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Racial ingroup and outgroup attention biases revealed by event-related brain potentials

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Recent electrophysiological research indicates that perceivers differentiate others on the basis of race extremely quickly. However, most categorization studies have been limited to White participants, neglecting potential differences in processing between racial groups. Moreover, the extent to which race interferes with categorization along other dimensions when race is made irrelevant to a perceiver's task is not known. A gender categorization task was used to test the extent to which race information would implicitly interfere with explicit gender categorization. As predicted, behavioral and electrocortical data indicated that participants attended to both the task-relevant gender dimension and the task-irrelevant race dimension. Additionally, processing of target race differed between Black and White participants. Ingroup attention biases in the N200 component of the event-related brain potential facilitated target categorization, suggesting a potential functional role for early differentiation of ingroup and outgroup targets.

Keywords: social categorization; gender; race; Event-related potentials; implicit

The person perception process often begins with social categorization (Fiske *et al.*, 1999). That is, people are quickly (Zarate and Smith, 1990; Banaji and Hardin, 1996) and effortlessly (Fiske, 1998) identified as members of a group or groups, often on the basis of visually prominent features (Brewer, 1988; Fiske, 1998). Many studies have outlined the benefits (e.g. processing efficiency) and costs (e.g. activation of negative group stereotypes) of perceiving others categorically (Greenwald and Banaji, 1995; Bodenhausen and Macrae, 1998). Still, numerous questions concerning the categorization process itself are unresolved. For example, there is some debate concerning the extent to which certain social categories capture attention more than others, and little research has explored potential differences in categorization as a function of the perceiver's category. The present research investigated these issues by testing the neural responses to race cues during a gender categorization task, focusing on potential differences associated with perceivers' racial group memberships.

It is often noted that certain categories, namely race, gender and age, are 'privileged' in the sense that they tend to be easily identifiable and thus likely to guide impressions (Fiske *et al.*, 1999). However, it is not clear whether one of these so-called privileged categories dominates or takes precedence over others upon viewing a target. That is, a target could be categorized by gender (e.g. male), race (e.g. Hispanic) or age (e.g. elderly). Another possibility is that a perceiver could attend simultaneously to a combination of these features (i.e. an elderly Hispanic man). The question of how perceivers attend to multiple social categories has been the subject of several investigations (Stangor *et al.*, 1992; Gardner *et al.*, 1995; Macrae *et al.*, 1995). Some evidence suggests that making particular categories salient can lead to their dominance in target impressions. For example, Macrae *et al.* (1995) reported that a Chinese woman was viewed in stereotypical terms according to either her gender or her ethnicity depending on which category was made temporarily more accessible. However, other data (Stangor *et al.*, 1992) indicate that manipulations of both short-term category accessibility and explicit processing goals have little effect on the category to which perceivers will attend, suggesting that certain features or categories may dominate the categorization process regardless of task-relevant processing goals. By measuring neural responses to race cues during a gender categorization task, the present study investigated whether attention is spontaneously drawn to race even when race is irrelevant to perceivers' task-specific goals.

Understanding issues associated with potential dominance of certain features depends upon the ability to parse the processes that unfold quickly upon perception of a target. When used alone, behavioral measures of categorization, such as response latency (Zarate and Smith, 1990; Zarate *et al.*, 1995; Stroessner, 1996), provide only limited information on this issue in that they represent the outcome of a conscious categorization decision (Ito and Cacioppo, 2000). Fortunately, such behavioral data can be augmented by psychophysiological measures such as the event-related brain potential (ERP). ERPs reflect neural activity associated with various information processing operations, including social categorization (Fabiani *et al.*, 2007). Of primary

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concern here is the general notion that the amplitude of ERP components reflects the extent to which particular information processing operations are engaged by a stimulus (Coles *et al.*, 1995). A particular advantage of the ERP in the current research is that multiple components of the ERP waveform can be assessed from a single stimulus, each representing a somewhat different aspect of processing, and thus it is possible to measure multiple cognitive responses to the same target person as they unfold in real time.

A number of ERP components are of interest in the present research. First and foremost are two components associated with early attention-related processes, the P200 and the N200. The P200 has been associated with low-level stimulus-classification processes (Crowley & Colrain, 2004), but also has been specifically linked to perceptions of threat. For example, angry faces tend to elicit larger P200s than neutral or happy faces (Schutter *et al.*, 2004). The N200 has been linked to a number of processes, including conflict detection (van Veen and Carter, 2002) and activation of inhibitory mechanisms (Heil *et al.*, 2000), but has also been shown to be sensitive to differences in social category cues (Ito and Urland, 2003, 2005; Ito *et al.*, 2004). Finally, the P300 component has been linked with evaluative categorization processes (Cacioppo *et al.*, 1993; Ito *et al.*, 1998; Bartholow *et al.*, 2001), including implicit categorization of task-irrelevant target features (Ito and Cacioppo, 2000).

