THE INFLUENCE OF SUSPECT RACE AND ETHNICITY ON DECISIONS TO SHOOT IN
A DEADLY FORCE JUDGMENT AND DECISION-MAKING SIMULATOR

BY

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the requirements for the degree of

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THE INFLUENCE OF SUSPECT RACE AND ETHNICITY ON DECISIONS TO SHOOT IN
A DEADLY FORCE JUDGMENT AND DECISION-MAKING SIMULATOR

ABSTRACT

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During the past several decades substantial research has addressed the broad public concern that suspect race and ethnicity influences police use of deadly force. Previous research based on incident reports of police shootings and experimental research using still images as stimuli prompts have supported two, contrasting hypotheses: (1) that police in the United States disproportionately shoot Black suspects because of racial bias, or (2) that police disproportionally shoot Black suspects because they were more likely than Whites to constitute a threat. The goal of this dissertation was to shed empirical light on these competing hypotheses by advancing the methodological techniques used to examine the influence of suspect race and ethnicity on police use of deadly force.

After developing and testing a novel set of sixty realistic, high definition video deadly force scenarios based on thirty years of official data on officer-involved shootings in the United States, three experiments were conducted testing participant responses to the scenarios in computerized simulators. In each experiment, participants were presented with White, Black and
Hispanic suspects in potentially deadly situations. In the first experiment (n = 24), we found that participants took longer to shoot Black suspects than White or Hispanic suspects, were more likely to shoot unarmed White suspects than unarmed Black or Hispanic suspects, and were more likely to fail to shoot armed Black suspects than armed White or Hispanic suspects. In the second experiment (n = 48), we found that participants experienced higher levels of neurophysiological arousal in response to Black suspects than White or Hispanic suspects, but still took longest to shoot Black suspects. In the third experiment (n = 30), we found that across both fatigued and rested conditions participants took longer to shoot Black suspects than White or Hispanic suspects, and were more likely to shoot unarmed White suspects than unarmed Black or Hispanic suspects.

In sum, this research demonstrated that neither of the two dominant hypotheses is sufficient to explain racial and ethnic bias in police use of deadly force. Despite evidence of implicit racial bias, participants displayed significant bias favoring Black suspects in their decisions to shoot. The results of these three experiments using a more externally valid research design have challenged the results of less robust experimental designs and have shed additional light on the broad issue of the role that status characteristics, such as race and ethnicity, play in the criminal justice system. Future research should assess whether this finding holds among other populations of research subjects, determine whether bias favoring Black suspects is a consequence of administrative measures (e.g., education, training, policies and laws), and identify the cognitive processes that underlie this phenomenon.
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For Steve and Sarah
Concern that the status characteristics of individuals affect how they are treated within the criminal justice system has generated substantial theorizing and research in the social and behavioral sciences during the past several decades. The status characteristic that has received the most attention is race. Scholars have asserted that race plays a major role in how individuals are treated at every phase of the justice system, including their treatment by the police. One specific policing issue that has received a great deal of attention is the use of deadly force.

Research indicates substantial disparities in the application of deadly force by the police (Geller, 1982; Brown and Langan, 2001). Study after study has shown that Blacks are involved in police shootings at rates higher than expected from their representation in the population (Robin, 1963; Takagi, 1974; Kobler, 1975; Sherman, 1979; Mayer, 1980; Sorenson et al., 1993; Jacobs and O’Brien, 1998). Two major hypotheses have been proposed to explain this disparity. The first suggests racial discrimination against Blacks. The second focuses on the disproportionate involvement of Blacks in violent crime. The purpose of this dissertation is to shed empirical light on these competing perspectives within the criminal justice system.

A. Police use of Deadly Force Based on Suspect Status Characteristics

Police are expected to use deadly force as a last resort, and even then, only when it is within the confines of the law. Police in the United States are justified to use deadly force under two conditions; 1) to prevent loss of life, or 2) to stop the flight of violent fleeing felons
(Tennessee v Garner, U.S. Supreme Court, 1985). Officer-involved shootings risk lives, and the consequences of these encounters can devastate communities. The consequences of police shootings tend to be particularly grave when the subject of police fire is a minority group member. High profile police shootings of unarmed Black men, such as Amadou Diallo (Cooper, 1999), fuel the belief that police officers are influenced by suspect race when they make split second decisions about whether a suspect is armed and poses a legitimate risk to others. Riots over fatal shootings or misuse of deadly force against Black males have occurred in alarming numbers over the last 100 years (e.g. Cincinnati, 2001). Public concern is not limited to the treatment of Blacks, but extends to the treatment of ethnic minorities as well. For example, the shooting of Latino journalist Ruben Salazar by police with a tear gas missile fuelled riots in East Los Angeles in 1970 (Lopez, 2011). For the purposes of this dissertation the terms “racial” and “ethnic” must be defined carefully. While race refers to groups differentiated by skin color, body proportions and other physical features, ethnicity refers to groups differentiated by cultural customs such as language, religion or family values (Walker, 2004). High profile shootings of minority suspects can lead the public to believe that the police are racially or ethnically biased.

Research suggests that Blacks are the subjects of police deadly force disproportionate to their representation in the population (Geller, 1982; Brown and Langan, 2001). Although no comprehensive nationwide data on police shootings in the United States exist, the FBI supplemental homicide reports suggest that during the twenty-three year period from 1976-1998 Blacks were approximately four times more likely to be shot by officers than Whites (U.S. Department of Justice, 2001). The statistics on police use of deadly force against ethnic minority suspects such as Hispanics are less clear, in part due to criminal justice agencies not always using the same ethnic categories in reports (Walker, 2004). For example, Hispanics may be
characterized as “Hispanic White” or “Hispanic Black.” For the purposes of this dissertation “Hispanic” refers to “Hispanic White.” Research suggests that Hispanics, who make up approximately sixteen percent of the population, are shot by the police about as frequently as Whites, who make up approximately seventy percent of the population (U.S. House Committee on the Judiciary, Subcommittee on Criminal Justice, 1989; James and Pasquale-Styles, 2009). This suggests that Hispanics, like Blacks, are more likely to be shot by the police than Whites.

Two major hypotheses have been proposed as to why the police use deadly force against racial and ethnic minority suspects disproportionate to their representation in the population. The difference between these hypotheses lies in the difference between discrimination and disparity. Discrimination refers to the differential treatment of groups, based on status characteristics such as race or ethnicity, without considering individual behavior. Disparity refers to a difference in treatment, but not necessarily involving discrimination based on status characteristics (Walker, 2004). The evidence suggests that there is disparity in police use of deadly force; Black and Hispanic suspects are more likely to be shot by the police than would be expected given their representation in the population. Whether or not this disparity is caused by discrimination is the core of the following hypotheses.

I. Bias Hypothesis

The first hypothesis to explain the disproportionate shooting of racial and ethnic minority suspects is that the police are biased. Takagi summarized this perspective with his statement that “the police have one trigger finger for whites and another for blacks” (Takagi, 1974, 30). Sherman reported: “the demonstrably higher rates of police homicide for blacks strongly suggests racial discrimination on a national basis” (Sherman, 1979, 57). Research suggests that discrimination based on racial or ethnic cues is a primary cause of the disproportionate number
of minority suspects shot by the police (Jacobs and O’Brien, 1998; Sorenson, Marquart and Brock, 1993). This hypothesis has been called the “quasi-labeling view” (Goldkamp, 1976), and has also been called the “conflict approach” (Takagi, 1974). For the purpose of this dissertation, the hypothesis that discrimination based on suspect racial or ethnic minority status causes the disparity in police use of deadly force is referred to as the “bias hypothesis.”

II. Threat Hypothesis

A second major hypothesis offers a very different take on the observed disparity in police use of deadly force based on suspect race or ethnicity. It holds that minorities are more likely to be fired upon by the police because they are more likely to engage in the actions that warrant police use of deadly force. Bureau of Justice Statistics data show that police officers are more likely to be shot by Black suspects than by White suspects. Between 1976 and 1998 the population of Black citizens made up an average of twelve percent of the U.S. population, yet committed forty-three percent of all felonious killings of officers (Brown & Langan, 2001). Logically the extent to which racial and ethnic minorities are involved in crime, particularly assaults against the police, should be taken into account when attempting to understand their disproportionate representation among the subjects of police use of deadly force. This hypothesis suggests that racial and ethnic minority suspects pose more of a threat to the police, and are consequently more likely to get shot at by the police. According to this hypothesis, officers’ decisions to shoot are based on how aggressive or threatening the suspects are. The central premise of this hypothesis is that the level of force used by the police will match the level of danger they are in (MacDonald et al., 2001). The hypothesis that discrepancy in police use of deadly force occurs due to increased threat from racial or ethnic minority suspects is referred to in this dissertation as the “threat hypothesis.”
B. Methods of Prior Research and Current Limitations

Research based on incident reports from deadly force encounters and laboratory-based experiments are the two major methods of research that have investigated the extent of racial and ethnic bias amongst the police. Other study designs have not been well presented in the research literature. Observational studies conducted by researchers in the field are not feasible given the rarity of deadly force encounters – less than two percent of police citizen encounters result in any use of force and only a fraction of those develop into police shootings (Alpert and Dunham, 2010). According to the 1999 national survey conducted by the U.S. Department of Justice, of the 422,000 police-citizen encounters that resulted in the use of force, 15.3% of citizens reported that the police pointed a gun at them. No citizen in the survey reported being shot at by the police (Bureau of Justice Statistics, 2001). Research has been conducted that observed police officers as they trained on deadly force judgment and decision making simulators to assess the impact of suspect characteristics on decision making (Ho, 1991). Although valuable to the research literature, these observational studies have not focused on suspect race or ethnicity and lack the experimental control of laboratory-based studies.

I. Research Based on Incident Reports

Prior research has examined incident reports from deadly force encounters to determine whether suspect race and ethnicity influences police use of deadly force. Some studies have suggested that suspect race, and to a lesser extent suspect ethnicity, play an influential role in police use of deadly force (Sorenson et al., 1993; Jacobs and O’Brien, 1998; Stone et al., 2010). Other studies suggest that minority suspects, in particular Black suspects, pose a greater threat to the police, and that the influence of suspect race and ethnicity on police use of deadly force is insignificant when community-level violent crime rates and dangerousness of the offense
underlying deadly encounters are controlled for (Inn et al., 1977; Fyfe, 1978; Brown and Langan, 2001; MacDonald et al., 2001). Studies based on incident reports are dependent on the accuracy and completeness of those reports. Deadly force encounters tend to be so complex that it is difficult to reliably distinguish between race-bias effects and other threat markers such as suspect demeanor and behavior, based on recorded information. Research based on incident reports of encounters in the field are necessary, but not sufficient to accurately assess the impact of racial and ethnic bias on police decision making in deadly force encounters. Although this type of research sheds light on the extent of disproportionate shooting of minority suspects, it is often difficult to determine whether this is due to racial or ethnic bias, or due to a combination of factors leading to a higher level of danger that officers respond to with higher levels of force. During the last decade, research on racial bias in police use of deadly force has turned to a laboratory setting in an attempt to answer this question.

II. Experimental Research

Laboratory research employing traditional psychological experiments has been used to determine racial bias in civilian and police participants’ decisions to shoot Black and White suspects (Plant and Peruche, 2005; Plant et al., 2005; Correll et al., 2006; Correll et al., 2007). To date experimental research has not tested ethnic bias against Hispanic suspects. These experiments present participants with a series of computer generated images of armed or unarmed suspects on a computer screen, to which they respond by pressing a “shoot” button or a “don’t shoot” button. Racial bias is inferred in two ways: 1) by whether participants are consistently quicker to press “shoot” and “don’t shoot” in response to images of armed and unarmed suspects of a particular race (measured by reaction time in milliseconds after the image is presented); and 2) if participants make “shooting errors” based on race (measured by pressing
“shoot” in response to images of unarmed suspects and “don’t shoot” in response to images of armed suspects). Prior studies suggest that both civilian and police participants are quicker to press “shoot” for armed Black suspects than armed White suspects, and quicker to press “don’t shoot” for unarmed White suspects than unarmed Black suspects (Correll et al., 2006; Correll et al., 2007). Furthermore, participants tend to be more likely to mistakenly press “shoot” for images of unarmed Black suspects than unarmed White suspects, and are more likely to mistakenly press “don’t shoot” for images of armed White suspects than armed Black suspects (Plant et al., 2005; Plant and Peruche, 2005).

Experimental research has examined participant neurophysiology during “shoot/don’t shoot” testing to determine whether participants experience a higher level of neurophysiological arousal in response to images of Black suspects than in response to images of White suspects. This enables a clearer estimate of whether participants make implicit, or unconscious, associations between race and threat. Research suggests that participants become significantly more aroused when faced with an image of a Black suspect than with an image of a White suspect (Correll et al., 2006), as measured by Event Related Potentials (which are described in detail in chapter 2). This indicates that participants implicitly relate “Black” with “threat.” Furthermore research suggests that implicit racial bias, measured by higher levels of neurophysiological arousal in response to images of Black suspects, predicts behavioral bias in decisions to press “shoot” or “don’t shoot.”

Experimental testing using “shoot/don’t shoot” designs has greater internal validity than research based on incident reports because all other variables are constant; the only variation in stimulus prompts are suspect race and the presence or absence of a weapon. However, traditional experimental designs sacrifice external validity in order to control for the complex nature of
actual police encounters. Critical external validity issues arise when generalizing from experimental results to racial bias in police use of deadly force in the field. Participants in traditional “shoot/don’t shoot” experimental studies are seated in front a desktop computer, they do not interact with the image in front of them, and they do not fire a weapon. The experimental designs used in prior laboratory studies bear almost no resemblance to an actual deadly force encounter.

C. Research Goals and Contributions of the Dissertation

The limitations from both research based on incident reports and research using traditional “shoot/don’t shoot” experiments have created barriers to understanding the influence of suspect race and ethnicity on police use of deadly force. The goal of this dissertation was to extend the base of evidence on racial and ethnic bias in police use of deadly force by improving study design. The first improvement in study design was greater external validity. The current research used controlled randomized trials across three experiments, but was superior to previous laboratory experiments in that participants were placed in situations that more closely resembled real life deadly force encounters. A set of realistic scenarios was developed for use in the deadly force judgment and decision-making simulators at the Washington State University (WSU) Simulated Hazardous Operational Tasks Laboratory; a laboratory dedicated to analyzing and understanding high-risk operational performance, including police use of deadly force. The laboratory simulators are the type used for training by many law enforcement agencies in the United States and around the world. The content of the scenarios was based on research examining incidents where officers were killed or assaulted during the past three decades (Federal Bureau of Investigation, Criminal Justice Information Services Division, 2006). The
second improvement in study design was that White, Black and Hispanic suspects were presented in the scenarios (proportional to their involvement in police shootings), making this the first experimental study to go beyond the question of racial bias and investigate the possibility of ethnic bias against Hispanic suspects. Research based on incident reports has suggested that the police treat Hispanic suspects differently than they treat White suspects (Liska and Yu, 1992; Stone et al., 2010). This research is the first step in testing whether participants respond differently to White and Hispanic suspects in a controlled laboratory setting.

This dissertation presents the results of three separate but related experiments that used simulators with realistic scenarios as stimulus prompts to measure participant decision making in deadly force encounters. From these experiments, analyses were conducted to look at three specific issues regarding the influence of suspect race and ethnicity on deadly force judgment and decision making: 1) the basic question of whether suspect race and ethnicity affected deadly force judgment and decision making; 2) whether participant neurophysiology varied depending on the race or ethnicity of the suspect they encountered, and whether neurophysiological arousal predicted deadly force judgment and decision making; and 3) the impact of fatigue on racial and ethnic bias in deadly force judgment and decision making. In keeping with prior experimental research, deadly force judgment and decision making was measured as reaction time to shoot (in fractions of seconds) and shooting errors. Errors in shooting were operationalized as either shooting an unarmed suspect or failing to shoot an armed suspect. The experimental design used in this research has the potential to provide a more valid measure of racial and ethnic bias than has been possible to date.

The following chapter presents a review of the research literature on the extent of racial and ethnic bias in police decisions to shoot. Chapter three describes the development of the
scenarios used in the current experiments. Chapter four details how the three experiments were conducted and how the data were analyzed. Chapter five presents the results of the three experiments. Chapter six discusses the results in light of prior research, considers their implications for policy and training, and discusses future directions for research.
A. Statistics on Suspect Race and Ethnicity and the use of Deadly Force

The available statistics suggest that Black suspects are more likely to be shot by the police than White suspects. While no comprehensive nationwide data on police shootings in the United States exist, the FBI does keep statistics on homicides by police officers (Supplemental Homicide Reports (SHR) from the Bureau of Justice Statistics). According to the SHR data, at the turn of the century Blacks were approximately four times more likely than Whites to be killed by police officers in shootings that were ruled as justifiable (Brown and Langan, 2001). This discrepancy used to be more pronounced: in 1978 Blacks were eight times more likely to be killed by police officers than Whites, indicating that “a growing percentage of felons killed by the police are white, and a declining percentage are black” (Brown and Langan, 2001, iii).

Nevertheless, Black suspects appear to be over-represented in police shootings.

Up to date statistics on the race and ethnicity of suspects shot at by the police are not easily accessible. With the exception of Brown and Langan’s research described above, the vast majority of studies examining the percentage of Black suspects in police shootings (compared to the percentage of Blacks in specific cities) were conducted in the 1970s and 1980s. Table 1 shows that across a number of U.S. cities the percentage of Black suspects shot by the police was greater than would be expected from their representation in those cities’ populations.
Table 1: Percentage of Blacks in the population of selected American cities compared to percent Black suspects shot by the police

<table>
<thead>
<tr>
<th>Study</th>
<th>City</th>
<th>Proportion of Blacks</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>General population</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shot by police</td>
</tr>
<tr>
<td>Harding and Fahey (1973)</td>
<td>Chicago</td>
<td>33%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>75%</td>
</tr>
<tr>
<td>Milton et al. (1977)</td>
<td>Seven Cities</td>
<td>39%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>79%</td>
</tr>
<tr>
<td>Fyfe (1978)</td>
<td>New York</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60%</td>
</tr>
<tr>
<td>Meyer (1980)</td>
<td>Los Angeles</td>
<td>18%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>55%</td>
</tr>
<tr>
<td>Blumberg (1982)</td>
<td>Kansas City</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>73%</td>
</tr>
<tr>
<td>Binder et al. (1982)</td>
<td>Birmingham</td>
<td>56%</td>
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<td></td>
<td>79%</td>
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<td></td>
<td>Miami</td>
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<td></td>
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<td>51%</td>
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<tr>
<td></td>
<td>Newark</td>
<td>58%</td>
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<td></td>
<td>78%</td>
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<tr>
<td></td>
<td>Oakland</td>
<td>47%</td>
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Very few statistics are available on Hispanic suspects in police shootings. Research suggests that Hispanics, who make up approximately sixteen percent of the population, are shot about as frequently as Whites, who make up seventy of the population (Brown and Langan, 2001). In 2009, James and Pasquale-Styles examined the forty-two gunshot deaths caused by police over a four-year period in New York City and found that twenty-six were Black, nine were Hispanic, and seven were White. This finding suggests that Hispanics, like Blacks, are over-represented among the subjects of police use of deadly force (given that their representation in the population is considerably lower than Whites). Furthermore, according to the Law Enforcement Officers Killed or Assaulted (LEOKA) data, Hispanics feloniously kill police considerably less often than Whites, as compared to their representation in the population (during the last ten years only twelve of the 588 suspects that shot police officers have had a race
or ethnicity other than Black or White). There are problems in interpreting these data due to ambiguity surrounding ethnic categories across separate datasets, in which Hispanics may be differentiated from Whites (categories such as “Hispanic” and “non-Hispanic White”), or may be combined with Whites (“White” and “non-White”) (Walker, 2004). The limited statistics do, however, suggest that Hispanic suspects are more likely to be shot by the police than White suspects.

