Neural responses to faces reflect social personality traits

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Abstract

Faces are a developmentally primary and critically important source of social information, and they are processed differently from most other visual percepts. Studies of brain electrophysiology reveal a face-sensitive component, the N170, which is typically enhanced to faces relative to other stimuli. Research in social disabilities suggests that atypical N170 response in this population may stem from decreased developmental exposure to faces secondary to reduced social interest. Here we examined the relationship between neural response to faces and social personality characteristics in a normative sample. Participants were pre-screened to identify individuals scoring high on extroversion or introversion. Both groups were presented upright and inverted face stimuli. An inversion effect, a marker of expertise for faces, was observed in people with high extroversion but not those with high introversion. These findings suggest that, within typically developing populations, social attitudes are reflected in the neural correlates of face perception.

Introduction

Face analysis is vital for social cognition. Expertise in face perception is indexed by the inversion effect: when faces are presented upside down, the N170 is larger and slower than to upright faces. Individuals with social disabilities, such as autism, exhibit a reduced face inversion effect. This has been theorized to stem from atypical developmental exposure, secondary to reduced interest in people and diminished social motivation. Research in personality traits has also elucidated empirical differences in social motivation across groups of individuals. Those scoring high on introversion are characterized as more socially inhibited than those scoring high on extroversion, who actively seek social engagements.

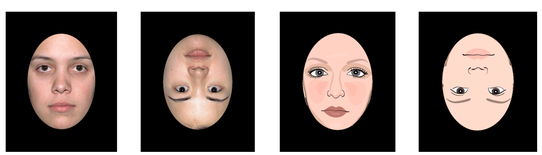
This study seeks to examine the relationship between neural responses to faces and social motivation in a normative population. Specifically, we examined extroversion and introversion as contrasting indices of social motivation.

Methods

Participants: 24 typically developing adults with extreme high or low extroversion scores were included in the study. There were 14 participants in the extroversion (7 females; mean age 22 years) and 10 in the introversion (3 females; mean age 22 years) group.

Design: ERP data was recorded using a 128 lead Geodesic sensor net. Stimuli consisted of 60 each (240 total) natural and cartoon faces upright and inverted. 25 target stimuli were randomly interspersed to monitor attention.

Stimuli:



Measure: The 48-item Eysenck Personality Questionnaire Revised Short Scale was used to measure extroversion. 12 items measure extroversion and require 'yes' or 'no' response.

Analysis strategies: N170 amplitude and latency to peak were analyzed using 3 (face type (cartoon/natural), hemisphere (left/right) and orientation (upright/inverted)) x 2 (extroversion vs introversion) repeated measures ANOVA.

Results

N170 Amplitude

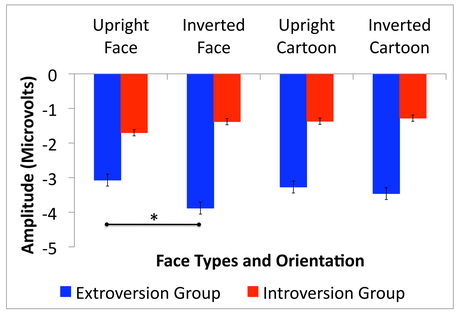
1) N170 amplitude was larger in response to inverted relative to upright faces [main effect of orientation, $F(1, 21) = 6.81$, $p = .02$].
2) N170 amplitude was greater in the right hemisphere [main effect of hemisphere, $F(1, 21) = 4.34$, $p = .05$].
3) The extroversion group showed greater N170 amplitude for inverted relative to upright faces in both natural and cartoon face conditions; the introversion group showed no significant difference between inverted and upright faces in either condition [orientation by group interaction, $F(1, 21) = 5.11$, $p = .03$].

Post-hoc analyses indicated a significant inversion effect in the extroversion group in the right hemisphere [$t(13) = 4.43$, $p = .001$], and a marginal effect in the left hemisphere [$t(13) = 1.91$, $p = 0.08$]. In contrast, the introversion group showed no inversion effect in either the right [$t(9) = 1.21$, $p = .26$] or left [$t(9) = -.65$, $p = .53$] hemisphere.

N170 Latency

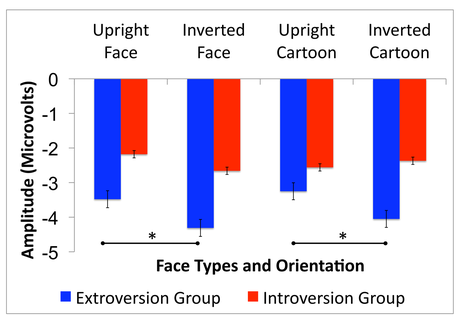
1) N170 latency tended to be faster in the right hemisphere, though this effect did not attain statistical significance [$F(1,22) = 3.79$, $p = .06$].
2) N170 latency is longer in response to cartoon faces than natural faces in the left hemisphere only [face type by hemisphere interaction, $F(1,22) = 5.35$, $p = .03$].

Figure 1. Mean N170 amplitude (microvolts) for upright and inverted natural and cartoon faces presented as a function of personality type in the left hemisphere. Error bars represent +/-1 S.E.M.



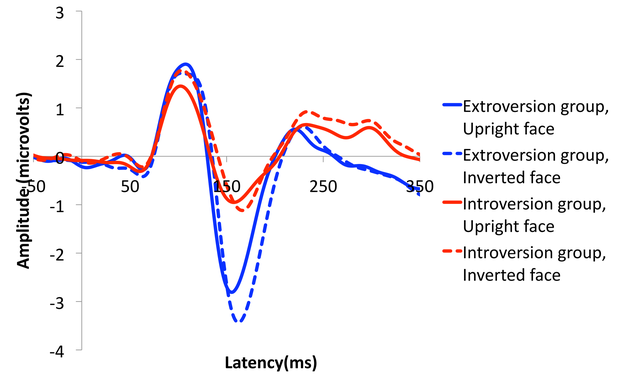
* *P<.05*

Figure 2. Mean N170 amplitude (microvolts) for upright and inverted natural and cartoon faces presented as a function of personality type in the right hemisphere. Error bars represent +/-1 S.E.M.



* *P<.05*

Figure 3. Mean N170 amplitude (microvolts) for upright and inverted faces (across hemisphere and face type) displayed for introversion and extroversion groups.



Conclusions

Here we report for the first time the influence of personality traits on face perception as reflected by EEG. Neural responses to faces were influenced by differences in social personality traits. Only the extroversion group showed the expected inversion effect in response to upside down faces, indicating the characteristic marker of expertise for faces. In contrast, the introversion group showed no differential sensitivity to inverted faces.

In studies of individuals with social disabilities, such as autism, the absence of an inversion effect has been hypothesized to reflect a lack of expertise secondary to decreased developmental exposure to faces. Because these individuals attend less to faces, neural specialization does not occur, and the N170 inversion effect as an index of expertise does not manifest. The current findings suggest a similar effect in typical individuals. Those more inclined towards social interaction displayed neural specialization associated with expertise for faces. In contrast, those less inclined towards social behavior did not display the same degree of neural specialization. We interpret this pattern of results as reflecting a developmental history of differential interaction with others and consequently differential exposure to faces. However, individuals with high introversion scores in this study did not show increased N170 latency to upright faces, indicating that the overall efficiency of face processing did not differ as a function of personality type. The differences in neural responses observed in those who scored high in introversion were reflected only at the highest level of face expertise.

In conclusion, this study highlights the importance of understanding individual differences in social motivation in both typical and atypical populations. Furthermore, the extent to which faces are highly salient visual stimuli may be uniquely determined by personality and individual differences in social motivation.

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