Contingent Negative Variation to Emotional In- and Out-Group Stimuli Differentiates High- and Low-Prejudiced Individuals

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Abstract

■ Low- and high-prejudiced individuals exhibited differential cortical and behavioral responses to the pending and actual evaluation of emotional in- and out-group faces. Participants viewed warning stimuli indicating the subsequent presentation of an angry or happy African-American or Caucasian face. Upon presentation of the face, participants judged whether they would enjoy working with the individual. The contingent negative variation (CNV) component of the event-related potential in response to the pending presentation of in- and out-group emotional stimuli distinguished low- from high-prejudiced individuals. Specifically, low-prejudiced individuals showed greater early CNV in anticipation of angry African-American targets, and increased reaction time to evaluating these faces. High-prejudiced individuals showed decreased early CNV in anticipation of angry African-American faces, accompanied by decreased response latencies, and enhanced CNV in anticipation of happy Caucasian faces. Notably, no group differences emerged in either the pending or actual evaluation of happy out-group faces. The data are discussed with regard to implications for understanding the nature of prejudice, and underscore both the importance of emotional expression on how a target is appraised and also the utility of using converging measures to clarify processes that may contribute to social behavior. ■

INTRODUCTION

The current research explores cortical resources and cognitive processes that may index or contribute to prejudiced attitudes and behavior toward emotional in- and out-group targets. The investigation of neural and behavioral responses to in- and out-group stimuli has to date focused exclusively on reactions to neutral faces of different races, to imagined partners of a different race within a neutral context, or to race-specific words (e.g., Richeson, Baird, et al., 2003; Golby, Gabrieli, Chiao, & Eberhardt, 2001; Hart et al., 2000; Phelps et al., 2000). However, given the demonstrated impact of emotion on social perception and interaction (Vrana & Rollock, 1998, 2002; Hess, Barry, & Kleck, 2000; Keltner, Ellsworth, & Edwards, 1993), and the particularly rapid, possibly unconscious, processing of negative expressions (e.g., Fox et al., 2000; Dimberg & Oehman, 1996; White, 1996), both the racial and emotional salience of a target face are likely to affect the presentation of prejudiced behavior. The current study thus examines the cortical and behavioral responses of high- and low-prejudiced individuals to happy and angry in- and out-group faces. In contrast with previous investigations that have thus far all used passive viewing tasks to examine neural responses to out-group stimuli, we employ an active evaluation task in which participants are asked to make a socially relevant judgment (i.e., do I want to work with this person?) regarding in- and out-group members.

Prejudice and the Impact of Emotion

Considerable evidence suggests that social stereotypes associated with out-group members are often invoked rapidly and, sometimes, prior to awareness (e.g., Bargh, Chen, & Burrows, 1996). These stereotypes may subsequently contribute to the manifestation of prejudice, or negative attitudes and behavior toward out-group members relative to in-group members (e.g., Allport, 1954). High- and low-prejudiced individuals may thus differ in the degree to which stereotypes related to race are activated and/or the degree to which effortful suppression of these stereotypes occurs (Fazio & Towles-Schwen, 1999; Wittenbrink, Judd, & Park, 1997; Fazio, Jackson, Dunton, & Williams, 1995; Locke, MacLeod, & Walker, 1994). That is, individuals low in prejudice, in contrast with those high in prejudice, may be able and motivated to suppress prejudiced reactions to negative stereotypes and to monitor their reactions and behavior toward out-group members (Blascovich, Wyer, Swart, & Kibler, 1997; Fazio et al., 1995; Devine, Monteith, Zuwerink, & Elliot, 1991; Monteith, Devine, & Zuwerink, 1993; Devine, 1989). However, there also exists some debate

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regarding whether individuals low in prejudice never activate stereotypes or whether they control prejudiced reactions once a negative stereotype has been activated.