Although statistics suggest that the police shoot racial and ethnic minority suspects disproportionate to their representation in the general population, they do not indicate whether this is due to discrimination. Research based on incident reports has attempted to explain the disproportionate representation of racial and ethnic minorities among the targets of police shootings.

**B. Research based on Incident Reports of Deadly Force Encounters**

Incident reports are created following police shootings to document details of the encounter. Recorded information includes officer or agency-written reports of the suspect’s demographics (race, gender, age etc.) and behavior (level of aggression, compliance, etc.). The strength of research examining these reports is that it examines data collected from actual incidents of police use of deadly force, directly and in context (Correll et al., 2007). Research based on incident reports has produced findings that provide apparent support for both the bias and the threat hypotheses.
I. Research Supporting the Bias Hypothesis

During the past fifty years research has been carried out which suggests that suspect race and ethnicity are influential in police decisions to use deadly force. In 1963, Robin examined incident report data from an eleven-year period in Philadelphia and found that twenty-eight of the thirty-two suspects fatally shot by the police were Black. During this eleven-year period Blacks accounted for twenty-two percent of the city’s population and thirty-one percent of the city’s crime arrests (Robin, 1963), indicating that Blacks were the subjects of police shootings disproportionate to their involvement in crime.

In 1975, Kobler found that the number of Black suspects shot and killed by the police in the United States exceeded the number of Black suspects who attacked and killed police officers; for every officer killed by a Black, six Black suspects were killed (Kobler, 1975). Similarly, in 1980, Mayer examined shooting incidents from a five-year period in Los Angeles and found that twenty-eight percent of Black suspects shot by the police were unarmed, compared to twenty percent of White suspects and twenty-two percent of Hispanic suspects (Meyer, 1980).

In 1992, Liska and Yu used Maximum Likelihood Estimation methods (ML), a type of structural measurement model, to test whether the percentage of racial and ethnic minority members in a city influenced police use of deadly force. They found that the higher the percentage of non-White community members in a city (including Blacks and Hispanics), the higher the rates of police use of deadly force (Liska and Yu, 1992). In a separate macro-level study, Sorenson, Marquart and Brock examined the FBI Supplemental Homicide Reports from the largest cities in the United States and found, using Ordinary Least Squares (OLS) regression, that economic inequality and percent Black in a city significantly predicted increased numbers of shootings by the police (Sorenson et al., 1993). Similarly, in 1998, Jacobs and O’Brien tested data from the FBI Supplemental Homicide Reports using Tobit regression and found that cities
with a larger Black population, a recent growth in the Black population, and greater economic stratification based on race had significantly greater numbers of shootings by the police (Jacobs and O’Brien, 1998).

Recently it has been suggested that the police are even racially biased against each other. In 2010, the New York State Task Force on Police-on-Police Shootings reported that during the past fifteen years, ten of the fourteen police officers who have been killed in mistaken identity, police-on-police shootings have been “people of color” (Stone et al., 2010, ii).

In sum, some research based on incident reports supports the notion that police officers are influenced by race or ethnicity when making decisions to shoot.

II. Research Supporting the Threat Hypothesis

In contrast to the research described above, some research based on incident reports supports the notion that police are not influenced by suspect race or ethnicity, but rather they are influenced by the dangerousness of the situation in which they find themselves. Inn, Wheeler and Sparling (1977) analyzed incident reports from a major metropolitan police department using ANOVA, and found that officers shot significantly more Black suspects than White suspects representative of their numbers in the city’s population, however this discrepancy occurred at the criminal involvement level. Black suspects were more likely to shoot at the police than White suspects, representative of their numbers in the population (Inn et al., 1977). In fact this study found that officers fired more shots at White suspects than at Black suspects (three versus two shots respectively – not a statistically significant difference), suggesting “perhaps, police behave more cautiously with Blacks because of departmental policy or public sentiment concerning treatment of Blacks” (Inn et al., 1977, 35).
In 1978, Fyfe found that sixty percent of Black suspects shot by the police were carrying handguns compared to thirty-five percent of White suspects (Fyfe, 1978). In 1980, Meyer examined shooting incidents in Los Angeles and found that Blacks made up eighteen percent of the population, but were responsible for forty-four percent of attacks on officers (compared to Whites who made up fifty-two percent of the population and twenty-eight percent of attacks on officers, or Hispanics, who made up twenty-four percent of both the population and attacks on officers). In a similar vein, Brown and Langan reported that between 1976 and 1998 Black suspects made up twelve percent of the population but committed forty-three percent of felonious killings of officers, suggesting that the discrepancy in police use of deadly force against Black suspects may be due to Black suspects presenting a greater risk to the police (Brown and Langan, 2001).

In 2001, MacDonald and his colleagues tested their “ratio-threat” model, which specifically explained police shootings of suspects as “a fixed ratio or function of the level of violence (real or perceived) in society” (MacDonald et al., 2001, 159). The model predicted that as the rate of homicide or violent activity in a community went up, the rate of police shootings would go up proportionately. These researchers examined the temporal relationship between police use of deadly force and the homicide rate by analyzing the FBI’s supplemental homicide reports during a twenty-one year period. A time series analysis confirmed the ratio-threat model, suggesting that a temporal relationship existed whereby police use of deadly force matched the existing level of violence within a community (MacDonald et al., 2001). Although this study supports the threat hypothesis, it did not look specifically at suspect race or ethnicity, so it does not provide evidence against the bias hypothesis.
In sum, research suggests that it is the level of threat, and not the race or ethnicity of the suspect, that influences police use of deadly force. These studies also stress the importance of moving beyond individual-level variables such as race, gender and age, to broader “place” variables, such as level of violence in the community, that need to be considered in an objective assessment of police racial or ethnic bias.

III. Limitations of Research Based on Incident Reports

Research based on incident reports has several major flaws when used to examine the extent of racial and ethnic bias in police use of deadly force. First, this type of research depends on the accuracy and completeness of the information recorded. Although reports of suspect race and ethnicity are likely to be reasonably reliable, other aspects of an encounter may not. Studies suggest that perceptual memory can be severely distorted during deadly force encounters. The ability to engage in rational thinking, which is required for comprehensive, narrative recall, is limited under conditions of trauma or high stress. Fragmented memory can result from deadly encounters. In 1986, Solomon and Horn studied eighty-six officers who had been involved in shootings and found that sixty-seven percent experienced the feeling of slow motion, fifty-one percent experienced diminished sound, and thirty-seven percent experienced tunnel vision (Solomon and Horn, 1986). In 1998, Honig and Rolland studied the reactions of 348 officers involved in shootings and found that fifty-one percent experienced diminished sound, forty-five percent experienced tunnel vision, and twenty-two percent experienced memory loss for part of the incident (Honig and Rolland, 1998). In 2004, Klinger conducted detailed interviews with eighty officers and found that eighty-two percent experienced diminished sound, fifty-one percent experienced tunnel vision, and twenty-three percent experienced the feeling of fast
motion (Klinger, 2004). These studies suggest that perceptual distortions can occur during deadly force encounters that may complicate accurate recall of the encounter.

The second major flaw in research based on incident reports is that measures are coarse and confounds are often not controlled or even taken into account. Deadly force encounters tend to be complex, fast-paced and ambiguous. There are clear complications in extracting any one variable as causal out of a complex set of interactions that occur during police encounters. It is difficult to identify racial or ethnic bias as the cause of the disproportionate shooting of minorities when research based on incident reports cannot empirically measure this bias. In most cases, racial and ethnic bias cannot be parsed out unless other major variables are controlled for.

D. Research Based on Observation of Police Training

Deadly force encounters are so rare that direct observation of police decision making in the field by researchers is not feasible. However, in 1993, Ho conducted a study that observed police officers as they trained using computerized deadly force judgment and decision making simulators. By recording officers’ performance during simulation, Ho collected data on the effects of officer characteristics and suspect demographics on deadly force judgment and decision making. Ho’s study found that suspect race had an inconsistent impact on decision making. Officers tended to be quicker to shoot armed Black suspects than armed White suspects, and less likely to fail to shoot armed Black suspects than armed White suspects; but the likelihood of shooting an unarmed suspect was not affected by suspect race (Ho, 1993). Ho’s findings suggested “that officers are more cautious in responding to high risk encounters with Black suspects” (Ho, 1993, 53).
By directly observing officers during training, Ho’s study controlled for much of the ambiguity surrounding incident reports of deadly force encounters. The impact of suspect race was assessed independent of suspect age and gender, and whether scenarios had a single suspect or multiple suspects. However, Ho’s study did not control for other factors that are thought to influence scenario difficulty, such as suspect demeanor, behavior, and weapon type. Furthermore, observation was conducted in a police training facility, making it impossible to control for the reactive effects of experimental arrangements (Campbell and Stanley, 1963). For example, scenario training tends to be highly interactive between the trainee and the trainer. We have no way of knowing whether officers received feedback between scenarios, whether feedback was consistent between scenarios or differed based on scenario difficulty, and whether feedback was consistent between officers or whether some officers received more feedback than others. Furthermore, we do not know what kind of priming officers received prior to training, and whether instructions were consistent among officers. In sum, observing police officers as they train using deadly force judgment and decision-making simulators is not the same as using these simulators to experimentally test police officers’ responses to scenarios with suspects of varying races and ethnicities. When researchers observe police training they have limited control over the stimuli officers receive, and very little control over the procedures officers are put through.

C. Experimental Research on Racial or Ethnic Bias in the use of Deadly Force

During the last decade research into racial bias in deadly force judgment and decision making has turned to a laboratory setting. Using traditional “shoot/don’t shoot” designs, this research has examined both civilian and police participants for implicit racial bias in decisions about whether or not suspects are armed. The intellectual basis for experimental studies of racial
bias in deadly force judgment and decision making lies with substantial research indicating that many Americans subconsciously associate Blacks with crime (Payne, 2001; Payne et al., 2002; Amodio et al., 2004).

I. Experimental Research Supporting the Bias Hypothesis

The results of repeated randomized trials suggest that civilian participants display implicit racial bias. For example Payne (2001) found that when participants were primed with Black faces on a computer screen, they were significantly more likely to automatically identify a “target picture” that followed as a weapon (even though half of the pictures were of tools). Furthermore participants were quicker to pair pictures of weapons with Black faces, and tools with White faces. Research has also found that participants were significantly more likely to mistake weapons for neutral objects when primed with White faces (Payne et al., 2002; Amodio et al., 2004). These results suggest that an implicit association existed between Blacks and crime, without the awareness or intent of the participant (Payne, 2001). These studies were suggestive, however they did not test police officers, nor did they test decisions to shoot, limiting their generalizability to racial bias in police use of deadly force.

The first experimental study to examine racial bias in police officers was conducted by Eberhardt and colleagues in 2004. This study primed participants with abstract concepts, for example crime, basketball, arrest, violent and shoot, then tested participants’ attention orientation to Black and White faces in a series of images. Results showed that when officers were primed with the concept of crime, their attention was significantly oriented towards Black (more than White) faces (Eberhardt et al., 2004). These results were also suggestive, however, this study did not test decisions to shoot, limiting their generalizability to racial bias in police use of deadly force.
In 2005, Plant and colleagues conducted a series of experiments to determine whether the implicit racial bias previously found in civilian and police samples extended to racial bias in deadly force judgment and decision making. They presented a sample of college students with a series of images of either Black or White faces randomly superimposed with either an image of a weapon or an innocuous object such as a wallet. Participants had to respond by pressing a button marked “shoot”, or one marked “don’t shoot”. Initial results showed a significant implicit association between Blacks and crime, similar to Payne (2001). Plant and Peruche also tested police officers using the same design (Plant and Peruche, 2005), and found that, similar to the civilian participants, officers were more likely to shoot Black targets paired with neutral objects, and to fail to shoot White targets paired with guns. Plant and colleagues’ results suggest that racial bias existed in police decisions to shoot.

Over a series of studies Correll and colleagues confirmed the results of prior experimental research using a more sophisticated research design. Participants were exposed to a series of 100 video game simulations in which a still image slide show of armed and unarmed Black and White men appeared against a variety of backgrounds (an apartment building, a parking lot, a busy street etc.). Similar to Plant and colleagues, participants were instructed to press a button labeled “shoot” or a button labeled “don’t shoot”, depending on whether the suspect was armed or unarmed. Civilian participants displayed significant racial bias in their reaction times and in their errors (Correll, Park, Judd & Wittenbrink, 2002; Correll et al., 2006). In 2007 this research was expanded to include police participants. Three samples were compared: 124 Denver police officers, 113 officers from across the country, and 127 civilians that the Denver officers served. Results showed that, similar to civilians, the police were significantly quicker to press “shoot” for armed Black suspects and quicker to press “don’t shoot”
for unarmed White suspects. Similar to Plant and colleagues, Correll and colleagues’ results suggest that racial bias existed in police decisions to shoot.

The tendency to implicitly associate Blacks with weapons across repeated randomized trials described in the studies above provides clear-cut support for the bias hypothesis.

II. Experimental Research Supporting the Threat Hypothesis

Several experimental studies appear to support the threat hypothesis. Plant’s 2005 study found during initial testing that civilian participants tended to implicitly pair Black faces with weapons and White faces with neutral objects. However, a sub-sample of participants in this study were repeatedly exposed to multiple trials where the race of the suspect was unrelated to the superimposed object. The purpose of this follow-on testing was to determine whether participants could learn to override the implicit racial bias they displayed initially. A separate group of participants was presented with multiple trials where Black faces were deliberately paired with weapons and White faces with innocuous objects. Following the repeated trials both groups were tested using the same “shoot/don’t shoot” design. The group that had been exposed to random pairings of images showed significant error reductions, while the group who had consistently seen Black faces matched with weapons showed no such reductions. Only participants for whom race and dangerousness were associated disproportionately “shot” Black suspects after the follow-on testing.

Plant and Peruche’s 2005 study testing police participants found similar results. Like the civilian participants, the implicit racial bias displayed initially fell to non-significant levels in the second part of the study for the group that was repeatedly exposed to randomized pairs. These results suggest that, like civilians, police officers had a level of implicit racial bias that could either be amplified (evidenced by the group repeatedly exposed to Black faces paired with
Correll and colleagues’ 2007 study testing police participants found that, unlike civilian participants, the sample of police officers showed no significant racial bias in their errors (they did not mistakenly shoot unarmed Black suspects or fail to shoot armed White suspects disproportionately). Correll and his colleagues suggested that: “by virtue of their training or expertise, officers may exert control over their behavior, possibly overriding the influence of racial stereotypes” (Correll et al., 2007, 1014).

Correll conducted a second study where thirty-one police participants were tested on the same video-game simulation, but with less time to respond. The results found in the first study were replicated: police participants were not significantly more likely to shoot unarmed Black suspects than unarmed White suspects, or more likely to fail to shoot armed White suspects than armed Black suspects. It is possible that Correll’s finding that police officers displayed less racial bias than civilians is due to the scenario-based deadly force judgment and decision-making training police officers receive from their agencies.

III. Limitations of Experimental Research

Experimental research into racial bias in police use of deadly force has the ability to vary suspect race while holding all other stimuli constant. For example, facial expression, clothing, physical build, stance and background image can be exactly replicated with a Black suspect and a White suspect. This allows for control over confounding variables that may influence a participant’s decisions to press “shoot.” Having said that, the complexity of real world deadly force encounters is sacrificed when presenting participants with still images of armed and unarmed suspects. The first major limitation of prior experimental research is that the
test stimuli used in these experiments lack external validity, which raises the question of whether prior experimental results are generalizable to police and civilian populations outside laboratory settings.

A second major limitation of prior experimental research is the difference between firing a weapon and pressing a button. Firing a handgun is a complicated endeavor; at minimum it involves un-holstering, bringing the weapon to a ready position, aligning sights with the target, and ultimately pulling the trigger. Pushing a button is a simple reflex, dramatically different to the complex process involved in shooting a firearm. Furthermore, there is no active difference between pressing a “shoot” and a “don’t shoot” button. The same action is required for a decision to shoot and a decision not to shoot, whereas in field encounters a decision not to shoot is marked by inaction. The difference in response between pressing a button and firing a weapon is another constraint on the external validity of prior experimental studies.

A third major limitation of prior experimental research is that decisions to shoot or not to shoot are not registered with a realistic response. The still image does not change when a decision is made. Furthermore, there are no consequences for making an error. Although it could be argued that there are no real consequences for making an error in a shooting simulator, the system does at least register participant decisions with realistic responses: the suspect in the scenario falls down if an accurate shot is fired. Having no response from the system following a decision to shoot or not to shoot is another limitation in external validity that may constrain the implications of prior experimental results.

Correll’s research is an important step in our efforts to accurately measure racial bias in police use of deadly force. His video simulation design is more sophisticated than the simple images of weapons or neutral objects superimposed on Black and White faces used in prior
research. However, Correll’s video-game design still does not accurately portray a highly complex and ambiguous deadly force encounter. Prior to the research reported here, no controlled experimental research has tested participants for racial bias in conditions that are anywhere close to the real conditions police officers face in the line of duty.

A final limitation of prior experimental research is that it has only tested participant responses to Black and White suspects. As such it can only increase our knowledge of racial bias in police use of deadly force. Research based on incident reports suggests that bias in police use of deadly force may not be limited to racial bias against Black suspects; ethnic bias against Hispanic suspects also appears to influence police use of deadly force. With the exception of the research reported here, no experimental research has tested for ethnic bias against Hispanic suspects.

E. Neurophysiology, Fatigue and Racial or Ethnic Bias

I. Research on Participant Neurophysiology in Response to Suspect Race

An additional issue that Correll and colleagues explored was the influence of neurophysiological arousal on racial bias in deadly force judgment and decision making. Monitoring participant neurophysiology during controlled experimental trials provides another way to measure racial bias in deadly force judgment and decision making (Correll et al., 2007). Neurophysiological arousal is a robust measure of participant threat response. A threat response indicates that the participant being monitored associates whatever stimulus they are observing with dangerousness or threat (Carretie et al., 2001). One way of measuring neurophysiological arousal is by monitoring Event Related Potentials (ERPs). ERPs are fluctuations of electrical activity in the brain that can be monitored with electrodes at the scalp in response to various
stimuli. There are two major types of ERPs: early and late. While late ERPs occur under resting states, early ERPs are rapid and automatic responses that have been associated with threat orientation (Carretie et al., 2001). An early ERP that is frequently observed in response to threatening stimuli is the potential 200 (P200) response, so named because it is an electrical potential that peaks about 200 milliseconds after a stimulus is presented.

