

ASSOCIATIVE PRIMING AND IMPLICIT BIAS TOWARDS AFRICAN  
AMERICANS

by

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## TABLE OF CONTENTS

	<b>Page</b>
ACKNOWLEDGEMENTS.....	iv
LIST OF TABLES.....	vi
LIST OF FIGURES.....	vii
LIST OF ABBREVIATIONS.....	viii
ABSTRACT.....	ix
CHAPTER	
I. LITERATURE REVIEW.....	1
II. METHOD.....	26
III. RESULTS.....	33
IV. DISCUSSION.....	39
LITERATURE CITED.....	53

## LIST OF TABLES

<b>Table</b>	<b>Page</b>
1. Correlational analysis of the MRS, MCPRS, reaction time, and accuracy.....	37
2. Correlational analysis of the MRS, MCPRS, and the LPC component.....	38

## LIST OF FIGURES

<b>Figure</b>	<b>Page</b>
1. Four face primes (Black male, Black female, White male, White female) .....	26
2. Mean voltage values at electrode FCz to targets primed by A) male and B) female African American (AA) and Caucasian (C) face primes .....	29
3. Mean voltage values at electrode Pz to targets primed by A) male and B) female African American (AA) and Caucasian (C) face primes .....	30
4. Race and target category interaction indicating average reaction times (in milliseconds) for targets primed by Black and White female faces .....	33
5. Race and target category interaction indicating average reaction times (in milliseconds) for targets primed by Black and White male faces .....	34

## LIST OF ABBREVIATIONS

<b>Abbreviation</b>	<b>Description</b>
EEG	Electroencephalogram
EMS	External Motivation Scale
ERP's	Event-Related Potentials
ERN	Error-Related Negativity
IMS	Internal Motivation Scale
MCP	Motivations to Control Prejudiced Reactions Scale
MRS	Modern Racism Scale
ms	Milliseconds

## **ABSTRACT**

Understanding racial prejudice towards African Americans using implicit measures, such as associative techniques like racial priming, provide a sensitive way to assess racial bias. In addition to understanding racial prejudice, it is also important to explore the interaction between race and gender as well as the neural correlates of these effects. This study examined the neural correlates of weapon bias against African Americans and the effect of race and gender using event-related potentials (ERPs). EEG was recorded while thirteen White participants completed a racial priming task that required them to decide whether a target preceded by a face prime was a weapon or a tool. Participants also completed 2 explicit measures: The Modern Racism Scale (MRS) and the Motivation to Control Prejudiced Reactions Scale (MCP). Analyses revealed faster response times preceded by a Black prime. ERPs to targets suggested that the P2, N2, and P3 were sensitive to prime type, being larger for Black primes, while the late positive component (LPC) was sensitive to targets, being larger for weapons. Correlational analyses revealed that increased motivations to control prejudice were associated with longer reaction times to identify targets, while MRS scores were negatively associated with LPC amplitudes to targets. These findings suggest that early latency ERPs to targets were sensitive to prime type, and the LPCs was sensitive to threat-related targets and that cue/target activity did not interact. These results could be beneficial for creating training programs nationwide for police officers.

## I. LITERATURE REVIEW

According to Schaefer (1990), racial prejudice consists of beliefs that will eventually turn into negative attitudes toward a certain out-group. For many decades, racial prejudice has affected the mainstream media, the education system, economy, politics, and other sectors of society (Welsing, 1991), impacting stigmatized groups in many ways. For instance, the Jews were systematically exterminated by the Nazis, the rights of Blacks in the US were restricted due to segregation, and Muslims were called terrorists after the events of September 11, 2001. Unfortunately, racial prejudice is still prevalent today. For instance, anti-Muslim sentiments remain (Parris, 2015), discrimination against Hispanics, Latinos, and Mexican Americans is steadily increasing in California (Gibson, n.d., p. 1), and Asian students have been the victims of prejudice at Southern Methodist University (Nguyen, 2014). The persistence of racial prejudice makes it imperative to better understand how racist attitudes develop, so that efforts can be made to reduce or prevent their formation.

Historically, African-Americans in the US have endured different kinds of struggles (e.g. slavery, segregation, lack of civil rights, etc.) and they are also victims of other forms of discrimination such as police brutality. Negative racial attitudes towards African Americans and the marginalization of African-Americans continue in spite of increased awareness of prejudice towards this particular group. For instance, McDonald's restaurant was sued in Virginia due to firing dozens of African Americans after they hired dozens of White employees (Lobosco, 2015). Moreover, a White Kansas professor said the N-word to 5 Black students who subsequently filed a complaint (Dicker, 2015).

Current news media is replete with instances of African Americans who experienced discrimination because of racial profiling. For instance, an article summarizing key findings of racial profiling (The W. Haywood Burns Institute For Juvenile Fairness & Equity, 2013), revealed that African Americans were 7 times more likely to be arrested in San Francisco than Whites and Hispanics. A similar report of data obtained in Chicago reported similar results, African Americans were 4 times more likely to be pulled over for a car search in Illinois than Whites (American Civil Liberties Union of Illinois, 2013). In a New York City ruling, Blacks and Hispanics were more likely to be stopped by the police because they were minorities (Floyd v. City of New York, 2013). In conclusion, statistics suggest that racial profiling may be a significant factor in police discrimination towards African Americans.

Unfortunately, there were more shootings of unarmed African Americans than unarmed Whites (Police Accountability Task Force, 2016; Mapping Police Violence, 2016). For instance, from 2008-2015 in Chicago, 74% of individuals killed by police were African Americans compared to 14% Hispanics, 8% Whites, and 0.25% Whites (Police Accountability Task Force, 2016). In 2016, 303 African Americans were killed by police officers (Mapping Police Violence, 2016). In 2015, African Americans were 3 times more likely to be killed by the police than White Americans (Mapping Police Violence, 2016). In conclusion, statistics suggest that shooting biases may be a significant factor in police discrimination towards African Americans.

Racial prejudice also influences the perception of traits. Two surveys (one interview and one self-administered survey) examined how explicit prejudice influenced White voters in the 2008 presidential election (Piston, 2010). One thousand one hundred

ten respondents completed 2 surveys called the American National Election Studies (ANES) and the Audio Computer-Assisted Self-Interviewing (ACASI). The ANES survey interview measured the respondents' attitudes before and after the election. The ACASI computer survey measured sensitive questions (racial prejudice, religious affiliation, and sexual orientation). In order to measure explicit prejudice, the respondents had to rate 2 racial stereotype questions on a 7-point scale in both studies. In the first question, the respondents had to rate their perceptions of the laziness of Blacks and Whites; in the second, respondents rated their intelligence. At least 45% of White respondents rated Blacks lazier than they rated Whites and that 39% of White respondents rated Blacks as less intelligent than they rated Whites (Piston, 2010). Therefore, racial prejudice toward African Americans remains a problem, underscoring the importance of understanding the affective and cognitive processes underlying this phenomenon.

When examining prejudice, asking people directly about their own biases can lead to response biases (Dovidio & Gaertner, 1993; Quillian 2006), which makes it less likely that respondents will be candid about their own racial biases. Moreover, respondents may be unaware of the extent of their own prejudices (Furnham, 1985). Because of the social desirability effects inherent in self-reports, other methods to study racial biases using implicit measures have evolved. The difference between explicit and implicit measures in the study of racial biases lies largely in whether these biases are measured directly via self-report, or are inferred from behavior. Explicit measures assess biases that are consciously accessible. However, explicit measures (e.g. self-reports) may not be sensitive measures of racial biases because of social desirability effects and other

response biases associated with cognitive control (Greenwald & Krieger, 2006). On the other hand, implicit measures are thought to index racial biases in a way that is less accessible to conscious awareness and therefore not as susceptible to response biases (Greenwald & Krieger, 2006). Therefore, implicit measures (e.g., priming techniques) may be more suitable for the assessment of racial biases because they are less amenable to cognitive control and are sensitive to biases outside of conscious awareness.

### **Police Brutality among African Americans**

Racial biases towards African Americans have featured prominently in recent news reports regarding law enforcement (Police Accountability Task Force, 2016; Mapping Police Violence, 2016). In particular, police brutality toward African Americans remains a problematic issue. Research with police officers suggests that law enforcement officers are more wary of members of minority groups (Alpert, McDonald, & Dunham, 2005), and may be relying on their own stereotypes (oversimplified generalizations about a certain out-group) to decide how to respond in a certain situation. For example, Blacks may be associated with violence, especially Black males (Duncan, 1976). A study conducted by Duncan (1976) suggested that attributions may play role in how an individual will perceive intergroup violence among Blacks. According to attribution theory (Heider, 1958), individuals generate explanations for the causes of their own behavior or other people's behavior. According to Heider (1958), there are 2 types of attributions (internal and external). Internal (dispositional) attribution occurs when individuals attribute their own actions or someone else's actions to individual factors (e.g. individual characteristics). External (situational) attribution occurs when individuals attribute their own situation or someone else's situation to environmental factors. In

conclusion, this theory suggests that an individual will generate explanations for the causes of their own or others' behavior based on situational or individual factors.

Duncan (1976) randomly assigned 104 White college participants to 4 conditions (Black actor-White victim, White actor-Black victim, Black actor-Black victim, and White actor-White victim). Depending on the condition, participants watched a videotape of 2 males (actor and victim) that they believed to be in the next room engaged in a discussion about a whether a man should make a risky decision in order to move forward in his career. The "discussion" becomes heated, at which point the actor shoves the victim. After watching the video tape, participants had to evaluate the actor's behavior. The results indicated that when Black actors were shoving the victims, White participants were more likely to make internal attributions about the actor and were more likely to make external attributions when the aggressor was White. Additionally, when the aggressor was Black, participants were more likely to perceive the shove as more violent than when the aggressor was White. These results suggest that the White participants were more likely to believe that Blacks were violent due to their personality or character, and more likely to justify White violence as arising from external factors unrelated to character. In a real world setting, some police officers may treat Blacks more harshly because of negative attributions about African Americans (e.g., Blacks are violent or dangerous). Two types of racist behaviors on the part of police officers that are associated with internal negative attributions, racial profiling and shooting behaviors, are discussed in further detail below.

According to Gross and Livingston (2002), racial profiling causes a police officer to assume that a certain group will be more likely commit a crime. As a result, a police

officer will target members of that group (often unfairly). According to Walker et al. (2012), racial profiling can occur in 3 contexts for any racial group. The first context involves assumptions about drugs, such that African Americans or Hispanics may more likely to be targeted by police officers because they are assumed to be more likely to participate in drug trafficking. The second context occurs when individuals are out of place, meaning that they are not meant to be at a certain place because of their racial background. For instance, a police officer will be more likely to target an African American in a neighborhood that consists of mostly Whites. The last context involves assumptions about crime and poverty wherein police officers will be more likely to target Blacks or Hispanics in poorer neighborhoods that have high crime rates.

