

5-2014

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### Recommended Citation

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Racial Expectancy Violations in Mixed-Race Minimal Groups

Matthew Schafer

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### **Abstract**

Previous research has found differential neural processing to racial ingroup and outgroup faces and greater neural processing for individuals who violate social expectations in the early attentional components of the ERP. Other lines of research using behavioral paradigms and fMRI methodology have demonstrated the ability of minimal group assignment to override race effects. This research sought to combine these lines of research to investigate the effects of an arbitrary group membership on attention in a racial expectancy violation paradigm, as measured by P2 amplitude. Hypotheses were generally unsupported but two effects were found that merit discussion. That is, we replicated previous person perception research by showing that participants show larger P2 amplitudes to racial outgroup members and extended the minimal groups literature by showing that racially stereotypical minimal outgroup targets elicit more P2 processing than other combinations. Limitations, implications and future directions are discussed.

## Introduction

Social categorization is crucial in person perception. Because the brain is limited in its cognitive capacity, categorical thinking helps us order and make sense of the world (Bodenhausen, 1990; Fiske & Taylor, 1991; Fiske, 1998). The activation of structured schemas, or sets of learned information about particular groups, allows us to rapidly process social information (Fiske, 1998; Moscovici, 1984). These schemas become automatically activated in person perception when we attend to cues (e.g., skin color) in other people that identify the social categories to which they belong (e.g., race). When activated, the information associated with these schemas becomes salient, such as stereotypes associated with group membership (e.g., “Blacks are athletic”). Stereotypes then may direct subsequent cognitions and behaviors (Fiske & Neuberg, 1990; Hogg, 2004; Macrae, Milne, & Bodenhausen, 1994). Social categorization can thus have a number of consequences, such as individuals behaving more favorably and allotting more resources to members of the group with which they identify (i.e., “ingroup”) relative to outgroup members, a phenomenon termed ingroup favoritism (Tajfel & Turner, 1986). People also tend to overemphasize intergroup differences, leading to the outgroup homogeneity effect in which outgroup members are viewed as sharing central tendencies while ingroup members are individuated (e.g., Tajfel, 1969). Stereotype activation can also have consequences for behavior (Bargh, Chen, & Burrows, 1996) such that individuals identify words consistent with Black stereotypes (e.g., violent, lazy) more quickly when the ‘Black’ category is activated in memory than when the ‘White’ category is activated (e.g., Fazio, Jackson, Dunton, & Williams, 1995). Stereotype activation can also have negative consequences in situations such as an employer interviewing Black candidates (Jussim, Palumbo, Smith, & Madon, 2000) or a police officer

deciding whether or not to shoot a Black suspect (Correll, Park, Wittenbrink, & Judd, 2002; Payne, 2001). Thus, the automatic process of social categorization can lead to downstream consequences such as individuals perceiving and behaving towards outgroup members in a way that is consistent with learned stereotypes.

## **Race**

Perhaps no social grouping in America has been more salient than race, given how replete our history is with racial division. Accordingly, a significant body of research has examined how race cues can lead to race-related cognitions, such as how automatic racial categorization can lead to differential processing of racial ingroup and outgroup members extremely quickly after viewing a target. Most of this research has focused on the processing of racial ingroup and outgroup faces, given their inherent social nature and the amount of social information conveyed in them. Due to the automatic nature of social categorization and the fact that self-report measures assess more controlled processes and are affected by participants' conscious motives, such as maintaining social desirability (e.g., Dovidio & Gaertner, 2000), more implicit measures have been used. For example, the dot-probe task measures how quickly participants react to the location of a dot after it replaces one of several simultaneously presented stimuli, giving an index of attentional bias (MacLeod, Mathews, & Tata, 1986). A relatively shorter mean response latency in dot detection suggests that participants had been attending to the stimulus that was just obscuring it. When used to measure attention to Black versus White faces among White perceivers, researchers found faster reaction times when the dot was presented on the same side as a Black face, which was interpreted as an attendance to potential threat (Trawalter, Todd, Baird, & Richeson, 2008). Behavioral measures, however, also have limitations in that they are dependent on the speed of motor processes and task requirements

(Bartholow, Dickter, & Sestir, 2006; Ito & Cacioppo, 2000). In addition, the underlying cognitive processes can be obscure and interpretation of results may be difficult (Brunel, Tietje & Greenwald, 2004). Given these considerations, research has gradually moved towards incorporating physiological measures in the study of social categorization.

One such method, functional magnetic resonance imaging (fMRI), can elucidate the neurological underpinnings of social categorization. Its spatial precision in measuring blood flow in the brain, which is related to neuronal activity, allows the imaging of neural networks involved in social cognitive processes. For example, one fMRI study has shown heightened activity in the fusiform face area (FFA) when Black and White participants are shown own-race faces relative to other-race faces (Golby, Gabrieli, Chiao & Eberhardt, 2001). As the FFA has been implicated in individuating faces (Rhodes, Byatt, Michie, & Puce, 2004) and perceptual expertise (Gauthier, Tarr, Anderson, Skudlarski & Gore, 1999), the authors suggested this activation reflected greater familiarity with own race faces. The researchers also found that the level of activation positively correlated with the degree of memory for own race versus other race faces, suggesting that the observed differential neural activation contributes to the often found same race memory bias. In another fMRI study, the processing of Black and White faces in the fusiform face area (FFA) was related to levels of implicit racial bias, implying that racial bias decreases the similarity in neural representations of racial ingroup and outgroup members (Brosch, Bar-David and Phelps, 2013), which may bias the perception of Black and White faces.

Similarly, another fMRI study also found that implicit racial bias modulates activity in another brain region. Researchers found greater amygdala activation when White participants viewed Black faces relative to White faces with a more pronounced difference in participants with higher levels of implicit racial bias (Cunningham et al., 2004). The likely function of the

amygdala, a structure located in the anterior medial temporal lobe, is to detect ambiguous sources of information and then allocate resources (Barrett, et al., 2007) and it has been implicated in emotional processing (Phelps & LeDoux, 2005). Since behavioral research has indicated that Blacks may be viewed as threatening to Whites (Payne, 2001; Correl, Park, Judd & Wittenbrink, 2007), this fMRI research suggests neural regions and cognitive processes that may underlie these sorts of behavioral responses.

