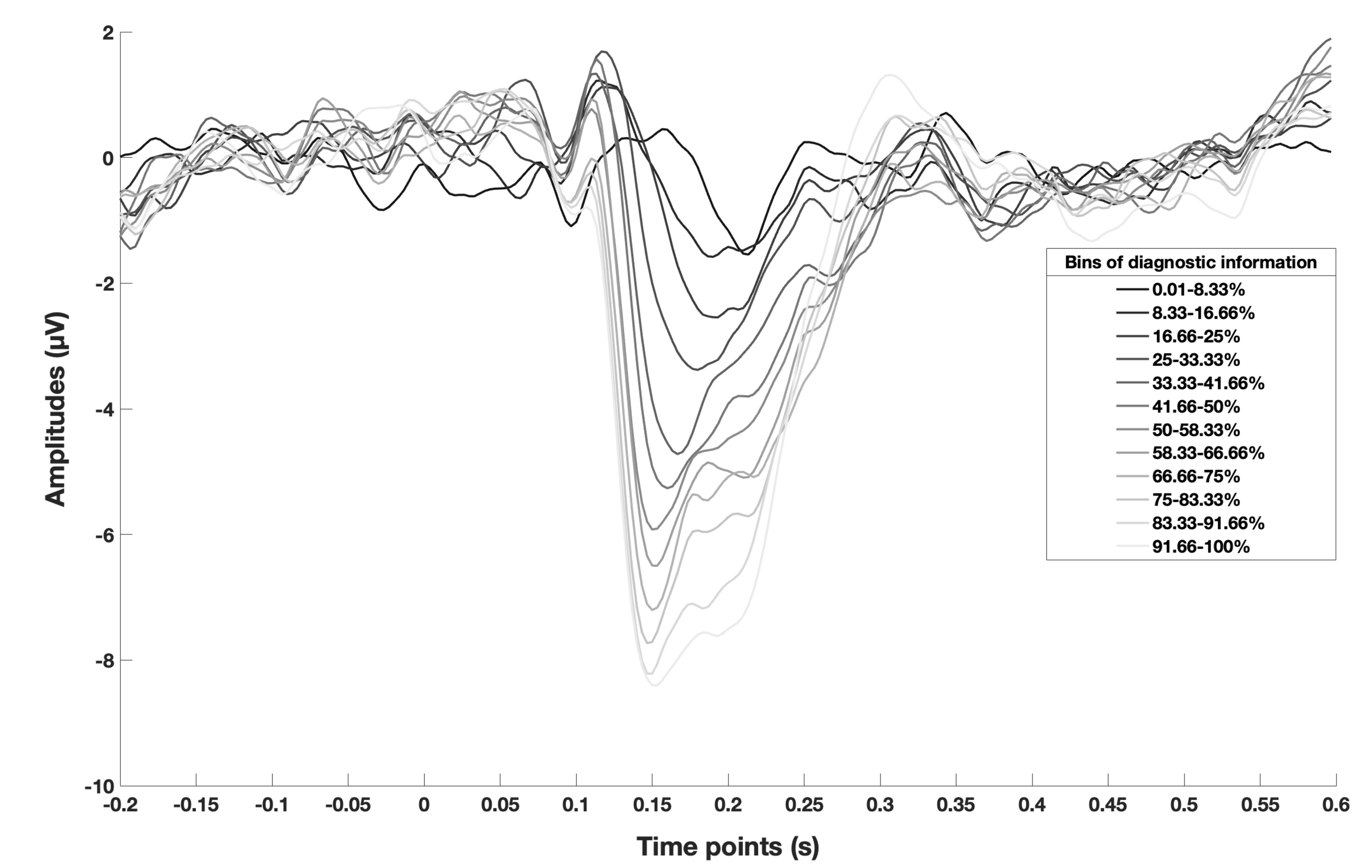


*Figure 5.* Mean ERP at PO8 for each diagnostic information bins (using 0% condition as baseline).