Research suggests that P200 activation is a measure of racial bias. In 2003, Ito and Urland found that in White participants, P200 activation was more pronounced when presented with images of Black males and females, compared to images of White males and females (Ito and Urland, 2003). This research suggests that White participants subconsciously associated Blacks with threat, as evidenced by an increase in neurophysiological arousal when presented with images of Black males and females.

Correll and colleagues have monitored participant neurophysiology using ERP electrodes while responding to the “shoot/don’t shoot” video game design (Correll et al., 2006). Results showed that participants had more pronounced P200 responses to Black suspects, indicative of greater neurophysiological arousal. Correll and colleagues’ key finding was that neurophysiological arousal was linked to behavioral bias; the degree of racial differentiation in P200 activation predicted racial bias on the video game (Correll et al., 2006). These results suggest that implicit racial bias was translated into behavioral bias in decisions to shoot.

Another way of measuring a threat response is by measuring alpha suppression. Alpha brain waves occur when a person is relaxed. Alpha suppression indicates neurophysiological arousal and, like P200, been associated with a threat response (Kolb and Whishaw, 2001). Alpha waves are rhythmical patterns in the brain’s electrical activity that can be measured using Electroencephalography (EEG); whereas ERPs like P200 are brief changes in electrical signals in
response to stimuli. Alpha brain waves occur on a slower time frame and are easier to monitor than ERPs, which can be difficult to detect because they co-occur with so many other electrical signals (Kolb and Whishaw, 2001). Alpha brain waves are robust and relatively easy to monitor, an important consideration for experimental designs that involve substantial participant movement (such as in the experiments presented in this dissertation).

II. Research on Fatigue and Racial or Ethnic Bias

Police shift-work related fatigue has received considerable attention in recent years, particularly the impact it may have on use of deadly force (Barton et al., 2004; Vila, 2000; 2006; 2010; Senjo, 2010). To date no research has examined the interaction between shift-work related fatigue and racial or ethnic bias in police use of deadly force.

Experimental research testing for the impact of fatigue on decision making has found that fatigue tends to make participants more likely to make hasty decisions and engage in risky behavior on gambling tasks (Kilgore et al., 2005). Fatigue has been found to have a particularly strong impact on moral decision making. When asked whether they would intervene and take a life to save five other lives, participants were less able to integrate emotion and cognition to guide moral judgments under fatigued conditions (Kilgore et al., 2007). Participants took significantly longer to decide whether a course of action was appropriate when fatigued. Overall fatigue increased the likelihood of a course of action being judged as appropriate, suggesting that fatigue also tends to increase permissiveness or tolerance (Kilgore et al., 2007).

In 2004, Barton and colleagues tested the effect of shift patterns on decisions to shoot in a deadly force judgment and decision-making simulator. Officers were tested at the end of an early day shift (13:00), at the end of a late day shift (21:00) and at the end of a night shift (05:00).
Findings revealed that officers in the early day shift made the most incorrect decisions to shoot or not shoot (Barton et al., 2004). However, this experiment did not use a repeated measures design, so it possible that between-officer differences accounted for significant variation in decision making.

Although experimental research has yet to investigate the impact of shift-work related fatigue on racial or ethnic bias, research suggests that experimental or “time on task” fatigue increases the likelihood of race-based misperceptions of weapons (Payne et al., 2002). Furthermore, alcohol impairment significantly reduces participant ability to inhibit race bias responses (Bartholow et al., 2006). Impairment due to alcohol and fatigue have been compared: 24 hours awake is equivalent to a blood alcohol level 0.10, or 20% above the U.S. standard for drunk driving (Dawson and Reid, 1997; Williamson and Feyer, 1997). It is therefore possible that shift-work related fatigue may influence the impact of suspect race and ethnicity on participants’ decisions to shoot.

Police research has established that fatigue due to shift work can limit ability to assess risks and benefits, increase avoidable accidents and errors, and affect high consequence moral decisions in fast paced, stressful encounters (Durmer and Dinges, 2005; Vila, 2010). Police officers suffer from the same negative effects from excessive work hours, circadian disruptions and sleep loss found in physicians (Barger et al., 2005), pilots (Van Dongen et al., 2004), and military personnel in the combat arms (Wesenten et al., 2005). Fatigue reduces prefrontal cortex functioning and can impair the ability to exercise restraint in the face of threat (Vila, 2010). This can lead to officers “unnecessarily putting themselves into vulnerable situations in which they will have no choice but to shoot if anything appears threatening” (Fyfe, 1997, 6).
F. Conclusions

Statistics on police use of deadly force suggest that racial and ethnic minority suspects are more likely to be shot by the police than White suspects (Geller, 1982; Brown and Langan, 2001). Research based on incident reports has provided apparent support for both the bias hypothesis (Robin, 1963; Takagi, 1974; Kobler, 1975; Sherman, 1979; Mayer, 1980; Sorenson et al., 1993; Jacobs and O’Brien, 1998; Stone et al., 2010) and the threat hypothesis (Inn et al., 1977; Fyfe, 1978; Brown and Langan, 2001; MacDonald et al., 2001). The strength of research based on incident reports is that it captures the complexity of a deadly force encounter; the weakness is that this methodology does not allow the researcher to isolate the impact of individual variables, such as suspect race or ethnicity. Furthermore, incident reports may be incomplete or even inaccurate, limiting the internal validity of research based on them.

Experimental research during the past decade has also tested participants for racial bias. This research suggests that both civilians and police officers display signs of implicit racial bias. Experimental research has provided apparent support for the bias hypothesis (Payne, 2001; Plant and Peruche, 2005) and the threat hypothesis (Plant and Peruche, 2005; Correll, 2007). The strength of experimental research is that it rigorously controls confounding variables while manipulating suspect race. However, prior studies have sacrificed external validity for increased control of variables; prior to the current study, experimental research has not used designs that come close to replicating complex deadly force encounters. Furthermore, prior to the current study, experimental research has only examined racial bias against Black suspects, not ethnic bias against Hispanic suspects.

This dissertation has attempted to overcome many of the limitations of previous research by analyzing the influence of suspect race and ethnicity on participants’ decisions to shoot in a
more realistic deadly force judgment and decision-making simulator. This research was conducted in a controlled laboratory setting, but with substantially greater external validity than previous experimental studies by placing subjects in immersive environments where test stimuli more closely resembled real-life deadly-force encounters. This research design is more controlled than research based on incident reports, yet more sophisticated and face valid than experimental research using “shoot/don’t shoot” button-pressing designs. It is therefore possible that this research may provide the most accurate measure to date of racial and ethnic bias in police use of deadly force.

The next two chapters lay out the research design used in the current study. Chapter three presents in detail the development of the scenarios used in the current research design. Chapter four presents the details of how the three experiments in the current study were conducted.
Using deadly force judgment and decision making simulators to test participants for racial and ethnic bias has greater external validity than traditional “shoot/don’t shoot” button-pressing designs; shooting a modified weapon at a moving, talking, human target bears more relevance to actual deadly force encounters than pressing a button in response to a series of still images. Using deadly force judgment and decision-making simulators to test for racial and ethnic bias is an advance in experimental research sophistication, however the validity of this experimental design depends in part on the realism of the scenarios.

In the spring of 2009 sixty scenarios requiring decisions about whether or not to use deadly force were filmed for use in the WSU Simulated Hazardous Operational Tasks Laboratory. The scenarios were filmed in naturalistic settings using professional actors. Suspects in the scenarios were Black, White, and Hispanic, and were either unarmed (approximately thirty-five percent of the time) or armed with handguns or knives. Difficulty level within scenarios was carefully and objectively controlled. By carefully manipulating scenario difficulty, we were able to determine whether an interaction existed between the effect of suspect race/ethnicity and the effect of scenario difficulty on our research participants’ decisions to shoot. This was particularly important because of prior evidence suggesting that stereotypes tend to “fill in” in high risk, moralistic, and uncertain situations (Kilgore et al., 2007). The more difficult scenarios tended to have a higher level of ambiguity, making it possible that the impact of suspect race and ethnicity on participant decision making would be greatest at the highest
difficulty level. By varying scenario difficulty, suspect weapon type, and suspect race/ethnicity, we were able to assess which variables influenced participants’ decisions to shoot.

A. The Dynamics of Deadly Force Encounters

The information available on all encounters in which an officer fired his or her weapon is limited. However, data is available on police shootings in which the officer was killed or assaulted. From the year 2000 to the year 2009, 536 officers were killed in the line of duty (Law Enforcement Officers Killed and Assaulted, 2009), and it is estimated that over 50,000 officers are assaulted every year (Federal Bureau of Investigation Criminal Justice Information Services Division, 2006). Research conducted by Pinizzotto, Davis, and Miller examined the dynamics of the deadly force encounters that resulted in an officer being killed or assaulted (Federal Bureau of Investigation, Criminal Justice Information Services Division, 1992, 1997, 2006). This research is known as the “deadly mix” research, and provided the content for the scenarios used in the current research.

The deadly mix is the interactive combination of situation, officer, and offender; and how they converge. This FBI research began in 1992 in response to the growing awareness of the uniquely hazardous nature of the police profession. The 1992 report, *Killed in the Line of Duty*, examines fifty cases of officer slayings, selected to be representative of all FBI data available on the felonious killing of officers. The research continued with the publication of *In the Line of Fire* in 1997, a study of forty cases of serious assaults on law enforcement officers (in which the officer was justified in using deadly force), selected from a pool of over 600 felonious assaults. The final report, *Violent Encounters*, was published in 2006 and examines another forty cases of felonious assaults on officers, selected from a separate pool of over 800 cases. The goal of this
FBI research was to understand the dynamics of deadly force encounters, and to provide law enforcement agencies with insight that may help them improve training practices to better protect their officers.

During scenario development we used the collective “deadly mix” research to create scenarios that were as true to life as possible. The deadly mix research reports that over eighty percent of deadly force encounters occur during either a disturbance call, an arrest situation / crime in progress, an investigation of suspicious persons / circumstances, or a traffic stop / pursuit. Approximately thirty percent of deadly force encounters occur during the day, forty percent during the evening, and thirty percent during the night. Over eighty percent of suspects assault officers with a firearm (most frequently a handgun). Knives are the second most common type of suspect weapon. The most common distance between suspect and officer at the time of assault is five feet. Approximately fifty percent of offenders are White, and fifty percent are non-White. Over ninety percent of offenders are male. Over seventy percent of offenders are under the influence of alcohol or drugs at the time of the incident. These dynamics of deadly encounters were critical to the development of our scenarios. (Federal Bureau of Investigation, Criminal Justice Information Services Division, 1992, 1997, 2006)

B. Theoretical Roots of Complexity and Coupling

A second major source of information that was vital in developing our scenarios was Perrow’s (1984) Normal Accident Theory (NAT), and Klinger’s (2005) adaptation of NAT to a theory of deadly force incidents. Perrow’s theory has been used to understand why accidents involving complex human systems occur, such as the Challenger space shuttle that blew up in flight, railway accidents, aircraft and air-traffic control accidents, and the near disaster at the
Three Mile Island nuclear power plant. The core of NAT’s argument is that accidents in complicated interactive systems are normal; to completely eradicate them is impossible. Perrow defines two key concepts that influence the likelihood of a normal accident occurring: complexity and coupling.

The first concept that influences the likelihood of a normal accident occurring is complexity. A system can be linear, where one part predictably affects the next, which affects the next, and so on. This type of system tends to be simplistic and effective, with limited potential for accidents. A system is complex when it has interconnecting parts that are not arranged linearly. For example, instead of A influencing B influencing C in a linear fashion, A and B may combine in various different ways to influence C. The potential for accidents increases with each complex interaction of parts or variables. Ironically in an effort to guard against accidents, systems often have safety valves or procedures that introduce new variables, increase complexity, and consequently increase the likelihood of the very accident they are designed to prevent. The basic premise of complexity is that the more complex the system, the more likely accidents will occur.

The second concept that influences the likelihood of a normal accident occurring is the coupling, or connection, between the parts of a system. A system can be either tightly or loosely coupled. In a tightly coupled system there is very little slack between the parts. In other words, the system is tightly linked, where a change in A causes an immediate change in B. Change in any one part can ricochet through the system with potentially devastating effects. Accidents are most likely to occur in tightly coupled systems. The basic premise of coupling is that the less slack between interconnecting variables, the more likely accidents will occur.
Klinger’s adaptation of NAT explains why the potential for error in deadly force judgment and decision-making increases as a result of complexity and coupling. The main lesson of NAT is that the more interconnecting variables and the less slack between them (the more complex and tightly coupled the system) the more likely accidents will occur. In a deadly force encounter, a situation becomes more complex as the number of variables (e.g. officers, suspects, bystanders, weapons) and the number of interactions between those variables increase. For example, a deadly force encounter with three armed suspects and twelve bystanders is more complex than a deadly force encounter with one armed suspect and no bystanders. The more complex the situation, the harder it is to interpret and respond accordingly, and the greater the likelihood of an accident occurring, such as shooting an unarmed suspect or failing to shoot an armed suspect (Klinger, 2005). In addition to complexity, tighter coupling, where change in one variable quickly affects another, causes a police-citizen encounter to become more unpredictable. For example, if a suspect who appeared to be unarmed produces a knife in close proximity to an officer the situation becomes more tightly coupled due to the increase in threat. There is less slack in the social system, because the time the officer has to make a decision shortens dramatically. If that suspect were to produce a gun instead of a knife the coupling would tighten further. While the officer faced with a knife has the amount of time it takes a knife to cross the distance between the officer and the suspect, the officer faced with a gun has the amount of time it takes a bullet to reach him or her to react. As both the complexity and coupling of a deadly force encounter increase, the difficulty of the situation and the probability of a negative outcome also increase (Klinger, 2005).

Normal Accident Theory does not just apply to situations that result in human error. Klinger also argues that appropriate shootings can be explained using the twin concepts of
complexity and coupling. The more complex the situation the more difficult it is for the officer to manage, and the more tightly coupled the situation the less time the officer has to react. High complexity and tight coupling in a deadly force encounter do not necessarily result in human error, they just make the situation more challenging, and increase the likelihood that an accident will occur (Klinger, 2005).

The shooting of Amadou Diallo in New York City, February 1999, is an example of an encounter where high complexity and tight coupling created a disastrous situation where the risk of an accident occurring was high. Diallo, an unarmed West African immigrant, was shot and killed by four New York City police officers. Over forty rounds were fired at Diallo. The night Diallo was killed the police were looking for a suspect whose description loosely matched Diallo’s. When approached by the police, Diallo ran into a small outer hallway that had reflective coating on the walls. The officers pursued who they thought was the suspect. When asked to show his hands, Diallo reached into his rear pant pocket, leading the officers to believe that he was reaching for a handgun. One of the officers fired his weapon and, as he was retreating, tripped off a step. The resulting muzzle flash reflected in the hall, the ricocheting bullet, the officer falling, and the suspect’s outstretched arm led the officers to believe that the suspect was firing at them. The officers opened fire at Diallo. Reflected muzzle flashes and ricocheting bullets made them escalate their fire. Diallo, under the impact of the officer’s fire, was pinned to the back of hallway, leading the officers to believe that he was wearing body armor because he had not fallen to the ground. When the officers stopped firing, one of them went to retrieve the suspect’s weapon, and found that Diallo was unarmed, and had been reaching for his wallet. The shooting of Amadou Diallo demonstrates the tragic outcome of a complex and tightly coupled encounter.
The factors that led to this tragic accident were multiple, in a system so complex and tightly coupled that the likelihood of an accident occurring was extremely high. The number of officers, number of weapons, low visibility, language and cultural barrier, tight enclosed physical space, and reflective walls all influenced the negative outcome. The race of the suspect may have been an influencing factor to some of the officers, however it was the complex interaction of multiple factors in an encounter with little room to pause for thought that caused this accident (Klinger, 2005).

Police shootings are not always as complex and tightly coupled as the encounter that led to the death of Amadou Diallo. During scenario development we used the lessons of Perrow and Klinger to recreate as realistically as possible encounters that vary in complexity and coupling. Multiple variables were considered when designing the scenarios, for example suspect variables (race/ethnicity, age, gender, demeanor, intoxication), situational variables (distance from suspect, time of day, type of weapons, number of suspects, number of bystanders, physical space), and ecological variables (type of neighborhood). We manipulated scenario complexity and coupling and created realistic variation in difficulty based on multiple, controllable variables. This enabled an assessment of whether suspect race/ethnicity influenced participants’ decisions to shoot.

An important difficulty element of our scenarios was “threat congruity” (our own term). This concept was based on two different types of threat: actual and perceived. In the scenarios actual threat was determined by a suspect being armed or unarmed; scenarios with armed suspects had high actual threat, scenarios with unarmed suspects had low actual threat. Perceived threat was the level of danger apparent in a scenario. A scenario with an aggressive, abusive suspect appeared more threatening than a scenario with a compliant suspect. As the levels of difficulty increased the congruence between actual and perceived threat tended to decrease. In a
less difficult scenario perceived threat often correlated with actual threat, whereas a more difficult scenario may have seemed non-threatening but required the use of deadly force, or seemed threatening and resulted in a null scenario. By manipulating threat congruity we were able to further influence scenario difficulty.

C. Scenario Development Method

The WSU Simulated Hazardous Operational Tasks Laboratory scenarios were developed in February 2009. This development took two stages: determining scenario content and scenario filming. In determining scenario content the work of Perrow, Klinger, and Pinizzotto, Davis and Miller was highly influential. As complexity increased and coupling tightened the level of scenario difficulty went up. For example, increasing the number of people in the scenario, the number of weapons, and the level of noise (intoxicated and abusive behavior) increased complexity and consequently difficulty. Decreasing distance from the offender, decreasing visibility, and increasing the speed of suspect movement tightened coupling and resulted in a higher level of difficulty.

During the first stage of scenario development we conceptualized scenarios that were as true to life as possible. Three types of deadly force encounter were represented in our scenarios: vehicle stops, suspicious person stops and disturbance calls. Thirty five percent of the scenarios were null and did not require the use of deadly force, this was necessary because the scenarios were designed to measure judgment and decision making (i.e. whether or not to shoot at a suspect), requiring null or “trick” scenarios where a wallet, driver’s license, or cell phone could be mistaken for a weapon. Approximately fifty percent of the suspects in the scenarios were White, thirty percent were Black, and twenty percent were Hispanic. Eighty percent of suspects
were male. Eighty percent were between the ages of seventeen and twenty-five; the remaining twenty percent were between the ages of twenty-six and forty-five. These percentages were determined based on the deadly mix research, and were representative of situational variables and suspect demographics from the past thirty years of officer involved shootings (Federal Bureau of Investigation, Criminal Justice Information Services Division, 1992, 1997, 2006).

The second stage of scenario development was filming and production. This included coordinating with the scenario production crew, coordinating with an acting agency, filming, and production. A suspect attack and a police shooting (suspect death scene) were filmed for each scenario requiring the use of deadly force. An incident that could potentially be mistaken for an attack (such as the suspect suddenly producing a wallet) and a suspect death scene were filmed for each null scenario. The scenarios were filmed with actors from the Big Fish talent agency, and were produced by Advanced Interactive Systems (AIS). A step-by-step guide to developing scenario content, filming, and production is presented in Appendix A, together with scenario synopses.