Interestingly, race and personal experience may be important indicators of racial profiling. For instance, multiple phone surveys were given to 903 White and 961 African American participants nationwide (Weitzer & Tuch, 2002) that asked about participants' attitudes toward racial profiling and the police. They were also asked about their social class, socio-demographic factors, and neighborhood crime. The researchers found that both Black (94.3%) and White (84.4%) respondents disagreed with how racial profiling is used in law enforcement. Black participants (especially Black males) who experienced racial profiling were more likely to have stronger negative attitudes toward racial profiling. Based on this evidence, there is a relationship between personal experiences (e.g. attitudes toward the police) and racial profiling. The negative attitudes of Black participants about the police and racial profiling may be strong because they observe this behavior in their own communities.

Although there are real world instances of racial profiling, experimental evidence of racial profiling in more controlled laboratory tasks has also been demonstrated. For example, Eberhardt and colleagues (2004) investigated how stereotypes about African Americans and criminal behavior influenced racial profiling in a sample of police officers. Police officers (76% White and 24% Non-White) examined White and African American faces and decided whether the face looked like a criminal or not. The researchers found that all police officers rated the African American faces as criminal more often than White faces, suggesting that these police officers were relying on racial stereotypes in order to decide who was a criminal and who was not (Eberhardt et al., 2004; Kahn et al., 2016).

These stereotypes that police officers possess can also lead to shooting biases. Shooting biases occur when a police officer automatically shoots an individual because of his/her stereotypes of that person. For instance, Amadou Diallo was shot 41 times in front of his apartment on February 4, 1999 (Flynn, 1999; Fritsch, 2000) because police officers mistakenly identified an object in his hand as a gun instead of a wallet. Shooting biases are not limited to law enforcement officers. The unfortunate shooting of Trayvon Martin is another example of shooting bias (Botelho, 2012), where a civilian mistakenly shot a 17-year old boy wearing a hoodie at night because he expected that the boy had a gun in his hand. As in most cases of shooting biases, shooters mistakenly assumed that these boys were armed because they were African American.

There are several factors associated with shooting biases. According to the ecological contamination hypothesis (Werthman & Piliavin, 1967), the environment will influence how a police officer will perceive a situation. For instance, environmental cues

(e.g. graffiti on buildings, shabby buildings, trash on the street) may cause a police officer to react as if an unarmed person is dangerous, suggesting that there may be an association between poor neighborhoods and police aggression (Bayley & Mendelsohn, 1969). In a community that consists of mostly African Americans, a police officer may more likely treat residents more brutally (e.g. use excessive force or display shooting biases) when the neighborhood is poor and/or if crime is more prevalent, which may cause police officers to feel threatened and act more harshly toward residents. Smith (1986) examined data from 21 police departments that included crime rate factors, socioeconomic factors, neighborhood characteristics, age, race (Black suspects), and gender (male suspects). Different kinds of police behavior (e.g. arrests) were also examined. Smith (1986) observed that the police officers were more likely to use brutal force on African-Americans in poorer neighborhoods, consistent with the view that the environment can influence shooting biases.

A second factor that has been associated with shooting biases is anxiety, which can cause a police officer to make quick decisions that are more likely to tap into automatic associations about race and violence. Neiuwenhuys et al. (2012) examined the role of anxiety among 36 police officers by having them participate in a video simulation where the police officers had to determine whether the suspects (targets) had a gun or were unarmed. The police officers were randomly assigned to 2 conditions: high-anxiety (HA) and low-anxiety (LA). Anxiety was manipulated by either turning on a “shootback cannon” that fired plastic bullets back at the participants (HA condition) or turning the cannon off (LA condition). The bullets fired from the cannon caused pain; therefore, it was expected that the police officers’ anxiety would increase in the HA condition.

Participants were instructed to shoot if the suspect had a gun (was armed) and to refrain from shooting if the suspect did not have a gun (was unarmed). Overall, officers were more likely to shoot armed targets; however, participants in the HA condition were more likely to shoot regardless of whether the target was armed or unarmed and thus more likely to shoot unarmed targets. The authors concluded that under conditions eliciting anxiety and the perception of threat, officers may be more likely to act more automatically on the basis of threat-related inferences and associations (Neiuwenhuys et al., 2012). A limitation of this study was that only White suspects were used in the simulation and race was not manipulated. However, it is possible that anxiety associated with viewing armed suspects would be greater for African American suspects if they are associated with threat.

In sum, racial prejudice occurs for all races. However, racial biases against African Americans are important to examine because of the strong link between shooting biases and Blacks. Therefore, it is vital to clarify the cognitive and affective correlates of shooting biases and why they occur. Furthermore, little is known about the neural correlates of this phenomenon. Examining how weapon biases are manifested in the brain has the potential to inform our understanding of why certain racial groups are associated more easily with weapons, with implications for preventing or reducing these biases in both the general public and law enforcement officers. In the next section, a review of implicit measures (e.g. priming) will be presented, along with studies examining weapon bias will be discussed. Next, event-related potentials (ERPs) will be discussed, along with weapon bias studies utilizing ERP techniques, followed by the rationale for the current study.

## **Priming and Weapon Bias**

Due to the persistent nature of racial biases against African Americans, understanding how these biases are manifested is imperative in order to develop strategies to prevent and/or reduce these biases in both the general public and in law enforcement officers. As discussed above, a brief overview of the measurement of racial biases was provided, which will be explained more fully in the following sections. Essentially, there are two ways to assess racial biases: to assess them through self-report measures (explicit measures) or to infer them by examining behaviors that arise in the presence of race-related stimuli (implicit measures).

Many implicit measures are used to examine racial biases, including priming tasks, which will be the focus of this review. One type of priming paradigm used to examine implicit biases, racial priming, is a task that examines participants' responses to a target (e.g., weapon or tool) when it is preceded by a face prime (e.g. White or Black). Studies using this paradigm with White participants have shown evidence of implicit racial biases toward African-Americans as evidenced by faster reaction times to identify weapon targets preceded by Black face primes (Payne, 2001; Payne et al., 2002; Govorun & Payne, 2006; Bradley & Kennison, 2012; Correll et al., 2002; Kenworthy et al., 2011; Correll et al., 2007). These studies are described in further detail below.

According to Tulving (1983), priming occurs after a certain stimulus (the prime) triggers pre-existing mental representations/associations in the perceiver, which then leads to a change in responding. In many cases, priming activates a mental representation which will lead to an automatic response (Molden, 2014). According to the dual process theory, there are two types of processing that occur in this situation (Posner & Snyder,

1975): automatic (unintentional) and controlled (intentional) processing, which can both occur in a priming task (Payne et al., 2002). One particular priming paradigm that has been used to index implicit attitudes without conscious awareness is associative priming or conceptual priming (Bargh, 1994). In an associative priming paradigm, individuals are exposed to stimuli (e.g. face primes) that may be associated (based on internalized stereotypes) with other kinds of stimuli (e.g. threatening or nonthreatening targets). Associative priming has been used to examine racial biases, such as implicit stereotyping of African Americans in the medical field (Moskowitz, Stone, & Childs, 2012) and toward African Americans in general (Payne, 2001; Payne et al., 2002). Racial priming, a form of associative priming, can be used to determine whether individuals have threat-related biases toward certain races and not others, which is manifested as increased accuracy and/or faster reaction times for weapon targets when preceded by face primes of different races. Several racial bias studies have been conducted using Black or White face primes and weapon or tool targets that are reviewed below.

In an early study of race/weapon associations, Payne (2001) had 31 participants complete a racial priming paradigm and 2 explicit racial attitude scales: Modern Racism Scale (MRS) and Motivations to Control Prejudiced Reactions Scale (MCP). MCP scores were used to create 3 different groups (high MCP, middle MCP, and low MCP), which were used to examine the relationship between the MRS scores and accuracy and reaction times from the weapon task. The paradigm consisted of 4 face primes (2 White males and 2 Black males) and 8 targets (4 guns and 4 hand tools). Each stimulus was presented for 200 milliseconds (ms). The sequence consisted of a face prime, a target, and a visual mask that remained on the screen until the participant responded. Payne (2001) found that

the low MCP group displayed greater prejudice as indexed by MRS scale scores and were faster to identify weapons preceded by Black primes. With respect to accuracy, participants were more likely to mistakenly identify tools as guns when preceded by a Black prime vs. a White prime. Payne (2001) concluded that these results were due to the fact that White participants associated weapons with violence and violence with Black faces.

In a similar study, Payne et al. (2002) examined weapon bias and the role of cognitive control. Ninety-seven White participants completed a priming task that included 4 black and white face primes and 4 handguns and 4 tool targets. On each trial, a face prime was presented for 200 ms followed by a weapon/tool target for 100 ms. In order to explore the influence of automatic versus controlled processing, the response timing was manipulated into 3 response deadlines, with the rationale that responses should be more influenced by automatic processing when time constraints were greater (i.e., when response deadlines were shorter) and less so when time constraints were relaxed. In the first block, participants were required to respond to the target within 700 ms; in the second block, they were required to respond within 450 ms; and in the third block, they were required to respond within 200 ms. Similar to previous research (Payne, 2001), participants were more likely to mistakenly identify tools as guns when preceded by Black primes and guns were more likely to be mistakenly identified as tools when preceded by White primes. More interestingly, these biases increased as response deadlines decreased. These results suggest that Black primes were perceived as more threatening than White primes, especially when there was less time to control responding.

Therefore, racial weapon biases are more likely to occur when participants must respond quickly and are more likely to rely on automatic associations between primes and targets.

Payne's (2001, 2002) studies established the existence of weapon biases toward Black primes in White participants, especially when there was limited time to respond. Other research has focused on other factors affecting weapon bias, such as mortality salience. Mortality salience occurs when a person is reminded of their own mortality (Becker, 1962). Furthermore, it has been shown to enhance negative biases toward out-group members; therefore, White participants experiencing mortality salience should be more likely to display a bias to respond more quickly and accurately to weapon targets primed by Black faces (Bradley & Kennison, 2012). Bradley & Kennison (2012) had 88 White participants complete a questionnaire containing self-esteem and demographic questions. Participants were randomly assigned to either a control or a mortality salience condition. In order to elicit mortality salience, participants in that condition responded to two, open-ended questions. In the first question, they were asked to write about the emotions associated with the thought of their own death; in the second, they were asked about what they thought would happen when they died. Participants in the control condition completed two open-ended questions unrelated to mortality. Both groups completed a priming task that consisted of face primes (Black & White) for 200 ms, targets (weapon & tool) for 100 ms, and a visual mask for 200 ms. Overall, White participants were more likely to associate Black primes with weapons (Payne, 2001; Payne et al., 2002). However, relative to the control group, participants in the mortality salience condition were even more likely to mistakenly identify a tool as a weapon when preceded by a Black prime. These results suggest that the participants were more likely to

exhibit greater negative bias towards Blacks after the induction of mortality salience when they were more aware of their own mortality.

