GENDER, N170 EVENT RELATED POTENTIAL, AND IMPLICIT RACIAL BIAS

by

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ABSTRACT

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To better understand the N170 event related potential (ERP), we examined how factors such as participant gender and implicit racial bias might reflect upon amplitude and latency. White male (18) and female (34) participants performed an implicit association test (IAT) and Simple viewing EEG task with own-race White and other-race Asian faces. We were able to make several conclusions from the data. (1a) Participants generally showed an implicit racial bias favoring their own race group. (1b) The degree of this implicit racial bias did not differ between male and female participants. (2) Male, compared to female, participants expressed longer N170 latencies but similar amplitudes. (3) Lower compared to higher levels of implicit racial bias did not appear to influence the N170. (4) Participant gender, stimulus race, and implicit racial bias did not interact to influence the N170.

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INTRODUCTION

As racial tensions continue to polarize the United States, there has been increasing awareness towards the “Stop Asian Hate” movement. Its objective is to prevent discrimination against Asian individuals through education, protest, and conversation. Acts of discrimination such as violence or prejudice are known as "explicit" racial bias— done with purpose and intent. One's “implicit” bias is driven by unconscious behavior, which may be impacted by age, race, and even gender of stimulus (De Houwer, 2019; Poehlman et al., 2005). However, little data exists between implicit racial bias, event-related potential (ERP) results, and the gender of the observer. The data we currently possess offers mixed ERP results for own and other-race faces, but the reasons why are still unknown. The reason could potentially be found in the observer's gender and/or implicit racial bias. Thus, we will utilize electroencephalographic (EEG) and an implicit association test (IAT) to evaluate own- versus other-race face preception.

Recording Implicit Racial Bias

The IAT examines one's ability to make an association between a target and an attribute (Greenwald et al., 1995). For example, common target stimuli are individuals belonging to one of two different racial groups, and attributes of positive or negative words or images. Faces and words/non-facial images will appear, and one must categorize them. In our example, Asians and good words together versus White people and bad words together; followed by an additional, block with the face stimuli and word/non-face image pairings reversed. It is argued that one's ability to quickly and accurately categorize stimuli implies a more favored group (Greenwald et al., 1995). Meanwhile, slower responses and frequent errors in categorizing a group would be indicative of the less favored group (Greenwald et al., 1995). Since the inception of the IAT, researchers have utilized this test to examine implicit biases in race, sexuality, gender, and even weight (Marini et al.,2021).

While implicit and explicit racial bias appears to be more congruent among children, the two measures are not always congruent in adults (Baron and Banaji, 2006). For example, a child with an IAT score indicating an own-race preference would likely also demonstrate an explicit bias by preferring own-race over other-race classmates (Rae & Olson, 2017). Meanwhile, adults dictating their preference among photos featuring White and Black children, insects, and flowers, showed egalitarian explicit attitudes when choosing between white and black children (Baron and Banaji, 2006). Yet, the adult IAT results showed a similar and stable implicit racial bias as children (Baron and Banaji, 2006). One can conclude that the social-desirability bias is the likely cause of implicit and explicit bias growing less congruent with age, as seen in adults. A social-desirability bias would cause a participant to conceal their true attitudes for social approval (Devine, 2001). Thus, when observing racial bias in relation to the N170, it is important to use a measure that reflects responses that cannot be consciously controlled.

N170

The N170 is an event-related potential (ERP) sensitive to individual faces recorded around 170 ms after face presentation (Bentin et al., 1996; Caharel et al., 2008). This is one of the first steps in the electrophysiological stages of visual processing, and is observed as a negative amplitude in the temporal-parietal region (Deffke et al., 2007).

The earliest N170 study revealed a negative ERP in response to distorted human faces, a potential absent when viewing non-face stimuli. Stimuli of isolated eyes presented a significantly larger N170 than whole faces (Bentin et al., 1996). Meanwhile, isolated portions of the face such as the nose and lips elicited small negative ERPS. Bentin (1996) concluded that the N170 may reflect a neural mechanism to detect human faces. Another early study was able to conclude that the N170 was involved in the structual encoding of face components (Eimer et al., 1998). This is because Eimer (1998) also found a delayed N170 response, however, only when a face was presented without eyes.