D. Using Realistic Scenarios to Test for Racial and Ethnic Bias

The experiments presented in this dissertation tested participants’ responses to the scenarios described in this chapter. These scenarios were used as stimulus prompts in deadly force judgment and decision-making simulators. Internal research validity was improved from research based on incident reports by holding major situational and behavioral variables constant while presenting participants with White, Hispanic and Black suspects in a controlled laboratory setting. External research validity was improved from prior experimental studies because participants were placed in more immersive and realistic environments where they interacted.
with the scenarios and shot with modified weapons in high fidelity computerized simulators. Three experiments were conducted to assess the impact of suspect race and ethnicity on participant deadly force judgment and decision making.

The first experiment presented in this dissertation tested police, military and civilian participants for decisions to shoot, enabling an assessment of the impact of suspect race and ethnicity on deadly force judgment and decision making. The second experiment recorded civilian participants’ neurophysiology during decisions to shoot. Participants’ Alpha brain waves were monitored immediately prior to scenarios and during scenarios. By monitoring Alpha suppression, we were able to establish whether participant neurophysiological arousal varied by suspect race/ethnicity. We were also able to establish whether implicit racial bias predicted behavioral bias in the simulator. The third experiment tested police participants for decisions to shoot on two separate occasions, once immediately following five consecutive nights on duty, and once following three consecutive days off duty, which enabled an assessment of the impact of shift-work related fatigue on racial and ethnic bias in decisions to shoot.

Using realistic and engaging scenarios as test stimuli to measure participant responses to suspects of varying races and ethnicities has the potential to provide the most accurate measure to date of racial and ethnic bias in police use of deadly force. This methodology may shed more light on the reasons for the disproportionate shooting of minorities.
CHAPTER 4

EXPERIMENTAL METHODS

Three separate experiments were conducted at the Simulated Hazardous Operational Tasks Laboratory. The primary purpose of the first and second experiments was to see if deadly force judgment and decision making could be improved through neurophysiological feedback. The first experiment (experiment A below) was a pilot study to establish a baseline for novice performance and a baseline for expert performance. Twelve deadly force judgment and decision making experts (six police officers and six military personnel), and twelve complete novices (with no deadly force judgment and decision-making experience) were recruited for experiment A. Each participant’s neurophysiology was recorded to establish baseline correlates for novices and experts. This resulted in a baseline neurophysiological profile during deadly encounters for novices, and a separate baseline for experts. Experiment B then used these baselines to see whether neurophysiological feedback could accelerate learning from “novice” to “expert”. Participants were fitted with electrodes that delivered a mild buzzing sensation to the base of the neck when their neurophysiology resembled that of an expert. Forty-eight civilian participants with no deadly force judgment and decision-making experience were recruited for experiment B. Experiment C tested an unrelated matter; whether fatigue influenced operational performance (deadly force judgment and decision making and highway driving). Thirty active duty police participants who were working the night shift in a local police department were recruited for this experiment. Each participant was tested twice (once immediately following their fifth consecutive night shift, and once following three consecutive days off duty), to determine whether shift-work related fatigue influenced their decisions to shoot, and how they drove
(measured in a driving simulator). From these three experiments detailed analyses were conducted on the impact of suspect race and ethnicity on decisions to shoot. Table 2 lists the specific research questions we asked, and which experiments were suitable for answering them.

Table 2: Specific research questions

<table>
<thead>
<tr>
<th>The specific research questions we intended to answer were as follows:</th>
<th>Measured from experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did suspect race and ethnicity significantly influence participants’ reaction times to shoot?</td>
<td>✓ ✓ ✓</td>
</tr>
<tr>
<td>Did scenario difficulty significantly influence participants’ reaction times to shoot?</td>
<td>✓ ✓ ✓</td>
</tr>
<tr>
<td>Did suspect race and ethnicity significantly influence participants’ likelihood of shooting an unarmed suspect, or failing to shoot an armed suspect?</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Did scenario difficulty significantly influence participants’ likelihood of shooting an unarmed suspect, or failing to shoot an armed suspect?</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Did scenario difficulty influence the impact of suspect race/ethnicity on participants’ decisions to shoot? In other words was racial and ethnic bias more pronounced in difficult scenarios?</td>
<td>✓ ✓ ✓</td>
</tr>
<tr>
<td>Did participants with deadly force judgment and decision-making experience significantly differ from civilian participants in their responses?</td>
<td>✓</td>
</tr>
<tr>
<td>Did participants experience greater neurophysiological arousal when faced with a minority (Black or Hispanic) suspect?</td>
<td>✓</td>
</tr>
<tr>
<td>Did implicit racial or ethnic bias (evidenced by greater neurophysiological arousal) predict behavioral bias in the deadly force judgment and decision-making simulator?</td>
<td>✓</td>
</tr>
<tr>
<td>Did shift-work related fatigue influence racial and ethnic bias in decisions to shoot?</td>
<td>✓</td>
</tr>
</tbody>
</table>

Experiments A, B and C are described in detail below. The information includes methods of participant recruitment, study materials used, experimental procedures, study variables of interest, and the models used to analyze the data. This dissertation used the data collected from these three experiments to determine the impact of suspect race/ethnicity on deadly force
judgment and decision making. It needs to be emphasized that this was not the primary purpose for any of the three experiments. For that reason participants did not know that they were being tested for racial and ethnic bias. Furthermore, detailed procedural information that does not relate to this dissertation is omitted.

A. Experiment A: The Influence of Suspect Race/Ethnicity on Deadly Force Judgment and Decision Making

I. Participants

Twenty-four participants were recruited. Twelve civilians with no police, military or firearms experience were recruited to get an estimate of “novice performance” in deadly force judgment and decision making. Six active duty police officers with more than five years of patrol experience and six active duty military infantry personnel with at least one tour of combat operations were recruited to get an estimate of “expert performance” in deadly force judgment and decision making. No power analysis was conducted because this experiment was a pilot study for experiment B (see below).

Civilian participants were student and staff volunteers from the Spokane campus of WSU. An Institutional Review Board (IRB) approved flyer was posted in the Student Academic Center to recruit participants. Furthermore word of mouth was employed to ensure that we received a sufficient number of volunteers. Police participants were recruited from local police departments and Sheriff’s offices, and military participants were recruited from local Army and Marine Corps units. Permission to recruit police officers and military personnel was obtained through direct contact with training offices. The training offices then informed police officers and military personnel to contact us if they were interested in participating. All participants were required to
be physically and psychologically healthy (established during screening – see below). There were no specific inclusion or exclusion criteria other than general health, and level of deadly force judgment and decision-making experience. All participants received remuneration for taking part in the study. All participants were informed that their responses would remain confidential. The use of human subjects was approved by the WSU IRB prior to participant recruitment.

II. Materials

This experiment was conducted at the WSU Simulated Hazardous Operational Tasks Laboratory, part of the Sleep and Performance Research Center in Spokane, which is equipped with two high definition (HD) deadly force judgment and decision-making simulators of the type commonly used in law enforcement training. These simulators are fully enclosed and sound deadened shooting ranges, measuring seven by five meters, with a three and a half by two meter screen at the far end on which HD video scenarios are displayed. The handguns used in these simulators are modified Glock model 21s, whose barrels have been replaced with infrared emitters that register shot placement on the screen and time of shot after threat exposure. The scenarios used in this experiment were those described in chapter three.

III. Procedures

Each participant was screened for suitability, approximately one week prior to the experiment. As per ethical regulations participants were required to be physically and psychologically healthy; i.e., no clinical disorders and/or illnesses (by history and questionnaires). Prior to screening, participants were briefed about the study process, risks, and potential benefits of participating in the study. Following this briefing, participants were asked to sign an IRB.
approved consent form indicating their intention to participate in the study. Participation was voluntary. Participants were informed that they could withdraw at any point of the study.

On the day of the experiment participants were given an orientation on the weapon system, range layout, and the rules of engagement:

*The goal of a police officer in a deadly force encounter is to accurately identify a threat and neutralize it, while minimizing harm to bystanders, officers, and suspects.*

During the day-long experiment each participant responded to twenty-seven scenarios in a deadly force judgment and decision making simulator. The scenarios were randomized and organized into nine sets of three scenarios for each participant. The participants had a three-minute rest between each scenario, during which they sat quietly in a chair, and thirty minutes rest after completing a set of three scenarios. Participants were given lunch during one of the thirty minute rest periods. Participants were monitored at all times and were kept from discussing the scenarios or the simulators amongst other research participants. All commands that participants received while in the simulators were scripted to ensure that each participant received the same instructions. No feedback was given to participants between scenarios. After each participant completed the experiment they were debriefed.

**IV. Variables and Analytical Models**

In this experiment each participant responded to twenty-seven scenarios. This resulted in two levels of variation of response variables: between-participant variance, and within-participant variance based on repeated observations (scenario-driven variance). The study variables of interest in our analysis were primarily scenario-level variables: race/ethnicity of
suspect (White, Black, Hispanic), scenario difficulty level (naïve, intermediate, journeyman), and suspect weapon type (knife, gun). Combat group (police, military, civilian), a between-participant study variable, was also analyzed. The dependent response variables were reaction time to shoot, and two dichotomous variables: shooting an *unarmed* suspect (error A), and failing to shoot an *armed* suspect (error B). In the instance of failing to shoot an armed suspect, reaction time was automatically coded as non-applicable. For each study variable dummy variables were created to assess the specific influence of each race/ethnicity category (using White suspects as the reference group), difficulty level (using naïve scenarios as the reference group), and weapon type (using suspects armed with guns as the reference group) on reaction time, error A and error B. Each dependent response variable was analyzed independently.

Multi-level mixed effects models were used to examine factors associated with variation in response variables. This analytical strategy was chosen because each participant responded to twenty-seven scenarios, requiring multi-level mixed effects models to account for the potential lack of independence among observations. In order to determine whether the assumption of independence was violated, unconditional means models were conducted for each dependent response variable. When clustering of observations around participants occurred (violating the assumption of independence) the R project for statistical computing was used to create multi-level mixed effects models. Where no clustering was observed, multi-variate and binary logistic regression models were used to analyze the data in SPSS.
B. Experiment B: The Influence of Suspect Race/Ethnicity on Neurophysiological Arousal and Deadly Force Judgment and Decision Making

I. Participants

Forty-eight participants were recruited for an experiment that monitored neurophysiology while responding to simulated deadly force encounters. This experiment tested the impact of neurophysiological feedback on deadly force judgment and decision making. Participants had no policing, military or firearms experience. The logic behind using only civilian participants in this experiment was to try and accelerate performance from “novice” to “expert” using neurophysiological feedback. Apart from having no deadly force judgment and decision-making experience, participants were required to be physically and psychologically healthy (assessed during screening – see below). Participants were recruited through an IRB approved advertisement posted on Craigslist. No power analysis was conducted for this experiment. Sample size was determined by doubling the sample size of the pilot experiment (experiment A). All participants received remuneration for taking part in the study. All participants were informed that their responses would remain strictly anonymous. Ethical approval was obtained prior to participant recruitment through the WSU IRB.

II. Materials

The simulators and scenarios used for this experiment were the same as those described in experiment A above.

Participants’ neurophysiology was recorded during testing to establish the impact of the scenarios on participants. Alpha brain waves were measured using B-Alert X10 wireless ambulatory EEG caps, created by Advanced Brain Monitoring in Carlsbad, California. These caps are comfortable and non-intrusive, and can be set up in under five minutes. They can record
up to nine channels of high fidelity EEG, and have wireless acquisition and transmission up to ten meters, a vital feature given the size of the simulator ranges. Heart rate was also measured by EKG using LifeShirts, created by Vivo Metrics in Ventura, California.

III. Procedures

Participants went through the same screening procedures described in experiment A above. On the day of the experiment participants were fitted with EEG and EKG devices and given an orientation, which consisted of two forty-five minute standardized training sessions, taught by two law enforcement use of force instructors. The first training session was on the weapon system, marksmanship, range layout, and the rules of engagement (see experiment A procedures). The second training session was on interacting with the scenarios (e.g. use of assertive language such as “License and registration please”, “show me your hands”, “drop your weapon!”). During this training session participants watched a trainer complete a scenario, then completed a practice scenario themselves (on which they received trainer feedback). Following training each participant responded to eighteen scenarios in a day-long experiment. The scenarios were randomized and organized into six sets of three scenarios. As with experiment A, the participants had a three-minute rest between each scenario, during which they sat quietly in a chair, and thirty minutes rest after completing a set of three scenarios. Participants were given lunch during one of these thirty minute rest periods. Participants were monitored at all times and were kept from discussing the scenarios or the simulators amongst themselves. After each participant completed the experiment they were debriefed.
IV. Variables and Analytical Models

In this experiment each participant responded to eighteen scenarios. This resulted in two levels of variation of response variables: between-participant variance, and within-participant variance based on repeated observations. The study variables were both observed at the scenario level: race/ethnicity of suspect (White, Black, Hispanic) and scenario difficulty level (naïve, intermediate, journeyman). Suspect weapon type was not recorded in this experiment so we were unable to analyze its impact on participants’ decisions to shoot. No participant level variables were of interest in this analysis. As with experiment A, dummy variables were created for each study variable (using “White” and “naïve” as reference categories). The dependent response variables were reaction time to shoot after a threat was presented, and alpha suppression. Shooting errors were not analyzed as too few errors were made overall to enable appropriate parametric testing (the implications of which are considered in the discussion section). Alpha suppression was measured by the difference in alpha from rest to scenario. Alpha during scenarios was measured from the point suspect race/ethnicity became apparent to the point when threat became apparent. This was to ensure that changes in alpha were due to suspect race/ethnicity and not the introduction of a weapon. Alpha suppression was also measured for null scenarios to establish the impact of suspect race on participant neurophysiology in scenarios where no real threat existed. Each dependent response variable was analyzed independently.

As with experiment A, an unconditional means model was conducted for each dependent variable. When clustering of observations occurred, the R project for statistical computing was used to create multi-level mixed effects models to examine factors associated with variation in response variables, to account for the lack of independence among repeat observations. Where no clustering was observed, multi-variate regression models were used to analyze the data in SPSS.
C. Experiment C: The Influence of Fatigue on Racial/Ethnic Bias in Deadly Force Judgment and Decision Making

I. Participants

Thirty police participants were recruited for an experiment that tested operational performance under fatigued (due to consecutive night shift work) and rested conditions. Participants were recruited from a police department in Washington State. Word of mouth was used to generate sufficient numbers for the study. No power analysis was conducted, because this experiment was a pilot study for a larger experiment (not yet conducted). Inclusion in the study required officers to be working night shifts in a patrol assignment for the department (at the time of the experiment) and to be physically/emotionally fit for duty based on the department’s standards. All participants received remuneration for taking part in the study. The use of human subjects was approved by the WSU IRB prior to participant recruitment. Furthermore, an NIH Certificate on Confidentiality was obtained to protect all collected data, due to the use of a higher profile occupational group.

II. Materials

The simulators and scenarios used for this experiment were the same as those described in experiments A and B above.

III. Procedures

Prior to screening, participants were briefed about the study process, risks, and potential benefits of participating in the study. Following this briefing, participants were asked to sign an IRB approved consent form indicating their intention to participate in the study. Participation
was voluntary. During screening, participants filled out a series of questionnaires including a demographic form, and various questionnaires regarding their sleepiness and sleep habits.

Participants where then scheduled for two experimental days during their normal night-shift duty cycle of five consecutive nights on duty followed by four or five consecutive days off duty. In the fatigue condition, participants reported to the laboratory immediately following the last of their five consecutive 10.7 hour night shifts. In the rest condition, participants reported to the laboratory at the same time in the morning after three consecutive days off duty. Order of condition was randomly assigned for each participant.

On experimental days participants were given a brief orientation on the weapon system, range layout, and the rules of engagement (see experiment A procedures). Each participant received three scenarios in which threats were present and two null scenarios in which no threat appeared in the scenario. Each participant received three intermediate and two journeyman scenarios. The scenarios were randomized within these categories for each participant. A recovery nap lasting six hours was required for all officers following completion of the night shift condition to ensure participants were safe to drive home.

**IV. Variables and Analytical Models**

In this experiment each participant responded to ten scenarios, five during his or her fatigued condition, and five during his or her rested condition. This resulted in two levels of variation of response variables: between-participant variance, and within-participant variance based on repeated observations. The study variables of interest were condition (fatigued condition, rest condition), race/ethnicity of suspect (White, Black, Hispanic), scenario difficulty level (intermediate, journeyman), and suspect weapon (knife, gun). Participants in this experiment did not receive naïve scenarios, due to their deadly force judgment and decision-
making experience. As with experiments A and B dummy variables were created for each study variable (using “White”, “intermediate”, “gun” and “rest condition” as reference categories). The dependent response variables of interest were reaction time to shoot, shooting an unarmed suspect (error A), and failing to shoot an armed suspect (error B). In the instance of failing to shoot an armed suspect, reaction time was automatically coded as non-applicable. Each dependent response variable was analyzed independently.

As with experiments A and B, an unconditional means model was conducted for each dependent variable. When clustering of observations occurred, the R project for statistical computing was used to create multi-level mixed effects models to examine factors associated with variation in response variables, to account for the lack of independence among repeat observations. Where no clustering was observed, multi-variate regression models were used to analyze the data in SPSS.
A breakdown of participant characteristics can be seen in table 3. In experiment A the majority of participants were White males. The mean age of participants was 30 (range: 19-50). For police and military participants the mean number of years of experience was 13 (range: 6-24). In experiment B the mean age of participants was 26 (range: 18-45). Forty-four percent were female. The majority of participants were White. In experiment C the majority of participants were White males. The mean age of participants was 37 (range: 31-43).

Table 3: Characteristics of research participants, % / Mean (Range), (N=102)

<table>
<thead>
<tr>
<th></th>
<th>Experiment</th>
<th>A (n = 24)</th>
<th>B (n = 48)</th>
<th>C (n = 30)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td></td>
<td>83%</td>
<td>85%</td>
<td>100%</td>
<td>89%</td>
</tr>
<tr>
<td>Black</td>
<td></td>
<td>4%</td>
<td>2%</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td>Hispanic</td>
<td></td>
<td>13%</td>
<td>7%</td>
<td>0%</td>
<td>7%</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td>75%</td>
<td>46%</td>
<td>99%</td>
<td>73%</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>25%</td>
<td>44%</td>
<td>1%</td>
<td>27%</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Participants</td>
<td></td>
<td>30 (19-50)</td>
<td>26 (19-50)</td>
<td>37 (31-43)</td>
<td>31 (19-50)</td>
</tr>
<tr>
<td>Years of experience</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Police</td>
<td></td>
<td>17 (9-24)</td>
<td>NA*</td>
<td>NR**</td>
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</tr>
<tr>
<td>Military</td>
<td></td>
<td>7 (6-10)</td>
<td>NA*</td>
<td>NR**</td>
<td>7 (6-10)</td>
</tr>
<tr>
<td>Civilian</td>
<td></td>
<td>0</td>
<td>0</td>
<td>NA***</td>
<td>0</td>
</tr>
</tbody>
</table>

* NA = not applicable, Experiment B tested only civilians
** NR = not recorded, years of experience was not recorded for Experiment C
*** NA = not applicable, Experiment C tested only police
A. Experiment A: The Influence of Suspect Race/Ethnicity on Deadly Force Judgment and Decision Making

I. Tests for Normality

An examination of the data showed that reaction time was positively skewed in scenarios with White, Black and Hispanic suspects, across each level of difficulty, and for both scenarios with suspects armed with guns and suspects armed with knives. The Kolmogrov-Smirnov test was significant for each category. However, the outliers that were identified represented valid data points, specific to scenarios. For this reason outliers were not removed or transformed. Furthermore, we did not wish to transform the data as it would have changed the unit of measurement from seconds, which is easily interpreted. Because outliers existed for scenarios with White, Black and Hispanic scenarios, the analysis of racial and ethnic bias was not affected by a lack of normality.