Indeed, compared with high-prejudiced individuals, those low in prejudice have been found to be less reactive to subliminal primes intended to activate stereotypes (Lepore & Brown, 1997). In contrast, other evidence indicates that although stereotypes are automatically activated regardless of levels of prejudice, low-prejudiced individuals may not apply such stereotypes, in part due to their personal values and belief systems (e.g., Plant & Devine, 1998; Monteith et al., 1993). Devine (1989) proposes that nonprejudiced responses require the controlled inhibition of such automatically activated stereotypes and the conscious activation of nonprejudiced values and beliefs. Consequently, individuals who control prejudiced reactions to negative stereotypes are identified as low in prejudice (e.g., Bodenhausen & Macrae, 1998). Similarly, given the same negative stereotype, individuals who do not, or cannot, control automatic responses, (i.e., high-prejudiced individuals) may be more likely to show more prejudiced reactions and behavior toward out-group members. In further support of this argument relating controlled processing to less prejudiced behavior, Von Hippel, Silver, and Lynch (2000) found prejudice to be mediated by age-related differences in inhibitory ability. Although older adults, compared with young adults, exhibited more motivation to control prejudiced reactions, the older adults were also less able to inhibit stereotypes than were younger adults, indicating that controlled processing is required to inhibit stereotypes and prejudicial responses. Given the substantial social cost of prejudice, it is of import to clarify not only response strategies that contribute to the expression of prejudice, but also factors that may influence the implementation of these strategies.

Most physiological and behavioral studies examining responses to in- and out-group members have examined reactions to race-specific words, neutral faces of different races, or imagined partners of a different race. Despite the demonstrated impact of a perceiver's emotional state on the presentation of prejudiced attitudes and stereotypic judgment (Jackson, Lewandowski, Fleury, & Chin, 2001; Lambert, Khan, Lickel, & Fricke, 1997; Asuncion & Mackie, 1996; Bodenhausen, Kramer, & Susser, 1994; Bodenhausen, Sheppard, & Kramer, 1994) and the increasing evidence that physiological reactivity of perceivers during social interaction varies according to both racial and emotional context (Vrana & Rollock, 1998, 2002), scant attention has been given to the emotion expressed by the targets of such judgment (Vaes, Paladino, Castelli, Leyens, & Giovanazzi, 2003). Indeed, to our knowledge, little previous work has examined perceivers' responses to in- and out-group members expressing different emotions (e.g., Hugenberg & Bodenhausen, 2003). This is a surprising oversight given the considerable evidence indicating the rapid and efficient processing of facial expressions, particularly negative expressions. Specifically, evidence suggests that angry faces are processed preattentively and are detected more efficiently than happy faces, and that conditioned responses can be obtained to masked angry faces but not to masked happy faces (Fox et al., 2000; Dimberg & Oehman, 1996; White, 1996). Moreover, recent theories of prejudice emphasize that a combination of factors that make up a stereotype may in turn influence behavior toward out-group members (e.g., Fiske, Cuddy, Glick, & Xu, 2002; Fiske, 1998). That is, the degree to which prejudiced behavior is manifested may depend upon not just group membership of the target (e.g., out-group African-American), but also the extent to which the target possesses other qualities (e.g., warmth or competence; Fiske et al., 2002). Given that facial expressions are differentially processed depending on the valence of the expression, and that prejudiced behavior is influenced by the particular composition of qualities portrayed by an out-group target, an investigation of the interactions among race, emotion, and prejudice is warranted.

Simply put, the valence of emotion expressed by in- and out-group targets is likely to affect the response of a perceiver to the targets. Thus, as angry faces appear to be especially powerful stimuli, we propose that these faces have the potential to elicit particularly salient stereotypes. Moreover, if being low in prejudice requires control of automatically triggered behavior, angry out-group stimuli should thus elicit the most effortful processing in low-prejudiced individuals. In contrast, if such controlled responding plays little or no role in the nature of prejudice, increasing the salience and intensity of the stimulus should elicit little or no corresponding difference in the degree to which high- and low-prejudiced individuals show controlled responding. Further, we suggest that between-group differences will be particularly attenuated to the pending evaluation of an out-group member exhibiting a "positive" facial expression. Specifically, given that positive emotions tend to alleviate the perception of threat (e.g., Bradley, Codispoti, Cuthbert, & Lang, 2001), the intensity and salience of the negative stereotype elicited by an African-American out-group member will likely be diminished, and thus be reflected in little or no difference in the degree to which high- and low-prejudiced individuals respond to the pending and actual evaluation of happy out-group targets.

The Contingent Negative Variation: Potential Insights for Prejudice

In conjunction with a long tradition of using autonomic physiological measures as a measure of biased attitudes that may not be readily expressed (e.g., skin conductance, heart rate, facial electromyography, etc.;

for review, see Guglielmi, 1999), there is a growing literature suggesting that examining neural physiology in addition to behavioral and self-report responses may be of utility in clarifying the nature of prejudice and race-biased behavior (e.g., Richeson, Baird, et al., 2003; Golby et al., 2001; Hart et al., 2000; Phelps et al., 2000). We aimed to extend this literature by delineating the role of emotional expression in and the temporal resolution of physiological and behavioral responses that may index or contribute to the manifestation of prejudiced attitudes and behavior.