In addition to mortality salience, there are likely to be other factors involved in biases towards African Americans. Govorun and Payne (2006) examined the effects of ego depletion on racial priming using Black and White primes and weapon or tool targets. Ego depletion occurs when an individual loses the perception of being able to control their own situation due to depleted mental resources (Baumeister et al., 1998; but see Carter & McCullough, 2014 for a discussion re: the replicability of the ego depletion effect). Govorun and Payne (2006) hypothesized that participants who are ego-depleted would be more likely to exhibit heightened racial biases towards African Americans. Participants were assigned to one of two conditions: an ego-depleted and a control condition. Both groups were required to complete a Stroop task (Stroop, 1935) prior to a racial priming task, which required participants to view words of colors (e.g., red, blue, green, yellow) written in different colored fonts and to read the words as quickly as possible, ignoring font color.

Govorun & Payne (2006) randomly assigned the participants to two groups (depletion and no depletion), where participants in the no depletion condition only completed 30 trials, and participants in the depletion condition completed 300 trials. Overall, the researchers found that participants in the depletion condition made more errors on the racial priming task than participants in the no depletion condition. Moreover, the participants in the depletion condition were more likely to mistakenly identify a tool as a gun when it was preceded by a Black prime. These results suggest that when an individual's mental resources are depleted, the individual will be more prone to

racial biases and produce more errors on the task. Therefore, a lack of control may play a role in how an individual responds in a racial priming task examining weapon bias.

In addition to studies that have used racial priming paradigms, weapon biases have also been examined using a first person shooter task. Correll et al. (2002) conducted a study that involved participants performing a first person shooter task where they were presented with images of armed or unarmed White or Black males and were instructed to “shoot” individuals who were armed and to refrain from shooting those who were unarmed. Participants were shown photographs of twenty males (10 Black & 10 White). There were total of 80 images, in which either White or Black males held either a gun or a tool, and images were shown 4 times. The results indicated that participants responded more quickly when making a decision to shoot when a gun was held than not to shoot when the gun was not held. More notably, participants shot at Black males more often regardless of whether they were armed or unarmed, suggestive of an implicit bias toward Black males and an association between Blacks and weapons.

The previous study provides evidence that a first person shooter task is sensitive to racial weapon biases. Kenworthy et al. (2011) examined the effect of in-group identification as a moderator of weapon biases in a first person shooter task. In-group identification occurs when an individual identifies with their own in-group (e.g., race, gender, etc). Seventy-four White participants completed the first person shooter task used in the Correll et al. (2002) study. Participants then completed an in-group identification scale, which measured how strongly the participants’ identified with their in-group (i.e., Whites). Kenworthy et al. (2011) predicted that White participants who showed increased identification with their in-group would be more likely to shoot unarmed Black males,

while those who showed less identification with their out-group would not show this weapon bias. Confirming their hypotheses, they found that participants with higher scores on the in-group identification scale were more likely to shoot unarmed Black targets. These results suggest that in-group identification is a moderator of weapon bias such that the more that White participants identified as White, the more likely they were to mistakenly shoot unarmed Black men.

In a related study, Correll et al. (2007) examined how racial stereotypes about African Americans influenced decisions to shoot after participants read a news article about a crime (robbery). Participants were randomly assigned to two conditions. In the Black-criminal condition, participants read a news article about Blacks committing the robbery. In the White-criminal condition, participants read a news article about Whites committing the robbery. After reading the article, participants completed a weapon task identical to Correll et al. (2002). Analyses indicated that the participants who read the Black-criminal article shot at unarmed Blacks more often than those who read the White-criminal condition. Correll et al. (2007) speculated that this occurred because the Black-criminal article reinforced participants' stereotypes of Blacks as violent/dangerous, resulting in an increase in shooting unarmed Black models (Correll et al., 2007). These results suggest that media coverage of Black crimes may enhance weapon biases.

In previous studies of both racial priming and first-person shooter tasks, stimuli consisted of male models exclusively, and the role of stimulus gender was not manipulated. However, it is possible that males are more associated with violence and crime than females and that the gender of the prime might moderate racial weapon biases (Plant et al., 2011). Plant et al. (2011) examined the role of stimulus gender in weapon

bias by having 122 participants (60% female, 71% White, 10% Hispanic, 5% Asian, and 5% Black) complete a shooter task that used White college suspects (male and female). The armed suspects were paired with guns and the unarmed suspects were paired with neutral objects (e.g. wallet). Participants had to pretend that they were a police officer in this task. Participants had to press “A” on the keyboard to shoot if the target was armed. If the target is unarmed, they had to press “L” to shoot. The researchers found that participants were more likely to refrain from shooting an armed female. On the other hand, participants were more likely to mistakenly shoot an unarmed male, suggesting that males are more associated with threat than females. However, this study used only gender suspects and did not manipulate race; therefore, how these biases might also be modulated by race remains uncertain.

In conclusion, the participants (particularly Whites) respond differently in weapon tasks depending on the race and gender of the prime. More specifically, White participants were more likely to associate weapons with men, Black men in particular (Payne, 2001; Payne et al., 2002). Weapon biases are more likely to be observed under time constraints, when participants must react quickly. Racial weapon biases are also enhanced by mortality salience and ego depletion. In other words, when individuals are made more aware of their own mortality and when they feel a loss of control over their circumstances, existing biases are heightened. These findings may be of particular relevance to shooting biases in law enforcement officers, who often find themselves in life or death situations that may not be under their control and are often required to respond quickly. While informative, one limitation of behavioral studies is that they do not provide information about the neural correlates of weapon bias. Therefore, while

results suggest that weapon biases are relatively automatic, the exact timing of these biases cannot be confirmed. Electroencephalographic or event-related potential (ERP) studies have particular utility in examining the temporal dynamics of these effects. The next section will introduce ERP methodology and components relevant to weapon biases, followed by a more in-depth review of ERP studies examining weapon bias.

### **Event Related Potentials & Weapon Bias**

According to Hillyard & Kutas (1983), ERPs reflect cortical activity connected with information transfer. ERPs are recorded on the scalp and consist of various waveforms that can be isolated to examine various cognitive processes. ERPs are created by extracellular currents associated with the activity of columns of cortical neurons, and are derived from the raw electroencephalogram through averaging (Luck, 2014). ERPs are time-locked to a specific event (e.g., the presentation of a certain kind of stimulus) and can be used to yield an estimate of the neural activity elicited by different stimuli or psychological and disease states. There are several benefits to using this technique (Luck, 2014). One benefit is that ERPs have excellent temporal resolution allowing for the processing associated with cognitive processing to be tracked over time (usually in milliseconds to seconds). Moreover, ERPs can clarify how different processes (e.g. components) are influenced by an experimental manipulation over time. Another is that ERPs can provide an online measurement for processing in the absence of a behavioral response (e.g. infants who are unable to respond due to their age). Therefore, ERPs can be used to infer cortical activity associated with certain tasks, including weapon bias tasks.

A typical ERP waveform at any scalp location or channel contains a number of positive and negative peaks that correspond to changes in voltages over time. These peaks are referred to as components and their location and timing vary depending on stimulus type, task type, or scalp location (Luck, 2014). The nomenclature for these components typically includes some indication of whether the component is a positive or negative voltage deflection, as well as information about when the component occurs after stimulus onset. For instance, the N200 refers to a negativity occurring at approximately 200 ms, while a P300 is a positivity occurring at approximately 300 ms. Alternatively, components can be described in terms of their topography (e.g., vertex positive potential), or the conditions under which they are elicited (e.g., error-related negativity, mismatch negativity). A brief overview of ERP components relevant to racial priming and how certain ERP components are thought to be modulated by racial biases is described below, followed by a more in-depth discussion of ERP studies of weapon priming and how certain ERP components are thought to be modulated by racial biases.

Two ERP components (N200 and P200) have been associated with racial biases and conflict monitoring (Ito & Urland, 2003; Botvinick et al., 2001; Donkers & van Boxtel, 2004). The N200 component was first described by Hans Berger (1929), and is elicited when an individual recognizes target stimuli in a task. This negative waveform usually peaks at 200 ms over anterior midline frontal areas, and is thought to be generated by the anterior cingulate cortex (ACC), a brain area associated with conflict and social monitoring (Botvinick et al., 2001). In addition, the N2 was examined in go/no-go tasks that reflected conflict monitoring (Donkers & van Boxtel, 2004). Thirteen right-handed participants completed two tasks (go/no-go task and go/GO task). For both tasks,

participants were required to generate responses with their left or right finger depending on the direction of the arrow. In the go/no-go task, they generated a response for the go “white” stimuli and they refrained their responses from the no-go “red” stimuli. In the go/GO task, participants also generated a response for the go “white” stimuli and they were asked to respond to the GO “green” stimuli with as much force as possible. The researchers found that the N2 was enhanced on both go/no-go and GO trials. Their results suggest that the N2 is sensitive to conflict monitoring. The P200 component is a positive waveform that peaks at 200 ms over the central-frontal and parietal-occipital regions. The P200 is thought to index racial biases towards Blacks (Ito & Urland, 2003), which occurs when an individual recognizes target stimuli in a task, and it is typically the largest over the central-frontal and parietal-occipital regions.

Researchers examined the P200 and the N200 for targets in a first person shooter task (Correll et al., 2006). Forty right-handed participants completed a first person shooter task where they had to decide whether or not to shoot an armed or unarmed target (Black or White males). Thirty-one participants (19 Whites, 6 Asians, 4 Hispanics, 1 Black, and 1 Arabic) identified their race and nine participants did not identify their race. The same backgrounds, models, and targets used in a previous behavioral study (Correll et al., 2002). Four averages for each component were created for each trial type (Unarmed African American, Armed African American, Unarmed White, and Armed White). The N200 and the P200 associated with correct responses were elicited at six electrode sites (Fz, FCz, Cz, CPz, Pz, and Oz). Participants shot at armed targets that were Black quicker than unarmed targets that were White, similar to behavioral studies suggesting this speeded reaction time is due to an association between Blacks and

violence (Correll et al., 2002). The N200 was larger for unarmed targets and White males (decisions not to shoot), while the P200 was larger for armed targets and Black males (decisions to shoot). These results suggest that N200 amplitudes are sensitive to response inhibition for unarmed White targets, while P200 amplitudes may be more sensitive to threat detection. According to this logic, the authors concluded that Whites were perceived as non-threatening and Blacks were perceived as threatening, consistent with the results of Correll et al. (2002).