II. Variation between Participants

Unconditional means models run on each response variable showed that observations were not clustered around participants. The intra-class correlation coefficients (ICC) for reaction time, error A and error B were all smaller than 0.01, indicating that the vast majority (over 99%) of variation in response variables occurred within participants. This was strong evidence that the assumption of independence of observations was not violated. It was also strong evidence that between participant differences (including level of combat experience) had little impact on performance (when measured by reaction time to shoot and shooting errors). Because of this multi-variate and binary logistic regression techniques were the most suitable. See Appendix C for a lattice showing variation in reaction times across scenarios for each participant.
III. Reaction Time

Bivariate analyses were conducted between the study variables and reaction time (table 4). Average reaction time to shoot depended on the racial/ethnic status of the scenario’s suspect. Hispanic suspects were shot the quickest after a threat was presented; followed by White suspects; with Black suspects shot the slowest. Increased scenario difficulty was also associated with increased reaction times to shoot. Research participants shot scenario suspects armed with guns faster than suspects who were armed with knives.

Table 4: Bivariate results on average participant reaction time to shoot for each study variable in experiment A (n = 24)

<table>
<thead>
<tr>
<th>Study Variable</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Suspect Race/Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.79 (0.06)</td>
</tr>
<tr>
<td>White</td>
<td>1.29 (0.13)</td>
</tr>
<tr>
<td>Black</td>
<td>2.17 (0.26)</td>
</tr>
<tr>
<td><strong>Scenario Difficulty</strong></td>
<td></td>
</tr>
<tr>
<td>Naive</td>
<td>0.88 (0.04)</td>
</tr>
<tr>
<td>Intermediate</td>
<td>1.54 (0.17)</td>
</tr>
<tr>
<td>Journeyman</td>
<td>2.84 (0.40)</td>
</tr>
<tr>
<td><strong>Suspect Weapon</strong></td>
<td></td>
</tr>
<tr>
<td>Gun</td>
<td>1.16 (0.09)</td>
</tr>
<tr>
<td>Knife</td>
<td>2.81 (0.38)</td>
</tr>
<tr>
<td><strong>Combat Group</strong></td>
<td></td>
</tr>
<tr>
<td>Police</td>
<td>1.44 (0.21)</td>
</tr>
<tr>
<td>Military</td>
<td>1.49 (0.25)</td>
</tr>
<tr>
<td>Civilian</td>
<td>1.84 (0.22)</td>
</tr>
</tbody>
</table>

A multi-variate regression model was run to determine the impact of each study variable on reaction time (see table 5). Overall the regression model was significant ($f = 19.41; df = 6, 400; p = < .001$) and predicted 23% of the variance in reaction time ($r^2 = 0.23$).
Table 5: Summary of regression analysis for variables predicting reaction time to shoot in experiment A (n = 24)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Suspects</td>
<td>0.80</td>
<td>0.25</td>
<td>0.15**</td>
</tr>
<tr>
<td>Hispanic Suspects</td>
<td>0.07</td>
<td>0.46</td>
<td>0.01</td>
</tr>
<tr>
<td>Police and Military Participants</td>
<td>-0.30</td>
<td>0.24</td>
<td>-0.06</td>
</tr>
<tr>
<td>Suspect Armed with Guns</td>
<td>-1.93</td>
<td>0.27</td>
<td>-0.33**</td>
</tr>
<tr>
<td>Intermediate Scenarios</td>
<td>0.81</td>
<td>0.29</td>
<td>0.14*</td>
</tr>
<tr>
<td>Journeyman Scenarios</td>
<td>2.26</td>
<td>0.29</td>
<td>0.39**</td>
</tr>
</tbody>
</table>

* = p < .005   ** = p < .001

Participants took significantly (0.80 seconds) longer to shoot Black suspects than White suspects ($t = 3.25; p < .001$). There was no significant difference in reaction time between shooting Hispanic suspects and White suspects. Participants took significantly longer to shoot in journeyman ($t = 7.83; p < .001$) and intermediate ($t = 2.83; p < .005$) scenarios than they took to shoot in naïve scenarios (2.26 seconds and 0.81 seconds longer respectively). Participants took significantly (1.93 seconds) less time to shoot suspects armed with guns than they took to shoot suspects armed with knives ($t = -7.22; p < .001$). As expected from the unconditional means model, combat group did not significantly predict reaction time (although police and military participants took 0.30 seconds less to shoot than civilian participants). A significant interaction existed between suspect race/ethnicity and scenario difficulty ($t = 5.90; p < .001$). A graphical depiction of the data shows an increase in reaction time in response to Black suspects in journeyman scenarios (see figure 1).
Figure 1: Participant reaction time to shoot White, Black, and Hispanic suspects by level of scenario difficulty in experiment A (n = 24)
IV. Shooting an Unarmed Suspect

A binary logistic regression model was run with error A (shooting an unarmed suspect) as the dependent response variable (see table 6). Overall the regression model was significant ($\chi^2 = 27.10; df = 5; p < .001$) and explained 18% of the variance in likelihood of shooting an unarmed suspect ($r^2 = 0.18$).

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Suspects</td>
<td>-1.77</td>
<td>0.64</td>
<td>0.17*</td>
</tr>
<tr>
<td>Hispanic Suspects</td>
<td>-18.53</td>
<td>5801.64</td>
<td>0.00</td>
</tr>
<tr>
<td>Police and Military</td>
<td>-0.49</td>
<td>0.49</td>
<td>0.61</td>
</tr>
<tr>
<td>Participants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermediate Scenarios</td>
<td>2.28</td>
<td>0.79</td>
<td>9.76*</td>
</tr>
<tr>
<td>Journeyman Scenarios</td>
<td>2.24</td>
<td>0.80</td>
<td>9.40*</td>
</tr>
</tbody>
</table>

* = $p < .005$

Participants were less likely to shoot unarmed Black suspects than unarmed White suspects ($p < .005$). Using the Inverse Odds Ratio (dividing the Odds Ratio into 1) we calculated that participants were almost six times less likely to shoot unarmed Black suspects than they were to shoot unarmed White suspects (Inverse Odds Ratio = 1 / 0.17 = 5.88). There was no significant difference between the likelihood of shooting unarmed Hispanic suspects and unarmed White suspects. Participants were almost ten times more likely to shoot unarmed suspects in journeyman ($p < .005$) and intermediate ($p < .005$) scenarios than they were in naïve scenarios. There was no interaction between suspect race/ethnicity and scenario difficulty for
shooting an unarmed suspect. Although police and military participants were less likely to shoot unarmed suspects than civilian participants, combat group did not significantly predict likelihood of shooting an unarmed suspect.

V. Failing to Shoot an Armed Suspect

A binary logistic regression model was run with error B (failing to shoot an armed suspect) as the dependent response variable (see table 7). Overall the model was significant ($\chi^2 = 30.64; df = 6; p < .001$) and explained 18% of the variance in likelihood of failing to shoot an armed suspect ($r^2 = 0.18$).

Table 7: Summary of regression analysis for variables predicting failing to shoot an armed suspect in experiment A (n = 24)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Suspects</td>
<td>1.61</td>
<td>0.56</td>
<td>5.00*</td>
</tr>
<tr>
<td>Hispanic Suspects</td>
<td>-16.92</td>
<td>5859.91</td>
<td>0.00</td>
</tr>
<tr>
<td>Police and Military Participants</td>
<td>-0.80</td>
<td>0.46</td>
<td>0.45</td>
</tr>
<tr>
<td>Intermediate Scenarios</td>
<td>1.11</td>
<td>0.64</td>
<td>3.04</td>
</tr>
<tr>
<td>Journeyman Scenarios</td>
<td>1.69</td>
<td>0.47</td>
<td>5.40*</td>
</tr>
<tr>
<td>Suspects armed with Knives</td>
<td>0.53</td>
<td>0.47</td>
<td>1.70</td>
</tr>
</tbody>
</table>

* = $p < .005$

Participants were five times more likely to fail to shoot armed Black suspects than armed White suspects ($p < .005$). There was no significant difference between the likelihood of failing to shoot armed Hispanic suspects and armed White suspects. Participants were just over five
times more likely to fail to shoot armed suspects in journeyman scenarios \((p < .005)\) than they were in naïve scenarios. There was no significant difference between failing to shoot armed suspects in intermediate and naïve scenarios. A significant interaction existed between suspect race/ethnicity and scenario difficulty \((t = 3.37, df = 177, p < .001)\). Participants were most likely to fail to shoot armed Black suspects at the highest level of difficulty. Suspect weapon did not significantly predict failing to shoot an armed suspect. Although police and military participants were less likely to fail to shoot armed suspects, combat group did not significantly predict likelihood of failing to shoot an armed suspect.

B. Experiment B: The Influence of Suspect Race/Ethnicity on Neurophysiological Arousal and Deadly Force Judgment and Decision Making

I. Tests for Normality

An examination of the data showed that reaction time was positively skewed in scenarios with White, Black and Hispanic suspects, and in scenarios at each level of difficulty. The Kolmogrov-Smirnov test was significant for each category. There was one extreme outlier (over five standard deviations above the mean) on a journeyman scenario with a Black suspect. When this observation was removed, the analysis remained unchanged. Similar to experiment A, the rest of the outliers that were identified represented valid data points, specific to scenarios. For this reason (and to avoid changing the unit of measurement) outliers were not removed or transformed. Again, similar to experiment A, outliers existed for scenarios with White, Black and Hispanic suspects, so the analysis of racial and ethnic bias was not affected by a lack of normality. Alpha suppression was also slightly positively skewed across each racial/ethnic and difficulty category. The Kolmogrov-Smirnov test was significant, but a visual inspection showed
that the histograms and stem and leaf plots appeared normal, and no extreme outliers existed. Because the outliers appeared to represent valid data points they were not removed or transformed.

II. Variation between Participants

An unconditional means models run on reaction time showed that observations were not clustered around participants. The ICC was 0.03, indicating that 97% of the variance in the data was observed at the scenario level (within-participant variance). This was strong evidence that the assumption of independence of observations was not violated. A multi-variate regression model was the most suitable to analyze the impact of study variables on reaction time to shoot.

However, an unconditional means model run on alpha suppression confirmed that clustering of observations occurred within the data. The ICC was 0.37, showing that the proportion of total variance in alpha suppression explained by differences between subjects was 37%. This was strong evidence for individual differences in neurophysiological arousal. Because of this a multi-level mixed method model was the most suitable to analyze the impact of scenario level study variables on alpha suppression (see Appendix B for the documented R script). Unfortunately, because no participant level variables were recorded for the purpose of this analysis, it was impossible to determine what caused individual differences in alpha suppression.

The conflicting results of these unconditional means models suggest that alpha suppression (which appears to vary between participants) does not predict reaction time (which does not appear to vary between participants).

See Appendix C for lattices showing variation in reaction times and alpha suppression across scenarios for each participant.
III. Participant Neurophysiology

The EKG recordings of participants showed that heart rate increased significantly during scenarios \( (t = 44.33; df = 589; p < .001) \). The average heart rate immediately prior to a scenario was 77 beats per minute. The average heart rate during a scenario was 94 beats per minute. There were no significant differences in participant heart rate due to suspect race/ethnicity or scenario difficulty.

A multi-level mixed effects model was run to determine the impact of each study variable on alpha suppression. Suspect race/ethnicity significantly predicted alpha suppression; participants experienced greater alpha suppression when faced with a Black suspect \( (t = 3.48; df = 305; p < .001) \), than a White or Hispanic suspect. There was no significant difference in alpha suppression between facing White and Hispanic suspects. Scenario difficulty \( (t = 3.41; df = 305; p < .001) \) also significantly predicted alpha suppression. Participants experienced greater alpha suppression in journeyman scenarios than they did in naïve scenarios. There was no significant difference in alpha suppression between intermediate and naïve scenarios.

Suspect race/ethnicity also significantly predicted alpha suppression during null scenarios; even when no real threat existed participants experienced greater alpha suppression when faced with a Black suspect \( (t = 2.25; df = 181; p < .05) \), than a White or Hispanic suspect. There was no significant difference in alpha suppression between facing White and Hispanic suspects in null scenarios. Scenario difficulty did not predict alpha suppression in null scenarios.

IV. Reaction Time

Table 8 shows the average reaction time to shoot in response to each study variable. Hispanic suspects were shot the quickest after a threat was presented, followed by White suspects; with Black suspects shot the slowest. Intermediate level scenarios took the longest for
participants to respond to, followed by journeyman scenarios, with naïve scenarios taking the least time to respond to.

Table 8: Bivariate analysis on average participant reaction time in seconds to shoot after a threat was presented for each study variable in experiment B (n = 48)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Seconds to Shoot Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspect Race/Ethnicity</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.88 (0.27)</td>
</tr>
<tr>
<td>White</td>
<td>1.37 (0.09)</td>
</tr>
<tr>
<td>Black</td>
<td>1.61 (0.15)</td>
</tr>
<tr>
<td>Scenario Difficulty</td>
<td></td>
</tr>
<tr>
<td>Naive</td>
<td>0.59 (0.09)</td>
</tr>
<tr>
<td>Intermediate</td>
<td>1.78 (0.15)</td>
</tr>
<tr>
<td>Journeyman</td>
<td>1.33 (0.27)</td>
</tr>
</tbody>
</table>

A multi-variate regression model was run to determine the impact of each study variable on reaction time (see table 9). Overall the model was significant ($f = 12.25; df = 4, 563; p < .001$) and predicted 8% of the variance in reaction time ($r^2 = 0.08$).

Table 9: Summary of regression analysis for variables predicting reaction time to shoot in experiment B (n = 48)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Suspects</td>
<td>0.68</td>
<td>0.18</td>
<td>0.17**</td>
</tr>
<tr>
<td>Hispanic Suspects</td>
<td>0.17</td>
<td>0.71</td>
<td>0.01</td>
</tr>
<tr>
<td>Intermediate Scenarios</td>
<td>1.52</td>
<td>0.22</td>
<td>0.39**</td>
</tr>
<tr>
<td>Journeyman Scenarios</td>
<td>1.12</td>
<td>0.26</td>
<td>0.24**</td>
</tr>
</tbody>
</table>

**$= p < .001$
Participants took significantly (0.68 seconds) longer to shoot Black suspects than White suspects ($t = 3.85; p < .001$). There was no significant difference in reaction time between shooting Hispanic suspects and White suspects. Participants took significantly longer to shoot in journeyman ($t = 4.23; p < .001$) and intermediate ($t = 6.75; p < .001$) scenarios than they took to shoot in naïve scenarios (1.12 and 1.52 seconds longer respectively). A significant interaction existed between suspect race/ethnicity and scenario difficulty ($t = 2.00; p < .05$). A graphical depiction of the data shows an increase in reaction time in response to Black suspects in intermediate and journeyman scenarios (see figure 3).
Figure 2: Reaction time measured in seconds to shoot White, Hispanic and Black suspects by level of scenario difficulty in experiment B (n = 48)
C. Experiment C: The Influence of Fatigue on Racial/Ethnic Bias in Deadly Force Judgment and Decision Making

I. Tests for Normality

An examination of the data showed that reaction time was positively skewed in scenarios with White, Black and Hispanic suspects, in scenarios with suspects armed with guns and scenarios with suspects armed with knives, and in both intermediate and journeyman scenarios (participants in experiment C did not receive naïve scenarios). The Kolmogrov-Smirnov test was significant for each category. Similar to experiment B, there was one extreme outlier (over five standard deviations above the mean) on a journeyman scenario with a Black suspect. When this observation was removed, the analysis remained unchanged.

II. Variation between Participants

Unconditional means models run on each response variable showed that observations were not clustered around participants. As with experiment A, the intra-class correlation coefficients (ICC) for reaction time, error A and error B were all smaller than 0.01, indicating that the vast majority (over 99%) of variation in response variables occurred within participants. This was strong evidence that the assumption of independence of observations was not violated. Because of this multi-variate and binary logistic regression techniques were the most suitable. See Appendix C for a lattice showing variation in reaction times across scenarios for each participant.

III. Reaction Time

Average reaction time to shoot differed based on the racial/ethnic status of the scenario’s suspect (Table 10). Hispanic suspects were shot the quickest after a threat was presented;
followed by White suspects; with Black suspects shot the slowest. Participants took longer to shoot in journeyman scenarios than in intermediate scenarios, and shot scenario suspects armed with guns faster than suspects armed with knives. Participants shot at similar speeds during fatigue and rested conditions¹.

Table 10: Bivariate analysis on average participant reaction time to shoot for each study variable in experiment C (n = 30)

<table>
<thead>
<tr>
<th></th>
<th>Seconds to shoot</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean (SD)</td>
</tr>
<tr>
<td><strong>Suspect Race/Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.93 (0.05)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1.14 (0.10)</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>2.56 (0.40)</td>
<td></td>
</tr>
<tr>
<td><strong>Scenario Difficulty</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td>1.23 (0.15)</td>
<td></td>
</tr>
<tr>
<td>Journeyman</td>
<td>1.88 (0.24)</td>
<td></td>
</tr>
<tr>
<td><strong>Suspect Weapon</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gun</td>
<td>1.37 (0.15)</td>
<td></td>
</tr>
<tr>
<td>Knife</td>
<td>3.11 (0.66)</td>
<td></td>
</tr>
<tr>
<td><strong>Condition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatigue</td>
<td>1.63 (0.22)</td>
<td></td>
</tr>
<tr>
<td>Rest</td>
<td>1.69 (0.25)</td>
<td></td>
</tr>
</tbody>
</table>

A multi-variate regression model was run to determine the impact of each study variable on reaction time (see table 11). Overall the model was significant ($f = 10.68; df = 4, 156; p < .001$) and predicted 22% of the variance in reaction time ($r^2 = 0.22$).