Studies of face perception have similarly shown that race is identified rapidly, suggesting racial identity influences early stages of visual processing (Blair et al., 2004). Thus, studies have historically examined the N170 when testing an individual's response to own- and other-race faces. The N170 integrates perceptual information into meaning, and serves as an electrophysiological marker as individuals categorize other humans (Rossion, 2014; Hsiao, 2008). The N170 will adapt with familiarity of a category as well. For example, observations in children blind at birth found the absence of an N170 response towards facial stimuli after undergoing cataract surgery to obtain vision (Roder, 2013). Yet, the N170 can also be observed when viewing non-facial stimuli. For example, one study presented masks versus common Chinese characters to Chinese participants, eliciting longer N170 latencies when presented with the familiar Chinese characters (Luo et al., 2021).

In another study, researchers found identifiable N170 peaks when viewing facial stimuli, while no N170 components were identified for meaningless non-facial stimuli (Rousselet, 2008). A separate study asked participants to perform a butterfly detection task, in which they pressed a button once they recognized the butterfly (Mercure et al., 2011). When human faces and objects were mixed among the repeating butterfly stimuli, a larger negative N170 deflection was present when objects preceded facial stimuli (Mercure et al., 2011). This data is observed in comparison to a significantly smaller N170 amplitude when several faces, or several objects, were presented in a row (Mercure et al., 2011). Based on one's experience, the observer will even have an N170 amplitude response to pareidolia, the perception of a face where there is none (Hadjikhani, 2009). All this data implies that the N170 typically differentiates between face and non-face processing, and that it is influenced by visual experience.

The N170 and Face Race

One of the factors driving N170 responses is race of the stimulus, although, there have been mixed results when observing this ERP. Previous examinations have observed a larger and delayed N170 depending on the stimuli’s in- or out-group status (Caharel et al., 2008, Ofan et al., 2011). In one of these articles, researchers found that when subjects are presented with other-race faces, the N170 expresses a longer latency and increased amplitude (He, 2009; Hermann et al., 2007; Wiese, 2012; Ofan et al., 2011). The opposite has also been observed. N170 amplitudes were larger toward own-race White faces, yet, only when participants were explicitly required to attend to race (Senholzi & Ito, 2013). The same trend was found when White participants were asked to identify own-race inverted faces (Vizioli et al., 2010). There have even been cases where the N170 did not differ across face race (Caldara et al., 2004; Caldara et al., 2003).

These results suggest that mere attention to race can result in deeper processing for own-race individuals as an effort to identify same-race and/or in-group members. This is further supported when research found that participants more accurately remember faces from their race group, exhibiting an own-race advantage in facial recognition (Weise et al., 2012; Wiese et al., 2014). Attention to race may also explain these aforementioned conflicting results on N170 response to facial stumili, as not all studies involved attending to race— instead, objects, Chinese characters, or pareidolia (Hadjikhani, 2009; Luo et al., 2021; Mercure et al., 2011).

Varying ERP responses to face race are likely driven by differences in processing own- and other-race faces, rather than differences in low-level visual cues (e.g., skin color) alone (Zheng & Segalowitz, 2014). For instance, differences in ERP responses can also be observed for own-race individuals when alternate non-visual forms of group membership are manipulated (Zheng & Segalowitz, 2014). In one study, White participants viewed own-race stimuli that belonged to one of two nationalities, and one of two universities (Zheng & Segalowitz, 2014). Shorter N170 latencies were observed for so-called "double in-groups" (i.e., stimuli's nationality and university affiliation matched those of the participant's affiliations) compared to double out-group faces (Zheng, &

Segalowitz, 2014). Meanwhile, a different group of White participants exhibited the same N170 responses towards the two groups of own-race stimuli when shown the aforementioned stimuli—without knowledge of their nationality or university affiliation (Zheng, & Segalowitz, 2014).