Recent social categorization studies have shown that race captures attention very early in processing as indexed by the amplitude of P200 and N200 (Ito and Urland, 2003, 2005; Ito *et al.*, 2004; Bartholow and Dickter, 2006). In all of these previous studies, Black faces elicited larger P200 amplitudes than White faces, but White faces elicited larger N200 than Black faces. Three main hypotheses have been advanced to explain this pattern of target race effects. First, enhanced P200 to Black targets could reflect early direction of attention to threat (Schutter *et al.*, 2004), given that the stereotype for Blacks includes aspects of aggression and violence. Second, it may be the case that greater early attention is allocated to Black targets because they are numerically rare in many parts of the US (i.e. a stimulus distinctiveness effect; Ito and Urland, 2003). Third, the pattern of P200 and N200 effects together could be an index of early attention to outgroup members (P200), switching to an ingroup processing bias at a slightly later stage (N200) to support ingroup encoding biases that have been reported in other research (Levin, 2000). A major concern in drawing conclusions about the apparent target race effects seen in previous research is that, in every published study to date, nearly all participants have been White. Thus, it has been impossible to critically evaluate these hypotheses against one another because the pattern of larger P200 to Blacks and subsequent N200 to Whites can equally support either the race-specific nature of the effect (i.e. that Blacks represent threat) or ingroup–outgroup attention biases. To address this critical issue, the current study examined these effects in both Black and White participants.

A final consideration guiding the present work is that social categorization often occurs in a social context. That is, perceivers often encounter targets who are surrounded by other people, and those other people can belong to the same category as the target or can represent a different category (or categories). To date, researchers using ERPs to study the time course of social categorization have manipulated context in terms of the category membership of a given target relative to that of recently presented targets (Ito and Urland, 2003, 2005; Ito *et al.*, 2004). Such studies aptly represent situations in which isolated targets are categorized shortly after other individuals have been encountered. However, it is also of interest to know how categorization unfolds when other targets directly compete for a perceiver's attention. The presence of peripheral targets could lead to conflict in the categorization process, particularly if one category (i.e. gender) is goal-relevant but a different category is inherently likely to capture attention.

A useful paradigm to study such situations in the laboratory is the Eriksen flanker task (Eriksen and Eriksen, 1974). In this task, targets are simultaneously presented among distracting 'flanker' stimuli, which participants are told to ignore. The flankers are designed to elicit either the same response as the target (i.e. compatible trials) or an opposing response (i.e. incompatible trials). Numerous studies have shown that participants are faster and more accurate to respond to the target on compatible as compared to incompatible trials, a finding known generally as the *compatibility effect* (Coles *et al.*, 1985). The flanker task is often used to study the neural processes associated with conflict between prepotent but task-irrelevant stimulus features and attributes that are important for adaptive task performance (Botvinick *et al.*, 2001). A modified flanker task was used in one previously published study of social categorization (Macrae *et al.*, 1999), in which the authors found that participants were slower to categorize the gender of first names when they were flanked by names associated with the opposite gender.

To address the aims of this research we used a modified flanker paradigm in which centrally-presented target faces were flanked by other faces that varied according to both race and gender. Participants' task was to categorize the gender of target faces. This paradigm permits a conservative test of the interference hypothesis given that race is task-irrelevant and attending to it could impair task performance. We predicted increased flanker interference (i.e. slower responses) both when flanker gender was incompatible with target gender and when flanker race differed from target race. We had 2 primary interests for the ERP data in this research. Our main interest was in whether early attention effects that have differed according to target race in previous studies (Ito and Urland, 2003, 2005; Ito *et al.*, 2004; Bartholow and Dickter, 2006) would be driven here by the interaction of target race and participant race (i.e. ingroup–outgroup effects). A secondary interest was to use the ERP as an additional measure of the effects of context on categorization, focusing on when in the course of target processing any context effects emerge. When categorization is studied using oddball-type paradigms, context effects typically emerge in the P300 component (Ito and Urland, 2003), which is sensitive to trial-by-trial changes in stimulus features. However, context has a different meaning, and thus different effects, in a flanker paradigm. Specifically, to the extent that flanker faces elicit conflict when their race or gender is incompatible with the target, we expect context effects to emerge in the N200 component, which has been linked to conflict detection (Botvinick *et al.*, 2001). It is not clear whether context effects also will emerge in the P300 component in this study, given that the design is not meant to focus on sequential effects.

METHOD

Participants

Thirty-five undergraduates from a large, public university participated for partial fulfillment of course requirements. Twenty participants reported their race as White (11 men, 9 women) and 15 reported their race as Black (2 men, 13 women). All participants reported themselves in good health (e.g. no history of major medical conditions, including neurological disease or serious head injury), had normal or corrected-to-normal vision, and were right-handed.

Stimuli

Twenty-four color pictures of faces varying according to both race and gender (six Black men, six Black women, six White men, six White women) were used as stimuli. All pictures were equated for attractiveness as determined by a pilot test (Bartholow *et al.*, 2006) and displayed neutral facial expressions.

Paradigm

Stimuli were presented in five-picture arrays using a modified flanker task (Eriksen & Eriksen, 1974). Each trial consisted of a 200 ms pre-stimulus baseline period followed by a stimulus array in which a centrally presented target picture was flanked by two pictures on the left and two pictures on the right. Arrays appeared for 250 ms with an inter-trial interval of 1000 ms. Participants completed 10 blocks of 64 trials each, in which their task was to categorize the target's gender by pressing one of two designated keys (counter-balanced across participants). Participants were instructed to ignore the flanker faces. Four types of trials occurred with equal probability. *Compatible gender, compatible race* (CGCR) trials were those in which the target and flankers showed individuals of the same race and gender. *Compatible gender, incompatible race* (CGIR) trials were those in which the gender of the flankers was the same as the target, but the race was not. *Incompatible gender, compatible race* (IGCR) trials showed flankers of the opposite gender to the target but the same race as the target. Finally, *incompatible gender, incompatible race* (IGIR) trials were those in which the flankers differed from the target on both gender and race. Participants were seated approximately 90 cm from the screen, yielding a visual angel of approximately 30°.

