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FlashReport

# Seeing "us vs. them": Minimal group effects on the neural encoding of faces

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## HIGHLIGHTS

► We examined how early in face processing social group effects begin to take root.
► Group membership was manipulated with a classic minimal group paradigm.
► Electroencephalography was used to measure rapid neural responses to faces.
► Mere group information affected the structural encoding of faces.

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ABSTRACT

Faces are inherently social, but the extent to which social group information affects early face processing remains unknown. To address this issue, we examined cortical activity associated with structural encoding of novel ingroup vs. outgroup faces. Participants were assigned to one of two arbitrarily-defined groups using the minimal group procedure, and event-related potentials (ERPs) were recorded while participants categorized faces of people identified as members of their novel ingroup vs. outgroup. Our analysis focused on the N170 component of the ERP, which peaks 170 ms following face onset and reflects face structural encoding. Ingroup faces elicited larger N170 amplitudes than outgroup faces, suggesting that mere group information affects this initial stage of face perception. These findings show that social categories influence how we "see" faces, thus providing insight into the process through which categorizations may lead to biased intergroup perceptions.

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## Introduction

Interactions with members of other groups, whether on a crowded city street, a basketball court, or a battlefield, often occur face-to-face. During these encounters, facial information is used as a guide for determining the intentions of others. Although people generally trust their ability to process faces accurately, research increasingly suggests that face processing can be biased by social factors, including seemingly incidental group membership cues (Hugenberg & Corneille, 2009; Van Bavel, Packer, & Cunningham, 2008, 2011; Young, Bernstein, & Hugenberg, 2010; Young & Hugenberg, 2010). This research suggests that group membership cues may change the way we "see" a face. In the present research, we asked whether mere social group membership can influence the earliest stages of face processing.

Substantial research has shown that the arbitrary assignment of a person to one of two distinct novel groups is, by itself, sufficient to create an intergroup bias in which members of one's own group are favored (Tajfel, Billig, Bundy, & Flament, 1971). This effect is thought to constitute the origin of many intergroup biases (Brewer, 1999; Tajfel & Turner, 1986). Although early studies of the *minimal group* effect focused on its expression in relatively deliberative forms of ingroup favoritism, recent research has begun to show that minimal group effects can emerge implicitly in rapidly-made judgments (Ashburn-Nardo, Voils, & Monteith, 2001; Otten & Wentura, 1999). Findings such as these suggest that mere group membership may affect relatively low-level mechanisms of person perception.

Indeed, several recent studies have demonstrated that group membership modulates aspects of face processing, such that ingroup faces receive more cognitive and neural processing than outgroup faces (Hugenberg & Corneille, 2009; Van Bavel et al., 2008, 2011; Young & Hugenberg, 2010; Young et al., 2010). Although consistent with the hypothesis that mere group membership may affect the way we initially perceive faces of ingroup and outgroup members, the methods used to assess face processing in prior studies reflected relatively elaborated forms of face processing. This is because prior studies relied either on behavior-based judgments of faces or fMRI measures of brain activity that, due to their low temporal resolution, cannot discern early-stage structural processing from more elaborate cognitive effects on vision.

In the current study, we asked whether ingroup processing advantages based on mere category distinctions emerge as early as the structural encoding stage of face perception—the initial process in which

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physiognomic features and configurations are extracted from visual input to construct the mental representation of a face. Specifically, we examined the *N170* component of the event-related potential—an index of brain activity characterized by a negative-polarity neuro-electrical signal that peaks at occipitotemporal scalp sites approximately 170 ms after a face appears. The N170 has been identified as a reliable signature of structural face encoding (Bentin, Allison, Puce, Perez, & McCarthy, 1996), and it is the earliest ERP component known to reflect the perceptual processing of a face (Rossion & Caharel, 2011; Rousselet, Husk, Bennett, & Sekuler, 2008).