Gender and Racial Bias

Studies have found that black males are most likely to face explicit bias, such as discrimination, from White males as a result of the "subordinate male target" hypothesis (Assari, 2016; Brodish, 2011). This theory suggests that masculinity ideologies influence how men interact with power structures and those in the minority (Ifatunji, 2016). Studies on implicit racial bias and the intersection with gender have reflected the same results (Assari, 2018). Considering that the N170 might differentiate between processing race, and that a difference in IAT scores is present between males and females, one can speculate that the N170 may differ across gender for own- and other-race faces (Assari, 2018; Caharel et al., 2008; Ofan et al., 2011; He, 2009; Hermann et al., 2007; Wiese, 2012). However, the intersection of implicit bias, participant gender, and N170 has yet to be examined.

Gender differences in the N170

Gender differences indeed exist in other ERP responses. For example, women generally exhibit more negative N170 amplitudes for emotionally neutral faces when primed by fearful faces, while males exhibited decreased N170 amplitudes with fearful faces (Tanaka et al., 2021; Rodríguez-Gómez et al., 2020). Similarly, Choi and colleagues (2015) found that N170 amplitudes for emotional faces were more negative in women as a whole, while males showed no differences in their N170 responses to emotional and neutral faces. More negative N170 responses in women towards emotional faces are thought to be because women have traditionally played a role in raising children and gauging emotional states of infants, therefore resulting in specialization (Choi et al., 2015). However, this theory is arguable, as male and female adults show no significant difference in N170 latency when viewing infant faces, suggesting similar processing of a child's facial expression (Proverbio et al., 2020). It is possible that differences is the N170 is due to the male electrophysiological response of the N170, as a whole, showing longer latency and more positive amplitudes. Therefore, it is important that the present study observes if this gender-based variation is consistent for all faces, or if amplitude differs with the degree of implicit bias.

Present Study and Significance

While previous studies may have observed the N170 amplitude and latency ERP towards own- and other-race faces, we haven't observed the N170 alongside IAT data. In the present study, we hope to understand if the N170 ERP is associated with implicit racial bias. This data may help to shed light on the cognitive processes involved in this early stage of own- and other-race face processing. In past cases such as the Lee (2017), Ofan (2011), or Choi (2015) study, stimuli was explicitly own-race or digitally edited for color. Controlling for this could potentially prove relevant, as a manipulated face is akin to unfamiliar stimuli, just as an other-race face would be relatively unfamiliar stimuli. N170 studies have already found that longer latencies and positive amplitudes are associated with lack of familiarity in faces (Luck, 2011; Luo et al., 2021; Roder, 2013).

A lack of data likewise exists for studies focusing on gender differences, implicit racial bias, and N170 expression as a whole (Tanaka, et al., 2021; Wolff, et al., 2014). Any existing studies on N170 amplitude differences in participant gender have utilized non-human photographic stimuli, or stimuli with expressive faces that may alter results (Taylor, et al., 1999; Bourisly, et al., 2018; Hileman, et al., 2011). Controlling for this element is particularly significant, as males and females showed no difference in N170 responses when recognizing a neutral face (Wingenbach et al., 2018). Neutral faces would remove the factor of implied danger or warmth from the stimulus photo (Bourisly, A. K., & Shuaib, A., 2018; Lee et al., 2017)

HYPOTHESES

The present study aimed to examine the intersection between implicit racial bias and participant gender on N170 responses to own- and other-race faces. White participants were presented with White and Asian faces in an IAT and a simple viewing EEG task. Three hypotheses were specifically examined.

Hypothesis 1: A relationship exists between participant gender and IAT score. We can predict that White female participants will favor their own-race. However, a score suggesting their preference would be less dramatic compared to White male participants.