Psychophysiological data collection and reduction

The electroencephalogram (EEG) was recorded from 28 scalp sites using tin electrodes sewn into an electrode cap (Electrocap, International, Eaton, OH), according to an extended 10–20 system (Jasper, 1958). Active scalp sites were referenced online to the right mastoid; an average mastoid reference was derived off-line. Vertical and horizontal movements of electrooculograms were recorded with electrodes placed above and below the left eye and on the outer canthus of each eye. Electrode impedances were kept below 5 KΩ at all sites. EEG was sampled at 250 Hz by Neuroscan Synamps (Compumedics USA, El Paso, TX) amplifiers and was filtered online at .01 to 40 Hz. Ocular artifacts were removed using a regression-based procedure (Semlitsch *et al.*, 1986). Trials containing voltage deflections of ± 75 microvolts (μV) were removed prior to averaging according to participant, electrode and stimulus conditions. Averages were further lowpass filtered offline at 12 Hz.

Procedure

After obtaining informed consent, the experimenter explained that the purpose of the study was to assess facial recognition amid distraction. Participants completed the experiment individually while seated in a comfortable chair in a small, sound-attenuated room. The experimenter explained the instructions for the task and then attached and tested the electrodes. Participants then completed a short practice block (40 trials) before completing the experimental blocks. Participants moved at their own pace between blocks, allowing time to rest their eyes. When all blocks were completed, electrodes were removed and participants were debriefed and dismissed.

RESULTS

Analytic approach

Because the design included three within-subjects factors (flanker compatibility [four levels], target gender and target race), as well as two between-subjects factors (participant race and gender), testing the full model including all factors in this complex design results in some very complicated (and theoretically uninteresting) higher-order interaction terms. Thus, the data were examined using sets of planned contrasts to permit more focused tests of our hypotheses.

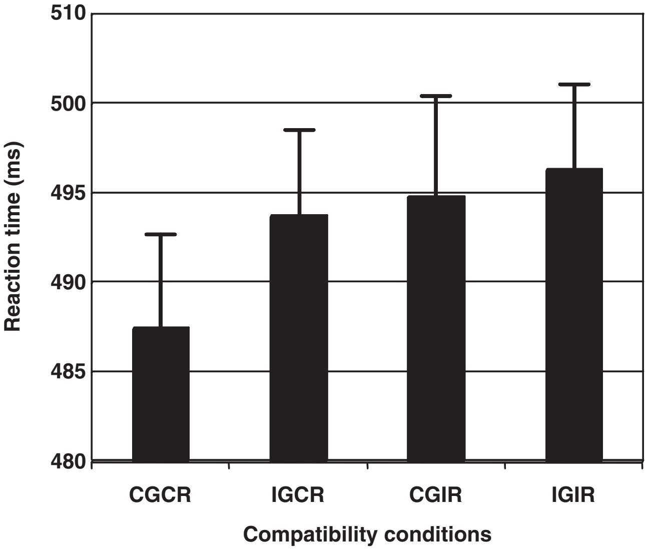

Fig. 1 Mean reaction time (+*SE*) as a function of compatibility conditions. CGCR = compatible race, compatible gender (i.e. flankers share both race and gender of target); IGCR = incompatible gender, compatible race (i.e. flankers' gender differs but race is the same as the target); CGIR = compatible gender, incompatible race (i.e. flankers' gender is the same but race differs from the target); IGIR = incompatible gender, incompatible race (i.e. flankers gender and race differ from the target). The mean in the CGCR condition differs from the other three conditions (P's < 0.002), which do not differ from each other (P's > 0.50).

Behavioral data

Only correct trial RTs that fell within ±3 s.d. from the mean were included in the analyses. These RTs initially were subjected to a 4 (Flanker Compatibility: CGCR, IGCR, CGIR, IGIR) × 2 (Target Gender: female, male) × 2 (Target Race: Black, White) repeated measures ANOVA.[1] As expected, the compatibility effect was significant, $F(3, 96) = 7.76$, $P < 0.001$. Inspection of the means in Figure 1 shows that responses were influenced by the compatibility of both flanker gender and flanker race. Specifically, when flankers were compatible with the target on both gender and race dimensions (i.e. CGCR), participants responded fastest ($M = 487$ ms). When either flanker gender or flanker race (or both) were incompatible with the target, responses were slower (M's = 494, 495, 496 ms for IGCR, CGIR, IGIR, respectively), as predicted. Planned contrasts showed that the CGCR condition differed from the other three conditions (P's < 0.002), which did not differ from each other (P's > 0.54). The compatibility effect did not differ as a function of participant race or sex, and no other effects of interest were significant.[2]

ERP data

Due to a large number of artifacts in their EEG, data from two participants (one Black, one White) could not be used; therefore, all ERP analyses were based on the data from 33 participants. Visual inspection of single participant average waveforms was used to identify epochs for measuring the amplitude of components of interest, followed by initial analyses to determine scalp locations (across all participants) where components of interest were maximal. The P200 was largest at the CPz (central-parietal midline) electrode, and was quantified as the average voltage between 150 and 225 ms at CPz. The N200 component was largest at the Fz (frontal midline) electrode, and was quantified as the largest voltage between 225 and 350 ms post-stimulus at Fz. The P300 was largest at the parietal midline electrode (Pz), and so was quantified as the largest voltage at Pz between 350 and 650 ms.