Specifically, we measured both behavioral responses and the contingent negative variation (CNV) component of the event-related brain potential (ERP)[1] in high- and low-prejudiced individuals who were asked to make evaluative judgments of emotionally and racially salient facial stimuli. The CNV is a slow negative-going ERP elicited by a warning stimulus that requires anticipation of a target stimulus (Picton & Hillyard, 1988; Walter, Cooper, Aldridge, McCallum, & Winter, 1964). The component is quantifiable into two distinct subcomponents: an ''early'' CNV and a ''late'' CNV (Rohrbaugh, Syndulko, & Lindsley, 1976). Especially relevant to the present study, the early CNV is thought to index initial attention to the information carried by the warning stimulus, the expected degree of expenditure of cognitive effort to respond to the target stimulus, and the degree of motivation to respond to the target stimulus (Forth & Hare, 1989; Hamon & Seri, 1987; Low & McSherry, 1968). Moreover, the presence of the early CNV is generally thought to be a cortical reflection of controlled, rather than automatic, psychological processes in response to an S1 that requires anticipation of a subsequent S2 (Picton & Hillyard, 1988; Shiffrin & Schneider, 1977). The late CNV is measured just prior to the onset of the target stimulus, and reflects the additional contribution of cortical resources required for motor response preparation (Damen & Brunia, 1994; Brunia & Damen, 1988).

Several groups have demonstrated the sensitivity of the CNV to the anticipation of affective stimuli and have successfully used the CNV to identify individual and group differences in distinct components of information processing that reflect the subjective significance of anticipated stimuli (e.g., Regan & Howard, 1995; Yee & Miller, 1988; Klorman & Ryan, 1980; Rockstroh, Elbert, Lutzenberger, & Birbaumer, 1979; Simons, Oehman, & Lang, 1979). In the current study, the well-established S1–S2 CNV paradigm was adapted to quantify the cognitive processes and neural resources that high- and low-prejudiced individuals may employ in anticipation of making an evaluative response of a racially and emotionally salient target face. Thus, given a warning stimulus that indicates the pending presentation of a target face, we expected the CNV to vary not only according to the category of the anticipated target but also according to group differences in prejudice and the strategies deployed in anticipation of making an evaluative response to the target. Indeed, several patterns of cognitive processes that are measurable by the early and late CNV may be related to the expression of prejudice. Specifically, if cognition that contributes to prejudice begins with an initial encounter with a target stimulus and extends until a behavioral response is made, high- and low-prejudiced individuals should exhibit differential ERP amplitudes beginning at least as early as the early CNV, and likely earlier, and continuing through the late CNV. However, if cognitive processes related to prejudice occur after an initial evaluation of a target stimulus has been elicited, this should be reflected in an equivalent early CNV for both high- and low-prejudiced individuals, but a divergence later in the CNV as participants prepare to make effortful behavioral responses. In comparison, if evaluation that manifests as prejudiced behavior is completed prior to response preparation, this should be reflected in early divergence of the CNV between high- and low-prejudiced individuals, and subsequent attenuation of these differences by the time of behavioral response. Moreover, given the demonstrated impact of both race and emotional expression on social perception, we anticipated that the most vivid and potentially threatening negative stimuli (i.e., angry black targets, in the current study) would yield the largest CNV differences between high- and low-prejudiced individuals.

The Present Study

This research had two primary objectives: first, to examine whether high- and low-prejudiced individuals differ in the degree to which the emotional salience of racial targets influences behavioral and physiological responses; and second, to use the CNV to begin to delineate processes that may be associated with the manifestation of prejudice. To these ends, we presented warning stimuli (e.g., ''+b'') indicating the pending presentation of a particular target stimulus (e.g., a happy black face), and measured high- and low-prejudiced participants' CNV and behavioral responses as they anticipated not only the target face but also making an evaluative judgment of the face.

RESULTS

The physiology data were subjected to a $2 \times 2 \times 5 \times 3 \times 3$ repeated-measures MANOVA with group (high-, low-prejudice) as the between-group factor and component (early, late CNV), condition (angry black, angry white, happy black, happy white, random), laterality (left, midline, right), and region (frontal, central, parietal) as within-groups factors. A series of Group $\times$ Condition univariate ANOVAs were used to investigate between-group differences in reaction time and response choice to each category of the target facial stimuli. The results of these analyses are presented below (see Figure 1 for a schematic representation of the paradigm).