Hypothesis 2: Participant gender will play a role in stimulus response on an electrophysiological level. Therefore, male participants will have longer N170 latencies and more positive amplitudes overall, but this gender difference will be enhanced for other-race faces.

Hypothesis 3: The White participants who show in-group favoritism via IAT will likely reflect as longer N170 latencies and more positive amplitudes.

Hypothesis 4: Gender plays a role in the statistical significance of IAT score versus N170 amplitude when viewing own- and other- race faces.

Proposed Analysis

Hypothesis 1: a one-sample t-test will be conducted to confirm that implicit bias favoring the own-race group exists in both male and female participants. IAT scores will be compared to zero. This is because a zero indicates no implicit bias towards either race group, while scores above zero indicate a bias favoring their own-race group.

An independent t-test will then be conducted with participant gender as the grouping variable, and IAT score as the dependent variable. Hypothesis 1 would be confirmed if both male and female participants favor own-race group, and if White male participants favor own-race faces to a greater degree than White female participants.

For hypothesis 2-4: ANOVAs will be conducted with participant gender, IAT score, brain hemisphere, and stimulus race as the independent and grouping variables. The dependent variables would be average N170 amplitude and latency. Further analysis will take place as follows;

Hypothesis 2: If male participants express longer N170 latencies, and more positive amplitudes compared to female participants when viewing both own- and other-race faces. This will present as a positive and significant relationship.

Hypothesis 3: The hypothesis will be confirmed if the main effects of IAT score on N170 amplitude and latency are significant and suggest two positive relationships.

Hypothesis 4: The hypothesis would be validated if we find increasingly positive amplitudes when IAT score errs more towards own-group among male participants.

METHODS

Participants

Fifty-two students from Florida Atlantic University, aged 18-27, participated in the study. All participants were White with normal vision. Participants also completed the Benton Facial Recognition Test (BFRT) to confirm that they did not have prosopagnosia (Albonico, 2017).

Stimuli

Implicit Association Task (IAT)

Participants were presented with five positive terms and five negative terms. The five positive terms were: adore, cheer, glorious, happy, and lovely. The five negative terms were: dirty, hatred, nasty, pain, poison. Participants were also presented with two sets of color photos, five White faces and five Asian (Chinese) faces. Of these five-photo sets, three images were of female adults, while two were of male adults. The photos were cropped to remove background and clothing. Each photograph had the face in frontal view with a neutral expression.

During procedure blocks ii, iii, and iv, one averaged White face and one averaged Asian face remained in the top corners of the screen. The averaged faces and the good/bad labels were used as a reference for any corresponding key presses.

Key presses were made via a specialized keyboard with two buttons, the left yellow, and the right blue.

Simple viewing EEG task

Participants were presented with 20 female and 20 male faces from both White (40) and Asian (40) races (80 total.) The photographs were in color, and were cropped to remove background, clothing, and hair. Each photograph had the face in a frontal view with a neutral expression. Images were presented on a White or gray background, with a plain oval between each presented facial stimulus as a general fixation area. The electrode sites that will be focused are P7/8 and PO7/8.

Procedure

Implicit Association Test (IAT)

The IAT was performed with PsychoPy 1.9 and split into five blocks. In block one, participants were verbally instructed to categorize the five positive terms and five negative terms as "good," and "bad" (20 trials.) Good and bad word labels remained on the top corners screen to remind participants of the key assignments. In block two, participants were asked to categorize five White and five Asian faces by race, illustrated by an averaged face of each race to show correlating key presses (20 trials) (see Figure 1).

In block three, participants were asked to categorize faces (see Figure 3) and terms (see Figure 2) combined. An averaged face accompanied by the corresponding good or bad word label would remain in the top corners for reference. One race face was paired with either a good or bad word label (40 practice trials, 40 critical test trials.) Block four would reverse block three’s assigned buttons to categorize White and Asian faces (40 trials) (see Figure 3). Any incorrect responses were followed by a red "X" on the screen.