Early attentional effects. The primary hypotheses for the early attention components concerned whether they would reflect differential attention to both gender (the explicit dimension) and race (the implicit dimension), and whether main effects of race would be consistent among Black and White participants. Thus, analyses of these components were carried out using specific race and gender contrasts within an ANOVA framework.

Analyses of the P200 component revealed a main effect for Target Race, $F(1, 31) = 9.18$, $P < 0.01$, which was qualified by a significant Target Race × Participant Race interaction, $F(1, 31) = 33.81$, $P < 0.001$. As shown in panels C and D of Figure 2, among White participants the P200 was larger to Black targets ($M = 2.30\,\mu$V) than White targets ($M = 0.9\,\mu$V), $F(1,18) = 46.09$, $P < 0.001$, consistent with previous research (Ito & Urland, 2003, 2005). However, among Black participants the opposite pattern emerged, with larger P200 amplitude to White targets ($M = 1.47\,\mu$V) than to Black targets ($M = 0.98\,\mu$V), $F(1,13) = 4.46$, $P < 0.05$. The analysis also showed a main effect of Target Gender, $F(1, 31) = 8.13$, $P < 0.01$, with female targets eliciting larger P200 ($M = 1.70\,\mu$V) than male targets ($M = 1.25\,\mu$V). This effect did not differ as a function of participant gender ($F < 1$). No other effects of interest were significant.

The analysis of N200 amplitude showed a main effect of Target Race, $F(1, 31) = 5.20$, $P < 0.05$, which was qualified by a Target Race × Participant Race interaction, $F(1, 31) = 18.59$, $P < 0.001$ (Figure 2, panels A & B).

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[1] As an alternative to the four-level compatibility factor used here, we constructed an ancillary analysis using separate two-level factors for race compatibility and gender compatibility, which results in a 2 (Target race) × 2 (Target sex) × 2 (Race compatibility) × 2 (Gender compatibility) ANOVA design. Using this design, the ANOVA produces significant main effects for both Race compatibility, $F(1, 32) = 13.56$, $P < 0.01$, and Gender compatibility, $F(1, 32) = 9.31$, $P < 0.01$, in addition to a marginally nonsignificant interaction between these two factors, $F(1, 32) = 2.63$, $P = 0.11$. The pattern of means produced by these effects is essentially identical to that presented in Figure 1, indicating that when flankers are compatible on both factors target responses are faster than when flankers are incompatible on either factor (or both factors). We opted to present the analysis using the four-level compatibility factor in order to reduce the overall number of factors in the design (and, hence, the number of effects produced by the analysis), and to simplify presentation of the means according to the hypotheses.

[2] The ANOVA also produced a significant Target Race × Target Gender interaction, $F(1, 32) = 33.17$, $P < 0.001$. Adding the between-subjects factors produced a main effect of Participant Race, $F(1, 29) = 10.16$, $P < 0.01$—Black participants responded more quickly overall ($M = 438$ ms) than did White participants ($M = 516$ ms)—and a main effect of Participant Gender, $F(1, 29) = 5.57$, $P < 0.05$—men responded more quickly ($M = 448$ ms) than did women ($M = 506$ ms). Finally, a significant Target Race × Target Gender × Participant Race interaction emerged, $F(1, 29) = 6.96$, $P < 0.05$. However, these effects are not pertinent to the hypotheses of this study and so they will not be discussed.