The Correll et al. (2006) study examined two components (P200 and N200) that were sensitive to threat detection and response inhibition. One additional study also examined these components (Ito & Urland, 2003), but Ito and Urland (2003) examined how race and gender played a role in attention. Thirty-six students (31 White, 1 Asian, 1 Hispanic, and 2 as other) were required to view Black males, Black females, White males, and White females (20 pictures each). Each picture was shown for 1000 ms. Participants had to decide whether each picture was male (Black or White) or female (Black or White) within 1200 ms. For the EEG recording, the data was recorded at three sites (Fz, Cz, and Pz) for two components (P200 and the N200). Four trial types were created (Black-male, Black-female, White-male, and White-female). Eight averages were created for each component. Four averages were created for shorter latency and four additional averages were created for longer latency. The researchers found a larger P200 for both Black and male primes. In addition, the researchers also found that the N200 was enhanced for female primes. Their results suggest that working memory was influenced by gender and race. Moreover, the participants were attending more to specific social categorization groups that are associated with the component.

In summary, the Correll et al. (2006) study employed a paradigm that showed that the P200 and N200 ERP components were sensitive to weapon biases that were modulated by race. Specifically, the results of this study suggest that White participants may associate African Americans with threat. The N200 (associated with conflict monitoring and inhibition) was enhanced when participants decided not to shoot White unarmed targets (Correll et al., 2006). In contrast, the P200 (speculated to be associated with threat detection) was enhanced when the participants decided to shoot armed Black targets (Correll et al., 2006). Ito & Urland study suggested that the P200 and N200 components are sensitive to attention with regards to social categorization. The P200 was associated with Blacks and males whereas the N200 was associated with females. However, questions regarding the neural correlates of weapon biases remain. Most relevant to the current study, the Correll et al., (2006) and Ito & Urland (2003) studies did not use a priming task to determine if the N200 and the P200 to weapon/non-weapon targets are enhanced based on associations between targets and the race of the face prime.

### **Purpose & Rationale**

The purpose of the proposed research was to investigate the neural correlates of weapon bias and the influence of face prime gender in a racial priming task using ERPs. Since a weapon is considered a threat toward an individual, it should grab attention quickly; therefore, participants should respond faster and more accurately to weapon targets (especially when preceded by a Black prime). Previous studies have shown that individuals associate Blacks with a weapon (Payne, 2001; Payne et al., 2002; Amodio et al., 2004). Also, if male primes (particularly Black) are considered more threatening than females, weapon biases should be enhanced to males, African American males in

particular. In the Plant et al. (2011) study, differences in White male and female primes were observed, but the effect of race was not examined. Moreover, it is unknown whether weapon bias effects found in previous studies using first person shooter tasks (Correll et al., 2002; Correll et al., 2007; Kenworthy et al., 2011; Plant et al., 2011) will also be observed in a racial priming task. For example, the sensitivity of the P200 to racial biases has been demonstrated in a first-person shooter task, with larger amplitudes noted for armed Black males (Correll et al., 2006). In contrast, Correll et al. (2006) observed an enhanced N200 amplitudes for White targets and unarmed males relative to other males.

With respect to reaction times, it was expected that White participants would respond to weapons more quickly if weapon targets were preceded by a Black prime. Previous research has found that weapons are responded faster when preceded by a Black prime (Payne, 2001; Payne et al., 2002), but gender bias was not examined in those studies. In the current study, it was expected that weapons would be responded to more quickly if preceded by a male prime vs. a female prime. With respect to accuracy, it was expected that target identification would be more accurate for weapons preceded by a male prime. In addition, it is also expected that target identification would be more accurate for weapons preceded by a Black prime.

With respect to ERP amplitudes, it was hypothesized that racial biases would be manifested in larger amplitudes for the P200 and enhanced amplitudes for the N200. For P200, it was hypothesized that racial and gender biases would be manifested in increased amplitudes for the P200 to weapon targets. Correll et al. (2006) found that the P200 is more sensitive in threat detection (armed and unarmed Blacks). Therefore, it is likely that amplitudes should be higher for targets preceded by Black primes, especially male faces.

With respect to the N200, Correll et al. (2006) found that the N200 was more sensitive for response inhibition (unarmed Whites). Therefore, it was expected that racial and gender biases would be manifested as enhanced amplitudes for the N200 for Black-tool and White-weapon trials.

Although explicit measures are more prone to social desirability effects and response biases (Dovodio & Gaertner, 1993; Quillian 2006), the Modern Racism Scale (MRS) may be a sensitive measure for racial bias towards African Americans. The Payne (2001) study did use two explicit measures (MRS and Motivations to Control Prejudiced Reactions Scale, [MCP]), but only the MCP was examined in the context of performance on the racial priming task. Payne (2001) did find that the low MCP group had greater prejudice and were faster to identify weapons preceded by Black primes. However, Payne (2001) did not correlate the MRS scale with performance on the racial priming task. Both the MRS and MCP were examined in the current study. Although several researchers used different scales (e.g. in-group identification scale) to correlate with their behavioral/ERP results, they did not use the MRS scale (Correll et al., 2002; Kenworthy et al., 2011). For the proposed study, two different outcomes for the MRS scale are possible. On one hand, if the MRS is a sensitive index of racism despite social desirability/explicit response bias effects, relationships between behavioral and ERP correlates of weapon bias and the MRS should occur. However, if the MRS scale measures different aspects of racism, no correlates between MRS scores and behavioral and neural correlates of weapon bias should occur. The results of the proposed study will provide insight into the behavioral and neural correlates of weapon bias, as well as the relationship between explicit and implicit measures of racial and gender biases.

## II. METHOD

### Participants

Twenty-Four White right-handed participants (7 male, 17 female) at Texas State University were recruited from an announcement email on TRACS and they received money and/or extra credit. Eleven participants were excluded due to problems merging some ERP files, blank responses on behavioral files, and artifacts. Thirteen participants (6 male, 7 female) were included in the analyses. The average age was 22.14 years ( $SD = 2.31$ ). This study was limited to only White participants with no history of seizure or concussion in the last 6 months, normal or corrected-to-normal vision, no history of skin sensitivities or psychiatric conditions requiring medication. Study materials and procedures were approved by the Institutional Review Board at Texas State University.

### Stimuli

Forty neutral face primes (20 Black, 10 male, 10 female; 20 White, 10 male, 10 female) and 40 word targets (10 weapons [e.g. gun] and 10 tools [e.g. screwdriver]) were used as stimuli. Each word was presented in black Arial 72-point font. The width for all words ranged from 1 to 5 inches and the height for all words were nearly 1 inch. Face stimuli consisted of color photos of Black and White male and females obtained from the NimStim database (Tottenham et al., 2009). All images were in color and cropped to 4 x 4 inches (see Figure 1).



*Figure 1. Examples of face primes (Black male, Black female, White male, White female)*

### **Weapon identification task**

Superlab 5.0 (Cedrus, Goleta CA) was used to create the racial priming task. The task sequence included a fixation point (centered on the screen) for 400 ms. After the fixation point was presented, it was replaced by a face prime (for 200 ms), then replaced by a target (for 200 ms). After the target was presented, an inter-stimulus interval (a blank screen with a “+” sign at the center) was presented for 1500 ms. For version A, participants had to press “1” if it was a weapon and press “2” if it was a tool. For version B, participants had to press “2” if it was a weapon and press “1” if it was a tool. There were a total of 4 practice trials and 640 critical trials. Out of the 640 trials, there were 8 runs of 80 trials. In each run, there were 8 different trial types (Black-male-weapon, Black-male-tool, Black-female-tool, Black-female-weapon, White-male-weapon, White-female-tool, White-female-weapon, and White-female-tool) that were repeated 10 times. The task lasted for approximately 30 minutes.

### **Self-Report Measures**

Participants were required to complete a pre-screening survey prior to the study in order to determine eligibility for participation. This survey consisted of 4 medical questions that asked them about medication use, concussions/seizures, and psychological

disorders. Once eligibility for participation was confirmed, a lab session was scheduled. When participants arrived in the lab, they completed an online survey, which consisted of 6 demographic questions about the participant's gender, education, age, and ethnicity. They also completed the Modern Racism Scale (MRS), and the Motivation to Control Prejudiced Reactions Scale (MCP).

The MRS was adapted by McConahay (1986) and consists of 7 questions that measure explicit attitudes of Whites towards African Americans and has demonstrated strong reliability ( $\alpha = .82$ ). This 7-item scale consists of a 6-point Likert scale that ranges from 1 (strongly disagree) to 5 (strongly agree). Some examples include: "Discrimination against African Americans is no longer a problem in the United States" and "It is easy to understand the anger of African Americans in America". The scores from each participant were added together to create a total score.

The MCP scale was adapted by Dunton & Fazio (1997), and it also measures racial attitudes towards Blacks that demonstrated a strong reliability ( $\alpha = .77$ ). This 17-item scale consists of a 6-point Likert scale that ranges from -3 (strongly disagree) to 3 (strongly agree). Some examples include: "It's important to me that other people do not think I'm prejudiced" and "I feel it's important to behave according to society's standards". The scores from each participant were added together to create a total score.