IAT calculated by subtracting the response times from trials involving own-race stimuli paired with nice words from the response times from trials involving other-race stimuli paired with nice words. There was a penalty for incorrect responses such that response times from error trials were replaced with the block mean value two standard deviations above the block mean. From our calculations, a negative score on the IAT would equate to an other-race preference, zero would suggest no implicit racial bias, and a positive value would suggest an own-race preference.

Simple viewing EEG task

Electroencephalogram (EEG) data was recorded using Brain Vision Recorder and a fitted 64-channel electrode cap. The electrode sites focused were P7/8 and PO7/8 in consideration of the left and right brain hemispheres. The N170 was maximal at P7/8 and PO7/8. We, therefore, used the N170 responses measured at these sites in our analyses. Participants' responses were averaged over the two sites in the left hemisphere and over the two sites in the right hemisphere. During the procedure, subjects were asked to remain as still as possible while keeping their feet placed on a foot rest. Participants were also video recorded to identify and remove trials that included blinking and other motion artifacts.

Forty White and 40 Asian faces were presented twice and in random order. Participants were asked to press the down arrow key on a keyboard whenever they viewed a face on a dark gray background, while the more frequently occurring background was White. Each face stimulus was shown for 1000 ms, followed by a blank oval presented between 1300-1500 ms. Participants were verbally corrected if they seemed inattentive and regularly failed to press the arrow key with the gray background.

RESULTS

Hypothesis 1: Participant Gender and Implicit Racial Bias

One-Sample T-Test

The test was significant, $t(51)= 7.112$, $p < .001$. The average IAT score in this sample ($M = 0.363$, $SD = 0.3677$) was significantly greater than zero. This data suggests that participants, as a group, showed a significant implicit bias favoring their own race over the other race group.

Independent Samples T-Test

An independent samples t-test was conducted to evaluate if men implicitly favored own-race over other-race groups. The test was not significant, $t(50)= 0.010$, $p = 0.496$. There were no significant differences in implicit racial bias between men ($M = 0.363$, $SD = 0.364$) and women ($M = 0.3623$, $SD = 0.375$).

Hypotheses 2-4

Two mixed ANOVAs were performed, one utilized P100 to N170 peak-to-peak amplitude in microvolts (μV), and the other N170 latency in milliseconds (ms). P100 to N170 peak-to-peak amplitude was favored, over the N170 peak amplitude, to control for individual differences in P100 amplitude. IAT scores were also analyzed via a median split into higher and lower IAT score categories. The analysis revealed a main effect of stimulus race ($F(1,48) = 8.328$, $p = 0.006$, $\eta 2 = .148$) and participant hemisphere ($F(1,48) = 20.010$, $p < 0.001$, $\eta 2 = 0.294$). The P100 to N170 peak-to-peak amplitude was smaller in response to own-race White (*M*= 11.627 μV, *SD*=0.707) than other-race Asian faces (*M*=12.308 μV, *SD*= 0.760) (see Appendix B). P100 to N170 peak-to-peak amplitudes were also larger in the right hemisphere (*M* =10.333 μV, *SD* = 0.724) than in the left hemisphere (*M* = 13.602 μV, *SD* = 0.890).

Meanwhile, there was also a significant interaction between stimulus race, participant gender, participant hemisphere, and implicit racial bias ($F(1,48) = 0.612$, $p = 0.051$, $\eta 2 = 0.007$). All remaining interactions that were not of interest were not significant (see Appendix A).

Hypothesis 2: Participant gender and P100 to N170 peak-to-peak amplitude, N170 Latency

Amplitude. There was no significant main effect of gender on N170 amplitude ($F(1,48) = 2.660$, $p = 0.109$, $\eta 2 = 0.053$).

Latency. The main effect of participant gender on N170 latency was significant. Thus, as expected, male participants (*M*= 152.591 ms, *SD*= 1.954) and female participants (*M*= 145.776 ms, *SD*= 1.408) indeed reflected different latencies, with males reflecting a longer latency.