These differences in neural activation may also be modulated by goals in social interactions. Research has demonstrated differences in neural activity when participants are tasked with the social categorization or individuation of racial ingroup and outgroup targets (Wheeler & Fiske, 2005). When White participants racially categorize Black faces, the amygdala shows a heightened response and greater stereotype activation, as measured by lexical priming, relative to when the participants are instead tasked to individuate the Black targets (Wheeler & Fiske, 2005). These results suggest that the explicit task of individuating other-race individuals can alter brain activity and stereotype activation, demonstrating the goal dependence and malleability of these processes.

While fMRI research has been helpful in demonstrating some of the neural substrates of person perception, it has limitations. Due to its lack of temporal acuity, it cannot neatly provide precise temporal measurements of the neural processing of faces, since fMRI images brain activity on the scale of seconds and much of early face processing occurs on the scale of milliseconds. In contrast, electroencephalography (EEG) can precisely identify the time course of social categorization (Fabiani & Donchin, 1995), allowing the early cognitive processes of person perception to be studied. In EEG recordings, electrodes are placed upon the scalp to measure the electrical activity of populations of cortical neurons. The event-related potential

(ERP) technique uses EEG signals time-locked to stimulus presentation in order to provide a neural index of a cognitive process specific to the type of stimulus presented (Cacioppo, Crites, Gardner, & Berntson, 1994; Stern, Ray, & Quigley, 2001).

Research using ERPs has found racial ingroup/outgroup effects in the N1, P2 and N2 components, which occur if the participant is explicitly instructed to attend to race or not (for a review, see Ito & Bartholow, 2009). The N1 and the P2 are both implicated in the engagement of attentional resources and are typically larger to racial outgroup than ingroup members, suggesting an early process for directing attentional resources towards outgroup members relative to ingroup members. The N2, also an attentional component, shows larger amplitudes to racial ingroup faces compared to racial outgroup faces (Dickter & Bartholow, 2007). As larger differences in early ingroup versus outgroup attention, as reflected in N2 processing, has also been related to better ingroup categorization (Dickter & Bartholow, 2007), this early differentiation may have a role in distinguishing ingroup and outgroup members. This process may also have a functional role in directing other person perception processes and behavioral responses. For example, White individuals who exhibit larger P2 and N2 responses to Black targets are more likely to view as a Black male as holding a gun rather than a tool in simulations (Correll, 2006), suggesting that early neural differentiation of Black and White faces may elicit stereotypes which then may bias behavioral responses. ERP research such as this reveals that very early on in person perception, processes are activated that are sensitive to racial ingroup and outgroup membership, which may in turn guide future cognitions and behaviors.

### **Social expectancy violations**

While social categorization shapes our interactions with social targets by leading us to expect stereotyped information, the social mind is also capable of processing situations involving



schema-violating information, which may require novel behavioral responses (Macrae et al., 1999). In order to reveal the cognitive processes involved in a schema violation, research has examined what happens both behaviorally and neurally when there is incongruence between social expectations and reality. Learning that individuals violate expectations by behaving in a manner inconsistent with stereotypes leads perceivers to experience heightened arousal (Jussim, Coleman & Lerch, 1987) and make more extreme evaluations of targets who violate expectancies (Bettencourt, Dill, Greathouse, Charlton, & Mulholland, 1997). Individuals also show greater working memory load (Stern, Marrs, Millar, & Cole, 1984) and better memory for targets exhibiting stereotype-violating behavior, suggesting more cognitive processing is recruited for expectancy incongruent information (Stern, Marrs, Millar, & Cole, 1984). It seems that when perceivers encounter people who act in nonstereotypic ways, individuating processes are activated which may have downstream cognitive and behavioral consequences.

One fMRI investigation (Cloutier et al., 2011) examining social expectancy violations used targets who differed based on political party (Democrat and Republican) who were described as holding views that were stereotypical or nonstereotypical of their political affiliation. The bilateral temporoparietal junction (TPJ) and medial prefrontal cortex (MPFC), both regions previously found to be involved in mentalizing about others, were found to be preferentially engaged when targets violated expectations based on political affiliation. Both areas are broadly implicated in social cognition, but specifically the TPJ has been found to be involved in attributing mental states to others (Saxe & Wexler, 2005), with damage to this area impairing performance on Theory of Mind (ToM) tasks (Samson et al., 2004), while the MPFC has been implicated in impression formation (Mitchell et al., 2004) and ToM (Frith & Frith, 2006). These findings suggest overlap between neural networks involved in mentalizing about others and in

the individuation of targets, supporting the notion that social expectancy violating targets recruit neural systems that rapidly act to create individuated impressions.

Dickter and Gyurovski (2012) used a similar impression formation task in an ERP study to help elucidate the early processes underlying person perception when targets violate expectations based on racial stereotypes. White participants viewed sentences describing positive and negative behaviors stereotypical of a White person or a Black person, which were designed and tested in a series of pilot studies to elicit a social expectation for the target that followed. Thus, there were four classes of statements: Black stereotypical negative, Black stereotypical positive, White stereotypical negative and White stereotypical positive. After sentence presentation, a face of a Black male or a White male was presented; the faces were matched on attractiveness, age and stereotypicality. These targets either confirmed (e.g., Black stereotype-Black face) or violated (e.g., Black stereotype-White face) expectations based on racial stereotypes. The researchers found that the amplitudes of the N1, P2 and N2 components in response to Black and White male faces were moderated by the impressions formed prior to target presentation. The N1 showed a larger amplitude when a White face followed a negative impression and when a Black face followed a positive impression. The N2 was larger when a White face followed a Black stereotypic and/or negative impression, suggesting that expectancy violations demand more attention when ingroup members are seen negatively or as demonstrating outgroup characteristics. The N1 and N2 results both suggest that more early attention is allocated in trials involving expectancy violations rather than expectancy confirmations, indicating that individuals attend to stereotype violating targets more quickly and on a deeper neural level than stereotype confirming targets. The P2 component had the largest effect when Black faces followed stereotypically Black behaviors, supporting the theory that the P2 component reflects racial

outgroup processing (Dickter & Bartholow, 2007) and possibly the perception of social threat (Schutter, de Haan, & van Honk, 2004). As social expectations may function as a threat preventer by leading perceivers to avoid potentially dangerous individuals (Olson, Roese, & Zanna, 1996), it may be that outgroup faces are processed as more threatening when they seem to conform to outgroup stereotypical behavior. The Cloutier et al. (2011) and Dickter and Gyurovski (2012) studies together suggest that early neural attention is directed differentially to individuals based on the stereotypic consistency of information presented about them as well as their racial ingroup or outgroup status, offering an important avenue of research into person perception. This suggests that facial perception is modulated by the content of the social information available about the target, showing that even something so basic as perceiving a face can be affected by social expectations.