### **Electrophysiological Recording**

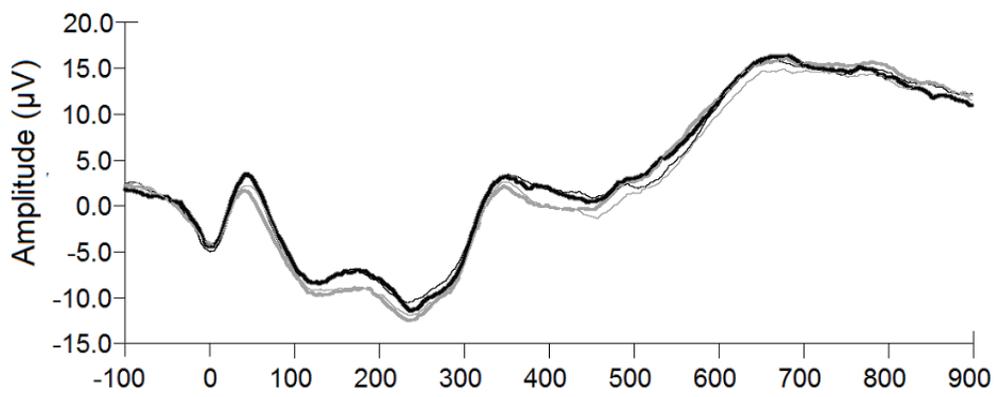
EEG data was collected from 64 channels using Ag/AgCl QuikCaps and the SynAmps2 system running Acquire version 4.5 (Neuroscan, Compumedics USA). EEG was recorded with a sampling rate of 1000 Hz. For all participants, impedances were below 5 kOhms. Trials with artifacts (e.g. blinking or muscle movement) above 100 or

below  $-100 \mu\text{V}$  were excluded. Stimulus-locked averages to targets were created that included a 100 millisecond pre-stimulus baseline before the appearance of the target, and 1100 ms post-stimulus (after the onset of the word target for each component). A bandwidth of 0.01Hz to 35Hz was used to filter the data offline and ERPs were re-referenced offline to linked-mastoids. Epochs began 100 ms before stimulus onset and 1100 ms after stimulus onset. Epochs were averaged separately for each of the 8 trial types (Black-male-weapon, Black-male-tool, Black-female-tool, Black-female-weapon, White-male-weapon, White-female-tool, White-female-weapon, and White-female-tool). For each trial type, 80 trials were included. If there were less than 20 trials per trial type, the participant was excluded from the analyses. All participants that were used in the final data set had more than 20 trials per trial type. The average number of correct trials for each trial type was 70. Responses to targets were recorded for the two different response types (e.g. tool and weapon) and only trials associated with correct responses were included in the averages. Therefore, 8 averaged ERPs corresponding to neural activity time-locked to correctly identified word targets were created for each participant.

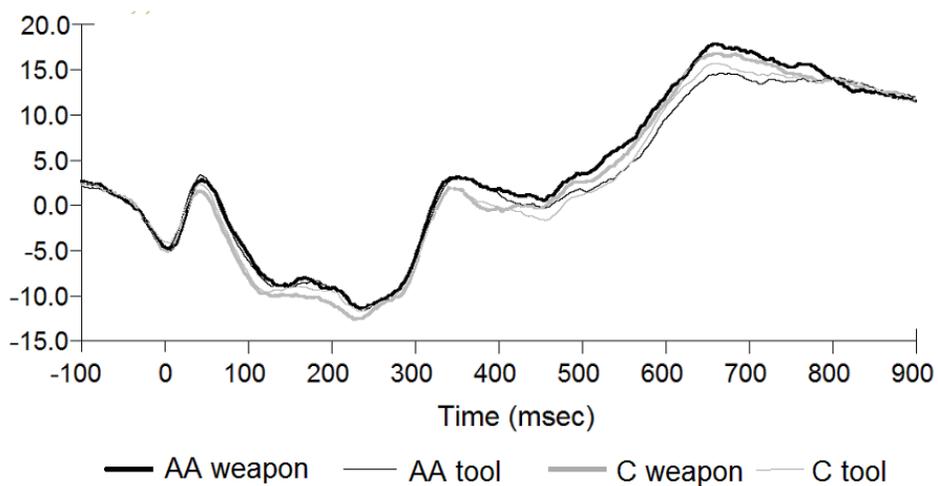
A priori analyses focused on the P200 and the N200, but visual inspection of the ERP waveforms revealed 2 additional components of interest, the P300 and a late positive component (LPC). For each component, the peak voltage was based on a time window around each peak. There was not a single voltage value that represented the actual peak. The P200 was identified as a positive peak occurring between 325 and 425 ms at the FCz site, time-locked to target onset. The N200 was identified as a negative peak occurring between 400 and 475 ms at the FCz site, time-locked to target onset. The P300 was identified as a positive peak occurring between 525 and 650 ms at the FCz and

Pz sites, time-locked to target onset. A late positive component (LPC) maximal over centroparietal areas was also observed that appeared to be sensitive to target type. The LPC was identified as a positive peak occurring between 700 and 800 ms at the Pz sites, time-locked to target onset (see Figures 2 and 3).

### A. Male face primes

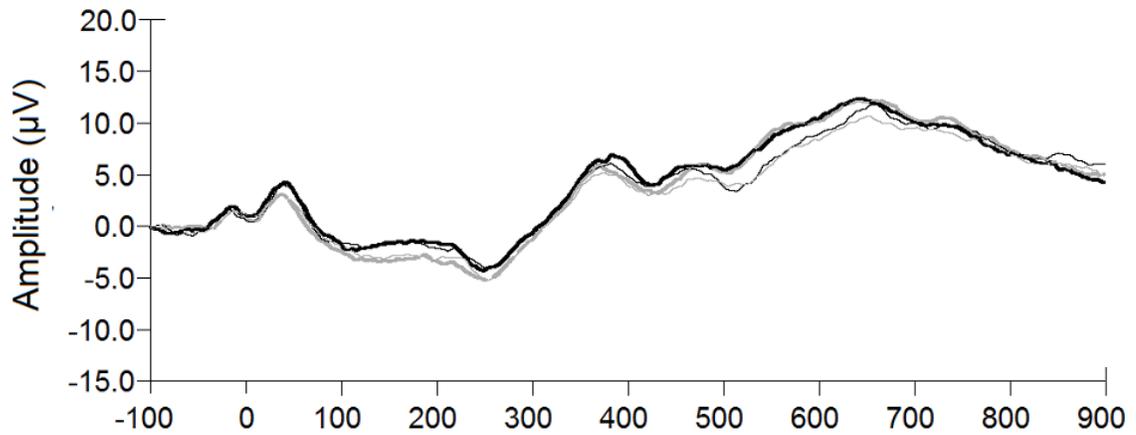


### B. Female face primes

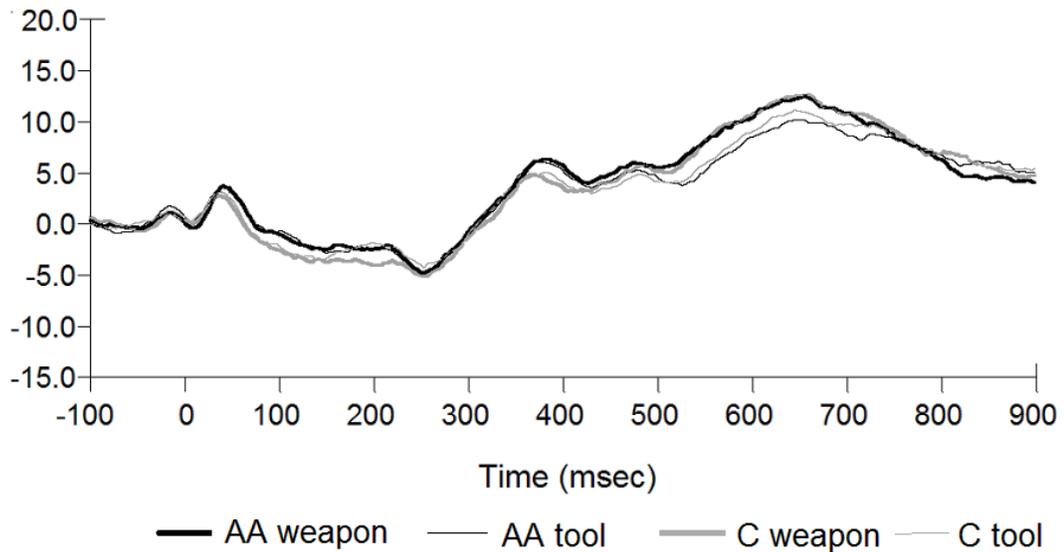


**Figure 2.** Mean voltage values at electrode FCz to targets primed by A) male and B) female African American (AA) and Caucasian (C) face primes.

**A.** Male face primes



**B.** Female face primes



*Figure 3. Mean voltage values at electrode Pz to targets primed by A) male and B) female African American (AA) and Caucasian (C) face primes.*

**Procedure**

The study was conducted in the ERP lab (UAC 261) at Texas State University and lasted for approximately 2 hours. When the participants arrived in the lab, they were

informed about study procedures and asked sign an informed consent form. EEG recording equipment was applied. Once capped, participants were seated in an electrically and radio-frequency shielded chamber and instructions were given for the task. Participants were led to believe that the purpose of the study was to examine visual perception of images and words on a computer screen. Their task was to identify whether they saw a word referring to a weapon or tool after the face prime was shown. The task lasted approximately 30 minutes. After they completed the task, they were asked to complete the online survey. Once they completed the survey, participants were debriefed and paid for their participation.

### **Data Analysis**

The study employed a within-subjects factorial 2 x 2 x 2 design. Within-subject factors were prime race (White vs. Black), prime gender (male vs. female), target category (weapon vs. tool), and electrode (anterior vs. posterior). Dependent variables included behavioral measures (reaction time and accuracy), as well as peak voltages at selected electrode sites (FCz and Pz) for the P200, N200, P300, and LPC to targets. Where applicable, a priori and post hoc analyses were performed using ANOVAs and *t*-tests, correcting for Type I error (Bonferroni) where appropriate. In the event of violations of sphericity, degrees of freedom were adjusted with Geisser-Greenhouse corrections.

**Behavioral data.** Two repeated measures ANOVAs were used to analyze the behavioral reaction time and accuracy data with prime race (White vs. Black), prime gender (male vs. female), and target category (weapon vs. tool) as within-subjects factors.

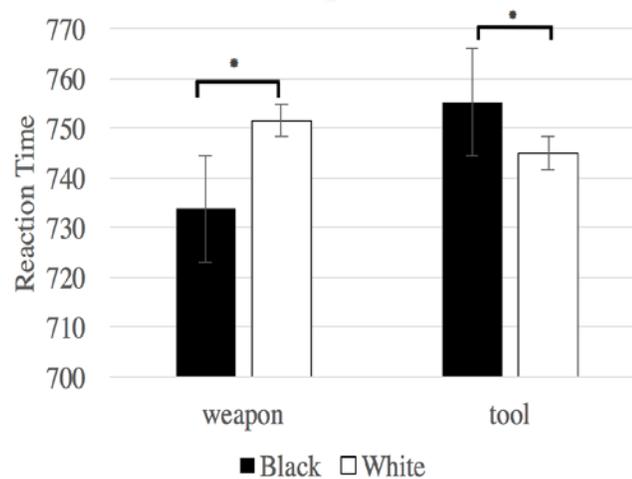
**ERP data.** Analysis of the ERP data were conducted using 4 repeated measures ANOVAs (one for each component: the P200, N200, P300, and LPC) with within-subject factors of face prime race, face prime gender, and target category. For the P300, an additional factor of electrode site (anterior/frontal vs. posterior/parietal) was included.