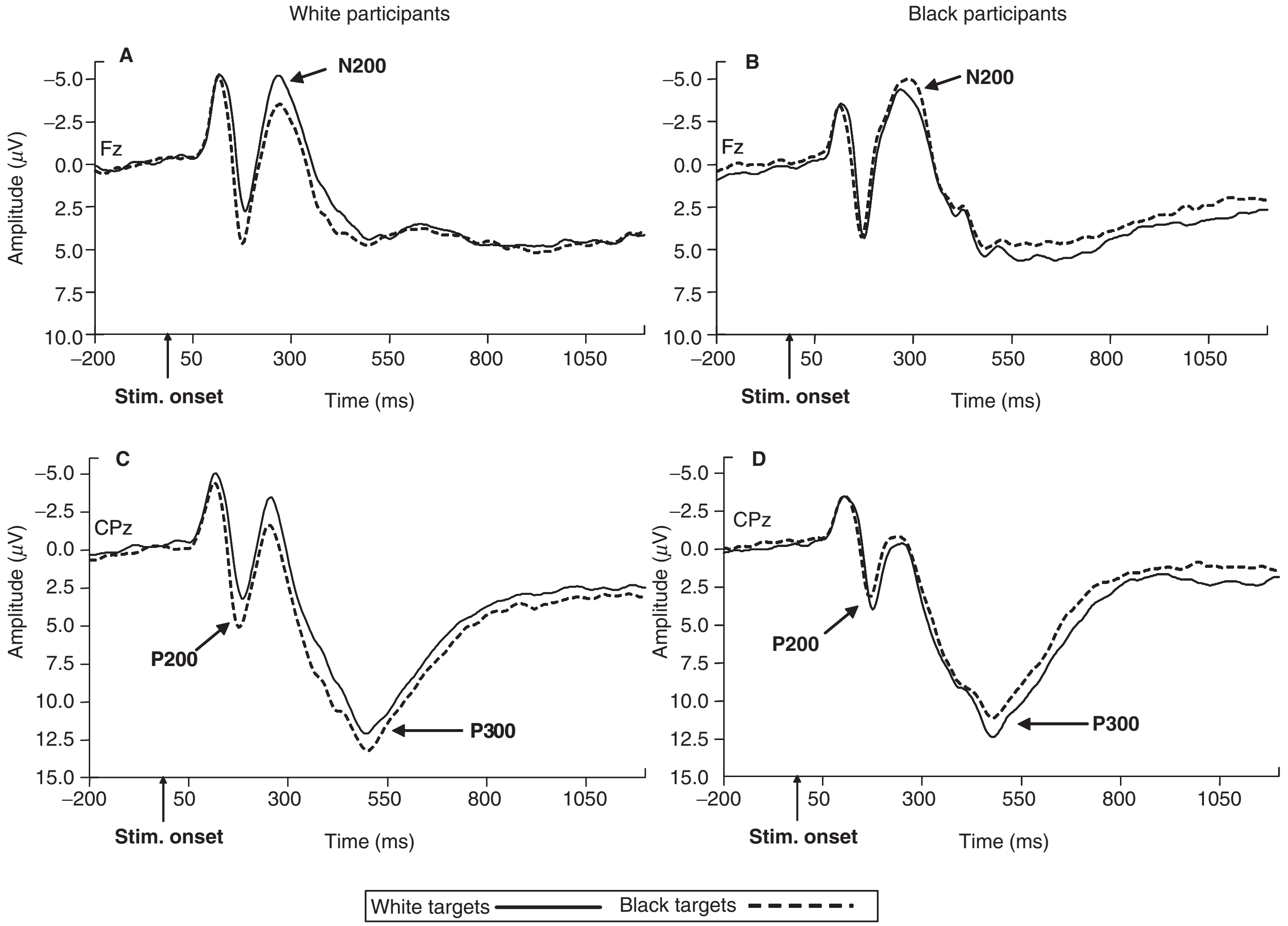

Fig. 2 ERPs elicited by Black and White targets as a function of participant race. Panels A and B show waveforms measured from the frontal midline electrode (Fz), where the N200 was largest, collapsed across all factors except target race. Panels C and D show waveforms measured from the central-parietal midline electrode (CPz), where the P200 was maximal, collapsed across all factors except target race. Panels A and C present data recorded from White participants, and Panels B and D present data recorded from Black participants.

White participants showed larger N200 amplitude to White targets ($M = -3.23\,\mu\text{V}$) than to Black targets ($M = -1.98\,\mu\text{V}$), $F(1,18) = 25.60$, $P < 0.001$, again replicating prior research (Ito and Urland, 2003, 2005; Ito *et al.*, 2004). However, Black participants showed the opposite pattern, with larger N200 amplitude to Black targets ($M = -3.54\,\mu\text{V}$) than to White targets ($M = -2.65\,\mu\text{V}$), $F(1,13) = 4.94$, $P < 0.05$. The analysis also showed a main effect of Target Gender, $F(1, 31) = 5.50$, $P < 0.05$, wherein male targets elicited larger N200 ($M = -3.11\,\mu\text{V}$) than female targets ($M = -2.73\,\mu\text{V}$). As with the P200, this effect was not qualified by participant gender ($F < 2$). The analysis also showed a significant Target Race × Compatibility interaction, $F(3, 96) = 3.02$, $P < 0.05$. Tukey follow-up tests showed that, for White targets, incompatibility in the flankers on either the race or gender dimension significantly increased the N200 (M's $= -3.63$, -3.29, and $-3.17\,\mu\text{V}$, respectively, for IGCR, CGIR, and IGIR), compared to the condition in which flankers were compatible on both dimensions (CGCR; $M = -2.50\,\mu\text{V}$), P's < 0.05. Flanker compatibility had little effect on the N200 for Black targets (M's ranged from -2.40 to $-2.85\,\mu\text{V}$; P's > 0.20). This effect was not further qualified by Participant race ($F < 2$).

Later evaluative categorization. Consistent with the other components we examined, the analysis of P300 amplitude showed a Target Race × Participant Race interaction, $F(1, 31) = 12.72$, $P < 0.01$. Whereas White participants showed a larger P300 to Black targets ($M = 8.30\,\mu\text{V}$) than to White targets ($M = 7.57\,\mu\text{V}$), $t(18) = 3.79$, $P < 0.01$, Black participants showed an opposing pattern of larger P300 to White targets ($M = 8.04$) than to Black targets ($M = 7.74\,\mu\text{V}$), though this difference was not significant, $t(13) = 1.44$, $P = 0.16$. The analysis also showed a main effect of Target Gender, $F(1, 31) = 5.69$, $P < 0.05$, with larger P300 amplitudes to female ($M = 8.22\,\mu\text{V}$) than to male targets ($M = 7.62\,\mu\text{V}$).

In addition, this analysis showed a Compatibility main effect, $F(3, 93) = 4.19$, $P < 0.05$, qualified by a Compatibility × Target Race interaction, $F(3, 93) = 3.82$, $P = 0.01$. Inspection of the means associated with this effect showed that the P300 elicited by Black targets was similar across compatibility conditions (*M*'s ranging from 7.73 to 8.29 μV, *P*'s > 0.10). In contrast, the P300 elicited by White targets was smaller when flankers were incompatible according to either race or gender (*M*'s = 7.16 and 7.46 μV, respectively), compared with when flankers were compatible on both dimensions ($M = 8.29$ μV) or neither dimension ($M = 8.35$ μV), producing a significant quadratic trend, $F(1, 31) = 19.84$, $P < 0.01$.