Hypothesis 3: Implicit racial bias and P100 to N170 peak-to-peak amplitude and N170 Latency

Amplitude. Contrary to predictions, the main effect of implicit racial bias on N170 amplitude was not significant ($F(1,48) = 2.146$, $p = 0.150$, $\eta 2 = 0.043$). This means that participants with smaller implicit racial biases (*M*= 10.906 μV, *SD*= 1.126) and those with larger implicit racial biases (*M*= 13.026 μV, *SD*= 0.913) did not differ in P100 to N170 peak-to-peak amplitude.

Latency. The main effect of IAT score on N170 latency is not significant ($F(1,48)= 3.342$, $p = 0.074$, $\eta 2 = 0.065$). Thus, contrary to predictions, participants with smaller implicit racial biases ($M= 146.982$ ms, $SD= 1.871$) and those with larger implicit racial biases ($M= 151.385$ ms, $SD= 1.517$) did not differ in N170 latency values. Yet, the latency responses showed a trend towards the predicted direction.

Hypothesis 4: Participant Gender, Implicit Racial Bias, Stimulus Race and P100 to N170 Peak-to-peak Amplitude and N170 Latency

Amplitude. We found a trend towards a significant four-way interaction between participant gender, brain hemisphere, and own-race bias ($F(1,48) = 4.013$, $p = 0.051$, $\eta 2 = 0.077$). However, our original hypothesis was concerned with a three-way interaction between participant gender, stimulus race, and implicit racial bias. Thus, we ran separate ANOVAs for each hemisphere for further analysis.

The three-way interaction in the left hemisphere was not significant ($F(1,48) = 1.766$, $p = 0.190$, $\eta 2 = 0.035$). The three-way interaction in the right hemisphere was also not significant ($F(1,48) = 0.942$, $p = 0.337$, $\eta 2 = 0.019$).

Latency. There was no significant three-way interaction ($F(1,48) = 0.022$, $p = 0.883$, $\eta 2 = 0.000$).

DISCUSSION

From our data, we can both support and deny a number of conclusions regarding our analysis of participant gender, and implicit racial bias in relation to N170 amplitude and latency responses to own- and other-race faces. To begin, hypothesis 1 predicted that White participants would generally show implicit racial biases favoring their own race group. This was indeed confirmed, and reflects pre-existing findings on the IAT (Greenwald et al., 1995; Marini et al.,2021; Caharel et al., 2008; Ofan et al., 2011; He, 2009; Hermann et al., 2007; Wiese, 2012). However, hypothesis 1 also predicted that White males would show larger implicit biases favoring their own race compared to White females. Contrary to our prediction, we found no significant difference in implicit racial bias between male and female participants.

Perhaps the results would reflect differently if stimuli had been separated by gender. Mentioned earlier, the "subordinate male target" hypothesis may have played a role as well, as it frequently occurs in multiple types of implicit bias studies (Assari, 2016; Brodish, 2011; Ifatunji, 2016). However, past literature namely mentions the phenomenon in regard to implicit racial bias towards other-race Blacks. The United States faces a unique political climate and historical context towards violence against black males, incarceration rates, and institutionalized racism that establishes the hypothesis. Thus, it may be difficult to predict if male Asian populations would face the same subordinate male target hypothesis. Instead, it could be the concept of the "model minority" that could impact either gender to different degrees. For example, research examining Asian-American immigrants, gender, and school victimization found that female Asian students were most likely to face discrimination in the classroom (Koo, 2012).

If there is no effect on implicit bias after separating stimulus gender, it may be interesting if future studies compared White participant's N170 response to other-race Asians and Blacks. Among other results, we may find that a factor such as skin color may play a larger role than once thought. Aforementioned past studies yielded different N170 responses when altering same-race stimuli for darker color (Lee, 2017; Ofan, 2011; Choi, 2015). In fact, implicit bias studies have already observed the existence of a skin tone bias (Crutchfield, 2022).