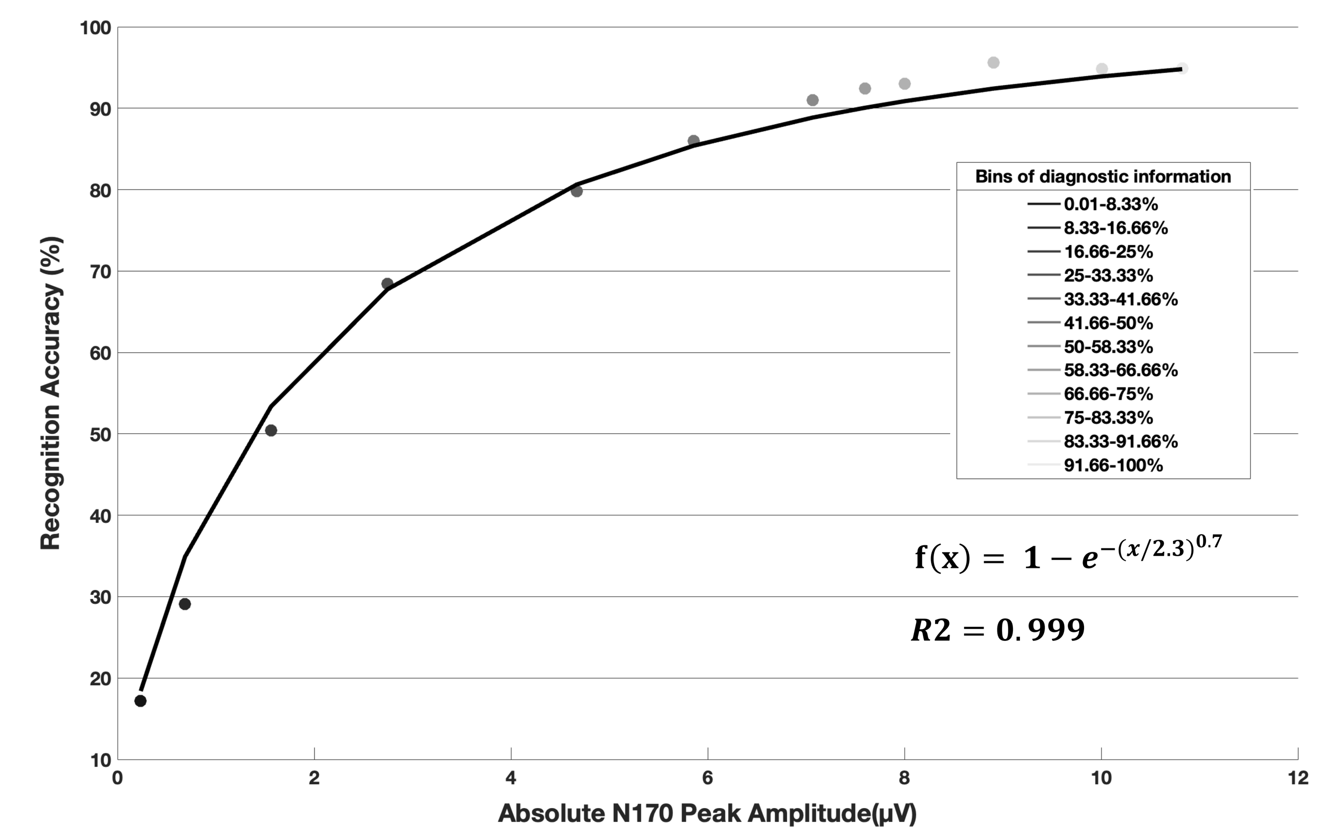


*Figure 6.* Relationship between absolute mean N170 peak amplitude (μV) and recognition accuracy (%).