Behavioral Data

Univariate Group × Condition ANOVAs yielded between-group differences in response time and response selection to each stimulus type (i.e., angry black, angry white, happy black, happy white). The following findings are illustrated in Figure 2.

The high-prejudiced group responded more quickly than the low-prejudiced group when assessing whether they would enjoy working with angry black individuals [Condition, $F(1,33) = 5.4, p \leq .03$]. No differences in response preference (i.e., "Yes" or "No" in response to the question, "Would you enjoy working with this individual?") emerged in response to the angry black stimuli.

In response to the happy black faces, the low-prejudiced group showed a trend toward more affirmative responses compared with the high-prejudiced group to the question "Would you enjoy working with this individual?" [Condition, $F(1,33) = 3.4, p \leq .07$]. No differences in response time emerged between groups for happy black stimuli.

No other significant differences in between-group response preferences or response times emerged.

Contingent Negative Variation

High- and low-prejudiced individuals exhibited differential CNV responses to emotional in- and out-group stimuli [Group × Condition × Laterality × Component,

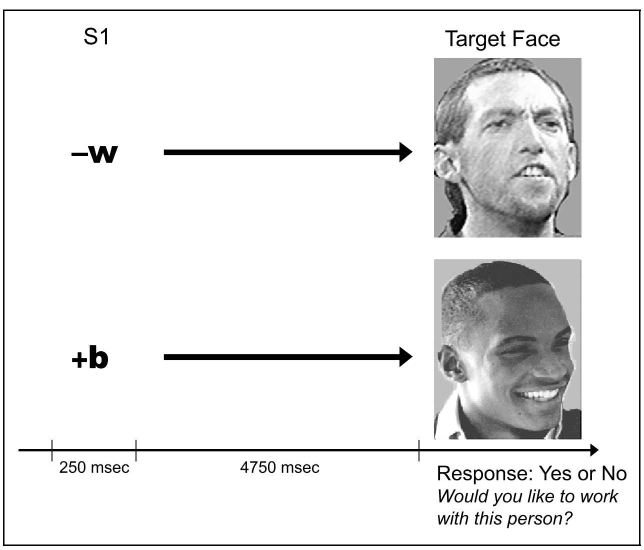

Figure 1. Schematic representation of task. Each trial consisted of a warning stimulus (−w, +w, −b, +b, r) presented for 250 msec followed 4750 msec later by a corresponding target face (happy white, angry white, etc.). The participant was asked to respond "Yes" or "No" according to their preference for working with the individual.

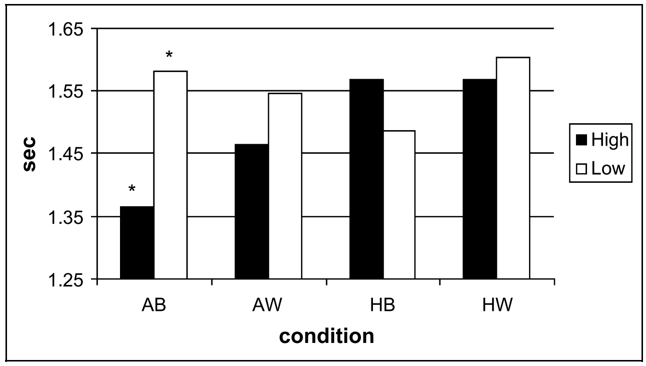

Figure 2. Reaction time of high- and low-prejudiced individuals in response to the question "Would you like to work with this person?" to each S2 category of facial stimuli. A = Angry, H = Happy, B = Black, W = White (*$p < .05$).

$F(8,26) = 4.6, p \leq .001$]. Specifically, full parsing of this interaction revealed that, as illustrated in Figure 3, the low-prejudiced group showed greater early CNV in anticipation of the angry black S2 across midline sites, compared with the high-prejudiced group [Group, $F(1,33) = 8.0, p \leq .008$]. No significant effects were observed for the late CNV.

Decomposition of the omnibus ANOVA also revealed a Group × Condition interaction for early CNV at midline sites [Group × Condition, $F(4,30) = 3.4, p \leq .02$] that was further examined using pairwise within-group comparisons of condition means of early CNV. As illustrated in Figure 4, this analysis subsequently revealed enhanced early, midline CNV of low-prejudiced individuals in anticipation of angry black faces relative to happy white ($p < .05$) or happy black ($p < .02$) faces. Within the white stimuli, the low-prejudiced group also showed a trend toward greater CNV in anticipation of angry compared with happy faces ($p \leq .08$). Similar comparisons within the high-prejudiced individuals re-

