The N170 Response to Standard versus Scrambled Mooney Faces: The Eyes Don't Have It!

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Purpose

To determine the role of bottom-up and top-down influences on the N170 by using stimuli without veridical facial features and a design preventing expectations that a face will be present on every trial.

Background

Evidence for bottom-up influences:

- N170 is enhanced by
  - the presence of features in the face[4]
  - scrambled faces with real features[2]
  - isolated eyes[2,7]
  - a single eye[8]

Conclusion: The adult brain rapidly detects that a face is present from bottom up information and is thereby primed to do additional processing specific to faces.

Evidence for top-down influences:
- N170 is enhanced by
  - simple shapes primed to be seen as eyes[3]
  - white noise when the subject expects to see a face[9]

Conclusion: Conceptualizing the stimulus as a face based on a single feature or context is sufficient to elicit an N170 but no features need to be present.

Hypotheses

- In the absence of an expectation that there will be a face on any given trial, the presence of an enhanced N170 to intact (over scrambled) Mooney faces would indicate that face detection influences the N170 in the absence of facial features.
- The sensitivity of the P100 to the categorization of the intact Mooney faces would suggest that top-down facilitation of face recognition can be triggered by very early, preliminary categorization.[5,6]

Method

Stimuli

- Mixed set of intact (canonical) Mooney faces and scrambled Mooney faces
- Facial features (including external contour) missing
- Presented for 250 ms
- Random Order
- ISI = 1200-1800 ms

Canonical   Scrambled

Task

- Face/nonface judgments

Participants

- 16 adults (13 females); M = 20.9 yrs (18 – 25)

Electrophysiological Recordings

- recorded continuously using a 256-Channel EGI System
- 500 points per second
- referenced to the vertex
- offline filtered 1 to 30 Hz
- Impedances < 50 kΩ.
- Trials in which EEG exceeded ± 70 µV rejected automatically
- ERPs re-referenced to the average of all sites.
- Greenhouse-Geisser corrections for sphericity

Results

Accuracy:
- Intact: M =89% (SD = 7.4)
- Scrambled: M = 92% (SD = 7.1)
  $t(15) = 1.5, ns.$

Response time:
- Intact M = 488 ms (SD=95)
- Scrambled M = 562 ms (SD = 74)
  $t(15) = 5.4, p < .001$

N170:

- Scored at ventral parietal-temporal sites near to standard positions of P7 and P8
- M latency = 167 ms (SD = 24 ms) with no difference for intact and scrambled faces
- Larger for intact (M = -1.8 µV, SD = .98) than scrambled (M = -1.3 µV, SD = .91), $F(1, 15) = 9.77, p=.007, \eta^2 = .39$
- Effect marginally more apparent at left relative to right sites, $F(1,15) = 3.66, p=.075, \eta^2 = .20.$ (Fig. 3)
- Interaction more robust at topographically maximal sites (Fig. 4).

Figure 2.
Mooney Faces
Scrambled Faces

P7C83

N170

P8C180

P100

O1C109

O2C141

Figure 3. N170 Laterality x Stimulus interaction

Mooney Faces
Scrambled Faces

Figure 5. P100 Laterality x Stimulus interaction

P100:

- Scored at occipital sites near standard positions O1 and O2
- Amplitude same for Intact vs. Scrambled
- M latency=102 ms (SD = 17 ms)
- Latency shorter for Intact (M =99.9 ms, SD = 12.7) vs. Scrambled (M = 105.8 ms, SD = 13.5) at left sites $F(1, 15) = 6.19, p =.025, \eta^2 = .29$ (Fig. 5)
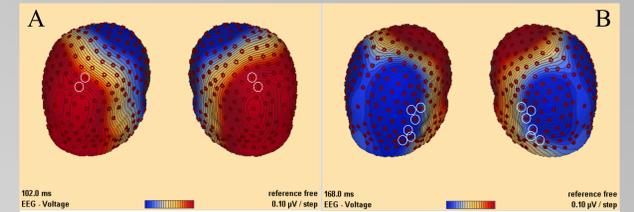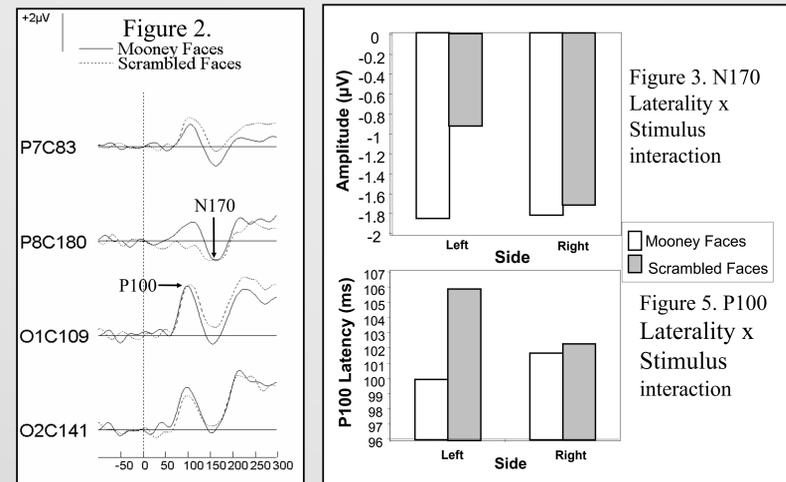

Figure 4. P100 (A) and N170 (B) topographies.
- Circles indicate occipital and ventral parietal-temporal sites initially scored.
- Rescoring N170s at asymmetric maximal sites strengthened results.
- Intact > scrambled, $F(1, 15) = 9.86, p = .007, \eta^2 = .40$
- Stimulus type x laterality interaction more reliable, $F(1,15)= 4.47, p= .052, \eta^2 = .23.$

Conclusions

- An enhanced N170 and an earlier P100 can be elicited by stimuli that participants perceived to be a face even though these faces lacked definable features.

- This early categorization presumably depends on some holistic approximation strategy being far enough along before 100 ms to elicit a faster P100 and to initiate an iterative process leading to an enhanced N170.[1]

- Eyes may be sufficient, but are not necessary for an enhanced N170, but this may be due to the N170 being enhanced whenever top-down processing causes the observer to detect that a face is present.

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