¹ See Waggoner, Grant, Van Dongen, Belenky and Vila (2011—publication pending) for a full description of the impact of shift-work related fatigue on operational performance.
Table 11: Summary of regression analysis for variables predicting reaction time to shoot in experiment C (n = 30)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Suspects</td>
<td>1.34</td>
<td>0.32</td>
<td>0.31**</td>
</tr>
<tr>
<td>Hispanic Suspects</td>
<td>0.05</td>
<td>0.54</td>
<td>0.01</td>
</tr>
<tr>
<td>Suspects Armed with Knives</td>
<td>1.70</td>
<td>0.43</td>
<td>0.29**</td>
</tr>
<tr>
<td>Journeyman Scenarios</td>
<td>0.93</td>
<td>0.32</td>
<td>0.21**</td>
</tr>
</tbody>
</table>

** = p < .001

Participants took significantly (1.34 seconds) longer to shoot Black suspects than White suspects ($t = 4.14; p < .001$). There was no significant difference in reaction time between shooting Hispanic suspects and White suspects. Participants took significantly (0.93 seconds) longer to shoot in journeyman scenarios than they took to shoot in intermediate scenarios ($t = 4.23; p < .001$) (participants in this study did not respond to naïve scenarios). A significant interaction existed between suspect race/ethnicity and scenario difficulty; participants took the longest to shoot Black suspects in journeyman scenarios ($t = 29.63; p < .001$). Participants also took significantly (1.70 seconds) longer to shoot suspects armed with knives than they took to shoot suspects armed with guns ($t = 3.98; p < .001$). The interaction between condition and suspect race/ethnicity was not significant.

Figure 3 shows how little fatigue influenced participants’ reaction time to shoot White, Black and Hispanic suspects; participants had very similar reaction times across fatigued and rested conditions.
Figure 3: Reaction time measured in seconds to shoot White, Hispanic and Black suspects by condition in experiment C (n = 30)²

² Rest = rested condition, Work = fatigued condition
IV. Shooting an Unarmed Suspect

A binary logistic regression model was run with error A (shooting an unarmed suspect) as the dependent response variable (see table 12). Overall the regression model was significant ($x^2 = 31.77; df = 3; p < .001$) and predicted 23% of the variance in likelihood of shooting an unarmed suspect.

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Suspects</td>
<td>-3.22</td>
<td>1.03</td>
<td>0.04*</td>
</tr>
<tr>
<td>Hispanic Suspects</td>
<td>-19.76</td>
<td>8011.82</td>
<td>0.00</td>
</tr>
<tr>
<td>Journeyman Scenarios</td>
<td>-0.48</td>
<td>0.43</td>
<td>0.62</td>
</tr>
</tbody>
</table>

* = $p < .005$

Participants were less likely to shoot unarmed Black suspects than unarmed White suspects ($p < .005$). Using the Inverse Odds Ratio we calculated that participants were twenty five times less likely to shoot unarmed Black suspects than they were to shoot unarmed White suspects (Inverse Odds Ratio = $1 / 0.04 = 25.00$). There was no significant difference between the likelihood of shooting unarmed Hispanic suspects and unarmed White suspects. Scenario difficulty did not significantly predict shooting an unarmed suspect. There was however a significant interaction between suspect race/ethnicity and scenario difficulty; participants were most likely to shoot unarmed White suspects in journeyman scenarios ($p < .05$). As with reaction
time no interaction was found between condition and suspect race/ethnicity (participants were equally likely to shoot unarmed White suspects in both fatigued and rested conditions).

V. Failing to Shoot an Armed Suspect

A binary logistic regression model was run with error B (failing to shoot an armed suspect) as the dependent response variable (see table 13). Overall the regression model was significant ($\chi^2 = 28.96; df = 4; p < .001$) and predicted 40% of the variance in likelihood of failing to shoot an armed suspect.

Table 13: Summary of regression analysis for variables predicting failing to shoot an armed suspect in experiment C (n = 30)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Suspects</td>
<td>18.47</td>
<td>3168.85</td>
<td>1.05</td>
</tr>
<tr>
<td>Hispanic Suspects</td>
<td>0.62</td>
<td>8618.32</td>
<td>1.86</td>
</tr>
<tr>
<td>Journeyman Scenarios</td>
<td>-0.48</td>
<td>0.76</td>
<td>1.86</td>
</tr>
<tr>
<td>Suspects armed with Knives</td>
<td>2.63</td>
<td>0.77</td>
<td>0.001**</td>
</tr>
</tbody>
</table>

** = $p < .001$

However, the only variable that significantly predicted the likelihood of failing to shoot an armed suspect was weapon type. Participants were over one hundred times more likely to fail to shoot suspects armed with knives than suspects armed with guns ($p < .001$). Suspect race/ethnicity, scenario difficulty, and condition did not significantly predict the likelihood of failing to shoot an armed suspect.
A. Summary of Results

Experiment A tested police, military and civilian participants in a deadly force judgment and decision-making simulator. Subsequent analysis revealed that racial and ethnic bias existed, but in the opposite direction than would be expected from prior experimental studies (Plant and Peruche, 2005; Correll et al., 2007). Participants were significantly slower to shoot Black suspects, than Whites or Hispanics, were significantly more likely to shoot unarmed White suspects than Blacks or Hispanics, and were significantly more likely to fail to shoot armed Black suspects than Whites or Hispanics. Scenario difficulty also significantly affected decision making. Participants took longer to shoot and made more errors in scenarios with a higher level of difficulty. A significant interaction existed between the impact of suspect race/ethnicity and scenario difficulty on reaction time to shoot: the tendency to hesitate longer before shooting Black suspects was greatest at the highest level of scenario difficulty. A significant interaction also existed between the impact of suspect race/ethnicity and scenario difficulty on the likelihood of failing to shoot an armed suspect; participants were most likely to fail to shoot armed Black suspects at the highest level of difficulty. In sum, the participants in experiment A showed evidence of bias favoring Black suspects, rather than discriminating against them.

Experiment B recorded the neurophysiology of a sample of civilian participants as they responded to realistic scenarios in a deadly force judgment and decision making simulator. We then assessed whether participant neurophysiological arousal varied depending on the
race/ethnicity of the suspect they encountered. This analysis found that participants experienced greater neurophysiological arousal when faced with a Black suspect than when faced with a White or Hispanic suspect. This result was observed in both deadly force and null scenarios. Scenario difficulty also significantly affected neurophysiological arousal; participants experienced greater neurophysiological arousal during more difficult scenarios. This analysis also found that, despite greater arousal, participants were significantly slower to shoot Black suspects than White or Hispanic suspects (similar to the results of experiment A). Scenario difficulty also significantly affected reaction time to shoot; participants took longer to shoot in scenarios with a higher level of difficulty. Similar to experiment A, results showed a significant interaction between the impact of suspect race/ethnicity and scenario difficulty on reaction time to shoot. The tendency to hesitate longer before shooting Black suspects was greater in intermediate and in journeyman scenarios than it was in naïve scenarios. Too few errors were made in this experiment to enable an analysis of the impact of suspect race/ethnicity on shooting an unarmed suspect or failing to shoot an armed suspect. It is possible that the additional and extensive training session (with trainer feedback) that these participants received prior to testing reduced their likelihood of shooting unarmed suspects or failing to shoot armed suspects. In sum, participants in experiment B showed evidence of implicit racial bias against Black suspects, but behavioral bias favoring Black suspects.

Experiment C tested active duty police patrol officers for the impact of shift-work related fatigue on performance in a deadly force judgment and decision making simulator. Subsequent analysis found that fatigue did not have a significant impact on participant racial or ethnic bias in decisions to shoot. Participants responded to Black suspects in similar ways in both the fatigued and rested conditions. This was also the case for White and Hispanic suspects. This analysis
found evidence of bias favoring Black suspects: participants were significantly slower to shoot Black suspects than White or Hispanic suspects, replicating the findings from experiments A and B. Participants were also significantly more likely to shoot unarmed White suspects than Black or Hispanic suspects, replicating the findings from experiment A. Scenario difficulty significantly affected reaction time to shoot (participants took longer to shoot in journeyman scenarios), but did not predict shooting errors. Participants in experiment C only responded to intermediate and journeyman scenarios, while participants in experiments A and B also responded to naïve scenarios. It is possible that this explains why scenario difficulty significantly increased errors for participants in experiment A but not experiment C. In sum, the participants in experiment C showed evidence of bias favoring Black suspects.

Across all three experiments the majority of variation in reaction time and shooting errors occurred within-subject (scenario-driven variation), indicating that participants responded to scenarios in similar ways, regardless of whether they were civilians, police, or military personnel. This finding is in contrast to Correll and his colleagues’ (2007) finding that police are significantly less likely to make errors than civilians, and may reflect differences in the challenges presented by Correll’s video game design and this study’s more complex deadly force judgment and decision making design. It is important to note that although our research found that police, military, and civilian participants had similar reaction times to shoot and made similar shooting errors; this did not mean that police and military participants were not better than civilian participants at deadly force judgment and decision making. It is possible that police and military participants had higher bullet hit rates and were less likely to hit bystanders than civilian participants. These dependent variables are measures of deadly force judgment and
decision making performance that were not considered to have specific relevance to racial and ethnic bias, which is why they were not analyzed.

**B. Review of the Results in Light of Prior Research**

The results from these experiments are markedly different to the results of prior experimental research. Participants across all three experiments took significantly longer to shoot Black suspects than White or Hispanic suspects, particularly in the most difficult scenarios. This finding is in direct contrast to prior experimental findings that participants are significantly quicker to shoot Black suspects (Correll et al., 2007). Participants in experiments A and C were significantly more likely to shoot unarmed White suspects, and participants in experiment A were also more likely to fail to shoot armed Black suspects. These findings are in direct contrast to Plant and colleagues who found that participants were more likely to shoot unarmed Black suspects and fail to shoot armed White suspects, with a lessening of racial bias after repeated randomized trials (Plant et al., 2005). They are also in direct contrast to Ho’s (1993) research finding that officers failed to shoot armed White suspects significantly more often than armed Black suspects during training (Ho, 1993). It is possible that the differences between our results and prior experimental results reflect differences in the challenge participants faced with a more immersive and realistic research design; or that historical changes in law, public policy, education, training, and cultural beliefs have sensitized police and the general public to the pernicious nature of racial and ethnic bias.

The results of experiment B are both in keeping and in contrast to prior experimental research. Our results show that Black suspects elicited greater neurophysiological arousal than White suspects. This finding is consistent with prior experimental research (Ito and Urland,
Whereas Correll and his colleagues found that Black suspects elicited a greater P200 response, we found that Black suspects elicited greater alpha suppression in participants, another indicator of neurophysiological arousal. However, the participants in experiment B took significantly longer to shoot Black suspects, despite displaying greater neurophysiological arousal in response to Black suspects than in response to White or Hispanic suspects. This is in direct contrast to Correll’s finding that neurophysiological arousal predicted behavioral bias on their video game design (Correll et al., 2007). We also investigated the possibility of implicit ethnic bias against Hispanic suspects. We found that Hispanic suspects did not elicit significantly greater alpha suppression than White suspects, nor were there significant differences in reaction times to shoot White and Hispanic suspects. In fact across all three experiments there was no evidence of ethnic bias either against or favoring Hispanic suspects.

The findings reported in this dissertation also bear relevance to research based on incident reports. Our findings are contrary to the recent implication that the police are racially biased based on the disproportionate number of Black police officers who have been shot in mistaken identity shootings (Stone et al., 2010). They are also contrary to Mayer’s (1980) finding that a greater proportion of Black suspects than White or Hispanic suspects shot by the police were unarmed in Los Angeles during a five year period (Mayer, 1980). This study found the opposite; a greater proportion of unarmed suspects shot by the participants in these experiments were White. Our findings undermine the belief that Black skin color increases the likelihood that the police will shoot in deadly encounters. In fact, the results suggest the opposite: participants were more hesitant to shoot a Black suspect than a White or Hispanic suspect.
C. Contributions to the Understanding of the Bias and Threat Hypotheses

The results of these three experiments provide complex and nuanced insight into the bias and threat hypotheses. The findings from experiment A support the bias hypothesis, although not in the way the hypothesis was originally intended. Participants showed evidence of bias favoring Black suspects over White suspects. The impact of ethnic bias on participants’ decisions to shoot is not as clear. Although Hispanic suspects tended to be shot the quickest, these results were not statistically significant. Overall, Hispanic suspects were treated similarly to White suspects, with the exception that unarmed Hispanic suspects were not shot as frequently as unarmed White suspects. It is possible that the fewer scenarios featuring Hispanic suspects may have reduced the number of opportunities participants received to shoot unarmed Hispanic suspects.

The neurophysiological findings from experiment B provide clear-cut support for the bias hypothesis as it was originally intended. Civilian participants experienced greater neurophysiological arousal in response to Black suspects, indicative of implicit racial biases associating Black suspects with threat. This result is strengthened by the observation that Black suspects elicited greater alpha suppression than White suspects in null scenarios where no actual threat existed. Hispanic suspects did not elicit significantly different alpha suppression than White suspects, indicating that Hispanics were not considered to be more threatening than Whites. Of critical importance however, was the finding that implicit racial bias did not predict behavioral bias in the simulator. Participants were slower to shoot Black suspects than Whites or Hispanics. This suggests that neurophysiological arousal does not necessarily correspond with behavioral bias.
The findings from experiment C provide support for the bias hypothesis, but again, not in the direction it was originally intended. Police participants appeared to favor Black suspects in both fatigued and rested conditions.

Takagi summarized the bias hypothesis with his statement that “the police have one trigger finger for whites and another for blacks” (Takagi, 1974, p30). The results of the three experiments presented in this dissertation suggest that this is true, however not in the way that Takagi intended. For the participants in these experiments the “trigger finger” for Black suspects was the more hesitant.

D. Policy Implications

It is possible that the collective findings from the three experiments presented here indicate a growing cultural awareness that Blacks and crime are not synonymous. However the results from experiment B show participants displayed greater neurophysiological arousal in response to Black suspects (indicating implicit racial bias), while still being more hesitant to shoot. This may indicate a growing concern over the treatment of Black suspects, without actually implying a lack of racial bias.

The results may also indicate self-awareness or a desire to appear unbiased. On this point it is important to note that participants were not aware that their responses were being analyzed for racial and ethnic bias. Furthermore, research suggests that self-awareness and restraint are reduced under conditions of fatigue (Kilgore et al., 2005; Durmer and Dingis, 2005). The results of experiment C show that police participants tended to favor Black suspects in rested and fatigued conditions. These points suggest that the desire to appear unbiased in the experiment was limited.
For police and military participants, the findings may reflect an administrative effect; many law enforcement agencies have tightened their formal policies and increased cultural awareness training, due to public pressure and awareness that consequences of deadly force encounters tend to be graver when the suspect in question is a member of a racial or ethnic minority (White, 2001). This relates to Inn et al.’s finding from the 1970s that officers fired more shots at White suspects than at Black suspects, suggesting “perhaps, police behave more cautiously with Blacks because of departmental policy or public sentiment concerning treatment of Blacks” (Inn et al., 1977, 35).

The New York State Task Force report on Police-on-Police Shootings released in 2010 implied that the police are racially biased, based on the disproportionate number of “officers of color” who have been killed in mistaken identity, police-on-police shootings over the past fifteen years (Stone et al., 2010). The report cites Correll’s research in support of this implication; focusing on the finding that police officers display the same unconscious racial biases that civilians tend to display (although Correll has consistently found that police officers are only racially biased in their reaction times, not in their shooting errors). The results from the current research suggest that even if implicit racial bias exists, it does not predict behavioral bias in a deadly force judgment and decision-making simulator – a research design with greater relevance to deadly encounters in the field than a “shoot/don’t shoot” button-pressing design.

Overall, the results of the three experiments presented in this dissertation suggest that cultural awareness, tightened departmental policy, or perhaps self-awareness may be having a positive impact. Police, military and civilian participants showed no signs that suspect racial or ethnic minority status increased the likelihood of shooting in a deadly force judgment and
decision-making simulator. It is possible that concern over the treatment of racial and ethnic minority suspects, and consequent pressure on the police to guard against bias, may be working.

E. Limitations

The experiments presented in this study have a number of limitations. First, the scenarios used in this research are realistic and complex, which increases external validity, but also tends to decrease experimental control compared to other studies in which stimulus prompts are exactly the same except for suspect race. For example it is possible that variation in actors’ performances in the scenarios may have created variation in participant decisions during testing that was attributed to suspect race or ethnicity. Furthermore, because more scenarios were filmed with White suspects than Black suspects, and more scenarios were filmed with Black suspects than Hispanic suspects, participants received more opportunities to shoot White suspects than Blacks or Hispanics. Consequently, is possible that participants had more opportunities to shoot unarmed White suspects than unarmed Black or Hispanic suspects (consistent with our significant study finding that participants were more likely to shoot unarmed White suspects). However, by the same logic, they should have also had more opportunities to fail to shoot armed White suspects than armed Black or Hispanic suspects (contrary to our significant study finding that participants were more likely to fail to shoot armed Black suspects). It is possible that subtle differences exist between the scenarios that may have influenced how threatening a White, Black, or Hispanic suspect appeared. For example, although both White and Black suspects were represented in hostage scenarios, Hispanic suspects were not (see Appendix A for a full description of scenarios). As participants tended to take longer to shoot in hostage scenarios this may explain why Hispanic suspects were shot quickest overall (although this result was not
statistically significant). It is possible that the smaller number of scenarios depicting Hispanic suspects, compared to the number of scenarios with Black or White suspects, limited the power of our experiments to find an influence of ethnic bias on deadly force judgment and decision-making outcomes. In sum it is possible that differences between the scenarios may have created variation in participant performance that was not controlled by scenario difficulty, and was attributed to suspect race or ethnicity. This limitation will be further addressed in the future directions section below.

Second, generalizability from these three experiments should not be assumed. Only six military participants were tested, limiting the generalizability of these results to that population. Overall thirty-six police participants were tested. The majority of officers were White males, limiting the generalizability of the results to larger, more diverse police departments. Seventy-two civilian participants were tested. Although a larger number were female, the majority were White, again limiting the generalizability of the results to more racially and ethnically diverse populations. It is important to caveat that, although each outlier represented a valid data point and the analysis was unchanged by removing extreme outliers, the data was not normally distributed. It is possible that larger sample sizes may have resulted in a more representative snapshot of the population. Despite the limitations in sample sizes, results were replicated across the three experiments, strengthening research reliability.

Third, it is possible that the limited racial and ethnic diversity in Spokane influenced the way in which participants responded to suspects in the scenarios. Only 3.6% of the population in Washington State is Black, compared to the national average of 12.6%. The population of Hispanics in Washington State is more representative of the national average: 11.2% and 16.3% respectively. It is possible that participants from Spokane may be less racially biased than a
national sample because they are less likely to encounter Blacks. However, contact theory suggests that interpersonal contact between majority and minority group members is one of the most effective ways to reduce prejudice (Allport, 1954; Brown and Hewstone, 2005). Contact requires equal status between group members, common goals or interests, acquaintance potential, and the support of authorities, laws or customs to successfully reduce racial and ethnic bias. Without these criteria it is possible that contact between groups could exacerbate prejudice. Although it could be argued that the limited racial diversity in Spokane made participants less likely to be biased against Black suspects, it could also be argued that they had less potential for overcoming prejudice through positive contact with racial minority members.

It could also be argued that the history of bigotry surrounding Spokane may counteract any potential lack of bias through limited exposure to diversity. The Neo-Nazi organization “Aryan Nations” has a stronghold in Coeur D’Alene, and, until recently, had its headquarters in Hayden, both cities in close proximity to Spokane (Southern Poverty Law Center, 2011). Spokane itself has several radical Christian organizations that have been identified as anti-Semitic and racist hate groups (Southern Poverty Law Center, 2011). In sum, it is possible that the relative lack of racial diversity in Spokane may have resulted in participants being less inclined to be racially biased against Black suspects, but it is also possible that Spokane’s proximity to racist hate groups may have counteracted this effect.