Exploring links between neural and behavioral responses

The ERP data suggest that participants differentially process racial outgroup and ingroup targets, respectively, at early and somewhat later stages of processing. Whether these ingroup and outgroup processing biases have implications for behavior is unclear, however. Theoretically, it would be adaptive if enhanced processing of outgroup and/or ingroup targets was associated with more rapidly distinguishing targets on the basis of the group feature. Although the current study was not explicitly designed to test this idea, we conducted some exploratory analyses to test for patterns of correlation between ERP component amplitudes and response latency. First, average RTs to Black target trials and White target trials were computed for each participant. Outgroup response bias was calculated by subtracting RT to outgroup from RT to ingroup targets, separately for White and Black participants. Similarly, ingroup response bias was calculated by subtracting RT to outgroup from RT to ingroup targets, separately for White and Black participants. Similar difference scores were computed to create outgroup and ingroup bias scores for P200 and N200 amplitude, respectively. Next, these RT and ERP bias scores were correlated, separately for White and Black participants. The nature of the subtractions used to create these bias scores means that if outgroup bias in the ERP (i.e. larger P200 to outgroup than ingroup targets) is associated with outgroup bias in RT (i.e. facilitation of responses to outgroup relative to ingroup targets), the correlation between these two bias scores should be positive. For example, among Black participants, a larger P200 to White than to Black targets would produce a positive bias score (i.e. $\mathrm{P200_{White}} - \mathrm{P200_{Black}} = \text{positive}$), and faster responses to White than to Black targets would also produce a positive bias score (i.e. $\mathrm{RT_{Black}} - \mathrm{RT_{White}} = \text{positive}$). However, if ingroup bias in the ERP (i.e. larger N200 to ingroup than outgroup targets) is associated with ingroup bias in RT (facilitation of responses to ingroup relative to outgroup targets), the correlation between these two bias scores should be negative. For example, among Black participants, a larger (more negative) N200 to Black than to White targets would produce a negative bias score ($\mathrm{N200_{Black}} - \mathrm{N200_{White}} = \text{negative}$), and faster responses to Black than to White targets would produce a positive bias score (i.e. $\mathrm{RT_{White}} - \mathrm{RT_{Black}} = \text{positive}$).

The resulting correlations are depicted in Figure 3. Focusing first on the correlations associated with outgroup bias, panels A and B show that a larger P200 to outgroup targets is not associated with facilitation of responses to outgroup targets ($r = -0.26$ for Blacks; $r = -0.14$ for Whites; *P*'s > 0.10). However, inspection of the correlations associated with ingroup bias in panels C and D shows that a larger N200 to ingroup than to outgroup targets leads to significantly faster responses to ingroup than to outgroup targets among both Black participants ($r = -0.60$, $P < 0.05$) and White participants ($r = -0.56$, $P < 0.05$). These data suggest that whereas increased amplitude of the N200 to ingroup targets facilitates responses to ingroup targets for both White and Black participants, increased amplitude of the P200 to outgroup targets does not significantly influence the speed of overt responding to outgroup targets.

DISCUSSION

The primary aims of this experiment were to determine the extent to which race cues would interfere with categorizing targets by gender, particularly when other faces could lead to conflict in correctly categorizing the target, and to investigate whether target race effects in the ERP reported in previous research (Ito and Urland, 2003, 2005; Ito *et al.*, 2004) would differ as a function of participant race. The experiment produced a number of findings pertinent to these aims. The response latency data showed that categorizing target gender was slowed by incompatible flankers, regardless of whether those flankers were incompatible according to gender (the relevant dimension) or race (the irrelevant dimension). This pattern suggests that participants had a difficult time controlling their attention to race even though doing so would have been beneficial to their performance. Alternatively, it could be that the presence of distracting stimuli of any kind slows categorization responses, and that participants did not differentiate the flankers specifically on the basis of race or sex, but simply noticed when they differed from the target. However, there are two indications in the ERP data that participants did attend to race and gender information. First, significant effects of both target gender and target race emerged in both the early attention components and the subsequent P300. Second, the N200, known to index the detection of conflict in flanker and similar tasks (Botvinick *et al.*, 1999), was equally increased whether flankers were incompatible on the gender or the race dimension, although only for White targets. In a general sense, then, the data from this experiment suggest that attention is spontaneously directed to classifying targets on multiple social dimensions simultaneously and is consistent with previous data (Stangor *et al.*, 1992) suggesting that overt processing goals