**Correlational analyses.** Exploratory correlations (corrected for Type I error) were conducted to examine relationships between implicit (racial priming task) and explicit (MRS and MCP scale) data. Before analysis, the eight trial types were collapsed across gender into four trial types (Black-weapon, Black-tool, White-weapon, White-tool) to examine correlations with accuracy, reaction time, N2, P2, P3, and LPC.

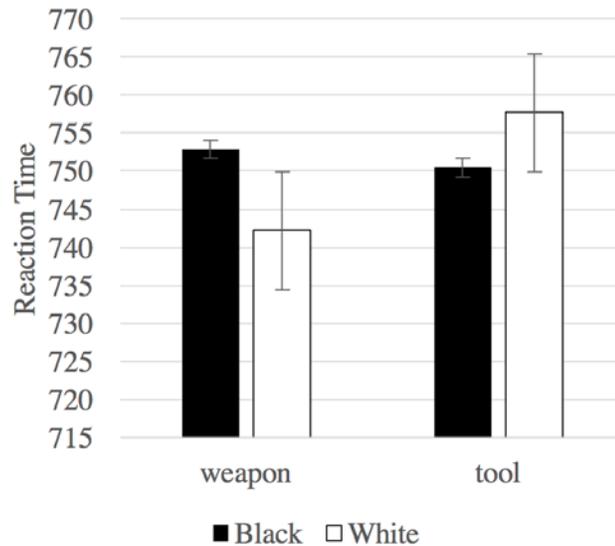
### III. RESULTS

#### Behavioral Data

On average, response times were faster for Black-female-weapon trials ( $M = 733.80$ ,  $SD = 71.14$ ) than Black-male-weapon trials ( $M = 752.83$ ,  $SD = 69.92$ ), Black-male-tool trials ( $M = 750.44$ ,  $SD = 80.50$ ), Black-female-tool trials ( $M = 755.32$ ,  $SD = 81.52$ ), White-male-weapon trials ( $M = 742.19$ ,  $SD = 76.85$ ), White-female-weapon trials ( $M = 751.59$ ,  $SD = 79.93$ ), White-male-tool trials ( $M = 757.66$ ,  $SD = 74.74$ ), and White-female-tool trials ( $M = 744.94$ ,  $SD = 79.31$ ). A 2 x 2 x 2 repeated measures ANOVA was conducted on reaction times, with the within-subjects factors of race, gender, and target category. There was a significant 3-way interaction between race, gender, and target category [ $F(1, 12) = 9.566$ ,  $p < .05$ ,  $\eta^2 = .444$ ].



*Figure 4. Race and target category interaction indicating average reaction times (in milliseconds) for targets primed by Black and White female faces (Error bars represent SEM, \* $p < .05$ ).*



**Figure 5. Race and target category interaction indicating average reaction times (in milliseconds) for targets primed by Black and White male faces (Error bars represent SEM).**

In order to interpret this interaction, 2 additional ANOVAs (for targets primed male and female faces, separately) were conducted on reaction times, with race and target as within-subjects variables. For males, there were no significant differences of race [ $F(1, 12) = .071, p = .79, \eta^2 = .006$ ], target category [ $F(1, 12) = , p = .637, \eta^2 = .019$ ], and race x target category [ $F(1, 12) = 2.746, p = .123, \eta^2 = .186$ ]. For female primes, there was a significant interaction between race and target category [ $F(1, 12) = 8.40, p < .05, \eta^2 = .41$ ]. Response times were faster for weapons preceded by Black primes and White primes preceded by a tool.

Six post-hoc paired samples *t*-tests were conducted on reaction times to female primes only in order to examine this interaction. Six post-hoc paired samples *t*-tests were conducted on reaction times to female primes only in order to examine this interaction.

There was a significant difference in the scores for Black-weapon trials ( $M = 733.80$ ,  $SD = 71.14$ ) and White-weapon trials ( $M = 751.59$ ,  $SD = 79.93$ ),  $t(12) = -2.207$ ,  $p < .05$ .

There was not a significant difference in the scores for Black-weapon trials ( $M = 733.80$ ,  $SD = 71.14$ ) and Black-tool trials ( $M = 755.32$ ,  $SD = 81.52$ ),  $t(12) = -1.454$ ,  $p = .172$ .

There was not a significant difference in the scores for Black-weapon trials ( $M = 733.80$ ,  $SD = 71.14$ ) and White-tool trials ( $M = 744.94$ ,  $SD = 79.31$ ),  $t(12) = .632$ ,  $p = .539$ . There was not a significant difference in the scores for Black-tool trials ( $M = 755.32$ ,  $SD = 81.52$ ) and White-weapon trials ( $M = 751.79$ ,  $SD = 79.93$ ),  $t(12) = .278$ ,  $p = .785$ . There was not a significant difference in the scores for Black-tool trials ( $M = 755.32$ ,  $SD = 81.52$ ) and White-tool trials ( $M = 744.94$ ,  $SD = 79.31$ ),  $t(12) = 1.705$ ,  $p = .114$ . There was not a significant difference in the scores for White-weapon trials ( $M = 751.59$ ,  $SD = 79.93$ ) and White-tool trials ( $M = 744.94$ ,  $SD = 79.31$ ),  $t(12) = .409$ ,  $p = .690$ .

Accuracy rates were high for Black-male-weapon trials ( $M = .93$ ,  $SD = .07$ ), Black-male-tool trials ( $M = .95$ ,  $SD = .03$ ), Black-female-weapon trials ( $M = .93$ ,  $SD = .06$ ), Black-female-tool trials ( $M = .94$ ,  $SD = .04$ ), White-male-weapon trials ( $M = .94$ ,  $SD = .07$ ), White-male-tool trials ( $M = .95$ ,  $SD = .02$ ), White-female-weapon-trials ( $M = .94$ ,  $SD = .07$ ), and White-female-tool trials ( $M = .94$ ,  $SD = .03$ ). A 2 x 2 x 2 repeated measures ANOVA was conducted on accuracy, with the within-subjects factors of race, gender, and target category. No significant effects were observed for race [ $F(1, 12) = .039$ ,  $p = .847$ ,  $\eta^2 = .003$ ], gender [ $F(1, 12) = .693$ ,  $p = .421$ ,  $\eta^2 = .055$ ], target category [ $F(1, 12) = .267$ ,  $p = .615$ ,  $\eta^2 = .022$ ], race x target category [ $F(1, 12) = 2.34$ ,  $p = .151$ ,  $\eta^2 = .164$ ], or gender x target category [ $F(1, 12) = .094$ ,  $p = .164$ ,  $\eta^2 = .008$ ].

## **ERP Data**

Significant effects were only discussed for the P200, N200, P300, and the LPC.

### **P200**

A 2 x 2 x 2 repeated measures ANOVA was conducted on P200 amplitudes, with the within-subjects factors of race, gender, and target category. Analyses revealed a main effect of race, [ $F(1,12) = 12.48, p < .05, \eta^2 = .51$ ], with higher P2 amplitudes for Black primes ( $M = -8.70, SD = 1.41$ ) relative to White primes ( $M = -9.98, SD = 1.28$ ). Analyses revealed a main effect of gender, [ $F(1,12) = 5.75, p < .05, \eta^2 = .32$ ], indicative of higher P2 amplitudes for male ( $M = -8.95, SD = 1.29$ ) vs. female primes ( $M = -9.73, SD = 1.39$ ).

### **N200**

A 2 x 2 x 2 repeated measures ANOVA was conducted on N200 amplitudes with the within-subjects factors of race, gender, and target category. Analyses revealed a main effect of race, [ $F(1,12) = 5.17, p < .05, \eta^2 = .3$ ], with higher N2 amplitudes for Black primes ( $M = -10.39, SD = 1.45$  vs. White primes,  $M = -11.43, SD = 1.17$ ).

### **P300**

A 2 x 2 x 2 x 2 repeated measures ANOVA was conducted for the within subject factors of race, gender, target category, and electrode (anterior vs. posterior). Analyses revealed a main effect of race, [ $F(1,12) = 13.14, p < .05, \eta^2 = .52$ ], with higher P3 amplitudes observed for Black ( $M = 2.68, SD = .9$ ) versus White primes ( $M = 1.4, SD = .72$ ). Analyses also revealed a main effect for electrode, [ $F(1,12) = 11.74, p < .05, \eta^2 = .49$ ], with larger P3 amplitudes observed over parietal ( $M = 3.74, SD = 1.01$ ) relative to frontocentral areas ( $M = .33, SD = .86$ ).

## LPC

A 2 x 2 x 2 repeated measures ANOVA was conducted on LPC amplitudes with the within subject factors of race, gender, and target category. Analyses revealed a main effect of target category [ $F(1, 12) = 7.02, p < .05, \eta^2 = .36$ ], indicative of higher LPC amplitudes for weapons ( $M = 7.51, SD = 1.15$ ) relative to tools ( $M = 5.41, SD = 1.3$ ).

## Correlational Data

**Behavior analyses.** Pearson's  $r$  correlations were conducted on reaction times and accuracy scores to the different trial types, MCPRS scores, and MRS scores. The Bonferroni corrected  $p$ -value was .008. For reaction times, analyses revealed significant positive correlations for Black-weapon, Black-tool, White weapon, and White-tool trials with the MCPRS scale. Overall, increases in the motivation to control prejudice are associated with longer reaction times. There were no significant correlations for accuracy with the MCPRS, accuracy with the MRS, nor reaction time with the MRS (see Table 1).

**Table 1. Correlational analysis of the MRS, MCPRS, reaction time, and accuracy**

	MRS	MCP	Acc_B W	Acc_ BT	Acc_ WW	Acc_W T	RT_B W	RT_B T	RT_ WW	RT_ WT
MRS	1.00									
MCP	.21	1.00								
Acc_BW	-.93	-.18	1.00							
Acc_BT	-.40	.34	.23	1.00						
Acc_WW	-.02	-.11	.96**	.24	1.00					
Acc_WT	-.27	.31	.21	.77**	.30	1.00				
RT_BW	.15	.81**	-.54	.31	-.46	.38	1.00			
RT_BT	.49	.78**	-.42	-.12	-.37	-.07	.78**	1.00		
RT_WW	.15	.83**	-.48	.33	-.41	.30	.95**	.81**	1.00	
RT_WT	.41	.79**	-.36	-.11	-.33	-.04	.74**	.97**	.81**	1.00

\*\*  $p < .01$ , BW (Black-weapon), BT (Black-tool), WW (White-weapon), and WT (White-tool), Acc (accuracy), RT (reaction time)

**ERP analyses.** Pearson's  $r$  correlations were conducted on amplitudes of the N2, P2, P3, LPC, and scores on the MCPR, and the MRS. The Bonferroni corrected  $p$ -value

was .005. For the LPC component, analyses revealed negative correlations between the MRS and Black-weapon and White-tool trials. Overall, higher scores on the MRS were associated with lower LPC amplitudes on these trials. There were no significant correlations for the LPC component with the MCPRS (see Table 2).