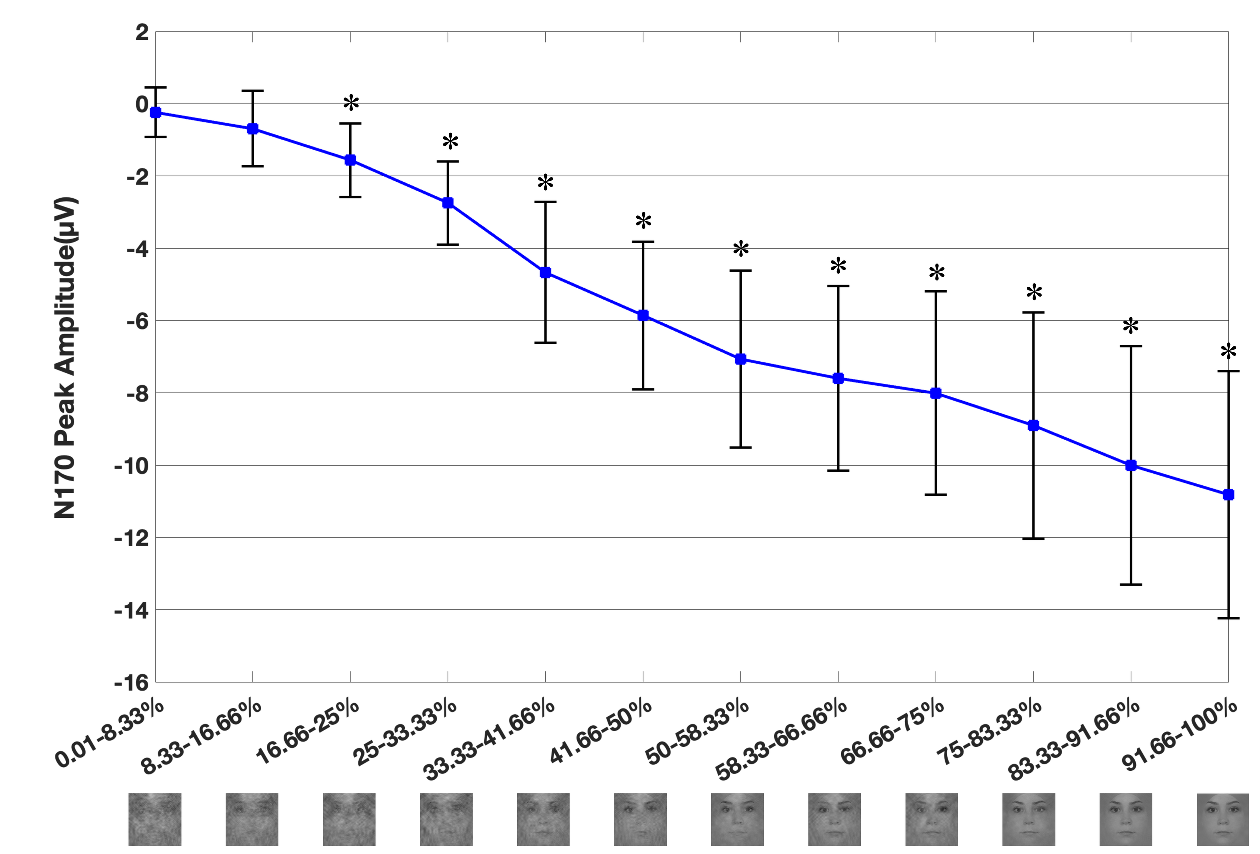


*Figure 7.* Mean N170 peak amplitude (μV) for each bins of diagnostic information. * indicates a significant difference ($p$<0.05) from null amplitude computed with a one sample t-test. Error bars display confidence intervals of 95% around the mean.

## Conclusion

The current study suggests a relationship between N170 amplitude, diagnostic facial information processing, and recognition accuracy. As diagnostic information increased, both N170 amplitude and recognition accuracy increased. Thus, it appears the N170 reflects in-depth task-relevant information processing during face recognition. However, seeing as diagnostic information was conflated with the amount of face/eye revealed, these results cannot be taken as a refutation of the face/eye detector hypotheses, respectively. This is currently under study in our lab.

**References**. **1)** Parkington, K. B., & Itier, R. J. (2018). One versus two eyes makes a difference! Early face perception is modulated by featural fixation and feature context. *Cortex, 109*, 35-49; **2)** Schyns, P. G., Petro, L. S., & Smith, M. L. (2007). Dynamics of visual information integration in the brain for categorizing facial expressions. *Current biology, 17*(18), 1580-1585; **3)** Gosselin, F. & Schyns, P. G. (2001). Bubbles: A technique to reveal the use of information in recognition. *Vision Research, 41*; **4)** Royer, J., Blais, C., Charbonneau, I., Déry, K., Tardif, J., Duchaine, B., & Fiset, D. (2018). Greater reliance on the eye region predicts better face recognition ability. *Cognition, 181*, 12-20.

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