### **Minimal groups**

While standing social categories such as race can evoke ingroup and outgroup distinctions and lead to differential processing, experimentally induced and mutually exclusive groups (e.g., minimal group assignments) are also sufficient to introduce processing differences between minimal groups, suggesting that prior ingroup contact and resource competition are unnecessary for group bias (Tajfel, Billig, Bundy & Flament, 1971). This implies that humans quickly and flexibly self-categorize into social groupings such that even low-level person perception is informed by group identity. Research into the cognitive basis of face perception has begun to elucidate how group membership is processed, with a burgeoning body of research suggesting that many effects previously thought to be unique to socially defined ingroups and outgroups such as race can be replicated with minimal group paradigms.

Research has suggested that basic recall of a target's race can be moderated by minimal group membership (Kurzban, Tooby, & Cosmides, 2001). In two experiments, participants were instructed to form impressions of individuals holding a conversation. The cues to group membership were strictly conversational in the first study, with the conversers indicating the group to which they were affiliated by how they spoke to one another. In the second study the cues were both conversational and based on a cue related to dress appearance (shirt color). At the end of the conversation, a surprise recall task was administered in which participants were tested on the memory of race and group membership. In Study One, participants remembered race and group membership at about the same level but in Study Two, where style of dress was indicative of affiliation, group membership was remembered at a similar level to Study One while recall of race was significantly worse (Kurzban, Tooby, & Cosmides, 2001). Similarly, ingroup faces are remembered better than outgroup faces whether the group distinction is university affiliation or an arbitrarily assigned personality type (Bernstein, Young & Hugenberg, 2007). Fear conditioning also can be affected by group membership. When participants were assigned a colored t-shirt for their performance on a color perception task, negative associations were more easily established for targets wearing the opposite color than targets wearing the same color as the participant (Navarette et al., 2012). Thus, when group membership for other minimal groups is salient, biases for social groups such as race can be moderated, suggesting that minimal group membership can supersede race in categorical importance and processing.

These results suggest that differential processing of racial ingroup and outgroup faces reflect basic group recognition processes that are not specific to race and that the simple act of social affiliation can bias our perceptual systems. Indeed, an fMRI study used mixed-race minimal groups to examine the neural substrates underlying facial recognition (Van Bavel,

Packer, & Cunningham, 2008). They informed participants that they had been assigned to one of two groups, the Leopards or Tigers, and that it was important to learn the members of their team and the competing team prior to the study. After the learning task, participants completed a facial categorization task. The researchers found that ingroup faces recruited greater activation in the amygdala, orbitofrontal cortex, dorsal striatum and FFA. As the effects were not moderated by race, this pattern of FFA activation, similar to previous work by Golby et al. (2001), may reflect ingroup attentional biases or greater ingroup member individuation rather than perceptual expertise (Van Bavel et al., 2008). Furthermore, the tendency seems to be perceptually automatic, since Van Bavel et al. found that task demands did not moderate the effects.

ERP research has shown that minimal groups can elicit neural differences very early on in facial processing. A study by Ratner and Amodio (2013) asked participants to complete a dot estimation task, in which they were to estimate the number of dots on an array of images. Participants were told that their group membership was based on their performance on the task, but were randomly classified as being either an overestimator or underestimator, which they were told related to personality characteristics. Participants then categorized a set of faces as being either overestimators or underestimators according to background color. The researchers found that ingroup members, as defined by targets who possessed the same estimator label as the participant, elicited greater N170 amplitudes after facial presentation, a component thought to be related to facial structural encoding (Ratner & Amodio, 2013), suggesting that a minimal ingroup is sufficient to induce differential facial processing very early on in person perception.

Taken together, these studies suggest that previously found race effects may be the result of a broad psychological system based upon categorical distinctions, rather than an effect specific to race. They also suggest that race effects in social categorization may often be

supplanted by basic group affiliations, even during low-level perceptual processes. Given the importance of race and other deeply embedded social distinctions in guiding social behaviors, the ease with which a minimal group can recruit similar neural processes and become the dominant social category by which we process individuals suggests a greater need for research in these basic person perception processes. By examining early attention to faces that differ on race, group affiliation and behavior, we can better understand what social cues drive social categorization and behavioral outcomes.

### **The current study**

As reviewed above, research into the social cognitive processes active when viewing faces of Blacks and Whites suggests a host of neural and cognitive processes hinge upon the racial ingroup or outgroup membership of a target. This membership then can activate stereotypes that may bias an individual's behavior. Other research has shown that when these stereotypes are violated with stereotype inconsistent information, neural processes are activated which lead perceivers to attend more to the target. As minimal group research has shown that many neural, cognitive and behavioral effects that were thought to be specific to race or learned group membership may actually in fact reflect a basic system tuned to ingroup and outgroup membership, this research seeks to explore whether early neural attention to a mixed-race minimal group will supersede the effects found previously in studies of neural attention to racial faces that violate expectancies. In the current study, we used Dickter and Gyurovski's (2012) racial expectancy violation paradigm in an attempt to replicate their effects and to extend it to examining both White and Black participants. We expect that the findings for White participants will replicate the original study while the data for Black participants will mirror the findings from White participants (Dickter & Gyurovski, 2012), with White and Black targets eliciting

ERPs consistent with outgroup and ingroup targets, respectively. In a second block, the paradigm is used in conjunction with a minimal group distinction, where participants are assigned to a group that contains both Black and White males and then are tested on their neural responses to the target-sentence pairings. The focus of the current study is on the P2 component, an early attentional component that has been shown to be larger to racial outgroup than racial ingroup faces (Ito & Bartholow, 2009) and when White participants view Black target-Black stereotype pairings (Dickter & Gyurovski, 2012). We decided to examine the P2 it is an index of participants attention and offers straightforward predictions for our particular study. It is hypothesized that the P2 will be larger to outgroup faces relative to ingroup faces and largest when negative impressions are paired with minimal outgroup target faces. This result would suggest that a minimal group distinction can supersede race in determining early neural responses to targets.