**Table 2. Correlational analysis of the MRS, MCPRS, and the LPC component**

	MRS	MCP	LPC_BW	LPC_BT	LPC_WW	LPC_WT
MRS	1.00					
MCP	.21	1.00				
LPC_BW	-.62*	-.25	1.00			
LPC_BT	-.47	-.21	.77**	1.00		
LPC_WW	-.54	-.41	.91**	.69**	1.00	
LPC_WT	-.60*	-.27	.87**	.90**	.71**	1.00

\*  $p < .05$ , \*\*  $p < .01$ , BW (Black-weapon), BT (Black-tool), WW (White-weapon), and WT (White-tool)

#### IV. DISCUSSION

Racial prejudice continues to be a major societal problem, especially the negative attitudes of the dominant majority (White/Caucasian) towards ethnic/racial outgroups such as African Americans. Racial biases are important to study through implicit assessments (e.g. racial priming) in order to eliminate the possibility of social desirability effects and response biases. The purpose of the current study was to investigate the neural correlates of weapon bias and the influence of face prime and gender in a racial priming task using ERPs. Behavioral evidence revealed that participants responded faster to weapon targets preceded by Black female primes. ERPs to targets indicated that P200, P300, and N200 amplitudes were sensitive to prime race, being larger for Black primes relative to White primes. The LPC was sensitive to target type, and was larger for weapons compared to tools. Correlation analyses revealed two significant relationships: positive correlations between reaction times in general and the MCPRS, and negative relationships between LPC amplitudes and MRS scores for weapon targets primed by Black faces and tool targets primed by White faces. These results are discussed in further detail below.

With respect to reaction times, it was hypothesized that weapons would be responded to more quickly than tools if preceded by a Black prime. The results showed that participants were faster to identify a weapon preceded by a Black female prime, but no such effects for male primes. Therefore, reaction time results from this study partially supported this hypothesis and converge with previous behavioral research (Payne, 2001; Payne et al., 2002) reporting faster reaction times to weapon targets primed by Black faces. These findings provide evidence that Blacks might be associated with violence

(Payne, 2001; Payne et al., 2002; Correll et al., 2002). However, the results of the current study suggest that this was limited to female primes. It was also expected that weapons would be responded to more quickly if preceded by a male prime due to the fact that males might be more easily associated with violence and weapons (Plant et al., 2011). The behavioral results failed to support this hypothesis. One possibility for this result is that prime gender overall is not a factor in race priming. However, the finding of a race priming effect in reaction times only for female primes does not support this conclusion. It is possible that for male primes, prime race did not influence target identification but that it was a factor for targets primed by female faces. Another possibility is that the associations between prime race, prime gender and target type differed as a function of participant gender, which may have influenced the observed results. Unfortunately, the small sample size in the current study precluded the inclusion of participant gender in the analyses. Furthermore, the sample size of the current study may have not provided enough power to detect small effects with respect to racial priming. Future studies should examine this possibility.

With respect to accuracy, it was hypothesized that target identification would be more accurate for weapons preceded by a Black prime. Behavioral results failed to support this hypothesis, in that no significant effects regarding target identification accuracy were observed in the current study. In this respect, results were not consistent with previous research findings that Caucasian participants were more accurate at identifying weapon targets preceded by Black primes (Payne, 2001). One possibility could be due to ceiling effects. Accuracy across all trial types in the current study were above 90%, indicative of ceiling effects. These effects could have restricted variability,

leading to null results. It was expected that target identification would be more accurate for weapons preceded by a male prime; however, accuracy results did not support this hypothesis. In addition, MRS and MCPRS scores were not associated with target identification accuracy. One possibility for these null results might be that participants in this study did not associate Black or male primes with weapons, suggesting that participants in the current study did not have strong racial biases against African Americans. Alternatively, ceiling effects and a lack of power due to small sample size may have limited the ability to detect small effects.

With respect to the P200, this component is thought to be sensitive to racial biases (Ito & Urland, 2003). It was hypothesized that racial and gender biases would be manifested in enhanced amplitudes to weapon targets, especially those preceded by Black and male primes. The ERP data failed to support this hypothesis. Rather, P200 amplitudes were sensitive to prime race, being larger to both male and female Black primes. These results suggest that in the current study, the P2 was sensitive to prime race, but was not sensitive to associations between primes and targets. Previous research did find that the P2 was larger for Blacks and armed targets, however, the researchers did not find an interaction between race and object (Correll et al., 2006). Moreover, Ito & Urland (2003; 2005) suggested that the prime race and target category are processed separately. The data from the current study support this latter interpretation of separable processes associated with prime and target processing.

Larger P200 amplitudes were also observed for male primes, and this finding suggests that the P200 is not only sensitive for Black primes, but also for male primes, an observation also noted by Ito and Urland (2003) who also found that participants devoted

more attention to Black and male primes. Ito and Urland (2003) suggested that their finding of enhanced P200 amplitudes to Black and male faces were due to the fact that participants attended more to race and gender primes due to salience. In the current study, this result was replicated and may indicate that Black and male primes were more salient to participants, resulting in enhanced P2 amplitudes to these prime types.

With respect to the N200, this component is thought to be sensitive to recognition of target stimuli (Berger, 1929) as well as response inhibition (Correll et al., 2006). It was expected that racial and gender biases would be manifested as higher amplitudes for the N200 for Black-tool and White-weapon trials. Instead, the N2 was sensitive to prime race, being larger to Black primes. This result suggests that the N2 was not sensitive to the association between primes and targets (e.g. Black-tool and White-weapon trials), but rather, was sensitive to the race of the prime. Previous research has reported enhanced N2 amplitudes for unarmed White targets (Correll et al., 2006), which was not replicated in the current study. One explanation is that the N2 may be sensitive to prime salience, similar to the P2, and not sensitive to targets. In other words, Black primes may have been more efficacious in grabbing participants' attention, recruiting more processing resources. There were no gender effects observed for N2 amplitudes, inconsistent with previous research, which did report larger N2 amplitudes for female faces (Ito & Urland, 2003). One possibility is that prime gender effects were small and the ability to detect these effects was hampered by the lack of power in the current study due to the small sample size. Furthermore, it is unclear whether participant gender differences or other individual differences would affect ERPs to male and female primes.

The current study also focused on two later components: the P300 and the LPC. A systematic examination of these components was conducted due to visual inspection of the grand-averaged data, which suggested that these components may be sensitive to prime and target types. The P300 component, first discovered by Sutton et al. (1965), is sensitive to stimulus probability, being larger when stimuli are unexpected, and larger to novel stimuli (Luck, 2014). It is also sensitive to attention, being larger to stimuli that capture attention or are task-relevant (Luck, 2014). This component is also elicited during working memory, and participants devote more effort in a certain task (Isreal et al., 1980). This positive waveform typically peaks around 300 ms, and is usually largest at parietal sites (Sutton et al., 1965). With respect to the P300, amplitudes higher over parietal areas, but were larger for Black primes at both frontal and parietal sites. Previous research has reported larger P3 amplitudes for Black and armed targets (Correll et al., 2006). However, in the current study, the finding of larger P300 amplitudes to Black primes and no interactions between primes and targets suggests that the P3 may be sensitive to prime race, but not target type, similar to the P2 and N2. One explanation is that Black faces recruited more processing resources because they were more novel or salient, possibly because the Caucasians in the current study did not have as much perceptual expertise with Black primes.

The LPC component, a positive voltage deflection that has the same onset time as the P300 (Cuthbert et al., 2000; Keil et al., 2002; Hajcak & Olvet, 2008), was also examined. It is typically largest at parietal sites, and is thought to be associated with emotional evaluation of a stimulus, memory, and self-relevance (Friedman & Johnson, 2000; Fields & Kuperberg, 2012). With respect to the LPC, the amplitude over parietal

areas was not sensitive to primes, but was larger for weapon targets relative to tools. This finding has not been reported in previous research and suggests that, unlike earlier components, the LPC is sensitive to target type and not prime race. Given that the LPC is sensitive to both emotional valence and self-relevance, it is possible that participants found weapon targets to be more negative (e.g. gun) and/or self-relevant due to their threat value than tool targets because they are intended to hurt individuals.

Fields and Kuperberg (2012) examined how self-relevance and emotional valence played a role in LPC amplitudes to words that were neutral, pleasant, and unpleasant. Two-hundred and twenty-two scenarios (consisting of two sentences) were developed. Two self-relevance conditions were created: sentences were presented in either second (self-relevant) or third (other-relevant) person. These conditions were crossed with three emotional conditions (pleasant, unpleasant, and neutral) that were created by changing a critical word at the end of the second sentence that changed the emotional tone of the scenario. Participants were assigned to 1 of 6 lists (e.g. self-pleasant, other-unpleasant, etc) and required to answer yes/no questions about the scenarios. ERPs were time-locked to critical words (the emotional words that occurred in the second sentence). Emotional words elicited a larger LPC, but only in the self-relevant condition (Fields & Kuperberg, 2012). In the current study, the LPC was larger for weapon targets, possibly indicating participants found weapon words to be more unpleasant and threatening (self-relevant) than tool words.

Correlational analyses performed on the MRS scores were expected to yield no evidence of relationships between the MRS and behavioral and neural responses to the different trial types, indicative of a lack of association between explicit (MRS) and

implicit (behavioral, ERP) indices of racial prejudice. For reaction time and accuracy, no significant correlations between MRS scores to the different trial types were observed. For ERP results, no significant correlations were observed between MRS scores and the amplitudes of the P200, N200, P300. However, for the LPC, negative correlations were observed between MRS scores and Black-weapon and White-tool trials (trials that would be considered congruent if participants associated Blacks with threat and viewed Whites as non-threatening). In other words, lower MRS scores were associated with larger LPC amplitudes for these particular trial types and no significant correlations were observed between Black-tool and White-weapon trials. Given that P200, N200, and P300 amplitudes were not sensitive to target status (weapon vs. tool) but that LPC amplitudes did vary as a function of target type, being larger for weapons vs. tools, this result is compelling and worthy of future scrutiny.