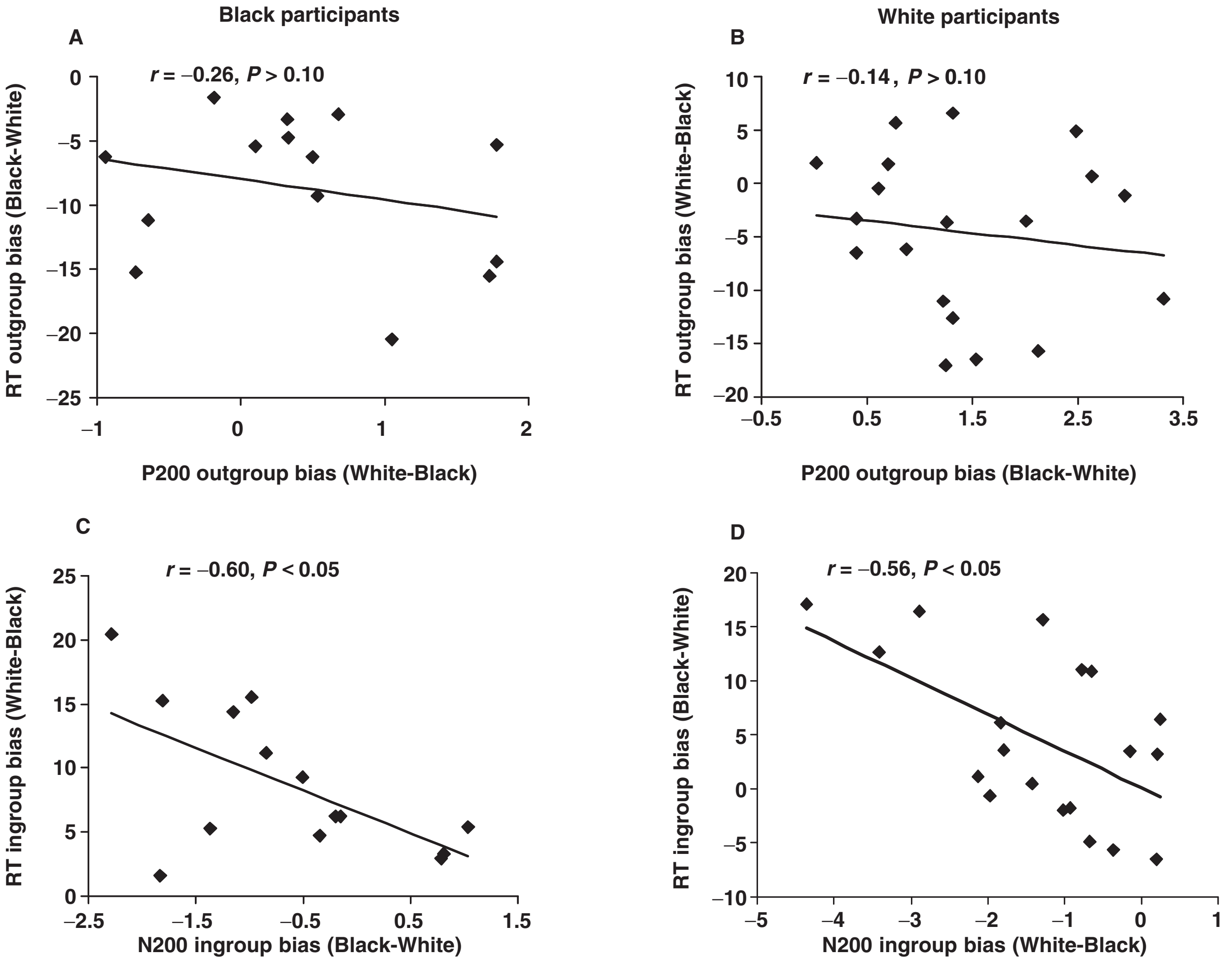

Fig. 3 Correlations between ERP and RT indices of outgroup bias (panels A and B) and ingroup bias (panels C and D), separately for White and Black participants. Panels A and C show correlations for Black participants, and Panels B and D show the correlations for White participants. For both Black and White participants, a larger N200 to ingroup relative to outgroup targets was associated with a faster response to ingroup relative to outgroup targets.

have little effect on the category to which perceivers will attend.

These results also have implications for understanding the control of attention in numerous contexts beyond social categorization. Previous research using flanker paradigms has suggested that participants will direct attention to the entire stimulus array when there is a good chance that doing so will facilitate quick and accurate responding; when attending to the flankers is unlikely to aid performance, however, participants tend to direct attention away from flankers and focus on the target (Gratton *et al.*, 1992; Bartholow *et al.*, 2005; Bartholow and Dickter, 2006). The current study suggests that control of attention to context information is not necessarily strategic, at least in terms of ensuring optimal task performance, but might depend on the salience or significance of the information provided by the context. In most flanker studies, the stimuli themselves—often strings of letters or arrows pointing left or right—have little relevance for participants beyond that related to their task. Here, the stimuli were inherently meaningful to participants, and thus the flankers were likely to capture attention despite their irrelevance for task performance.

This issue also could be important for better understanding the psychological processes that give rise to the N200 component. In many cognitive control tasks, the N200 is enhanced on trials involving conflict between stimulus dimensions that elicit differing responses (Botvinick *et al.*, 2001). In most such tasks, the stimuli themselves are not particularly meaningful to participants, beyond their relevance to the task itself. In the current case, however, the targets and flankers had inherent social meaning in addition to their task-specific meaning, which could potentially heighten conflict effects by drawing more attention to flankers than is warranted by the demands of the task. It could be that the N200 is influenced by two psychological processes in a task such as this one (i.e. conflict and attention to ingroup cues), and that the effect of these two processes is additive. Thus, a larger N200 would be expected if both of these processes are engaged. The present research was not designed to specifically test this hypothesis, and thus future research should test this possibility systematically. That is, researchers should examine the extent to which the social or personal relevance of stimuli enhances the conflict they elicit in cognitive control tasks, as well as whether the neural circuits that give rise to the N200 during response conflict are the same as those associated with attention to ingroup cues.