It is notable that N170 responses to faces differing on established group dimensions, such as race, sex, and age, have been examined previously, but with mixed results (e.g., Balas & Nelson, 2010; Ito & Urland, 2005; Mouchetant-Rostaing & Giard, 2003; Ofan, Rubin, & Amodio, 2011; Walker, Silvert, Hewstone, & Nobre, 2008). Importantly, in these previous studies, ingroup and outgroup faces differed in their inherent, bottom–up visual properties, and the groups were associated with preexisting rich knowledge structures. For these reasons, it is unclear whether these past findings reflect group membership distinctions or other factors. Thus, a precise test of group categorization effects on the face-sensitive N170 must control for existing group associations and low-level perceptual features. To this end, we used a minimal group paradigm (Tajfel et al., 1971) to experimentally create artificial group distinctions that did not covary with facial characteristics and were novel to participants. Given that minimal group categorization is known to enhance processing of ingroup members (e.g., Hugenberg & Corneille, 2009; Van Bavel et al., 2008, 2011; Young & Hugenberg, 2010), we hypothesized that once one's group membership is established, participants will be more strongly motivated to process ingroup faces than outgroup faces, in a top–down manner that would exert its influence within the first 200 ms of viewing a face (e.g., see Amodio, 2010, in the domain of race). Hence, we predicted that mere group categorization should enhance the N170 response to ingroup faces relative to outgroup faces.

## Method

### *Participants*

Forty-five New York University students participated in the study in exchange for course credit.

### *Procedure*

Upon arrival at the study session, participants completed a consent form and were fitted with an electrode cap for EEG recording. They then completed several computer tasks that were presented on a CRT monitor, which was positioned 90 cm from where they were seated.

#### *Cover story and group assignment*

A bogus cover story was used to assign participants to a believable yet novel group based on the dimension of numerical estimation style, defined as the tendency to overestimate or underestimate the number of objects a person encounters (Tajfel et al., 1971). They learned that this tendency was equally distributed in the population and not associated with any other known psychological characteristics.

Participants were told that they would categorize photographs of students from a previous semester whose numerical estimation style had been determined using the *Numerical Estimation Style Test* (NEST). The NEST involved viewing a series of dot patterns and the task was to estimate how many dots appeared in each image. As part of the induction, participants completed a version of the NEST and received feedback classifying them as an overestimator or underestimator. This feedback served as the manipulation of group assignment. This procedure met key criteria for a minimal group induction: no group competition, no explicit rationale for a group preference, no expectation of contact, and no reciprocity motivation.

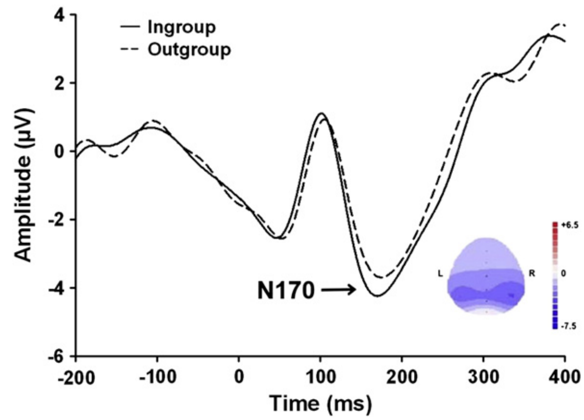


**Fig. 1.** Minimal group effect on N170 amplitude. Results indicated a larger N170 effect to ingroup faces than outgroup faces.

#### *Face categorization task*

Following the induction procedure, participants viewed faces of people purportedly classified as an overestimator or underestimator based on their NEST results. Each participant's task was to try to detect whether each person was an overestimator or underestimator. We explained that, because many people are not accustomed to this distinction, the background color of the picture (blue or green) would provide a clue to a target person's numerical estimation style. Background color and numerical estimation style were counterbalanced across participants to ensure that any effects could be attributed to group membership and not to numerical estimation style or background color. Importantly, although the background color provided the cue for social category information to be applied to visual face processing, the N170 is sensitive to faces and is not known to be responsive to color in the absence of a face (Minami, Goto, Kitazaki, & Nakauchi, 2011). Therefore, any effects obtained for N170 responses could be attributed to face processing and not to the background color alone. Furthermore, because faces were repeated in the task, participants could learn the membership of each face and would no longer have to rely on the background color when categorizing each face.