## **Method**

### **Participants**

Twenty Black and twenty White male undergraduates ( $M_{age} = 19.3$  years) from the College of William and Mary were recruited. The men participated either for course credit in an introductory psychology course or for payment. All participants were healthy, with no history of neurological dysfunction, and right-handed, with normal or corrected-to-normal vision. The protocol was approved by the college's ethics board and informed consent was obtained from all subjects.

### **Stimuli and experimental paradigm**

Impression Formation Tasks. The sentence and target face stimuli used were the same used by Dickter and Gyurovski (2012). The sentences were formed according to pilot studies. In

the first pilot study, participants ( $N=188$ ) listed common American stereotypes of Black and White males in a free response task. The most frequently mentioned stereotypes were compiled and then used in the second pilot study, where participants ( $N=68$ ) rated them on their applicability for White males and Black males. The 7-point scale ran from “not all applicable” to “extremely applicable.” The stereotypes that were rated most applicable for White or Black males were included. Any stereotypes that were rated as applicable to both Black and White males were excluded. A third pilot test had participants ( $N=49$ ) create sentences on the basis of the stereotypes provided from pilot study 2. Four commonly created sentence types were used for each stereotype. The impression-formation sentences that resulted were distributed evenly among four categories: Black positive stereotype, Black negative stereotype, White positive stereotype and White negative stereotype.

The picture stimuli for the impression formation tasks and for the minimal groups learning task consisted of 120 full-color photographs of the heads and necks of Black and White males with neutral facial expressions and direct eye gaze. All pictures were obtained from Jennifer Eberhardt and were pilot-tested to be similar in age, attractiveness and stereotypicality (Eberhardt, Davies, Purdie-Vaughns & Johnson, 2006). The sentence-face pairings consisted of Black positive stereotype-Black face, Black positive stereotype-White face, Black negative stereotype-Black face, and so on, for a total of 8 different categories of sentence-face pairings.

The stimuli were presented using E-Prime software (Psychology Software Tools, Inc., Pittsburgh, PA, USA). One hundred twenty sentence-face pairs were used over two blocks. The first block included forty pairings and the second block included eighty pairings. Both blocks had the same design. A message was presented for 1000ms at the start of each trial which notified participants that the next trial was about to begin. A fixation cross in the center of the



screen was then presented for 500ms. The impression-formation sentence was then presented on the screen until participants indicated they had read it by pressing the space bar. The target face was then presented for 500ms. After face presentation, participants indicated by button press whether the target could have been the person described by the sentence. The key press was counterbalanced across participants. The intertrial interval varied randomly between 2000 and 4000ms. Each face was seen only once.

Dot Estimation Task. Participants were presented with four screens of randomly distributed dots for 5s each and were asked to estimate the number of dots on each screen and record their answers using pen and paper. When finished, the experimenter came in, collected the responses and left the room briefly. Participants were then randomly assigned to be either an “underestimator” or an “overestimator.” The experimenter then reentered the experimental room and notified the participant of his categorization and provided him with a sheet of paper with the appropriate estimator label written on it. The participant was then presented with this message onscreen: “Although psychologists place no value on whether it is better to be an overestimator or an underestimator, individuals who underestimate tend to be similar to one another in other ways, just as those who overestimate tend to share a number of other characteristics” (Brown, Collins & Schmidt, 1988). While the message was presented, the experimenter also read the message to the participant to ensure he attended to the assignment. The goal of this task was to create an arbitrary minimal groups distinction.

Learning Task. The word “overestimator” or “underestimator” was first presented on the screen for 2s indicating the group label of an individual. The next screen presented a Black or White male face for 3s. A series of forty Black and forty White male faces was used for a total of eighty faces with both races being equally distributed between the two estimator groups. These

faces were distinct from the ones used in the first expectancy violation block. A blank screen followed the presentation of the face where participants evaluated what the previously presented face's group label was by a simple key press. The key press was counterbalanced across participants. Participants received real time feedback on their categorization of the faces, with "correct" in blue or "incorrect" in red appearing in the center of the screen for 1.5s. This learning block was designed to have participants learn the categorization of the faces (over vs. under), establishing a minimal in- and outgroup as a result. The immediate evaluation of the targets' group label was to ensure that participants were attending to the faces and the feedback was to motivate participants to provide correct responses.

Memory Task. Participants were tested on their recall of the faces used in the training task and second expectancy block. Each face was presented onscreen for 1000 ms during which participants had to respond with a simple key press to indicate the estimator group the face belonged to. They received immediate feedback on their responses: a blue "correct!" or red "incorrect" appeared in the center of the screen for 1500 ms.

## **Procedure**

Upon arrival, participants were asked to fill out a consent form. Participants were then seated roughly 70 cm away from the computer screen in an electrically shielded Faraday cage. Electrodes were then attached and tested. Participants were asked to sit as still as possible and to minimize eye blinks during the experiment to reduce noise in the EEG data. The first block began after presentation of instructions and included forty sentence-face pairings. On average it took participants 5 minutes to complete this first block. After completion of the trials in the first block, participants completed the dot estimation task, which took roughly a minute to finish. After being presented with their estimator classification and reading the onscreen message on its

significance, participants pressed the spacebar to continue. Participants then completed the learning portion of the minimal group assignment. On average, participants took roughly 8 minutes to complete this task. The next block shared the same design as the first expectancy block, except the faces this time were the same from the training task and the impression formation sentences were different from the first expectancy block, for a total of 80 unique sentence-face pairs. After completion of this block, which took approximately 10 minutes, participants were tested on their memory of the trained faces. Participants then had the EEG cap removed. Participants were then debriefed on the nature of the study and thanked for their participation.