Forth, measuring racial and ethnic bias was not the primary research goal of any of the three experiments. The scenarios were not matched by race/ethnicity but were randomly assigned. It is possible that a more careful selection of scenarios may have provided a more precise measurement of racial and ethnic bias. The major benefit of secondary use of the data was that neither the participants nor the researchers were aware that their responses were being
analyzed for racial or ethnic bias, limiting the likelihood that participant desire to appear unbiased influenced the results.

Finally, participant characteristics were not analyzed for their impact on racial and ethnic bias in decisions to shoot. Participant age, gender, race, ethnicity, and years of combat experience may have influenced decisions to shoot. In particular, it is possible that younger participants may have been quicker to shoot, given the greater likelihood of familiarity with first-person shooter video games. Having said that, the vast majority of variation in participant responses was within-participant or scenario-driven, suggesting that between participant differences (such as age, gender, race, ethnicity, and years of combat experience) had very little impact on reaction time to shoot or shooting errors.

**F. Future Directions**

The scenarios used in the three experiments presented in this dissertation were not developed specifically to measure racial or ethnic bias. Scenario difficulty was controlled, allowing for an estimate of the impact of suspect race/ethnicity on decision making. However, subtle complexities may have existed that clouded the influence of suspect race or ethnicity on participant decisions to shoot. At the WSU Simulated Hazardous Operational Tasks Laboratory we hope to develop a set of scenarios that are exactly replicated for White, Black and Hispanic suspects. This may enable a more precise measurement of racial and ethnic bias in a deadly force judgment and decision-making simulator.

Future research will take three stages. In stage 1 we hope to develop a set of scenarios that will have greater external validity than the stimulus prompts used in traditional “shoot/don’t shoot” button pressing designs, yet have greater experimental control than the scenarios used in
the experiments presented in this dissertation. As with the current scenarios, realism will be maximized by basing scenario content on data collected from the last thirty years of officer involved shootings, hiring professional actors, and filming in naturalistic settings. Experimental control will be maximized by scripting scenarios and carefully replicating each scenario with White, Black and Hispanic actors. This will create three versions for each test scenario with White, Black and Hispanic suspects. In stage 2 we hope to test police and civilian participants for racial and ethnic bias using the set of scenarios developed in stage 1 as stimulus prompts. Then, in stage 3 we hope to compare the results from experiments using the new set of scenarios to prior experimental results from both traditional “shoot/don’t shoot” designs, and the three experiments presented in this dissertation. By developing more controlled scenarios to measure racial and ethnic bias in deadly force judgment and decision making we hope to shed even more light on the role that status characteristics play in the criminal justice system.

G. Conclusions

The goal of this dissertation was to analyze the influence of suspect race and ethnicity on decisions to shoot in deadly force judgment and decision-making simulators using realistic scenarios as stimulus prompts. The results of three experiments were reported. Experiment A tested police, military and civilian participants for decisions to shoot and found evidence of bias favoring Black suspects. Experiment B monitored participant neurophysiology during deadly force judgment and decision making and found evidence of implicit racial bias against Black suspects, but evidence of behavioral bias favoring Black suspects; suggesting that implicit bias may not translate into racial or ethnic bias in deadly force judgment and decision making outcomes. Experiment C tested police officers for the impact of shift-related fatigue on decisions
to shoot, and found evidence of bias favoring Black suspects in both the fatigued and rested conditions, suggesting that fatigue does not influence racial and ethnic bias in decisions to shoot. The findings from these three experiments are an important contribution to the research literature on racial and ethnic bias in police use of deadly force.

By advancing the rigor of experimental designs, additional light is shed on the broad issue of the role that status characteristics play in the criminal justice system. Using deadly force judgment and decision-making simulators with engaging, arousing, and realistic scenarios as a platform to measure racial and ethnic bias is both more controlled than research based on incident reports, and more externally valid than experimental research using “shoot/don’t shoot” button-pressing designs. This novel research design provides a bridge between highly controlled experimental studies and research based on reports of real life encounters. In turn this research represents a step forward in our ability to accurately assess the extent of racial and ethnic bias in police officers’ decisions to use deadly force. By using an externally valid research design, the results of the three experiments presented in this dissertation challenge the results of less robust experimental designs. These results suggest that neither of the two dominant hypotheses is sufficient to explain racial and ethnic bias in police use of deadly force; despite evidence of implicit racial bias, participants displayed significant bias favoring Black suspects in their decisions to shoot. Future research should assess whether these findings hold among other populations of research subjects, determine whether bias favoring Black suspects is a consequence of administrative measures (e.g., education, training, policies and laws), and identify the cognitive processes that underlie this phenomenon.
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Step 1- Determining the Levels of Scenario Difficulty

- Deciding on the number of difficulty levels we wanted to explore. This resulted in 3 levels: easy, medium and hard.
- Deciding on a naming convention for the levels that would have relevance to law enforcement. This resulted in: naïve, intermediate and journeyman.
- Deciding what would distinguish the levels of difficulty from each other. Perrow’s ‘Normal Accidents’ concept of complexity and coupling was vital to this process. As complexity increased and coupling tightened the level of difficulty went up. Number of people in the scenario, number and type of weapons and level of noise (intoxicated and/or abusive behaviour) represented complexity. Distance from offender, visibility and speed/subtlety of movement represented coupling.
- Visibility and distance from suspect did not need to be considered in the filming of the scenarios as they are adjustable on the simulators (lighting ‘good’/’poor’ and standing the officer 17 or 10 feet from the simulator screen).
- ‘Threat congruity’ had relevance to levels of difficulty. We decided on two types of threat, actual and perceived threat. Actual threat was determined by the need to use deadly force in a scenario. Perceived threat was the level of danger that was apparent in a scenario. As the levels of difficulty went up the congruence between actual and perceived threat went down. That is for a naïve scenario perceived threat often linked with actual threat, whereas for a journeyman scenario the situation could seem non-threatening and
result in a deadly force situation. For simplicity we decided on two levels of threat: high and low.

- It should be noted that every aspect of difficulty (speed and subtlety of movement, number of people, visibility etc.) did not systematically increase as level of difficulty increased. We wanted to keep in mind variety and realism so as the levels increase the scenarios overall got harder to respond to, just not in every way as we wanted to avoid all of the scenarios feeling the same.

**Step 2- Determining the Content of Scenarios**

- The types of situations we wanted to represent were the most typical police deadly force situations, based on the LEOKA data. We decided on three types of situation: vehicle stop, suspicious person stop and disturbance call (shortened to a naming convention of ‘vehicle’, ‘suspicious person’ and ‘dwelling’).

- Variation was maximized by using different locations and vehicles. Location was varied within each type of situation. ‘Suspicious person’ and ‘dwelling’ were broken down into: suspicious person (parking lot, alley and fenced yard), dwelling (house and gas station) for variety. Vehicles used included automobiles, pickup trucks and minivans.

- The decision on the number of scenarios to be filmed, was limited by the number of person-days that we could afford and the number of scenarios we estimated could be filmed per day. We also decided to create twice as many naïve scenarios as intermediate or journeyman scenarios because we expected that it would take substantially longer for naïve subjects’ performance to plateau, and we wanted to be able to avoid re-presenting subjects with the same scenario more than once to the extent possible. In addition to one
day of travel and location review, we filmed scenarios for 5 days. At the end of the fifth
day, we had filmed 60 scenarios. Of these, there were 20 of each type (vehicle,
suspicious person, dwelling), with 10 naïve, 5 intermediate and 5 journeyman per type.
There were an additional 4 ‘bonus’ scenarios, one naïve, one intermediate and one
journeyman.
• Null scenarios, those where deadly force was not required, accounted for roughly 30% of
all scenarios. We decided on this proportion in order to avoid having officers always
expect to shoot. These null scenarios accounted for 30% of naïve, 35% of intermediate
and 25% of journeyman scenarios. We hope in the future to further differentiate between
situations in which shooting was required, those in which shooting would have been
within rules of engagement that we provide to subjects—but could sometimes be avoided
with luck and/or finesse, and those in which shooting was inappropriate.
• Representing crime demographics (taken from FBI deadly force reports) that show the
race, age and gender breakdown of the use of deadly force against police officers. This
resulted in three categories of ratios: race (white, black, Hispanic at a ratio of roughly
5:3:2), gender (male and female at a ratio of roughly 8:2) and age (17-25 and 25-40 at a
ration of roughly 8:2).
• We decided to represent intoxication in the scenarios for realism as between 60-80% of
all police assailants have consumed or are under the influence of alcohol or drugs
(Pinizzotto, Davis and Miller, 2006). This was roughly split into two types of intoxication
‘sluggish’ and ‘abusive’. Sluggish intoxication was shown by slurred speech and lolling
head and was generally used in naïve scenarios as it slowed movement (making it
generally easier to respond to a weapon etc). Abusive intoxication was shown by
swearing, obnoxious language and raised voices. This type of intoxication was generally used in intermediate and journeyman scenarios as it increased complexity (making it generally harder respond to a weapon etc).

- The decision about what type of clothing we wanted used in the scenarios was based in large part on advice from the AIS team because of their extensive experience with filming realistic scenarios. Actors provided their own clothing and we requested that they come dressed in “street casual” clothing that was neutral, loose-fitting and could realistically conceal a handgun or other weapon.

**Step 3- Coordinating with the AIS Film Crew**

- After an initial scenario matrix was created detailing a rough breakdown of number and content of scenarios it was sent to the AIS film crew for feedback.

- Upon advise the matrix was turned into a written document with more detail, including the key concepts described in steps 1 and 2 above. The document was organized by: vehicle (naïve, intermediate, journeyman), street (naïve, intermediate, journeyman) and dwelling (naïve, intermediate, journeyman).

- Upon further advise the organization of the document was altered to make filming easier. The revised organization of the document was as follows: vehicle (1-20), street (parking lot 1-8, alley 9-13, fenced yard 14-20), dwelling (house 1-14, gas station 15-20)

- Due to the revised organization a separate note was made on difficulty level (as the document’s organization no longer made this obvious).

- AIS also created an ‘AIS Filming Schedule’ document that detailed times, locations, actors, props and other important information.
Step 4- Deciding on Locations

- As the types of scenario were decided the next step was to find actual locations where the scenarios could be filmed.

- The first location to be finalized was the gas station. Harper Conoco (exit 276 off the I-90), owned by Deborah Harper, was volunteered due to a personal relationship with one of the researchers on the Simulated Hazardous Operational Tasks laboratory team.

- The second location to be finalized was the house. One of the researchers on the team (Lois James) volunteered their house for filming.

- The street and vehicle scenarios needed a reasonably secluded location where interference from the public would not be a concern. Furthermore due to the planned date of filming (the 2nd to the 6th of February) the weather was a concern so we needed a backup plan in case filming outside proved impossible.

- Upon advise from Jordan Ferguson of the Spokane Police Department the Jensen–Byrd building was chosen. The Jensen-Byrd is a large, vacant, warehouse style building owned by Washington State University. It met all of the requirements, having numerous parking lots, an ideal area for the ‘alley’ scenarios, ample variety for vehicle stops and locations inside the building in case of bad weather.

Step 5- Deciding on Role Players

- We decided to set aside a portion of the overall budget to hire actors for the week of filming. This decision was based on the desire to keep the scenarios as realistic as
possible and also due to time constraints (60 scenarios to be filmed in 5 days) where actors are generally quicker to follow direction, get into character, etc.

- Lonny Waddle, a contact at Washington State University and a personal acquaintance of Professor Vila’s was contacted for his experience in the film industry. He put us in contact with Becky Reiley from ‘Big Fish NW Talent Representation’, who supplied us with actors for the week.

**Step 6- Deciding on Props**

- For weapons the AIS crew brought their own modified handguns and knives.
- The knives needed to be blunt for safety and big so they could easily be picked up on camera.
- The handguns were modified glocks. There was no way they could have been used as real firearms, however one of them made a loud noise so all parties handling that gun were cautioned not to shoot it too close to other persons ears. More realistic gunshot sounds were put into scenarios during film production.
- The “null scenario” props were a wallet and registration papers for the vehicle scenarios and a wallet and empty beer bottles and cans for the street and dwelling scenarios. The idea was that a wallet, registration papers, a bottle or a can, if produced by the suspect quickly and/or in a threatening manner, could be mistaken for a weapon, causing incorrect use of deadly force.
- For the dwelling (house) scenarios a baby doll wrapped in a blanket was also used. The sound of a baby crying would be put into the scenarios utilizing this prop during film production.
• For the vehicle scenarios a car, a minivan, an SUV and a pick up truck were necessary props.

• Furthermore a WSU campus security car was utilized as the police car.

**Step 7 - Meeting Security and Law Enforcement Requirements**

• Campus security was informed of the dates and times of filming in and around the Jensen-Byrd building.

• For the first day of filming (vehicle stops) Jordan Ferguson of the Spokane PD was on hand in case of any trouble. When he was confident there would be no cause for public concern we were given the all clear to film without police presence.

• Spokane PD dispatch was informed of the dates and times of all filming in the city area.

• Spokane County dispatch was informed of the dates and times of filming in the gas station and house (which were outside of the Spokane city limits)

• Furthermore upon advise from Jordan Ferguson a County Sheriff was hired for the evening of the gas station filming, in case of public concern. This was organized through Lori Lucas of the Spokane Sheriffs department.

**Step 8 - Filming the Scenarios**

• The film crew arrived on the 1\(^{st}\) of February, 2009.

• At 12.30 on the 1\(^{st}\) Lois James met with David McLean, Joe Evans and Adam Rosencrantz from AIS to scout the locations (to make sure they were suitable for filming by AIS standard) and discuss any last minute issues.

• At 11.00 on the 2\(^{nd}\) filming commenced outside the Jensen-Byrd building.
• The actors were instructed by Joe Evans (AIS director) that the camera approaching them would be the police officer so to direct all communication strait at the camera.

• The actors were given direction (for example act intoxicated, move suddenly, some dialog etc) however no dialog was scripted to preserve realism.

• The actors were also told to imagine the police officer (represented by the camera) was actually issuing commands (for example ‘can I see your licence and registration’ for vehicle stops, or ‘you need to show me your hands’ for street stops etc) and to respond accordingly.

• For each deadly force scenario a suspect attack was filmed (the actors shot strait at the camera or lunged with the knife strait at the camera) and a police shooting was filmed (on command the actors performed a death scene).

• In certain scenarios with hostage/victim situations a victim death scenario was filmed (the suspect attacked the victim in the scenario and the victim performed a death scene) prior to a police shooting being filmed.

• Due to the quality of the actors most scenarios were filmed within three takes.

• As the scenarios were filmed quite quickly we filmed various additional scenarios (one hostage situation, one parking lot situation and two gas station robbery situations) that the AIS crew had developed.

• Slight variations were made from the scenario content description and AIS film crew schedule due to having extra time and expert advise from the AIS crew. The documents in the Appendices represent the final modified scenarios and schedule.

• The filming on the 5th of February (street-fenced yard) was filmed inside the Jensen-Byrd, all other street scenarios were filmed outside.
Step 9- Post Filming

- After the filming was completed and the AIS crew had returned to Seattle all of the documents were updated accordingly.

- A release form was received from the AIS crew and sent to Big Fish for the actors to sign and return to Lois James.

- A date was set for the content review in Spokane with the AIS crew- April 8th-9th, to go over any last minute changes before final production. Professor Vila, Lois James, Jason Moore, Terry Wollart from the simulation lab at the federal law enforcement training centre and representatives from Advanced Brain Monitoring (AMB), and AIS attended the content review.

- Clips from the finished scenarios were sent to Big Fish for the actors involved to include in their portfolios.

- A log of all the planning and execution of the scenarios was created for future reference (current document).

Step 10- Initial Content Review

- On the 8th of April representatives from the WSU Simulated Hazardous Operational Tasks laboratory research team (Professor Bryan Vila, Lois James and Jason Moore) met with representatives from AIS (Joe Evans and David McLean), AMB (Robin Johnson, Adrienne Behneman and Eugene Davis) and with Terry Wollart from the federal law enforcement training centre to review the content of the scenarios.
As the scenarios were played Bryan Vila, Jason Moore and Terry Wollart (due to their expertise in policing) rated each scenario for difficulty, judging it to be naïve, intermediate or journeyman. The criteria given for judging difficulty level was based on the complexity of the scenario (number of people, level of noise etc) and the coupling of the scenario (speed and subtlety of movement, confined space etc).

The ratings that Bryan Vila, Jason Moore and Terry Wollart assigned to each scenario were then compared to the original rating designed by Lois James. Of the 64 total scenarios only 5 were more than one level of difficulty from their original rating. These scenarios are Vehicle 16, Dwelling 1, 2, 4 and 15. It was decided that they would not be changed until the next set of ratings scheduled for summer 2009.

Other points brought to light in the content review were that 2 scenarios (Vehicle 11 and Street 20) needed to be cut shorter and that Dwelling 12 and 14 still needed baby crying sound added.
Key Concepts
(a breakdown of the variables involved)

Type of Scenario
- Vehicle (automobile stop)
- Street (suspicious person on the street)
- Dwelling (disturbance call)

Level of Difficulty
- Naive (easy)
- Intermediate (medium)
- Journeyman (hard)

Type of Threat
The higher the level of difficulty, the less congruity between actual and perceived threat
- Actual (high / low)
- Perceived (high / low)

Variables
Race and Gender: Black, White, Hispanic / Male, Female
Visibility: Good or poor (adjustable on the simulators)
Distance from suspect: 17 feet / 10 feet (adjustable by moving the officers’ position)
Speed and Subtlety of movement: Increase with level of difficulty
Intoxication: Either displayed as ‘sluggish’ with slurred speech and lolling head, or ‘obnoxious’ and yelling

Clothing: All loose fitting and neutral coloured, ‘street casual’

**Note on Numbering and Difficulty Level** (within the different types of scenarios)

**Vehicle:**
- 01-10 = ‘Naïve’
- 11-15 = ‘Intermediate’
- 16-20 = ‘Journeyman’

**Street (parking lot):**
- 01-04 = ‘Naïve’
- 05-06 = ‘Intermediate’
- 07-08 = ‘Journeyman’

**Street (alley):**
- 09-11 = ‘Naïve’
- 12 = ‘Intermediate’
- 13 = ‘Journeyman’

**Street (fenced yard):**
- 14-16 = ‘Naïve’
- 17-18 = ‘Intermediate’
- 19-20 = ‘Journeyman’

**Dwelling (house):**
- 01-07 = ‘Naïve’
08-11 = ‘Intermediate’
12-14 = ‘Journeyman’

Dwelling (gas station) 15-17 = ‘Naïve’
18 = ‘Intermediate’
19-20 = ‘Journeyman’

**Roll Players and Props Needed** (within the different types of scenarios)

**Vehicle**
Total Roll Players: 1 white male, 1 white female, 1 black male, 1 Hispanic male and 1 Hispanic female

Props: Car, SUV, minivan, pickup-truck, handgun, knife, wallet, registration papers

**Street (Parking Lot)**
Total Roll Players: 1 white male, 1 white female, 1 Hispanic male and 1 black female

Props: Handgun, knife, wallet, empty beer bottles and cans

**Street (Alley)**
Roll Players: 1 white male, 1 black male and 1 white female

Props: Handgun, knife, wallet, empty beer bottles and cans
Street (Fenced Yard)

Total Roll Players: 1 white male, 1 white female and 1 black male

Props: Handgun, wallet, knife, empty beer bottles and cans

Dwelling (House)

Total Roll Players: 1 white male, 1 white female, 1 black male, 1 black female

Props: Handgun, knife, empty beer bottles and cans, baby doll wrapped in a blanket

Dwelling (Gas Station)

Total Roll Players: 1 white male, 1 white female, 1 black male, 1 Hispanic male

Props: Handgun, Knife, six-pack of beer
Scenario Content Description

Note: Scenarios not used in these experiments are excluded

Name: SHOT_Veh_01_N  
Difficulty: Naive  
Synopsis: The vehicle contains a Black male driver, no passengers. The suspect appears intoxicated; his movements are sluggish. He appears to search for his license then slowly pulls out a handgun, points it at the officer and opens fire.