### *Materials*

#### *Numerical Estimation Style Test*

The NEST included ten dot patterns presented sequentially on a computer screen for 5 s each. Each pattern included 98–200 black dots arranged randomly on a white background. Following each image, participants were prompted to estimate the number of dots presented. Upon completion, participants waited for 12 s while the computer ostensibly analyzed their responses. The computer program then presented bogus, predetermined feedback regarding their numerical estimation style. Feedback was counterbalanced across participants.

#### *Face categorization task*

On each trial, a face was presented in the center of the screen and classified by participants as an overestimator or underestimator, via a key press. Faces remained onscreen until participants logged their response. A fixation cross appeared for 412 ms between trials. This task included 60 total trials: 30 ingroup trials and 30 outgroup trials.

Stimuli included color photographs of six Caucasian male faces with a neutral expression (Malpass, Lavigueur, & Weldon, 1973), superimposed on a green or blue background (325×417 pixels). Three unique faces were assigned to each group; thus, each face was repeated ten times, in a randomized order. Group assignment, face identity, response key mappings, and background color were counterbalanced across participants to ensure that any N170 effects could only be attributed to mere group categorization.

*EEG recoding and processing*

EEG was recorded from eight tin electrodes (Fz, Fcz, Cz, CPz, Pz, Oz, T5, and T6), embedded in a stretch lycra cap (ElectroCap, Eaton, OH), positioned according to the 10–20 system and referenced to the left earlobe (kΩ<5), with a forehead ground. Vertical and horizontal eye movements were recorded to facilitate artifact scoring. Following previous research (e.g., Amodio, 2010; Ofan et al., 2011), signals were amplified using a Neuroscan Synamps2 (El Paso, TX), with a .15–100 Hz online bandpass filter, and digitized at 500 Hz. Offline, EEG was rereferenced to average earlobes, scored for movement artifact and blink-corrected, and digitally filtered through a 1–15 Hz bandpass.

To create ERP waveforms, a 1200 ms stimulus-locked epoch was selected for each artifact-free trial beginning 200 ms before prime onset. Baseline correction procedures subtracted the average voltage during a 200 ms prestimulus period from each epoch, and then epochs associated with correct responses were averaged within trial types. The N170 was scored for each participant as the negative peak amplitude occurring between 120 and 220 ms post face-onset at left and right lateral posterior sites (T5 and T6, respectively), where the N170 is maximal (Ito & Urland, 2005).

## Results

Three participants were excluded from analysis because of extreme outlying values (>3 SD) of the N170 amplitude (one participant) or reaction time (two participants), leaving 42 participants for analysis.

*Behavioral effects*

In support of a processing advantage of the ingroup vs. outgroup faces, a paired t-test of the log-transformed response latencies revealed that participants were significantly faster to categorize ingroup ($M=465.47$ ms, $SD=90.35$ ms) than outgroup faces ($M=477.75$ ms, $SD=96.14$ ms), $t(41)=3.35$, $p<.01$. Not surprisingly, given the ease of the task, participants were highly accurate in categorizing faces, and their accuracy did not differ for ingroup faces ($M=95\%$, $SD=5\%$) and outgroup faces ($M=95\%$, $SD=6\%$), $p=.75$.

*N170 effects*

Our main hypothesis was that the N170 amplitude would be larger to ingroup than outgroup faces during the face categorization task. To test this hypothesis, we conducted a 2 (Electrode site: T6 vs. T5)×2 (Group: ingroup vs. outgroup) repeated-measures analysis of variance (ANOVA) on the N170 amplitudes. Supporting our hypothesis, a main effect for group indicated that peak N170 amplitudes (in μV) were significantly larger for ingroup ($M=-6.78$, $SD=3.27$) vs. outgroup faces ($M=-6.05$, $SD=3.31$), $F(1,41)=4.68$, $p=.04$ (see Fig. 1). A marginal main effect also emerged for electrode site, consistent with evidence that the face-sensitive N170 often is right-lateralized, $F(1, 41)=2.98$, $p=.09$. The Group×Electrode site interaction, however, was not significant, $p=.99$.