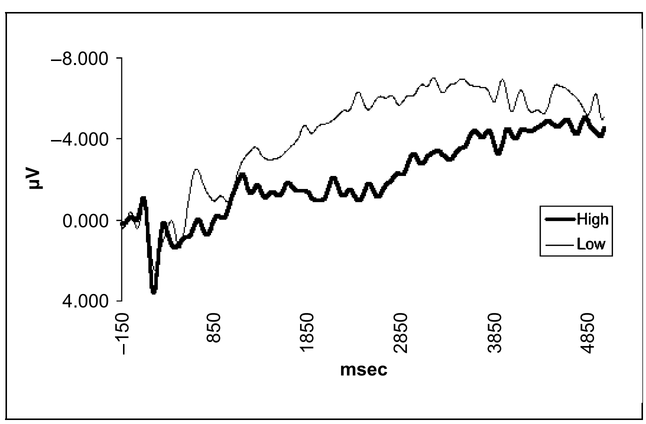

Figure 3. CNV amplitude at site Cz of high- and low-prejudiced individuals to the S1 indicating the subsequent presentation of an angry Black-American face (i.e., S1 = "−b").

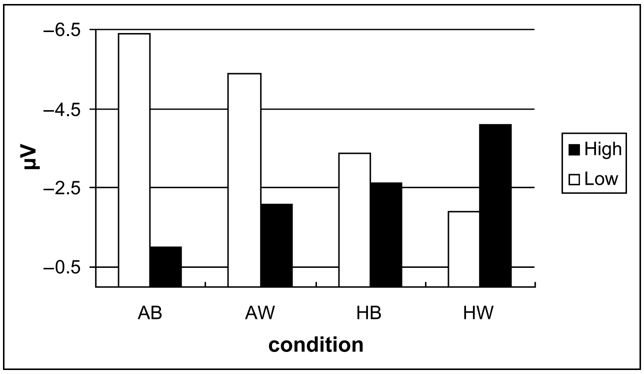

Figure 4. Early CNV amplitude across midline sites of high- and low-prejudiced individuals for each S1 condition. A = Angry, H = Happy, B = Black, W = White. Low prejudice: AB > HW, AB > HB ($p < .05$); AW > HW ($p < .08$); High prejudice: HW > AB ($p < .06$).

vealed greater CNV amplitude in anticipation of happy white faces compared with angry black faces ($p < .06$). Moreover, a post hoc contrast on the condition means comparing early CNV amplitude in anticipation of angry black faces versus the four other categories for the low-prejudiced group was significant [$t(4) = 4.25, p < .05$]. This effect was not found for late CNV. A similar contrast on the condition means comparing early CNV amplitude in anticipation of happy white faces with the other four categories for the high-prejudiced group was also significant [$t(4) = 2.87, p < .05$].

As further shown in Figure 4, Spearman's *rho* correlations between the two groups' rank order of CNV amplitude to each condition indicate that the high- and low-prejudiced groups exhibit exactly opposite patterns of early CNV amplitude to the conditions (Spearman's $rho = -1.0, p \leq .0001$).

DISCUSSION

Together, our data suggest that the early component of the CNV of the ERP, thought to reflect anticipated cognitive effort, is sensitive to effortful processes that contribute to the manifestation of prejudice. Our data also indicate that emotional facial expression affects both behavioral and physiological responses to racially salient faces.

The greater CNV demonstrated by low-prejudiced participants in anticipation of making evaluative responses of angry black faces is consistent with theories of prejudice proposing that these individuals monitor automatic reactions to negative stereotypes elicited by out-group stimuli (Bodenhausen & Macrae, 1998; Plant & Devine, 1998; Monteith et al., 1993; Devine, 1989). Our data thus argue against theories suggesting that low-prejudiced individuals may not activate stereotypes (Lepore & Brown, 1997). More specifically, the enhanced CNV suggests a greater anticipated degree of expenditure of cognitive effort, and also a greater motivation (Richeson, Baird, et al., 2003; Forth & Hare, 1989; Picton & Hillyard, 1988; Hamon & Seri, 1987; Shiffrin & Schneider, 1977; Low & McSherry, 1968), perhaps towards making an "appropriate" response to out-group members expressing negative, stereotype-consistent, emotion. The longer behavioral response latencies of the low-prejudiced group in evaluating angry black targets further support this enhanced processing. Similarly, the low-prejudiced group's relatively smaller CNV in anticipation of happy white faces is consistent with a decreased anticipated monitoring of evaluative decisions about happy white individuals.