Future research also could shed light on the pattern of P300 amplitude effects seen here. As noted previously, previous social categorization studies have shown context effects in the P300 component, which is larger when a current stimulus is inconsistent with the context established by preceding stimuli (Ito and Cacioppo, 2000; Ito and Urland, 2003, 2005). Such effects appear to depend on the sequential nature of the oddball paradigms typically used in those prior studies. Here, the P300 also was sensitive to context in terms of flanker incompatibility, but the complex pattern of effects differed for White and Black target trials and by compatibility condition On the basis of this one study, it would be premature to interpret the psychological meaning of this pattern.

The ERP data were of particular importance in specifying the influence of target race effects on early aspects of target processing. Consistent with numerous previous studies using White samples (Ito and Urland, 2003, 2005; Ito *et al.*, 2004; Bartholow and Dickter, 2006), Black targets elicited enhanced P200 and P300 amplitude whereas White targets elicited larger N200 amplitude, but only among White participants. Among Black participants the reverse pattern was observed, indicating that processing of social targets differs according to the perceiver's ingroup membership. Specifically, whereas the P200 (and, to some extent, the P300) appears to be a marker of outgroup processing bias, the N200 appears to reflect enhanced processing of ingroup members during social categorization. That the amplitude of the P200 differed as a function of participants' group members is inconsistent with some previous hypotheses suggesting that relative numerical representation in society and/or activation of threat-related Black stereotypes is responsible for enhancement of this component (Ito and Urland, 2003), and supports the more general notion that attention to outgroup features increases the size of the P200 during social categorization (Ito and Urland, 2003, 2005). Of course, it could also be that outgroup members are associated with threat, regardless of the content of cultural stereotypes about specific groups, supporting the idea that the P200 is sensitive to threat (Schutter *et al.*, 2004).

In addition to race effects, gender effects also emerged in both the P200 and P300 components. The P200 was sensitive to gender compatibility, providing some indication that early attentional processes were engaged differently depending on how the explicit (gender) category was represented in the stimulus array. Interestingly, unlike the influence of participant race on neural responses to race cues, participant gender had no such effects on responses to gender cues. This is somewhat surprising given that asking participants to focus on gender in the task should make their own gender group membership salient, which could be expected to elicit differential electrocortical responses as a function of gender ingroup and outgroup status. This did not happen, however. Instead, as discussed previously, it was participants' group membership with respect to the task-irrelevant (race) dimension that determined cortical responses to the targets. Future research should examine whether this task-irrelevant processing would occur if participants were explicitly attending to race rather than gender, to explore the possibility that the effects reported here depend on the particular task set that we used.

Thus far, and consistent with previous studies on this topic (Ito and Urland, 2003, 2005), we have discussed our ERP findings in terms of effects of stimulus and participant factors on the amplitude of specific components. Further consideration of the ERP data suggests that, at least with respect to effects of target race, ingroup and outgroup targets seem to elicit overall shifts in the waveform that begin to emerge around the time of the P200. Specifically, inspection of Figure 2 shows that racial outgroup targets elicited an overall positive shift, seen as larger P200 and P300 peaks for outgroup targets, whereas racial ingroup targets produced an overall negative shift, seen as a larger peak in the N200 for ingroup targets. In other words, it is possible that there is a single race category effect that begins at the P200 and continues throughout the measurement epoch of the ERP. This pattern suggests a continuity in the (here implicit) categorization of race, whereby the cognitive processes that produce the neural oscillations underlying the scalp-recorded ERP distinguish race relatively quickly upon perception of a target, and sets processing on a slightly different course depending upon the outcome of a comparison of one's own race and the race of the target. The current study was not designed to fully explore the mechanisms responsible for this comparison process, but this should be a concern for future researchers.

Another fruitful avenue for future research would be specification of the functional significance of the differential attention to ingroup and outgroup targets seen here for intergroup behavior. Our exploratory correlational analyses suggest that heightened attention to racial ingroup faces (i.e. the N200) facilitates responses to ingroup faces, whereas heightened attention to outgroup faces (i.e. the P200) has little effect on responses to outgroup faces. However, this study was not designed to test for links between neural and behavioral responses and these findings should be considered preliminary. Our goal with these analyses was to begin to explore whether increased processing of ingroup and outgroup cues at the neural level has implications for behavioral manifestations of categorization. In the future, researchers should design experiments in which ERP measures of attention to ingroup and outgroup cues are combined with other behavioral measures, such as encoding and retrieval biases. Future research also should explore possible links between neural measures of ingroup and outgroup categorization and ingroup bias and outgroup derogation (Brewer, 1999). In addition, more research is needed to better understand the reasons why processing seems to shift during target processing as a function of target and perceiver racial group memberships. Our data suggest that two previously stated hypotheses concerning early component amplitudes—that they reflect activation of racial stereotypes or the relative numerical representation of Whites and Blacks in society (Ito and Urland, 2003)—should be ruled out. However, the current data do little to specify precisely why attention to racial ingroup and outgroup targets differs early in processing.

In conclusion, the present study provides evidence that perceivers attend to multiple features of social targets, even when doing so may be irrelevant or detrimental to task performance. Furthermore, the results of this study underscore the inherent importance of race in social categorization, and indicate that overt processing goals to attend to a different feature (i.e. gender) do not eliminate attention to race. Finally, this study provides the first evidence that the race of the perceiver is an important factor in determining ERP responses to race cues, and suggests that the rapid differentiation of targets on the basis of ingroup and outgroup status could have implications for social behavior.

Conflict of Interest

None declared.

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