### **Electrophysiological recording and analysis**

EEG data were recorded with a DBPA-1 Sensorium Bioamplifier (Sensorium, Inc., Charlotte, VT, USA) with an analog high-pass filter of 0.01 Hz and a low-pass filter of 500 Hz (four-pole Bessel). The EEG was recorded from 74 Ag-AgCl sintered electrodes in an electrode cap, placed with the expanded International 10–20 electrode placement system. All electrodes were referenced to the tip of the nose, and the ground electrode was placed in the middle of the forehead, slightly above the eyebrows. Eye movement and blinking were recorded from bipolar electrodes placed on the lateral canthi and periocular electrodes on the superior and inferior orbits, aligned with the pupils. Before data collection was initiated, all impedances were adjusted to within 0–20 kilohms. EEG was recorded continuously throughout the computer task, and was analyzed off-line by EMSE software (Source Signal Imaging, San Diego, CA, USA). Data were undersampled at 500 Hz. The data were corrected for eye-movement artifacts, using independent component analysis (Jung, Makeig, Westerfield, Townsend, Courchesne, & Sejnowski 2000). Channels containing extreme values ( $\pm 300$  mV) in more than 40% of the sweeps were spatially

interpolated. All EEG data were filtered (FIR) at low-pass 20 Hz (Luck, 2005). The data were segmented between 200 ms prior to stimulus onset and 1000 ms post-stimulus onset. After baseline correction over the pre-stimulus interval, segmented data was averaged for each subject in each of the conditions (Fabiani, Gratton, & Federmeier, 2007; Luck, 2005). Sample-wide ERPs were identified from the grand-averaged waveforms.

## Results

Visual inspection of grand-averaged waveforms was used to identify epochs for the component of interest, as well as to determine scalp locations where neural activation was maximal. For the purposes of investigating the ERP component that is of most theoretical interest to the current research question, we chose to focus on just the P2 component in the analyses below. The P2 component was largest at the Pz (parietal midline) electrode, and was quantified as the average voltage between 170 and 300 ms at that electrode.

The data collected from four participants were not included due to excessive noise in the EEG recording. One other participant was rejected because of data recording failure. Thus, EEG data analysis was conducted with nineteen White participants and sixteen Black participants. In order to examine the neural effects of minimal group assignment and race on stereotype-consistent and -inconsistent conditions, a 2 (Group Membership: Underestimator, Overestimator) x 2 (Target Race: Black, White) x 2 (Stereotype Race: Black, White) x 2 (Stereotype Valence: Positive, Negative) x 2 (Race: Black, White) x 2 (Group: Underestimator, Overestimator) mixed model ANOVA was conducted with repeated measures on the first four factors and with P2 amplitude as the dependent variable.

Results revealed a marginal three-way interaction of Stereotype Congruence x Valence x Participant Group,  $F(1,34)=3.29$ ,  $p=.080$ ,  $\eta^2=.099$ . This interaction was not significant and not of theoretical interest so we did not explore this interaction further.

The analyses showed a marginally significant three-way interaction of Target Race x Stereotype Congruence x Participant Race,  $F(1,34)=3.36$ ,  $p=.077$ ,  $\eta^2=.101$ . Follow-up tests were conducted to understand the interaction. First, separate repeated measures ANOVAs for Target Race x Stereotype Congruence were conducted separately for Black and White participants. For Black participants, analyses revealed a significant main effect of Target Race,  $F(1,15)=6.10$ ,  $p=.026$ ,  $\eta^2=.289$ . A paired samples  $t$ -test revealed larger mean amplitudes to White targets ( $M=2.64$ ,  $SE=1.15$ ) relative to Black targets ( $M=1.89$ ,  $SE=1.16$ ),  $t(15)=-2.52$ ,  $p=.025$ . For White participants, there was a marginal Target Race x Stereotype Congruence interaction,  $F(1,18)=3.33$ ,  $p=.085$ ,  $\eta^2=.156$ . To examine this interaction further, paired samples  $t$ -tests showed that White Target-Stereotype Congruent trials ( $M=5.69$ ,  $SE=1.81$ ) elicited larger mean amplitudes than did Black Target-Stereotype Congruent ( $M=3.79$ ,  $SE=1.28$ ) pairings, although this difference was not significant,  $t(17)=-1.57$ ,  $p=.133$ . There were no differences between the White and Black targets in the Incongruent conditions.

Results also showed a significant three-way interaction between Target Race x Participant Race x Participant Group,  $F(1,34)=5.85$ ,  $p=.022$ ,  $\eta^2=.163$ . Additional repeated measures ANOVA were conducted for White and Black participants separately. For White participants there was a significant Target Race x Participant Group interaction,  $F(1,18)=5.94$ ,  $p=.026$ ,  $\eta^2=.259$ . White Underestimator and Overestimator participants were then analyzed separately. For White Underestimator participants, White targets ( $M=6.48$ ,  $SE=2.51$ ) elicited a larger P2 than Black targets ( $M=3.19$ ,  $SE=1.83$ ), although this was not significant,  $t(8)=-1.76$ ,

$p=.116$ . For White Overestimator Participants, Black targets ( $M=5.43$ ,  $SE=1.93$ ) elicited a larger P2 than White targets ( $M=4.01$ ,  $SE=1.93$ ), although this was also only marginally significant,  $t(9)=1.90$ ,  $p=.090$ . For Black participants, there was a main effect of Target Race,  $F(1,15)=6.47$ ,  $p=.023$ ,  $\eta^2=.316$ , such that White Targets ( $M=2.64$ ,  $SE=1.15$ ) elicited larger amplitudes than Black Targets ( $M=1.89$ ,  $SE=1.16$ ),  $t(15)=-2.52$ ,  $p=.025$ .

Analyses also revealed a significant four-way interaction between Target Group x Valence x Participant Race x Participant Group,  $F(1,35)=4.561$ ,  $p=.041$ ,  $\eta^2=.132$ . Repeated measures ANOVAs were then carried out for Overestimator and Underestimator participants separately. For Overestimator participants, analyses showed a Target Group x Valence x Participant Race effect, although this effect did not reach significance  $F(1,18)=2.91$ ,  $p=.107$ ,  $\eta^2=.154$ . Further repeated measures ANOVAs were done for Black and White Overestimator participants separately. There were no significant effects found for Black Overestimator participants. For White Overestimator participants, there was a significant effect of Valence,  $F(1,10)=5.12$ ,  $P=.05$ ,  $\eta^2=.363$ , which was qualified by an interaction of Target Group x Valence, although this effect was not significant,  $F(1,10)=2.80$ ,  $p=.129$ ,  $\eta^2=.237$ . There were no significant effects for participants who had been assigned as Underestimators.