The corresponding decreased CNV in the high-prejudiced group in anticipation of angry black targets supports theories suggesting that the individuals high in explicit prejudice may be characterized by a decreased tendency, or motivation, to monitor automatic prejudiced responses to negative stereotypes (e.g., Bodenhausen & Macrae, 1998; Plant & Devine, 1998; Monteith et al., 1993). The shorter behavioral response latencies of the high-prejudiced group to angry black targets further reflect an absence of effortful suppression of prejudiced behavior. In contrast, the enhanced CNV in anticipation of happy white targets suggests a greater recruitment of cognitive resources to respond to the happy white stimuli, and provides support for theories suggesting both that prejudiced individuals may expend extra effort to make individuating responses when required to evaluate in-group stimuli, and also that less effort in individuating out-group members may contribute to the expression of prejudice (Brewer, 1999; Miller & Brewer, 1986).

Although studies using verbal stimuli to examine prejudice have used both positive and negative words, and although faces are more vivid, meaningful, and immediately informative (Ro, Russell, & Lavie, 2001), no previous work, to our knowledge, has examined the neural and behavioral responses of high- and low-prejudiced individuals to in- and out-group faces expressing different emotions. Our behavioral and ERP data indicate not only that high- and low-prejudiced individuals are differentially influenced by the affective relevance of in- and out-group members, but also that the affective nature of target stimuli may be especially salient for low-prejudiced individuals. Specifically, low-prejudiced individuals showed not only an increased CNV to angry out-group stimuli, but also an enhanced CNV in anticipation of angry faces more generally, compared with happy faces. In contrast, high-prejudiced individuals showed enhanced CNV in anticipation of a specific nonthreatening in-group stimulus (i.e., happy white), but not a more general response to happy faces. Hugenberg and Bodenhausen (2003) recently reported that individuals who score high on implicit (but not explicit) measures of race bias are both quicker to affirm the onset and slower to identify the offset of hostile expression in out-group (but not in-group) members on a behavioral task. Their reported findings are consistent with our data that high explicit prejudice individuals were much quicker than low-prejudiced individuals to make negative evaluative judgments of angry out-group faces.

It is further notable that in our sample, the high- and low-prejudiced groups exhibited no differences in behavioral or physiological responses to the evaluation of happy out-group stimuli (Hugenberg & Bodenhausen, 2003, did not specifically investigate participants' identification of happy expressions). Indeed, differences between high- and low-prejudiced individuals in behavioral and physiological responses to out-group stimuli were enhanced or attenuated by simply varying the anticipated and actual valence of facial expression from angry to happy. The pattern of null group differences to happy out-group stimuli, in conjunction with the robust between-group differences to angry out-group stimuli, is striking and suggests at least that prejudice and stereotyping are not unitary phenomena, may be malleable, and perhaps even that stigmatized individuals may be able to avert victimization by a manipulation of facial expression. It should be emphasized, however, that no analyses within race or emotion alone yielded significant between-group effects—thus, both race and emotion, and likely an interaction between the two, appear critical in influencing behavioral, attitudinal, and physiological responses toward in- and out-group members.

The attenuation of between-group differences at late CNV provides intriguing insight about when in the processing of social information high- and low-prejudiced individuals may begin to diverge. Substantial evidence indicates that the late CNV is the sum of motor (i.e., response preparation) and nonmotor (i.e., cognitive anticipation of a task-relevant stimulus) components (Damen & Brunia, 1994; van Boxtel & Brunia, 1994). Thus, given that the early CNV is thought to reflect sustained processing that extends to the late CNV, and the greater early CNV in the low-prejudiced group, a relatively smaller contribution of motoric preparation to the late CNV in anticipation of angry black targets is evidenced in this group, compared with the high-prejudiced group. This observation is consistent with ample data from reaction time studies indicating an inverse relationship between reaction time and late CNV amplitude (Ulrich, Leuthold, & Sommer, 1998; Hillyard, 1969). Indeed, the low-prejudiced individuals, compared with high-prejudiced individuals, exhibited longer response latencies in evaluation of angry black targets. However, given the difficulty of distinguishing motoric from nonmotoric aspects of the late CNV, an interpretation of potential differences in motoric preparation between high- and low-prejudiced individuals remains tentative.