Name: SHOT_Veh_02_N  
Difficulty: Naive  
Synopsis: The vehicle contains a White male driver, no passengers. The suspect appears intoxicated; his movements are jumpy and erratic. He appears to search for his ID and pulls out his wallet.

Name: SHOT_Veh_03_I  
Difficulty: Intermediate  
Synopsis: The vehicle contains a White female driver, no passengers. She appears to search for her license and registration, then pulls out a handgun, points it at the officer and opens fire.

Name: SHOT_Veh_04_N  
Difficulty: Naive  
Synopsis: The vehicle contains a White male driver, no passengers. He appears to search for his license and registration then pulls out a handgun, points it at the officer and opens fire.

Name: SHOT_Veh_05_N  
Difficulty: Naive  
Synopsis: The vehicle contains a Black male driver, no passengers. He appears to search for his license and registration then pulls out his wallet, followed by his registration papers.

Name: SHOT_Veh_06_N  
Difficulty: Naive  
Synopsis: The vehicle contains a Hispanic male driver, no passengers. The suspect appears intoxicated; his movements are sluggish. He appears to search for his registration papers then pulls out a handgun, points it at the officer and opens fire.
<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_Veh_07_N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Naive</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>The vehicle contains a White female driver, no passengers. The suspect appears intoxicated; her movements are sluggish. She appears to search for her registration papers then pulls out a handgun, points it at the officer and opens fire.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_Veh_08_N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Naive</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>The vehicle contains a White male driver, no passengers. The suspect appears intoxicated; his movements are sluggish. He appears to search for his registration papers then pulls out his license and registration.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_Veh_09_N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Naive</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>The vehicle contains a Black male driver, no passengers. The suspect appears intoxicated; his movements are sluggish. He appears to search for his registration papers then pulls out a handgun, points it at the officer and opens fire.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_Veh_10_N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Naive</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>The vehicle contains a White male driver, no passengers. He appears to search for his registration papers then pulls out a knife and lunges out of the window at the officer.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_Veh_11_I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>The vehicle contains a White male driver and one Hispanic male front seat passenger. The passenger appears intoxicated; he is abusive. The driver appears to search for his registration papers then pulls out a handgun, points it at the officer and opens fire.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_Veh_12_I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>The vehicle contains a White male driver, one Hispanic male front seat passenger and one Black male back seat passenger. The passengers both appear intoxicated. The driver appears to search for his registration papers then the back seat passenger pulls out a wallet and shoves it out of the back seat window at the officer.</td>
</tr>
</tbody>
</table>
Name: SHOT_Veh_13_I  Difficulty: Intermediate  Synopsis: The vehicle contains a Hispanic female driver, no passengers. The driver appears to search for her registration papers, seems very compliant, then quickly pulls out a handgun, points it at the officer and opens fire.

Name: SHOT_Veh_14_I  Difficulty: Intermediate  Synopsis: The vehicle contains a Black male driver, no passengers. The driver appears to search for his registration papers, seems very compliant, then quickly pulls out a handgun, points it at the officer and opens fire.

Name: SHOT_Veh_15_I  Difficulty: Intermediate  Synopsis: The vehicle contains a White male driver, a front seat Hispanic female passenger and a back seat White female passenger. The driver produces a knife, saying he wants to make it known to the officer that he means no harm.

Name: SHOT_Veh_16_J  Difficulty: Journeyman  Synopsis: The vehicle contains a White male driver, a front seat Hispanic female passenger and a back seat White female passenger. The driver appears intoxicated; he is abusive. The driver quickly pulls out a handgun, points it at the officer and opens fire.

Name: SHOT_Veh_17_J  Difficulty: Journeyman  Synopsis: The vehicle contains a Black male driver, a front seat Hispanic male passenger and a back seat White male passenger. The driver appears intoxicated; he is abusive. The driver quickly pulls out a wallet and shoves it out of the window at the officer.

Name: SHOT_Veh_18_J  Difficulty: Journeyman  Synopsis: The vehicle contains a White female driver, no passengers. The driver appears to be compliant. She searches for her wallet then quickly pulls out a handgun, points it at the officer and opens fire.
<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_Veh_19_J</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Journeyman</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>The vehicle contains a Black male driver and a White female front seat passenger. Both appear intoxicated; they are abusive. The driver has hold of a knife and the passenger pulls out a handgun, points it at the officer and opens fire (through the driver seat window).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_Veh_20_J</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Journeyman</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>The vehicle contains a White female driver, a White male front seat passenger and a Hispanic female back seat passenger. The driver and back seat passenger appear very nervous. The front seat passenger grabs the driver and threatens her with a knife.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_SusP_01_N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Naive</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>A Hispanic male suspect in an empty parking lot appears to be breaking into a car with a knife. He appears intoxicated; his speech is sluggish. He throws the knife to the ground but then pulls out a handgun, points it at the officer and opens fire.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_SusP_02_N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Naive</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>A White male suspect in an empty parking lot appears to be breaking into a car with a knife. He appears intoxicated; he is twitching. He lunges towards the officer with the knife.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_SusP_03_N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Naive</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>A White female suspect in an empty parking lot appears to be vandalising a car with a knife. She is abusive and obnoxious. She throws the knife to the ground but then pulls out a handgun, points it at the officer and opens fire.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_SusP_04_N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Naive</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>A White male suspect in an empty parking lot appears to be breaking into a car with a knife. He complies with the officer commands; he puts the knife on the roof of the car. He then reaches behind his back and pulls out a wallet.</td>
</tr>
<tr>
<td>Name:</td>
<td>SHOT_SusP_05_I</td>
</tr>
<tr>
<td>------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Difficulty:</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>White male, Black female and Hispanic male suspects in a parking lot appear to</td>
</tr>
<tr>
<td></td>
<td>be dealing drugs. The Hispanic male appears intoxicated; he is abusive. The</td>
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<td></td>
<td>Black female appears to comply. The White male pulls out a handgun, points it</td>
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<td></td>
<td>at the officer and opens fire.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_SusP_06_I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>A Black female suspect in an illegally parked car appears to be drinking</td>
</tr>
<tr>
<td></td>
<td>alcohol. She appears to be intoxicated; her speech is slurred. As she gets</td>
</tr>
<tr>
<td></td>
<td>out of the car she pulls out a handgun, points it at the officer and opens fire.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_SusP_07_J</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Journeyman</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>A White male driver and a Hispanic male front seat passenger are talking to a</td>
</tr>
<tr>
<td></td>
<td>prostitute through the driver’s window. She leaves. The Hispanic suspect is</td>
</tr>
<tr>
<td></td>
<td>abusive. From the passenger side he pulls out a handgun, points it at the</td>
</tr>
<tr>
<td></td>
<td>officer and opens fire (through the driver seat window).</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_SusP_08_J</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Journeyman</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>A White female and a Black female appear to be vandalising a car with a knife.</td>
</tr>
<tr>
<td></td>
<td>The White female appears intoxicated; she is abusive. She appears to comply by</td>
</tr>
<tr>
<td></td>
<td>dropping the knife. Then both suspects pull out handguns, points them at the</td>
</tr>
<tr>
<td></td>
<td>officer and open fire.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_SusP_09_N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Naive</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>A Black male appears to be trying to get into a warehouse building. He pulls</td>
</tr>
<tr>
<td></td>
<td>out a handgun, points it at the officer and opens fire.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name:</th>
<th>SHOT_SusP_10_N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty:</td>
<td>Naive</td>
</tr>
<tr>
<td>Synopsis:</td>
<td>A White male who appears to be homeless is sleeping in an alley. He appears</td>
</tr>
<tr>
<td></td>
<td>to be intoxicated; he is sluggish and his head is lolling. He reaches for his</td>
</tr>
<tr>
<td></td>
<td>coat pocket and pulls out a wallet.</td>
</tr>
</tbody>
</table>
Name: SHOT_SusP_11_N  
Difficulty: Naive  
Synopsis: A White female who appears to be homeless is drinking in an alley. She appears to be intoxicated; her speech is sluggish and her head is lolling. She throws her beer can at the officer.

Name: SHOT_SusP_12_I  
Difficulty: Intermediate  
Synopsis: A Black male, White male and White female appear to be dealing drugs in an alley. The Black male appears to comply. The White male and female take off running and the Black male pulls out and fires a handgun.

Name: SHOT_SusP_13_I  
Difficulty: Intermediate  
Synopsis: A White male appears to be urinating in an alley. He appears to comply. He then quickly pulls out a handgun, points it at the officer and opens fire.

Name: SHOT_SusP_14_N  
Difficulty: Naive  
Synopsis: A White female who appears to be homeless is sleeping in an empty warehouse. She wakes up and slowly pulls out a handgun, points it at the officer and opens fire.

Name: SHOT_SusP_15_N  
Difficulty: Naive  
Synopsis: A Black male who appears to be homeless is walking around in an empty warehouse. He is holding a knife. He backs away slowly and then throws the knife at the officer.

Name: SHOT_SusP_16_N  
Difficulty: Naive  
Synopsis: A White male who appears to be homeless is sleeping in an empty warehouse. He wakes up and slowly pulls out a beer bottle and points it at the officer.

Name: SHOT_SusP_17_I  
Difficulty: Intermediate  
Synopsis: A White male and White female who appear to be homeless are sitting in an empty warehouse. They both appear intoxicated; they are abusive. The male suspect pulls out a beer bottle and points it at the officer.
Name: SHOT_SusP_18_I  Difficulty: Intermediate
Synopsis: A White male who appears to be homeless is sitting in an empty warehouse. He appears intoxicated; his movements are jerky. The suspect pulls out a knife and quickly lunges at the officer.

Name: SHOT_SusP_19_J  Difficulty: Journeyman
Synopsis: A Black male has a White female hostage at knife point on the roof of an empty warehouse. A White male bystander is yelling and the Black male suspect is highly threatening.

Name: SHOT_SusP_20_J  Difficulty: Journeyman
Synopsis: A Black male, a White female and a White male appear to be dealing drugs on the roof of an empty warehouse. The Black male and White female take off running and the White male quickly pulls out a handgun, points it at the officer and opens fire.

Name: SHOT_SusP_21_I  Difficulty: Intermediate
Synopsis: A Black female suspect in an illegally parked car appears to be drinking alcohol. She appears to be intoxicated; her speech is slurred. As she gets out of the car she throws a beer bottle at the officer.

Name: SHOT_DwelH_01_N  Difficulty: Naive
Synopsis: A Black female is irate, swearing and yelling at her husband (Black male) who appears intoxicated. The female shows the officer a handgun that her husband had threatened her with. The male then pulls out another handgun, points it at the officer and opens fire.

Name: SHOT_DwelH_02_N  Difficulty: Naive
Synopsis: A White male is irate, swearing and yelling at his wife (White female) who appears intoxicated. The male shows the officer a handgun that his wife had threatened him with. The female then pulls out another handgun, points it at the officer and opens fire.
Name: SHOT_DwelH_03_N  
Difficulty: Naive  
Synopsis: A Black female leads the officer through the house to the kitchen where a Black male who appears intoxicated is being abusive (swearing and yelling). The male pulls out a handgun, points it at the officer and opens fire.

Name: SHOT_DwelH_04_N  
Difficulty: Naive  
Synopsis: A Black female leads the officer through the house to the kitchen where a White female who appears intoxicated is being abusive (swearing and yelling). The White female grabs the Black female, pulls out a knife and attacks the Black female.

Name: SHOT_DwelH_05_N  
Difficulty: Naive  
Synopsis: A White female and a White male are shouting at each other. No weapons are drawn and both comply and calm down.

Name: SHOT_DwelH_06_N  
Difficulty: Naive  
Synopsis: A White male and a Black male are shouting at each other. No weapons are drawn and both comply and calm down.

Name: SHOT_DwelH_07_N  
Difficulty: Naive  
Synopsis: A Black female and a Black male are shouting at each other. No weapons are drawn and both comply and calm down.

Name: SHOT_DwelH_08_I  
Difficulty: Intermediate  
Synopsis: A White male has hold of a White female. They are both shouting and swearing. The male drags the female down a hallway and pulls out a handgun, shoots the female, then turns on the officer and opens fire.

Name: SHOT_DwelH_09_I  
Difficulty: Intermediate  
Synopsis: A White female has been cut by her roommate (Black female). The Black female still has the knife in her hand and lunges at the officer.
Name: SHOT_DwelH_10_I
Difficulty: Intermediate
Synopsis: A Black male has hold of a Black female and is threatening her with a knife. He attacks her, turns and lunges at the officer.

Name: SHOT_DwelH_11_I
Difficulty: Intermediate
Synopsis: A White male has hold of a Black female. They are both shouting and swearing. The male drags the female down a hallway and pulls out a handgun, shoots the female, then turns on the officer and opens fire.

Name: SHOT_DwelH_12_J
Difficulty: Journeyman
Synopsis: A White male and a White female who is holding a baby are shouting at each other. They are both at the bottom of a flight of stairs going down to the basement. The male pulls out a handgun, points it at the officer and opens fire.

Name: SHOT_DwelH_13_J
Difficulty: Journeyman
Synopsis: A White female leads the officer down a flight of stairs into the basement where a Black female who appears to be mentally disturbed has a baby at knife point. The Black female attacks the baby with the knife.

Name: SHOT_DwelH_14_J
Difficulty: Journeyman
Synopsis: A Black male and a Black female who is holding a baby are shouting at each other. They are both at the bottom of a flight of stairs going down to the basement. The male pulls out a handgun, points it at the officer and opens fire.

Name: SHOT_DwelS_15_N
Difficulty: Naive
Synopsis: A White male suspect is leaning over the counter of a convenience store, threatening a White female employee at gunpoint. The male turns, points the gun at the officer and opens fire.

Name: SHOT_DwelS_16_N
A Black male suspect is leaning over the counter of a convenience store, threatening a White female employee at gunpoint. The male turns, points the gun at the officer and opens fire.

A White male suspect who appears intoxicated is leaning over the counter of a convenience store, threatening a White female employee at knifepoint. The male turns and lunges at the officer.

A Hispanic male suspect who appears intoxicated is leaning over the counter of a convenience store, threatening a White female employee with his fists. There are two male bystanders. The Hispanic male turns and backs away from the officer.

A White male suspect who appears intoxicated is leaning over the counter of a convenience store, threatening a White female employee with his fists. There are two male bystanders. The White male turns and runs at the officer (with no weapon).

A Black male suspect has a Hispanic male held at gunpoint. There are two other hostages lying on the floor. The Black male shoots the Hispanic male then turns and runs from the officer.
Appendix B: Documented R Scripts for multi-level mixed effects models

Experiment B – Multi-level Mixed Methods Model for Alpha Suppression

> # Set the working directory
> setwd("c:/PracticeR/RaceArticle2")

> # Read the data
> threat=read.table("DARPA II race threat for R.csv", sep="", header=T)
> attach(threat)

> # Load the nlme library
> library(nlme)

> # Use the unfonditional means model to examine the intra-class correlation coefficient (ICC)
> model.a=lme(fixed=AlphaDiff~1, random=~1 | Subject, method="ML")
> summary(model.a)

Linear mixed-effects model fit by maximum likelihood

Data: NULL

AIC  BIC  logLik
155.8944 167.4938  -74.9472

Random effects:
Formula: ~1 | Subject

(Intercept) Residual

StdDev: 0.2019673 0.2689364

Fixed effects: AlphaDiff ~ 1

<table>
<thead>
<tr>
<th>Value</th>
<th>Std.Error</th>
<th>DF</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept) 0.1360086 0.03346315 307 4.064427 1e-04</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Standardized Within-Group Residuals:

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<thead>
<tr>
<th>Min</th>
<th>Q1</th>
<th>Med</th>
<th>Q3</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4.87600223</td>
<td>-0.40188562</td>
<td>0.01682377</td>
<td>0.41739921</td>
<td>6.18313395</td>
</tr>
</tbody>
</table>

Number of Observations: 353
Number of Groups: 46

> # Calculate the ICC (intercept=between variance, residual=within variance)

> VarCorr(model.a)

Subject = pdLogChol(1)

Variance  StdDev

(Intercept) 0.04079079 0.2019673
Residual  0.07232676 0.2689364

> # ICC = .36
> # Examine the fixed effects
> model.b=lme(fixed=AlphaDiff~Black+Intermediate+Journeyman, random=~1 | Subject, method="ML")
> summary(model.b)

Linear mixed-effects model fit by maximum likelihood

Data: NULL

AIC      BIC   logLik
142.1736 165.3724 -65.0868

Random effects:

Formula: ~1 | Subject

(Intercept) Residual

StdDev: 0.2002084 0.2609468

Fixed effects: AlphaDiff ~ Black + Intermediate + Journeyman

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<th>Std.Error</th>
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Correlation:

(Intr) Black Intrmd
Black    -0.563
Intermediate -0.812  0.505
Journeyman  -0.724  0.514  0.783

Standardized Within-Group Residuals:

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<th>Med</th>
<th>Q3</th>
<th>Max</th>
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Number of Observations: 353
Number of Groups: 46

> # Examine the interaction between race and difficulty

> model.c=lme(fixed=AlphaDiff~Black*Journeyman, random=~1 | Subject, method="ML")

> summary(model.c)

Linear mixed-effects model fit by maximum likelihood

Data: NULL

AIC   BIC  logLik
141.6661 164.8649 -64.83306

Random effects:

Formula: ~1 | Subject

(Intercept) Residual

StdDev: 0.2007512 0.2606552
Fixed effects: AlphaDiff ~ Black * Journeyman

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Correlation:

(Intr) Black  Jrnymn

Black       -0.309
Journeyman  -0.250  0.260
Black:Journeyman 0.066 -0.219 -0.228

Standardized Within-Group Residuals:

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Number of Observations: 353

Number of Groups: 46
Appendix C: Lattices Showing Variation in Reaction Time across Participants in Experiments A, B and C, and Variation in Alpha Suppression across Participants in Experiment B
Reaction Time by Subject ID for Experiment B

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RT
Alpha Difference by Subject ID for Experiment B