Hypothesis 2 asked if White male participants would express longer N170 latencies and more positive amplitudes. In this case, we found that latency was indeed impacted by gender, while amplitude was not. Against our former argument, a more positive amplitude did not agree with previous findings on male– compared to female– N170 responses (Tanaka et al., 2021; Rodríguez-Gómez et al., 2020; Choi et al., 2015). However, the type of facial expression used in past studies seemed relevant to the degree of amplitude response, (Tanaka et al., 2021; Rodríguez-Gómez et al., 2020). Our study's use of neutral faces likely played a role in the outcome, suggesting that previously reported gender differences in N170 amplitudes are likely reserved for emotional faces.

Meanwhile, as predicted, male participants did show longer N170 latencies towards own- and other-race faces compared to female participants. Previous studies have already observed that a stimuli's out-group status, including race, plays a role in longer N170 latencies (Caharel et al., 2008, Ofan et al., 2011; He, 2009; Hermann et al., 2007; Wiese, 2012; Ofan et al., 2011). However, N170 latency for own-race faces was also longer when participants were told to explicitly attend to race (Senholzi & Ito, 2013; Vizioli et al., 2010). The same study explains the results by suggesting that race indeed plays a role, however, one's goal state is likewise important.

In comparison, female N170 latencies may be shorter despite own- or other- race group due to face specialization. As one study identifies, N170 latency was faster when viewing faces in general, however N170 latency was longer when given Chinese characters as stimuli (Ji, 2016). Non-ERP studies have also found gender differences in face processing. For example, research on own-gender bias has indicated that women are better at recognizing female faces (Herlitz and Loven, 2013). Meanwhile, few studies have detected an own-gender bias in men's ability to recognize faces (Wright & Sladden, 200).

Studies have also mentioned the relevance of double-out-group bias, obtaining lengthier N170 latencies compared to single-out-group status (Zheng & Segalowitz, 2014). While face stimuli in the EEG task were an even 20 males and 20 females in both race groups, the ERP results could not be separated by stimulus gender. Meanwhile, the IAT task utilized three females and two males for own- and other-race faces. Thus, our consideration of stimulus race without being able to consider stimulus gender could have influenced the results.

Hypothesis 3 predicted that the main effect of IAT on N170 amplitude and latency would be significant, and would appear in the form of longer latencies and smaller amplitudes as participants favored their own group. We found that neither were significant. While N170 amplitude did not trend in the predicted direction, there remained a nonsignificant trend towards longer N170 latencies associated with implicit racial bias. This is consistent with previous studies that have related out-group bias (Zheng, & Segalowitz, 2014), and race identification (Caharel et al., 2008, Ofan et al., 2011) with N170 latencies. This is because none of these studies saw any changes in amplitude with implicit racial bias as well.

Lastly, hypothesis 4 asked if we would find a three-way interaction between participant gender, stimulus race, and implicit racial bias on N170 amplitude and latency. Analysis revealed a non-significant relationship for N170 amplitude and latency, disproving our hypothesis. Instead, a four-way interaction was observed, with brain hemisphere as an added variable. Follow-up analysis revealed that the three-way interaction in neither the left nor right hemisphere held any statistical significance on their own. However, our results might have been influenced by the overrepresentation of females in our sample, as well as by our inability to separate stimulus by gender.

In all cases, the simple fact that there were twice as many female participants could have produced results where females were better represented. As a result, even consolidated data or means could be skewed in certain directions. For example, there was a nonsignificant trend in the predicted direction pertaining to latency's association with IAT scores (p = .077). In a future study, a more equal sampling of participants by gender would be ideal.