Lower MRS scores, indicative of lower levels of explicit racial biases against African Americans, were associated with higher LPC amplitudes, which have been associated with top-down processes associated with the processing of emotional and self-relevant stimuli (e.g., Fields & Kuperberg, 2012). Therefore, the observation that higher LPC amplitudes to Black-weapon and White-tool trials were associated with lower self-reported prejudice may indicate that Black-weapon and White-tool trials were more self-relevant and/or emotionally salient to individuals reporting lower levels of prejudice. This result is somewhat surprising, in that if anything, higher LPC amplitudes to Black-weapon and White-tool should then be associated with higher MRS scores. One possibility is that individuals reporting lower levels of prejudice were more prone to social desirability biases and were, in fact, more prejudiced than those reporting higher

levels. An alternative explanation is that Black-weapon and White-tool trials represent more obvious racist associations and were therefore more salient and/or emotionally arousing (e.g., taboo) to individuals reporting low levels of prejudice against African Americans. Due the small sample size, the direct examination of LPC amplitudes in individuals high and low in MRS scores was not possible, and results are tentative at best. However, future research should examine whether these relationships still hold in a larger and more diverse sample in order to yield a wider understanding of the relationships between explicit, self-report measures of prejudice and implicit, ERP indices of racial priming.

It was also hypothesized that there will be no correlation between MCPRS scores and behavioral and neural correlates of race priming. Although the MCPRS was not the primary focus of the current study, positive correlations were observed between the reaction times (Black-weapon, Black-tool, White-weapon, and White-tool) and the MCPRS. This finding suggests that as the MCPRS scores increased, the participants took longer to respond, possibly indicating greater response control. However, MPCRS scores were not significantly correlated with accuracy scores or ERP indices, suggesting that individuals with higher motivations to control prejudice were more careful and deliberate in their responding than those lower in motivations to control prejudice. Possible future directions could include a more systematic examination of this issue.

### **Limitations and Future research**

There are several limitations in the current study. One limitation was the sample size. Because the sample was small, there may not have been enough power to detect small effects. Future research using larger sample sizes may help to determine whether

the lack of significant prime/target interactions were due to low power or if prime and target effects are actually separate processes that do not interact. Additionally, participant gender and race were not examined, and the sample was limited to young White college students. Therefore, whether results will generalize to other populations is unknown. Although the current study only examined young, White participants, future research should include Black, Hispanic, and Asian participants of different ages and levels of education. Comparisons and contrasts across different races/ethnicities and socioeconomic and age groups would provide a more comprehensive picture of how in-group and out-group biases moderate ERPs to face primes of different races and threatening vs. nonthreatening targets. Future research could also include recruiting participants from law enforcement agencies. Similarly, face primes consisting of other races (e.g., Asian, Hispanic) could help to expand our understanding of racial biases across a wider range of races and ethnicities.

Another limitation of the current study was that the accuracy scores produced ceiling effects, which prevented the systematic examination of trials associated with identification errors. However, future research using masked stimuli may increase the rate of errors, allowing for the examination of error-related negativity (ERN). The ERN component, first described by Falkenstein et al. (1990), occurs when an individual makes an error in a task (e.g., when misidentifying a target). The ERN is also sensitive to response conflict associated with a predisposition to respond in a certain way and inhibitory processes associated with overriding that pre-potent response (Luck, 2014). It is a negative waveform peaking at 100-150 ms after an incorrect response that tends to be larger over frontal and central sites (Falkenstein et al., 1990; Gehring et al., 1990).

Amodio et al. (2004) examined how the ERN plays a role in conflict monitoring and racial bias when White participants made errors during a weapon identification task. Four face primes (2 Blacks & 2 Whites) and 8 weapons (4 guns & 4 tools) were used to create stimulus sequences consisting of a pattern mask (for 1s), a face prime (for 200 ms), a target (for 200 ms), and a pattern mask (for 2 s). Participants had to indicate whether the target was a weapon or a tool within 500 ms. The ERN was examined at the frontal-central site, comparing correct and incorrect trials associated with each trial type (Black-tool, Black-gun, White-tool, White-gun). The researchers found a larger ERN when participants made errors on tool trials, especially when the faces were Black. This suggests that when participants saw Black primes, they expected a gun, causing response conflict when a tool actually appeared.

A similar study examined how self-regulation (internal and external motivations to respond without prejudice) was influenced by response conflict in an ERP task (Amodio et al., 2008). Participants were assigned to three groups based on their scores on the internal motivation scale (IMS) and external motivation scale (EMS). Two groups (high IMS/low EMS and high IMS/high EMS) reported similar pro-Black attitudes on the Attitudes Towards Blacks Scale (ATB), an explicit measure of racial attitudes towards Blacks. The third group (the low IMS group) did not report pro-black attitudes. Participants completed the same racial priming task from the Amodio et al. (2004) study. Participants from all groups were faster and more accurate at responding to guns preceded by a Black face (Amodio et al., 2008). As in the previous study (Amodio et al., 2004), ERP analyses were focused on the ERN elicited at frontal-central sites, examining correct and incorrect trials that were averaged based on the trial type (Black-tool, Black-

gun, White-tool, White-gun; Amodio et al., 2008). The ERN was larger for tools preceded by Black faces. The high IMS/low EMS group had larger ERNs, suggesting that when these participants saw Black face primes, automatic associations between Blacks and weapons/violence made it difficult to inhibit this response when tools followed Black primes. These results support the notion that the ERN plays a role in conflict monitoring and that weapon biases occur even when participants are internally and externally motivated to respond without prejudice. Future research that examines the ERN could help clarify the ERP correlates of racial priming.

Another limitation is that the current study focused on ERPs to targets and ERPs in response to the face primes were not examined due to time constraints. However, previous research suggests that the N170, a face-sensitive ERP component, may be modulated by racial biases. The N170 was first described by Jeffreys (1989), is elicited when an individual sees complex objects, and is especially large in response to faces (Jeffreys, 1989). It is a negative waveform peaking at 170 ms, tends to be larger over the right lateral occipital electrode sites for faces (Bentin et al., 1996). Ofan and colleagues (2011) were interested in knowing whether the N170 was sensitive to race and associated with racial biases. Thirty-four participants (82% White and 18% Asian) completed a priming task where participants had to categorize words (pleasant or unpleasant) preceded by Black and White male faces. The task included 20 faces (10 Black & 10 White) and 20 word targets (10 unpleasant & 10 pleasant). The task sequence started with a fixation (for 600 ms), followed by a face (for 300 ms), and target (for 600 ms). The N170 elicited by Black vs. White face primes was examined using lateral-occipital sites. Participants categorized unpleasant words faster when they were preceded by a Black

face than a White face. Furthermore, accuracy was higher for positive words preceded by White faces and negative words preceded by Black faces. For the ERP data, the N170 was larger for Black primes than White primes. These results suggest that the N170 may be sensitive to racial bias, possibly due to increased vigilance in response to faces associated with a racial out-group (Ofan et al., 2011). Future analyses that include the N170 will help to determine if racial biases are evident in ERPs during processing of the face primes.

Another avenue for future inquiry would be to examine the effect of different facial expressions on racial priming. One study done by Kubota and Ito (2014) used not only neutral faces, but also angry and happy faces. Participants completed a weapon task that consisted of face primes (6 Black and 6 White) and 8 targets (4 tools and 4 weapons). Each face prime posed an angry, happy, and neutral face. They found that participants were quicker to recognize a gun faster preceded by an angry Black face. These results suggest that the face expression of the prime elicited racial bias. Therefore, the participants associated Blacks with violence (Payne, 2001; Payne et al., 2002; Correll et al., 2002). Future research will need to include ERP techniques to see if different facial expressions will elicit any racial biases. In addition, future research should examine if facial expressions (especially angry Black faces) will elicit greater P2 amplitudes. On the other hand, it would be interesting to see if happy and neutral Black faces will elicit greater N2 amplitudes.

### **Implications & Conclusions**

In conclusion, this study provided preliminary evidence of behavioral and neural correlates of weapon bias in an ERP task. Reaction times indicated that Black males are

not particularly associated with violence relative to White males, but Black females are associated with violence relative to White females. ERP evidence suggested that the P2 was sensitive to prime race and gender, and that the N2 and the P3 were sensitive to prime race. Although the functional significance of these results is not clear, the enhanced amplitudes observed to Black primes may have been due to increased salience of these primes, leading to the recruitment of more processing resources. Unlike earlier components, the LPC was not sensitive to prime race but was sensitive to target type, being larger to weapons relative to tools. There were no significant interactions observed between prime race and target type, suggesting that prime race is processed separately from target type. Correlational analyses suggested that the participants with higher motivations to control prejudice took longer to respond, but motivations to control prejudice were not systematically associated with ERP amplitudes. In contrast, explicit measures of racism (MRS scores) were not associated with behavioral outcomes, but were negatively associated with LPC amplitudes to Black-weapon and White-tool trials.

Overall, the results provided insight into how implicit racial biases were manifested through using behavioral and ERP techniques. The results provided evidence of an association between Black female primes and weapons, suggesting that Black females are associated with violence. In addition, the ERP indices of salience and attention may be more sensitive for Black primes, male primes, and weapon targets. Moreover, a participant's control of prejudiced reactions may be associated with greater overall control of responding in a racially-charged task. Lastly, the association between the LPC amplitude and MRS scores for Black-weapon and White-tool trials is suggestive of some association between explicit (MRS) and implicit (ERP) measures of racial bias.

Studying racial and weapon biases from a behavioral and neural standpoint may prove to be beneficial in law enforcement. Additional training may help to reduce weapon biases and prevent the death or injury of unarmed civilians. Plant et al. (2005) aimed to re-condition 50 police officers (84% White, 10% Black, 4% Hispanic, and 2% Native American). The participants were required to complete a computer simulation task that consisted of college-aged males (9 Black and 9 White), neutral targets, (e.g. cell phone) and gun targets. The participants decided whether to shoot if the suspect had a gun and not to shoot if the suspect had a neutral object in their hand. The results indicated that participants were more likely to shoot an unarmed Black male. However, through repeated exposure of the computer simulation, this bias was eliminated. The results of the current study that validate the existence of implicit biases toward Blacks suggest that training programs focusing on eliminating implicit biases through exposure are worthwhile and can reduce the influence of implicit racial biases in decisions to shoot.

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