Although larger N170 amplitudes are typically interpreted as superior structural encoding of faces, greater N170 amplitudes coupled with a latency delay have been argued to signify enhanced engagement of the perceptual system due to encoding difficulty (Rossion et al., 1999, 2000). To examine this alternative explanation, we performed a 2 (Electrode site: T6 vs. T5)×2 (Group: ingroup vs. outgroup) repeated measures ANOVA on the N170 peak latency (in ms). No differences emerged between the ingroup ($M=176.60$, $SD=24.71$) and outgroup ($M=179.71$, $SD=26.56$), $F(1,41)=1.34$, $p=.25$. This result suggests that the group effect on N170 amplitude reflects a difference in face structural encoding and not encoding difficulty.

*Relationship between the N170 and behavior*

Correlations between group difference scores for response time, N170 amplitude, and N170 latency were non-significant, $ps>.25$. These findings suggest that the ingroup face processing advantage at approximately 170 ms does not relate directly to the type of behavior assessed by our categorization task.

## Discussion

Mere group categorization has been shown in past research to create intergroup biases (e.g., Tajfel et al., 1971). Here, we showed that it can also affect the initial visual encoding of a face, such that ingroup faces are more strongly encoded than outgroup members. This effect occurred in the absence of factors that often co-occur with group distinctions, such as prior knowledge of group attributes and differences in facial information. Our finding suggests that, in very early stages of visual perception, faces associated with one's ingroup are more readily processed than faces of outgroup members. This early bias in visual processing may facilitate more elaborate attributions of ingroup members as possessing more positive and more humanized characteristics, which in turn could contribute to prejudice and discrimination.

Although our broader interest is in how early group-based effects on face processing may contribute to downstream biases in attitudes and behavior, it is notable that the N170 effect for groups was not associated with behavior on the experimental task. Indeed, the task was designed for a rigorous test of N170 differences, but not for assessing meaningful intergroup behavior. Nevertheless, the minimal group scenario modeled in our experiment parallels many real-world situations in which arbitrary group memberships form, such as in corporate workgroups or sports teams. An important direction for future research will be to examine the processes through which group-based effects on early visual face processing can influence more elaborate forms of intergroup attitudes and behaviors.

Our findings have implications for how bias in intergroup responses may be detected and regulated. Dominant theories of prejudice control assume that the discrepancy between an intended and a biased response must be detected as a precursor to the engagement of control (Amodio et al., 2004; Monteith, 1993). However, if group membership influences the initial encoding of a face, then any group-based bias in an ingroup or outgroup member's appearance could be misinterpreted as a veridical representation of that person's face. In this case, a perceiver would not be privy to the bias and would not attempt to regulate his or her response to counter unintended prejudice. These findings suggest a need for new theorizing on how visual forms of intergroup bias might be regulated, as they may be resistant to corrective control mechanisms and instead require proactive forms of control (e.g., Amodio, 2010).

Finally, our results add new evidence that top–down information can influence early-stage aspects of visual perception. Influential models of face processing (e.g., Bruce & Young, 1986) posit that top–down social information, such as knowledge about group membership, should not influence structural face encoding. However, our findings suggest that mere group membership influences face processing at the point when the facial percept is disambiguated from bottom–up sensory information. This finding provides a critical advance to the growing evidence that conceptual and motivational factors can affect visual processes thought to be impenetrable to top–down input (Balcetis & Dunning, 2006; Bar, 2003; Bruner, 1957; Summerfield et al., 2006). By testing these effects in the social domain, our research begins to elucidate the role of motivated visual perception for social behavior and intergroup relations.

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