A significant five-way interaction of Target Race x Target Group x Stereotype Congruence x Participant Race x Participant Group was also found. Additional repeated measures ANOVAs were conducted for Underestimator and Overestimator participants independently. For Underestimators, there was a significant Target Race x Target Group x Participant Race interaction,  $F(1,17)=5.59$ ,  $p=.032$ ,  $\eta^2=.271$ . Black and White Underestimator participants were then subjected to separate repeated measures ANOVAs. No significant effects were found for Black Underestimator participants. For White Underestimator participants, a

repeated measures ANOVA revealed a significant Target Race x Target Group Membership effect,  $F(1, 9)=11.97, p=.009, \eta^2=.599$ , which was not of theoretical interest and therefore not explored further. For Overestimator participants, there was a significant Target Race x Participant Race interaction,  $F(1,18)=8.01, p=.012, \eta^2=.334$ , which was qualified by a significant Target Race x Target Group x Stereotype Congruence x Participant Race interaction  $F(1,18)=5.87, p=.028, \eta^2=.268$ . Further repeated measures ANOVAs were conducted for White and Black Overestimator participants. Results revealed a marginal main effect of Target Race among White Overestimator participants,  $F(1,10)=3.618, p=.09, \eta^2=.287$ , such that Black Targets elicited a marginally larger amplitude ( $M=5.43, SE=1.94$ ) than did White Targets ( $M=4.01, SE=1.94$ ),  $t(9)=1.90, p=.09$ . For Black Overestimator participants, there were main effects of Target Race,  $F(1,8)=8.21, p=.024, \eta^2=.54$ , and Stereotype Congruence  $F(1,8)=3.55, p=.102, \eta^2=.336$ . These main effects were qualified by a significant Target Race x Group Membership x Stereotype Congruence interaction,  $F(1,8)=9.12, p=.019, \eta^2=.566$ . Further analyses revealed that for Overestimator Targets, which constitute those participants' minimal ingroup, there was a significant interaction of Target Race x Stereotype Congruence,  $F(1,8)=5.60, p=.05, \eta^2=.444$ . A paired samples *t*-test showed that Stereotype Congruent Black Targets ( $M=4.61, SE=2.38$ ) yielded a larger amplitude than Stereotype Incongruent Black Targets ( $M=1.2, SE=1.53$ ),  $t(7)=2.465, p=.043$ . Analyses revealed no significant effects for White Targets. For Underestimator Targets, the minimal outgroup, there was an interaction between Target Race and Stereotype Congruence,  $F(1,8)=6.57, p=.037, \eta^2=.484$ . A paired samples *t*-test showed that for White Underestimator Targets, Stereotype Congruent Targets ( $M=5.79, SE=1.16$ ) yielded a larger amplitude than Stereotype Incongruent Targets ( $M=3.47,$

$SE=1.32$ ),  $t(7)=2.496$ ,  $p=.041$ . There were no significant effects for Black Underestimator Targets.

### **Discussion**

The current study investigated how a minimal group distinction can alter early attentional differences to race as a function of stereotypic expectancies. Our hypothesis that minimal group affiliation would supersede race in early attention, as indexed by the amplitude of the P2 component following an expectancy violation, was generally not supported. We did, however, find a number of other effects. Black participants had larger P2 amplitudes to White Targets relative to Black Targets, supporting previous literature that has shown the P2 component to be sensitive to racial outgroup members (Dickter & Bartholow, 2007). For Black Overestimator participants, White minimal outgroup targets who followed descriptions of White stereotypes elicited greater amplitudes than did White minimal outgroup targets who followed Black stereotype. Similarly, Dickter and Gyurovski (2012) found that for White participants Black stereotype-Black target pairings elicited the greatest P2 amplitude. While our expectation was that participants would have larger P2 amplitudes to minimal outgroup members generally, with those following negative impressions being the largest, this finding offers partial support for our hypothesis in that these White minimal outgroup targets were simultaneously in the Black participants' racial and minimal outgroups and were seen as behaving congruently with racial outgroup stereotypes. This combination may have been a potent one for participants in perceiving social threat (Schutter, de Haan, & van Honk, 2004). The salience of race in this study may have caused for the minimal group distinction to have a combinatory, rather than a overriding, effect with the racial distinction. The other effects we found were difficult to interpret.



For Black Overestimator participants, Black stereotype-Black minimal ingroup target pairings elicited larger amplitudes than did White stereotype-Black minimal ingroup target pairings. Since the amplitudes did not seem to differ based upon the valence of the stereotype, this finding is puzzling given previous research identifying the P2 component as an outgroup or social threat perception component and the targets were in both the participants minimal and racial ingroups (Dickter & Gyurovski, 2011; Dickter & Bartholow, 2007; Schutter, de Haan, & van Honk, 2004). A number of explanations could account for this discrepancy. It may be that Black participants in general were more tuned to the racial component of the study, shifting their attention or expectations in some unexpected way, or perhaps inducing increased anxiety. Research has shown that when minority stereotypes become salient minority group members' performances on tasks worsen, possibly as a result of increased anxiety due to fear of confirming a stereotypical expectation (Steele & Aronson, 1995). For example, once group membership is established Black participants may be especially sensitive to being affiliated with Black targets who behave in stereotypically Black ways, eliciting a larger P2 in response to a perception of social threat. Anecdotally, several Black participants asked after the study about the racial nature of the study and their performance, whereas no White participants inquired in a similar way, suggesting that the racial aspect of the study was more meaningful and perhaps anxiety-inducing for the Black participants. Considering this in conjunction with our minimal group paradigm, which implicitly suggests that participants share psychological traits with targets who share their estimator group, Black participants may have been especially sensitive to being associated with racial and minimal ingroup members who behave in a stereotypical manner. It also may be that the racial nature of the study negatively altered the valence of all the Black stereotypic impressions, causing Black participants to view stereotypical Black ingroup members negatively,

regardless of the pilot tested valence of the stereotype. On the surface this explanation seems less likely however, given previous studies that have shown that participants implicitly attend to race regardless of task (Dickter & Bartholow, 2007), suggesting that the explanation is something other than a priming effect.