The current findings augment the small but growing literature investigating the neural concomitants of race perception and race bias. In the one fMRI study (Phelps et al., 2000) that has employed measures of both implicit and explicit race bias, positive correlations between amygdala activity and race bias were found only on ''implicit'' (i.e., Implicit Association Test; startle potentiation) and not explicit measures of race evaluation (i.e., Modern Racism Scale [MRS]). In contrast, in the current study, CNV amplitudes distinguished participants with high and low scores on an ''explicit'' measure of racial bias (i.e., MRS) such that low, compared with high, prejudiced individuals showed increased cortical activity in anticipation of to angry black targets. At first glance, our data may seem at odds with those of Phelps et al. (2000). However, the majority of their participants scored below ''2''on the MRS, suggesting that their participants may be comparable to our ''low-prejudiced'' group. Indeed, within this group, our data show greatest cortical resources to angry black stimuli, compared with all other targets.

Another recent study investigating possible mechanisms by which race bias may be suppressed provides further evidence for the role of controlled processing in prejudice (Richeson, Baird, et al., 2003). Briefly, Richeson, Baird, et al. (2003) report that participants with high scores on an implicit measure of race bias (i.e., Implicit Association Test) exhibit greater activity in brain regions associated with cognitive control when viewing out-group faces. They note that this pattern of results is counterintuitive, and suggest that it may not be race bias per se that correlates with activity in brain regions associated with cognitive control, but rather a greater concern with exhibiting overt signs of prejudice that is subsequently reflected in the recruitment of cognitive control in order to suppress prejudicial behavior (Richeson, Baird, et al., 2003; Richeson & Shelton, 2003; see also Gehring, Karpinkski, & Hilton, 2003). Such an interpretation suggests that these individuals may score low on ''explicit'' measures of prejudice and, as suggested by current perspectives on prejudice, be more motivated to control prejudiced reactions to negative stereotypes, devote more cognitive resources to monitoring their behavior toward out-group members (e.g., Blascovich et al., 1997; Fazio et al., 1995; Devine et al., 1991; Devine, 1989), and thus show the greater activity in brain regions associated with cognitive control as reported by Richeson, Baird, et al. Although such an interpretation would, with our data, provide converging evidence of controlled processes in suppressing automatic prejudiced responses to negative stereotypes, further comparison must be tentative in part due to the ambiguous relationship between implicit and explicit measures of prejudice (Boniecki & Zuwerink, 2002). Clearly, it would be of theoretical interest to further explicate the nature of prejudice by examining whether individuals who score high on explicit measures of racial prejudice show differentiable subcortical activation to in- and out-group emotional faces, and also to investigate the relationship between implicit and explicit measures of race evaluation and cortical processes.

In summary, the CNV was used to examine the evidence for differential cortical processing between high- and low-prejudiced individuals to the pending presentation of angry and happy black and white faces. Our data indicate, first, that differences between high- and low-prejudiced individuals in anticipation of making an evaluative decision regarding emotional in- and out-group faces occur as early as 1500 msec after the onset of a warning stimulus. Second, the differential processing of racial stimuli between high- and low-prejudiced individuals is not only influenced by the affective salience of the target, but also present during the pending evaluation of in- and out-group members. The current findings are the first to show neural differentiation between individuals who score high and low on explicit measures of racial prejudice. Together, these data underscore both the importance of emotional expression on how a target is appraised and also the utility of using converging measures to clarify processes that may contribute to social behavior.

METHODS

Participants

Participants were recruited from Harvard University undergraduate and summer school students. Students were given an attitude survey within which the MRS (McConahay, Hardee, & Batts, 1981) was embedded. Thirty-five participants who scored in the bottom and top quartiles were recruited for the physiology session and are subsequently referred to as "low prejudice" (n = 16) and "high prejudice" (n = 19), respectively. Mean MRS scores for the high and low prejudice groups were 4.0 and 1.1, respectively [$F(1, 33) = 314.12, p < .0001$]. Participants ranged in age from 18 to 29 and were all right-handed. With the exception of one Asian-American individual in each group, all participants were Caucasian.

In accord with Harvard University Institutional Review Board guidelines, informed consent was obtained prior to commencing the study, and it was emphasized that participants could withdraw from the study at any time with no adverse consequences. Participants were compensated US$10 for each hour of their time in the laboratory.

Self-report Measures

The MRS is a seven-item self-report measure thought to indicate negative attitudes toward Black Americans. Subjects indicated their agreement with each of the items on a seven-item scale (1 = disagree strongly, 7 = agree strongly), where higher scores indicate more negative attitudes (McConahay, Hardee, & Batts, 1981). Composite MRS scores were obtained by taking the mean score of the seven items after reverse scoring when necessary.

Stimuli

S1 was one of five symbols, "−b," "+b," "−w," "+w," "r," indicating the subsequent presentation (S2) of the face of an angry or happy Black-American person, an angry or happy Caucasian person, or a randomly chosen person from one of these four groups, respectively.