In conclusion, a number of our hypotheses reached predicted and unpredicted results. We successfully predicted that White participants had an implicit racial bias over all. Yet, male participants did not possess significantly larger IAT scores than female participants. We also found that N170 latency was significantly impacted by gender as predicted, but not amplitude. Similarly, that White males would express longer overall N170 latencies than White females. Our predictions on a main effect of implicit racial bias on the N170 were not supported. Our final hypothesis that there would be an interaction between participant gender, stimulus race, and implicit racial bias on N170 amplitude and latency was likewise not supported. In future studies, the greatest way to expand our understanding of the N170 would come from an equal distribution of gender in participants and IAT stimuli, separation of stimulus gender in procedures and data analyses, and an additional other-race group.

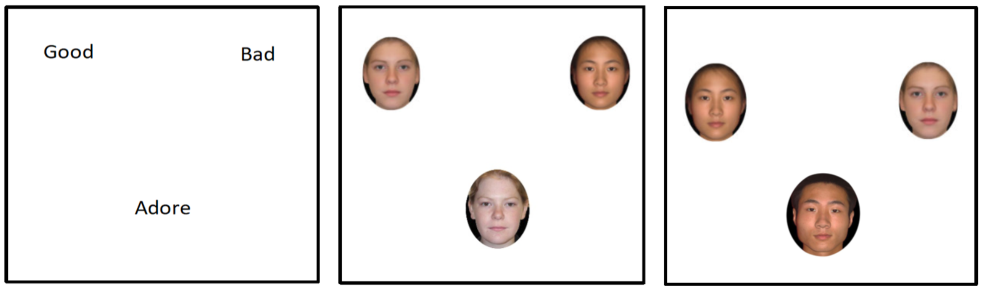

Figure 1. Examples of IAT trials when participants were asked to categorize good and bad words, and when they were asked to categorize people by perceived race.

Figure 2. An example of a trial in which good and bad words need to be categorized, and White faces and "good" words share a button press and Asian faces and "bad" words share a button press (left). A reversed trial of Asian faces with "good" words sharing a button press and White faces with "bad" words sharing a button (right).

Figure 3. An example of a trial in which White and Asian faces need to be categorized, and White faces and “good” words share a button press and Asian faces and “bad” words share a button press (left). A reversed trial in which White and Asian faces need to be categorized, with “good” words and Asian faces sharing a button press and White faces and “bad” words sharing a button (right).

APPENDICES

Appendix A

Table 1

ANOVA between stimulus race, participant gender, hemisphere, and implicit racial bias.

Measure	N170 Amplitude		N170 Latency	
	F(1,48)	*p*	*F*(1,48)	*p*
Race	8.328	0.006	1.391	0.244
Race * Gender	0.061	0.806	0.142	0.708
Race * Lower/Higher IAT	0.203	0.654	0.638	0.428
Race * Hemisphere	0.264	0.610	0.026	0.873
Race * Gender * Lower/Higher IAT	0.013	0.911	0.022	0.883
Race * Hemisphere * Gender	0.329	0.569	3.259	0.077
Race * Hemisphere Lower/Higher IAT	0.612	0.438	1.089	0.302
Hemisphere	20.010	< 0.001	0.733	0.396
Hemisphere * Gender	0.366	0.548	0.562	0.457
Hemisphere * Lower/Higher IAT	1.353	0.250	0.418	0.521
Hemisphere * Gender * Lower/Higher IAT	1.101	0.299	1.366	0.248
Race * Hemisphere * Gender * Lower/Higher IAT	4.013	0.051	0.481	0.491

Appendix B

Table 2

Means, Standard Deviations of N170 Amplitude and Latency between own- and other-race faces, participant gender, brain hemisphere, and implicit racial bias.

Measure	N170 Amplitude (μV)		N170 Latency (ms)	
	M	SD	M	SD
Gender				
Male	10.786	1.176	152.591	1.954
Female	13.149	0.847	145.776	1.408
Race				
White	11.627	0.707	148.907	1.194
Asian	12.308	0.760	149.406	1.259
Lower/Higher IAT				
Lower	10.906	1.126	146.982	1.871
Higher	13.029	0.913	151.385	1.517
Hemisphere				
Left	10.333	0.724	149.621	1.290
Right	13.602	0.890	148.745	1.327

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