Another consideration is the assumption in our design that our Black and White participants identify with their racial ingroup or find racial group distinctions equally salient. It may be that Black individuals perceive race, and therefore race expectancy violations, in fundamentally different ways than White individuals. Indeed previous research has suggested that racial identity is more important to Blacks than Whites (Jaret & Reitzes, 1999; White & Burke, 1987) which implies that a racially charged study may affect Blacks and Whites in different ways. Future analysis should examine neural responses in the first expectancy block prior to the introduction of a minimal group differentiation to better understand Black participants' responses to racial expectancy confirmations and violations. In addition, future research could correlate measures that probe participants' same race and other race experience and attitudes with their neural responses to expectancy violations, offering an index of early attentional activity in relation to racial experience and bias. Another possibility is examining the extent to which participants identify with or have anxiety evoked by racial stereotypes. Future research could also vary the race of the experimenter, given that this study used a White male to deliver the instructions and conduct the experiment, which may have caused a systematic difference in Black participants' perceptions of the study relative to White participants. The experimenter bias effect, whereby the presence of an experimenter may alter the participant's cognitions or affects, has been observed for years (Rosenthal, 1963). One study specifically investigated the effect of Black and White interviewers on the results obtained from

psychological assessment of Black females. The researchers found that Black females divulged more information to Black than White interviewers (Samples et al., 2014) suggesting that the race of an experimenter can significantly alter participants' responses. While it is unclear whether this effect can extend to physiological responses, given the extensive interaction between the experimenter and participants in our study, particularly during minimal group assignment, the possibility of experimenter race having a differential effect on Black and White participants must be taken seriously.

Other marginal effects were found as well. Among White participants, stereotype congruent White targets elicited larger amplitudes than stereotype congruent Black targets. Although this finding was not significant, it mirrors in some ways the finding of greater P2 amplitudes to stereotypical Black ingroup targets by Black participants. It is difficult to explain this finding, except to say that if this pattern is specific to the estimator expectancy block and not the racial expectancy block something about the introduction of this specific minimal group distinction altered the neural patterns in unpredictable ways. Even more confusing is that, despite random minimal group assignment, White Overestimator participants had larger amplitudes to Black targets, whereas White Underestimator participants had larger amplitudes to White targets. These findings offer no readily understandable pattern and are therefore currently inexplicable. Further analysis may offer some insight.

A number of different reasons could explain the lack of specific support for our hypothesis. One possibility is that participants suspected that they were being deceived, altering their responses to the task demands. Another possibility is that participants simply did not pay enough attention to or remember the faces in the learning task, given that they were asked to pay attention to and remember the estimator label for eighty faces. Future analysis could look at the

patterns of correct versus incorrect responses in the learning and memory tasks in relation to the expectancy violation block in order to parse out any relationship of recall of the targets to P2 amplitude.

It is also possible that the dot estimation paradigm is just not a salient enough group distinction to elicit minimal group effects, especially when race had been made salient in the first portion of the study. Some marker of group identity, such as t-shirt or background color, may be necessary for such a quickly constructed group distinction to take root. Our reasoning in using only the learning task to distinguish ingroup and outgroup targets was that any group effects we found would be all the more impressive, but it could be that the social relevance and perceptual salience of skin color necessitates a stronger minimal group distinction and perhaps even a visual cue to group affiliation. As Kurzban and colleagues noted (2001), patterns of social affiliation and shared appearance may both conspire to maintain race as a potent marker to group membership. They accounted for this by running two studies to assess the effects of group affiliation on memory of target race, one without a visual cue and the second one with a visual cue, t-shirt color. Only in the latter study did participants seem to prioritize group membership encoding over race, as judged by their spontaneous recall of target race (Kurzban, Tooby & Cosmides, 2001). Since previous research had shown that t-shirt color was not spontaneously encoded in the same paradigm, these results suggest that shared appearance may be an important condition in eliciting group affiliation, especially when the group membership is experimental and as minimal as ours was. Ratner & Amodio (2013) used a similar dot estimation paradigm as this study but in contrast used shirt color to differentiate the groups. They found that the N170, a component related to facial structure encoding, was larger to ingroup compared to outgroup

members. These researchers used only White targets, however. Future studies could use the same design and substitute some visual marker of shared group membership for the learning task.

Several limitations of the study must be noted. All participants were college-aged and -educated men, limiting the study's generalizability. Five participants' data had to be excluded, diminishing an already small sample size. When conducting analyses to understand the observed interaction effects, most effects were marginal, suggesting a need for greater power. Larger sample sizes should increase the power of the experiment, reducing the likelihood of Type II error. There also seemed to be some large systematic differences among Underestimator participants compared to Overestimator participants. Underestimators showed much smaller mean amplitudes than did Overestimators, which greatly complicated the analyses. Given that participants were randomly assigned into one of the two categories, why this occurred is entirely unclear.

Future analysis should examine the first expectancy violation block to determine if the findings from Dickter and Gyurovski (2011) were replicated. Since only White participants were used in the original study and this study used both Black and White participants, perceiver race effects could also be probed. We hypothesize that in the first block, Black participants will show the same pattern of neural activation and behavior along racial ingroup and outgroup lines as White participants in Dickter and Gyurovski (2011). Greater N1 amplitudes should be observed in response to negative impression-Black target and positive impression-White target pairings, relative to positive impression-Black target and negative impression-White target pairings. The P2 should show greater amplitudes to White targets compared to Black targets and greater amplitudes to White stereotype-White target pairings relative to other combinations. The N2 should show several effects. First, it should show greater activation to Black targets than White targets.

Second, it should show larger amplitudes to the negative stereotype-Black target condition when compared to other pairings. Third, it should show larger amplitudes to White stereotype-Black target pairings relative to White stereotype-White target, Black stereotype-Black target and Black stereotype-White target pairings. Finally, reaction times should be quickest and participants most likely to describe the target as the actor of the behavior in conditions with no expectancy violation. The results from both White and Black participants in this first block should then be compared to the results of the second block to understand the effects of the minimal group assignment and learning task, as mentioned above.

For the minimal group block, analysis could be simplified by collapsing across target group membership and participant group membership to create one factor, group membership (e.g., ingroup, outgroup). Other participants' data may also need to be excluded due to being statistical outliers. Additionally, we could analyze other attentional components for both race and minimal group effects.