S1 were printed in black on a light gray background, and approximately 2.5 cm in height. S2 consisted of photographs of angry and happy Black-American and Caucasian faces collected from the media. All stimuli were presented on a Nanao T2-17 monitor.

Procedure

Participants' electroencephalogram (EEG) was recorded as they were tested in the following paradigm: Subjects were instructed to keep the question "Would you like to work with this person?" in mind throughout the study and were given a two-button response box with which to enter behavioral responses. Participants were asked to keep the index fingers of both hands on the response box throughout the recording session. Each trial consisted of a symbol (S1) indicating the subsequent presentation of a particular category of face. Once the face (S2) was presented, participants pressed "Yes" or "No" on the response box according to their preference for working with the particular individual. Thus, the S1 "warned" of the pending presentation of a particular stimulus and provided a cue with which the subject could anticipate their behavioral response. Participants viewed 150 randomly presented trials, 30 trials of each S1 symbol, separated into two blocks. The order of the blocks was counterbalanced (see Figure 1 for schematic representation of the paradigm).

S1 duration was 250 msec, followed by a blank screen for 4750 msec and the onset of S2. Participants were given up to 5000 msec from the onset of S2 to make a button-press response about their preference for working with the individual. The hand with which "Yes" versus "No" responses were made was counterbalanced within both groups.

Data Acquisition and Reduction

EEG were recorded from A2 and nine cortical sites (F3, Fz, F4, C3, Cz, C4, P3, Pz, P4) using a lycra stretchable cap (Electro-Cap International, Eaton, OH) with electrodes positioned according to the International 10–20 system. Electrooculogram (EOG) data were recorded using tin electrodes placed lateral to the right and left outer canthi (horizontal EOG), and at the left supraorbital and suborbital positions (vertical EOG). Physiological signals were amplified and filtered through an S.A. Instruments Custom 37/64 Bioamp polygraph. High- and low-pass analog filter settings were set at 0.01 and 30 Hz, respectively. Digital sampling occurred at 512 Hz and all electrode impedances were below 10 kΩ. EEG were referenced on-line to the left ear (A1) and algebraically re-referenced to averaged-ears off-line (([A1 + A2]/2); Miller, Lutzenberger, & Elbert, 1991).

Analysis of the EEG data, including digital correction of eyeblink artifact, was conducted using software designed by the James Long Company. Raw EEG data were visually inspected to identify muscular and residual ocular artifact. When artifact occurred in a given channel, data from all channels were rejected (Barlow, 1986).

The integrity of the early and late CNV in our data was evaluated using temporal principal components analyses. The windows for analyses were quantified into two segments identified via visual inspection of the grand average waveforms and confirmation with the literature. Average CNV amplitudes were thus computed from a 150-msec pre-S1 baseline over these two time intervals: 1500–2500 msec (''early CNV'') and 4500–5000 msec (''late CNV'').

Statistical Analyses

Physiological data were subjected to a 2 × 2 × 5 × 3 × 3 repeated-measures MANOVA with group (high-, low-prejudice) as the between-group factor and component (early, late CNV), condition (angry black, angry white, happy black, happy white, random), laterality (left, midline, right), and region (frontal, central, parietal) as within-groups factors. As a conservative test of simple effects, we required interactions to be significant at each stage prior to further decomposition. Dissections and significant interactions stemming from parsing of the omnibus MANOVA are reported. Post hoc contrasts on early CNV mean amplitudes were performed as described in the Results section.

A series of four Group × Condition univariate ANOVAs were used to investigate between-group differences in reaction time and response choice to each of the four face conditions (angry black, angry white, happy black, happy white).

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Note

1. An extensive and rapidly growing literature in cognitive psychophysiology suggests that ERPs, voltage changes time-locked to stimulus presentation, may be a particularly useful tool for exploring the cognitive and emotional processes that may be associated with social behavior. The amplitude and latency of these voltages changes are thought to reflect the cognitive processing associated with the presentation, or pending presentation, of discrete events. Relative immunity to demand characteristics renders ERPs of particular utility for exploring phenomena, such as prejudice, that in purely behavioral paradigms may be especially sensitive to experimenter effects and self-presentation biases. Moreover, because ERPs are considered the ''gold standard'' among noninvasive imaging methods for measuring the temporal resolution of the physiological manifestation of psychological processes (Fabiani, Gratton, & Coles, 2000), the temporal pattern of social impression formation and reaction can be examined.

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