The N1 has previously been implicated in engaging attentional resources and is usually larger to racial outgroup members (Ito & Bartholow, 2009). In a racial expectancy violation setting, it has been shown to be greater when a racial ingroup face followed a negative impression and when a racial outgroup face followed a positive impression (Dickter & Gyurovski, 2012). We hypothesize that this component would be larger when ingroup targets are coupled with negative information and when outgroup targets are coupled with positive information, relative to the other conditions. The N2 typically has larger amplitudes in response to racial ingroup faces relative to racial outgroup faces and may be related to ingroup and outgroup differentiation (Dickter & Bartholow, 2007). It has also been shown to be larger when a White face follows a Black stereotype or negative impression (Dickter & Gyurovski, 2012).

Similar to the N1 component, our expectation would be that participants would show a larger N2 amplitude to ingroup members, especially when they are preceded by negative information. We could also look at the N170, a component related to facial structure encoding that has been shown to be sensitive to minimal group effects (Ratner & Amodio, 2013). We would expect that a larger amplitude would be found for minimal ingroup members relative to minimal outgroup members. The P3, thought to be an index of working memory updating, should also be investigated (Donchin & Coles, 1988). As it has been previously found to be larger to evaluatively inconsistent stimuli, especially when the stimuli is negatively valenced (Ito & Cacioppo, 2000), this component would be expected to be largest when there are incongruencies between several pieces of the presented social information (e.g., White participants viewing a negative Black stereotype-White ingroup member pairing).

The ERP amplitudes should also be analyzed in relation to participant behavior. Dickter and Gyurovski (2012) found that participants were most likely to report that a target could have performed the behavior in the impression formation sentence when there was no expectancy violation. We expect that participants would indicate that minimal ingroup members who are preceded by positive impressions could be the actor of the described behavior. We can also examine if P2 amplitudes in response to minimal group expectancy violations positively associate with reaction times (RTs). Previous work (Dickter & Gyurovski, 2012) has suggested that expectancy violations yield RTs than expectancy confirmations, particularly when a racial ingroup impression is followed by a racial outgroup target. Our expectation is that RTs will be longest when minimal ingroup impressions are followed by a minimal outgroup target.

Recall data should be examined for correlations with racial or minimal group distinctions. Previous work has demonstrated an own race bias in facial recall (for a review, see Meissner &

Brigham, 2001) and has been interpreted as resulting from individuals' superior perceptual expertise with own race faces. Other research, however, has suggested that this bias reflects basic group processes not specific to race (Van Bavel, Packer & Cunningham, 2008). We hypothesize that our participants' memory would track the minimal group distinction, such that minimal ingroup members would be better remembered than outgroup members. We also predict that expectancy violating targets (i.e., negative stereotype-ingroup member pairing) would be remembered better than expectancy confirming targets, given previous literature suggesting expectancy violating individuals are recalled better (Stern, Marrs, Millar, & Cole, 1984)

This study specifically and this line of reasoning generally is important in that it investigates what drives our attention, categorization and subsequent behaviors in person perception. It also seeks to understand how group membership modulates our social expectations and therefore what violates them. Although many of our current findings are confusing, future analysis may shed more light on the active processes. We also had issues with the data from participants randomly assigned as Overestimators, which is currently unexplainable. We did find, however, that Black participants exhibited larger P2 amplitudes in response to racial outgroup members, supporting previous findings on the P2 (see Ito & Bartholow, 2009). We also found greater P2s when Black Overestimator participants viewed White stereotype-White minimal outgroup members relative to Black stereotype-White minimal outgroup members, supporting previous literature showing larger P2s to racial outgroup stereotype-racial outgroup member pairings (Dickter & Gyurovski, 2012) and offering partial support for our hypothesis. This study then found partial support for previous literature on the P2 as a racial outgroup component and also contributed to the already extensive and growing minimal groups literature. There were also



many questions raised that have not yet been answered, offering many fertile avenues for future analysis and research.

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## Appendix

### Informed Consent Form

Psychology Department - College of William & Mary

The purpose of this study is to determine how quickly people can make judgments about other people. The procedure of this study is as follows:

First, several recording electrodes will be placed on your scalp and face. These electrodes will record the tiny electrical activity in your brain and muscles as you view and respond to the stimuli presented in this study; the electrodes will not be used to harm you in any way. Electrode gel will be inserted into each electrode prior to recording, and will need to be washed out of your hair following the session. This gel easily washes out with water. There are no known discomforts or risks associated with the response tasks in this experiment. It is possible that you will experience minor fatigue during set up of the experiment (cap administration and preparation) or after the experiment. If you do experience fatigue during the experiment, please alert the experimenter and a break will be given as soon as possible.

On a computer screen, you will see a series of trials in which a series of faces is presented. You will complete several judgment tasks in which you will be asked to make responses on a keyboard by pressing a key depending on the category of a target face.

After the computer tasks, you will fill out a short survey.

Your privacy is important to us and we will make every effort to protect your privacy. An arbitrary code number has been assigned to you for this study and the link between identifying information and your data will be kept in a password-protected database in a locked location. The results of this experiment will not be linked to any specific individual; we are only interested in group averages. No identifying information will ever be made public.

Please read the paragraph below and sign at the bottom.

The general nature of this study has been explained to me. I understand that I am participating in a reaction time study that will take approximately 90 minutes. I understand that my responses will be completely confidential and that my name will not be associated with any results of this study. I know that I do not have to participate in this study and that if I do choose to participate, I may stop at any time without any penalty. I know that I may refuse to answer any question asked and I also understand that any credit for participation will not be affected by my responses or by my exercising any of my rights. I am aware that I may report dissatisfactions with any aspect of this experiment to the Chair of the Protection of Human Subjects Committee, Dr. Raymond McCoy, 1-855-800-7187, [consent@wm.edu](mailto:consent@wm.edu). I understand that I may contact Dr. Cheryl Dickter about this experiment to ask any questions or to obtain the results of this study after it is completed at 757-221-3722 or [cltickter@wm.edu](mailto:cltickter@wm.edu). I am aware that I must be at least 18 years of age to participate.

My signature below signifies my voluntary participation in this project, and that I have received a copy of this consent form.

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Name

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Signature

Date

THIS PROJECT WAS APPROVED BY THE COLLEGE OF WILLIAM AND MARY PROTECTION OF HUMAN SUBJECTS COMMITTEE (Phone 757-221-3966) ON 2013-09-20 AND EXPIRES ON 2014-09-20.